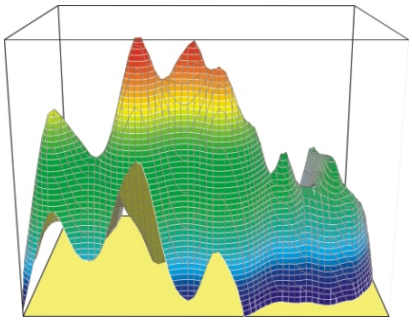
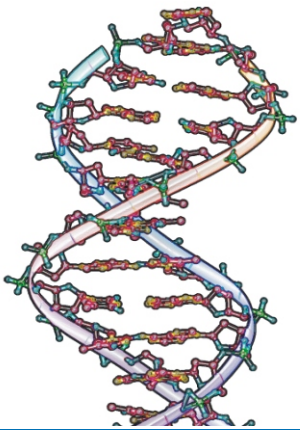
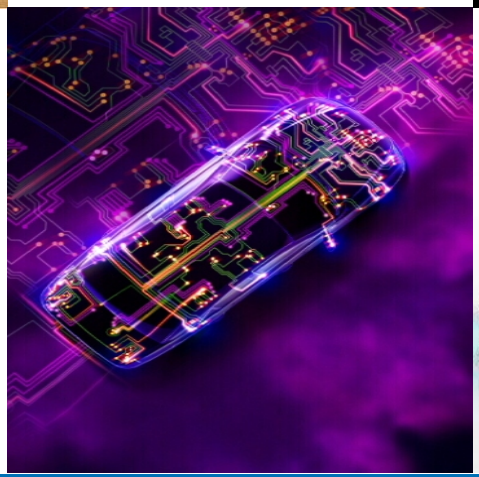
Харківської конференції молодих науковців „Радіофізика та електроніка” - Харків, Україна, 12-14 грудня 2007 р.

Institute of Radiophysics and Electronics
National Academy of Sciences of Ukraine

VII Kharkiv Young Scientist Conference on "Radiophysics and Electronics"

Conference Program & Book of Abstracts


Kharkiv, Ukraine, December 12 - 14, 2007

		Conference Hall	***Council Room***
Wed-nes-day **Dec. 12 2007**	8:00 – 9:00		Registration [1,2]
	9:00 – 9:30	**Opening Ceremony**	
	9:30 – 11:30	**PLENARY SESSION - 1**	
	11:30 – 13:30	*Time for Lunch and Accommodation*	
	13:30 – 15:30	**Biophysics – p.1**	**Plasmas and Microwave Electronics – p.1**
	15:30 – 16:00	**POSTER SESSION : BIO + PME** / Coffee break [2,3]	
	16:00 – 18:00	**Biophysics – p.2**	**Plasmas and Microwave Electronics – p.2**
	18:00 – 20:00	***Welcome Party*** [3]	
Thursday **Dec. 13 2007**	9:00 – 11:00	**Solid State Radiophysics – p.1**	**Optics & Photonics – p.1**
	11:00 – 11:30	**Poster Session : SSR + OP** / Coffee break [2,3]	
	11:30 – 13:30	**Solid State Radiophysics – p.2**	**Optics & Photonics – p.2**
	13:30 – 14:30	*Time for Lunch*	
	14:30 – 16:00		**PLENARY SESSION - 2**
	16:00 – 17:30	**Biophysics – p.3**	**OSA Ukrainian Regional Chapters Meeting**
	18:00 – 20:00	***Visit to Kharkiv Planetarium*** [4]	
Friday **Dec. 14 2007**	9:00 – 10:30	**Comput. & Experimental Electromagnetics – p.1**	**Radars, Propagation & Remote Sensing – p.1**
	10:30 – 11:00	**Poster Session : CEE + PME** / Coffee break [2,3]	
	11:00 – 12:30	**Comput. & Experimental Electromagnetics – p.2**	**Radars, Propagation & Remote Sensing – p.2**
	12:30 – 15:30	*Lunch time + **Visits to Departments** + **Bus city-tour*** [4]	
	16:00 – 17:30	**PLENARY SESSION - 3**	
	17:30 – 18:00	**Awards and Closing Ceremony**	
	18:00 – 22:00		***Banquet***

[1] *Participants registration is obligatory*
[2] *Lobby of the Council Room (3-rd floor of the Main Building)*
[3] *FREE for all registered participants of YSC'07*
[4] *Preliminary scheduled (can be modified later).*

Brief information about IRE NAS Ukraine

Institute of Radiophysics and Electronics of the National Academy of Sciences of Ukraine (IRE NASU) is the oldest Ukrainian academic institution of the Radiophysics field. Since its establishment in 1955, IRE has become a leading scientific center with deep expertise in various fields, such as: antennas, radars, communications, terahertz instrumentation, and biophysics.

The Institute is a founder of the following widely known scientific conferences: International Symposium „*Physics and Engineering of Millimeter and Submillimeter Waves*" (MSMW), International Conference „*Mathematical Methods in Electromagnetic Theory*" (MMET), and annual Kharkiv Young Scientist Conference (YSC) which traditionally gather over 100 young scientists from different parts of Ukraine as well as from FSU and European Countries. All these conferences are aimed at development of favorable conditions of communication between Ukrainian scientist and the worldwide electromagnetic community. These events are traditionally supported by IEEE, URSI, EuMA, OSA, and SPIE societies.

Welcome Note from the Organizing Committee

Dear Colleagues ,

We are glad to welcome you at the VII Kharkiv Young Scientist Conference (YSC-07) held in IRE NASU, Kharkiv, Ukraine. This time our conference attracted participants from many different institutions from Ukraine, Russia, and European Community.

We are very thankful to everybody for his/her interest to the YSC and believe that participation in the Conference will provide you with helpful experience and warm memories. We did our best to make the YSC not "just another conference" but a remarkable event in the life of each participant. We hope you will acknowledge and appreciate our efforts and will come back to us the next year.

Organizing Committee of YSC-07

Contents

	Geography of the Conference : Origin of the submitted papers	Q-ty
1.	Ukraine (*Kharkiv*)	58
2.	Ukraine (*Kyiv, Dnipropetrovsk, Dniprodzerzhinsk, Donetsk, Lviv, Sebastopol, Sumy, Chernivtsi, Uzhgorod*)	34
3.	Russia (*Barnaul, Irkytsk, Kaliningrad, Rostov-on-Don, Saratov*)	4
4.	Ukraine – Germany (*Lueneburg, Ulm, Stuttgart*)	2
5.	Ukraine – Mexica (*Oaxaca, Salamanca*)	2
6.	Czech (*Prague*)	1
7.	Ukraine – Bulgaria (*Sofia*)	1
8.	Ukraine – France (*Rennes*)	1
9.	Ukraine – Italy (*Napoli*)	1
10.	Ukraine – Japan (*Wako-shi, Saitama*)	1
11.	Ukraine – Korea (*Тейджон, Gwangju*)	1
12.	Ukraine – Russia (*St. Peterburg*)	1
13.	Ukraine – Spain (*Ciudad Real*)	1
14.	Ukraine – USA (*Maryland*)	1
	Total :	109

Org Committee is grateful to the following for their support of the Conference: Institute of Radiophysics and Electronics NAS Ukraine (IRE NASU), IEEE East Ukraine Joint Chapter, Optical Society of America (OSA), and the joint OSA/SPIE Student Chapters of the Kharkiv National University and the IRE NASU.

	List of institutes – participants of YSC-2007	Abbreviation	City, Country
1.	Altai State University	*ASU*	*Barnaul, Russia*
2.	Byelorussia State University	*BSU*	*Minsk, Byelorussia*
3.	*D.I. Mendeleyev* Scientific and Research Institute for Metrology	*SRIM*	*St. Petersburg, Russia*
4.	Dniepropetrovsk National University	*DNU*	*Dniepropetrovsk*
5.	Dneprodzerzhinsk State Technical University	*DSTU*	*Dneprodzerzhinsk*
6.	Donetsk National University	*DNU*	*Donetsk*
7.	Western division of IZMIRAN	*IZMIRAN*	*Kaliningrad, Russia*
8.	Institute of Ionosphere NAS and MES Ukraine	*II NAS & MESU*	*Kharkiv*
9.	Institute for Problems of Cryobiology and Cryomedicine NAS Ukraine	*IPCC NASU*	*Kharkiv*
10.	*A.Usikov* Institute of Radiophysics and Electronics NAS Ukraine	*IRE NASU*	*Kharkiv*
11.	Institute for Semiconductor Physics NAS Ukraine	*ISP NASU*	*Kyiv*
12.	Institute of Electron Physics NAS Ukraine	*IEP NASU*	*Uzgorod*
13.	*T. Shevchenko* Kyiv National University	*KNU*	*Kyiv*
14.	*I. Franko* National University of Lviv	*LNU*	*Lviv*
15.	Marine Hydrophysical Institute NAS Ukraine	*MHU NASU*	*Sebastopol*
16.	National Aviation University	*NAU*	*Kyiv*
17.	National Science Center “Kharkov Institute of Physics and Technology “	*NSC “KIPT”*	*Kharkiv*
18.	National Technical University “Kharkiv Polytechnic Institute”	*NTU “KPI”*	*Kharkiv*
19.	National Pharmacological University	*NPU*	*Kharkiv*
20.	*Institute of Physics of Mining Processes of NAS of Ukraine*	*IPMP NASU*	*Donetsk*
21.	Institute of Radio Astronomy NAS Ukraine	*IRA NANU*	*Kharkiv*
22.	Rennes University 1	*UR1*	*Rennes, France*
23.	*N.G. Chernishevskiy* Saratov State University	*SSU*	*Saratov, Russia*
24.	Saratov State University of Social Economics	*SSUSE*	*Saratov, Russia*
25.	Sebastopol National Technical University	*SNTU*	*Sebastopol*
26.	*V.I. Vernadsky* Taurida National University	*TNU*	*Simferopol*
27.	Ukrainian State University of Chemistry and Technology	*USUCT*	*Dniepropetrovsk*
28.	*Karpenko* Physico-Mechanical Institute of NAS of Ukraine	*PMI NASU*	*Lviv*
29.	*B. Verkin* Institute for Low Temperature Physics and Engineering NAS Ukraine	*ILTPE NASU*	*Kharkiv*
30.	Joint Research Institute of Armed Forces	*JRIAF*	*Kharkiv*
31.	*V.N. Karazin* Kharkov National University	*KhNU*	*Kharkiv*
32.	Kharkiv National University of Radio Electronics	*KNURE*	*Kharkiv*
33.	*Yu. Fedkovych* Chernivtsi National University	*CNU*	*Chernivtsi*
34.	Southern Federal University	*SFU*	*Roston-on-Don, Russia*
35.	Joint-stock company «SELMI»	*SELMI*	*Sumy*
36.	Biospheric Sciences Branch, NASA Goddard Space Flight Center, Greenbelt	*NASA GSFC*	*Maryland, USA*

37.	CNR-INFM Lab Coherentia, Università di Napoli Federico II	*UNF*	*Napoli, Italy*
38.	Faculty of Chemistry, University of Sofia, Bulgaria	*DAOC US*	*Sofia, Bulgaria*
39.	University of Calgary	*UC*	*Calgary, Canada*
40.	Gwangju Institute of Science and Technology	*GIST*	*Republic of Korea*
41.	European Technology Center, Panasonic Electronic Devices Europe GmbH,	*ETC*	*Lueneburg, Germany*
42.	FIMEE, Universidad de Guanajuato, Salamanc	*FIMEE UG*	*Mexico*
43.	Frontier Research System, The Institute of Physical and Chemical Research (RIKEN)	*RIKEN*	*Japan*
44.	Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic	*IOCB NASCR*	*Czech Republic*
45.	Instituto de Matemática Aplicada a la Ciencia y la Ingenería, Universidad de Castill-La Mancha	*IMAC*	*Ciudad Real, Spain*
46.	Institut für Optoelektronik, Universität Ulm	*IOUU*	*Ulm, Germany*
47.	Institut für Strahlwerkzeuge, Universität Stuttgart	*ISUU*	*Stuttgart, Germany*
48.	Université de Rennes 1	*UR1*	*Rennes, France*
49.	Institute of Solar-Terrestrial Physics RAS SB	*ISTP RAS*	*Irkutsk, Russia*

Organizing Committee Technical Program Committees of YSC-07

Dr. Artem V. Boriskin, IRE NASU — Co-chairs of the Technical Program Committee
Dr. Yuriy Goncharenko, IRE NASU

Michail Khodzitski, IRE NASU — Co-chairs of the Organizing Committee
Maxim Khruslov, IRE NASU

Yevgeniya Minakova, IRE NASU — Secretary

Members of the TPC and Organizing Committees:

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Dr. Olga Khorunzhaya, IRE NASU
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Sergiy Mizrakhi, IRE NASU
Yevgeniy Olkhovski, NTU “KPI”

Design of the Conference Program and the Cover – Artem V. Boriskin

CONFERENCE PROGRAM

PLENARY SECTION - 1

Conference hall **Wednesday** **12.12.2007** **9 :00 – 11 :30**

9:00 Opening Ceremony.
Welcome notes : **Dr. A.V. Boriskin**, *Head of the Technical Program Committee*.
Вступне слово : Academician NASU, **Prof. V.M. Yakovenko**, *Director of IRE NASU.*

9:30 – 10:00 " ELECTRON SPIN RESONANCE TECHNIQUE FOR NANOPHYSICS ",

Prof. Sergey I. Tarapov, *IRE NASU.*

10:00 – 10:30 " **USING OF NANOPARTICLES IN MEDICINE** ",

Prof. Nikolay N. Rozhitskii, *Kharkiv National University of Radioelectronics*.

10:30 – 11:30 " FOUR CENTURIES OF IMAGING TECHNOLOGY ",

Prof. **William T. Rhodes**, Florida Atlantic University (OSA Distinguished Lecturer)

PLENARY SECTION - 2

Council Room **Thursday** **13.12.2007** **14 :30 – 15 :30**

14:30 – 15:00 " MODELING METHODS FOR PBG STRUCTURES WITH APPLICATIONS ",

Dr. Igor Scherbatko, *IRE NASU.*

15:00 – 15:30 " **NUMERICAL MODELING OF ACTIVE INTEGRATED OPTICAL ELEMENTS ON THE PHOTONIC CRYSTALS BASIS** ",

Prof. Vladimir I. Fesenko, *Kharkiv National University of Radioelectronics*.

PLENARY SECTION - 3

Conference hall **Friday** **14.12.2007** **16 :00 – 17 :30**

16:00 – 16:30 " AUOTOMATED MILLIMETER WAVE SCALAR AND VECTOR NETWORK ANALIZERS FOR RADIOPHYSIC INVESTIGATIONS ",

Dr. Gennadiy P. Ermak, *IRE NASU.*

16:30 – 17:00 " DUCTS AND RESONANT CAVITIES IN THE GEOSPACE ",

Dr. Victor G. Sinitsin, *IRE NASU.*

17:00 – 17:30 " LASER SCANNING MICROSCOPY OF SUPERCONDUCTORS ",

Prof. Alexander P. Zhuravel, *Institute for Low Temperature Physics and Engineering NASU.*

17:30 – 18:00 **Awards and Closing Ceremony.**

SECTION: BIOPHYSICS - 1
Conference Hall Wednesday 12.12.2007 13:30 – 15:30

Invited paper

1.	V. Andrushchenko[1], H. Wieser[2], P. Bour[1]	VIBRATIONAL CIRCULAR DICHROISM SPECTROSCOPY AS A TOOL TO STUDY DNA STRUCTURAL CHANGES: EXPERIMENTAL AND COMPUTATIONAL APPROACHES	*IOCB NASC, Praha Univ. of Calgary, Canada*
2.	A.V. Filipskij	INVESTIGATION OF THERMAL DESTRUCTION MECHANISM OF NUCLEIC ASIDS	*IRE NANU, Kharkiv*
3.	Ju.N. Bliznyuk, T.V. Bolbukh, A.I. Gasan	THE MOLECULAR MECHANISMS OF BINDING OF FLAVINMONONUCLEOTIDE TO DNA BY THE DATA OF RAMAN SPECTROSCOPY AND SPECTROPHOTOMETRY	*IRE NANU, Kharkiv*
4.	A.S. Khrebtova, Ye.V. Dukhopelnykov E.G. Bereznyak	DETERMINATION OF BINDING PARAMETERS OF LIGANDS TO DNA BY DIFFERENTIAL SCANNING CALORIMETRY	*IRE NANU, Kharkiv*
5.	А.В. Федоренко	ИССЛЕДОВАНИЕ СТРУКТУРЫ СУПЕРСПИРАЛЬНОЙ ДНК В НУКЛЕОСОМАХ	*KhNU, Kharkiv*
6.	M.U. Tkachenko	MODELING OF CONFORMATIONAL DYNAMICS OF A DNA SUGAR-PHOSPHATE BACKBONE IN PROTEIN-DNA COMPLEXES	*IRE NANU, Kharkiv*
7.	K.V. Miroshnychenko A.V. Shestopalova	DYNAMICS OF DNA DODECAMERS OF DIFFERENT SEQUENCE	*IRE NANU, Kharkiv*
8.	A.M. Golius[1], K.V. Miroshnychenko[2] A.V. Shestopalova[2]	MOLECULAR DOCKING OF ACTINOCIN DERIVATIVE AND DNA FRAGMENTS OF DIFFERENT SEQUENCE	*KhNU, IRE NANU, Kharkiv*

SECTION: BIOPHYSICS - 2
Conference Hall Wednesday 12.12.2007 16:00 – 18:00

9.	E.L.Usenko, V.A.Sorokin, V.A.Valeev	EFFECTS OF Ni^{2+} IONS AND TEMPERATURE ON PHASE TRANSITIONS IN POLYNUCLEOTIDES CONTAINING ADENINE AND URACIL	*ILPTE NASU, Kharkiv*
10.	Ye.A. Minakova, E.B. Kruglova	MONOVALENT IONS INFLUENCE ON THE ACTINOCIN DERIVATIVE BINDING WITH NATIVE AND DENATURATED DNA	*IRE NANU, Kharkiv*
11.	N.M. Khomutova, V.V. Kostjukov, M.P. Evstigneev	ELECTROSTATIC CONTRIBUTION TO COMPLEXATION ENERGY OF ANTHRACYCLINE ANTIBIOTICS WITH DNA	*SevNTU, Sevastopol*
12.	Ie.L. Iermak, O.B. Kruglova	STUDY OF ACTINOCINE DERIVATIVE AND ETHIDIUM BROMIDE COMPETITIVE BINDING TO CALF THYMUS DNA	*IRE NANU, Kharkiv*
13.	O.P. Boryskina[1], V. Fleury[2]	TETRAPOD PATTERN OF VERTEBRATES: AN INCIDENCE OR THE LAW ?	*IRE NANU, Kharkiv GMCM, UR1, France*

14.	E.S. Zarudnev, A.M. Plokhotnichenko, *et al*	INVESTIGATION OF INTERACTION BETWEEN MOLECULES OF IMIDAZOPHENAZINE BY IR ABSORPTION SPECTROSCOPY AND AB INITIO METHODS	*ILTPE, Kharkiv*
15.	E.N. Zhivotova[1], A.V. Zinchenko[2]	ON FORMING THE GLASSY STATE IN AQUEOUS SOLUTIONS OF OXYETHYLATED GLYCEROL OF DIFFERENT POLYMERIZATION DEGREE	*NUP, IPCC NASU, Kharkiv*
16.	A.V. Zinchenko, I.A. Buriak, V.D. Zinchenko	OZONE EFFECT ON THERMOSTABILITY OF HEMOGLOBIN AND MEMBRANE-BOUND PROTEINS OF RED CELLS	*IPCC NASU, Kharkiv*

SECTION: BIOPHYSICS - 3
Conference Hall Thursday 13.12.2007 16:00 – 17:30

17.	Yu. Ya. Tomka	POLARIZATION SINGULARITIES OF BIOLOGICAL TISSUES IMAGES	*ChNU, Chernivtsi*
18.	N. Sheykina[1], V. Bondarenko[1], N. Bogatina[2]	COMBINED MAGNETIC FIELD EFFECT ON DIFFERENT BIOLOGICAL OBJECTS REGENERATION AFTER SHOCK CAUSED BY LOW TEMPERATURE	*KhNU, ILTPE, Kharkiv*
19.	A.S. Agafonova, V.A. Surkov	UPDATING PARAMETERS THREE-ELECTRODES ENERGY FILTER TWO-SIDE TYPE WITH END APERTURES	*IEP NASU, Uzhgorod OJSC SELMI, Sumy*
20.	A.V. Adeljanov, *et al*	ELECTROCONDUCTIVITY OF BOVINE SERUM ALBUMIN SOLUTIONS AT VARIOUS pH	*KhNU, Kharkiv*
21.	N. Belogurova, *et al*	SOFTWARE-HARDWARE COMPLEX FOR PHOTODYNAMIC DIAGNOSTICS AND THERAPY	*KhNU, Kharkiv*
22.	I.P. Makhnenko, *et al*	SOFTWARE AND ANALYTICAL CLUSTER FOR PSYCHOPHYSICAL RESEARCHES	*KhNU, Kharkiv*

Poster section: BIOPHYSICS
Lobby of the Council Room Wednesday 12.12.2007 15:30 – 16:00

23.	E.V. Dobrovolskaya, *et al*	MEMBRANE INTERACTIONS OF AMYLOID-SPECIFIC DYE CONGO RED	*KhNU, Kharkiv*
24.	O.K. Zakharenko, *et al*	CONGO RED INTERACTIONS WITH PROTEINS	*KhNU, Kharkiv*
25.	N. Sheykina[1], V. Bondarenko[1], N. Bogatina[2]	MAGNETIC NOISE EFFECT ON AMPLITUDE AND SPECTRUM OF MAGNETIC FIELD NOISE GENERATED BY PLANTS DURING THEIR GROWTH AND THE GRAVITROPIC REACTION OF PLANTS ROOTS	*KhNU, ILTPE NASU, Kharkiv*
26.	A.V. Yudintsev[1], V.M. Trusova[1], *et al*	FLUORESCENCE PROBE STUDY OF LANTHANIDE EFFECT ON STRUCTURAL STATE OF MODEL MEMBRANE	*KhNU,Kharkiv University of Sofia, Bulgaria*

SECTION: PLASMAS AND MICROWAVE ELECTRONICS - 1
Council room Wednesday 12.12.2007 13:30 – 15:30

27. Baran M.O., Khvyschun I.O.	RESEARCH OF THE ALMOST NEWTONIAN SPEED-UP ALGORITHM OF SEARCH OF PERIODIC MODES	*LNU, Lviv*
28. Goryashko V.A., Ilyenko K.V.	ADIABATIC INVARIANTS OF MOTION IN FREE ELECTRON MASER	*IPE NASU, Kharkiv*
29. Derevianko A., Silkin M., Styervoyedov A.	PROCESS STABILIZATION OF ULTRATHIN METALL NITRIDE AND OXYNITRIDE FILMS ION-BEAM SPUTTER DEPOSITION	*KhNU, Kharkiv НФТЦ МОН та NASU, Kharkiv*
30. Ivanchenko A.V.	THE VARISTORS DEGRADATION ELECTRICAL PARTICULARITY CONTAINING BORON OXIDE	*УГХТУ, Днепропетровск*
31. Koval V.A., Malakhova M.O., Stervoyedov N.G.	THE PROGRAM AND TECHNICAL COMPLEX FOR GAS-DISCHARGED PLASMA OPTICAL DIAGNOSTICS	*KhNU, Kharkiv*
32. Kovalenko V., Kryzhanovsky V., Marchenko V., *et al*	HI-EFFICIENCY F-CLASS BROADBAND AMPLIFIER	*DNU, Donetsk*
33. Kuzmin A.V, Posuhov A.S, Semenenko V.E.	THICKNESS DETERMINING OF VACUUM EVAPORATED THIN FILMS BY RESONANCE METHOD	*KhNU, Kharkiv*
34. Kushnir M.Y., Rusyn V.B.	TWO-PLANIMETRIC UPDATING GENERATOR CHUA FOR DIRECTLY CHAOTIC SYSTEMS OF TRANSFER INFORMATION	*CNU, Chernivtsi*

SECTION: PLASMAS AND MICROWAVE ELECTRONICS - 2
Council room Wednesday 12.12.2007 16:00 – 17:15

35. Makarov D.G., Krizhanovskii V.G.	HIGH-FREQUENCY HIGH-EFFICIENCY CLASS $E/F_{2,3}$ PUSH-PULL POWER AMPLIFIER	*DNU, Donetsk*
36. Moiseienko V. A., Vasyuchka V.I., *et al*	MAGNETOSTATIC NARROW BAND FILTER	*KNU, Kyiv*
37. Poprosimenko O.V.	THE STRIP ANTENNA FOR BASE STATION OF MOBILE COMMUNICATION	*SNTU, Sebastopol*
38. Posukhov A.S., Semenenko V.Y., Stervoedov N.G.	LABORATORY STAND FOR RESEARCH OF TEMPERATURE AND RADIATION STABILITY OF COMPOSITIONAL MATERIALS	*KhNU, Kharkiv*
39. Prilipskaya A.S., Printsovskii V.A. *et al*	DOHERTY AMPLIFIER CONSISTING OF CLASS-E AND CLASS-B AMPLIFIERS	*DNU, Donetsk*

POSTERS: PLASMAS AND MICROWAVE ELECTRONICS
Lobby of the Council room Wednesday 12.12.2007 15:30 – 16:00

40. Eremin A.V., Shishkin A.A.	PARTICLE AND POWER BALANCE IN FUSION PLASMA WITH DIFFERENT FUELING SCENARIOS AND HELIUM ASH REMOVAL	*KhNU, Kharkiv NSC «KIPT», Kharkiv*
41. Khorunzhiy M.O., Kuleshov A.N. *et al*	MICROWAVE DISCHARGE EXCITATION IN SINGLE CONDUCTOR LINE	*IRE NASU, Kharkiv*

SECTION: SOLID STATE RADIOPHYSICS - 1
Conference hall Thursday 13.12.2007 9:00 – 11:00

42. A.A. Andreew	DEGRADATION PHENOMENA IN VARISTOR CERAMICS ON THE BASIS OF WO_3	*DSTU, Dneprodzerzhinsk*
43. T.M.Bulanaya, I.V.Gomilko, A.J. Lyashko	ADAPTATION OF NEURAL NETWORK FOR TASKS OF SEMICONDUCTOR SENSORS GAS ENVIRONMENT ANALYSIS	*DNU, Dnipropetrovsk*
44. R.I. Hrytskiv	THE MODELING AND ANALYSIS OF CLUSTER STRUCTURES IN CdI_2 CRYSTALS	*LNU, Lviv*
45. R.V. Zaitsev, M.V. Kirichenko, V.R. Kopach	MINORITY CHARGE CARRIERS PARAMETERS IN BASE CRYSTALS OF SILICON SOLAR CELLS	*NTU «KPI», Kharkiv*
46. O.A.Zamuraev	EXPERIMENTAL RESEARCH OF INFLUENCE OF THE EXTERNAL MAGNETIC FIELD ON CHARACTERISTICS OF DISTRIBUTION OF SURFACE WAVES IN THE SEMICONDUCTOR	*IRE NASU, Kharkiv*
47. S.S. Apostolov, D.V. Kadygrob, Z.A.Mayzelis, *et al*	NONLINEAR RESPONSE OF LAYERED SUPERCONDUCTOR TO SYMMETRIC ELECTROMAGNETIC EXCITATION	*IRE NASU, KHNU, Kharkiv RIKEN, Japan*
48. M.V. Kirichenko, S.A. Bondarenko, R.V. Zaitsev, *et al*	EFFICIENCY OF SILICON SOLAR CELLS WITH VERTICAL P-N JUNCTIONS AT CONCENTRATED SOLAR IRRADIATION	*NTU «KPI», Kharkiv*
49. A.Ya. Kirichenko, E.V. Krivenko, V.I.. Lutsenko	DETERMINATION OF MOISTURE CONTENT IN A GAS COMPOSITION USING OSCILLATION OF 'WHISPERING GALLERY' TYPE IN CYLINDRICAL RESONATOR	*IRE NASU, Kharkiv*

SECTION: SOLID STATE RADIOPHYSICS - 2
Conference hall Thursday 13.12.2007 11:30 – 12:15

50. V.O. Ogol, S.O. Omel'chenko, *et al*	RESEARCH OF PROPERTIES OF NANOPARTICLES OF SEMICONDUCTOR MATERIALS IN AN ORGANIC MATRIX	*DNU, Dnipropetrovsk*
51. E.G. Plakhtiy, V.O. Makarov	THE TEMPERATURE DEPENDENCE OF THE CONDUCTION OF WO_3-BASED CERAMICS	*DNU, Dnipropetrovsk*
52. I.A. Skuratovsky[1], A.B. Glot[2], E.V. Skuratovskaya[1]	EFFECT OF Nb_2O_5 ON THE ELECTRICAL PROPERTIES OF TIN DIOXIDE BASED VARISTOR CERAMICS	*DNU, Dnipropetrovsk UTM, Mexico*

POSTERS SOLID STATE RADIOPHYSICS
Lobby of the Council Room Thursday 13.12.2007 11:00 – 11:30

53. T.V. Bagmut	PHENOMENOLOGICAL MODELING OF THE MAGNETIC ORDER IN GRANULAR NANOSTRUCTURE $(SiO_2)_{100-X}Co_X$/GaAs	*IRE NASU, Kharkiv*
54. A.V. Degtyar'ov, A.S.Tonkoshkur	VOLT-AMPERE CHARACTERISTIC OF POTENTIAL BARRIER FORMED IN COMPOSITE MATERIAL BASED ON STRUCTURE POLYETHYLENE-GRAPHITE	*DNU, Dnipropetrovsk*

55.	A.Yu. Lyashkov, I.V. Gomilko, *et al*	DEVELOPMENT OF NON-LINEAR COMPOSITE RESISTORS WITH POSITIVE TEMPERATURE COEFFICIENT OF RESISTANCE	*DNU, Dnipropetrovsk*
56.	M.K. Khodzitskiy	INVESTIGATION OF MAGNETIC PROPERTIES OF MANGANITE FILM $La_{0.775}Sr_{0.225}MnO_3$ BY ESR TECHNIQUE AT TEMPERATURE OF 4.2 K	*IRE NASU, Kharkiv*
57.	O.V. Khmelenko, K.A. Selin, Yu.N. Strizh	CHANGE OF STATIC DISLOCATIONS CHARGE IN ZNS-CRYSTALS BY EXCITATION OF ELECTRONIC SUBSYSTEM	*DNU, Dnipropetrovsk*
58.	J. Chekrygyna[1] , M. Khodzitskiy[2], T. Bagmut[2]	INFLUENCE OF MAGNETIC PHASE CONCENTRATION ON STATIC AND DYNAMIC MAGNETIC CHARACTERISTICS OF Co-SiO_2 GRANULAR NANOSTRUCTURES	*NTU "KPI", IRE NASU, Kharkiv*

SECTION: OPTICS AND PHOTONICS - 1
Council Room Thursday 13.12.2007 9:00 – 11:00

59.	Vozianova A.V., Nerukh A.G.	RESOLVENT OPERATOR OF MAXWELL EQUATIONS FOR 6-DIMENSIONAL FIELD VECTOR IN THE HALF-SPACE	*KNURE, Kharkiv*
60.	Vozniuk E.V., Starchevskiy Yu.L., Machehin Yu.P.	PHYSICAL PRINCIPLES OF THE BUILDING OPTICAL COMMUNICATIONS SYSTEMS ON BASE OF FEMTOSECOND LASER	*KNURE, Kharkiv*
61.	Girich A.A.	MODELLING OF MAGNETOFIELD CHARACTERISTICS OF 1D PHOTONIC CRYSTAL (SEMICONDUCTOR-DIELECTRIC) IN MILLIMETER WAVEBAND	*KNURE, Kharkiv IRE NASU, Kharkiv*
62.	Gryshchenko S.V., Dyomin A.A. , Lysak V.V.	CALCULATION THE QUANTUM EFFICIENCY SPECTRUM OF RESONANT CAVITY ENHANCED PHOTODETECTOR WITH TOP MIRROR DEFECT	*KNURE, Kharkiv Gwangju IST, Korea*
63.	Guryev I.V., Sukhoivanov I.A. Gnatenko A.S., Lipkina V.I.	THE METHOD FOR CHROMATIC DISPERSION CONSIDERATION IN PLANE WAVES EXPANSION METHOD	*KNURE, Kharkiv FIMEE, Mexico*
64.	Korchemkina E.N.	REGIONAL ANALYTICAL ALGORITHM OF CHLOROPHYLL CONCENTRATIONS RETRIEVING FROM SEA REFLECTANCE SPECTRA	*МГИ NASU, Sebastopol*
65.	Kukhtin S., Gnatenko A.	A METHOD OF MODULATION LASER SPECTROSCOPY FOR DETECTING METHANO-HYDRATES ON THE BOTTOM OF THE BLACK SEA	*KNURE, Kharkiv*

SECTION: OPTICS AND PHOTONICS - 2
Council room Thursday 13.12.2007 11:30 – 13:30

66.	Gnatenko A.S., Lipkina V.I., Guryev I.V.	PLANE WAVES EXPANSION METHOD FOR COMPUTATION OF THE BAND STRUCTURE OF 1D PHOTONIC CRYSTAL	*KNURE, Kharkiv*

67.	Lysiuk V.I, Staschuk V.S., Vakulenko O.V., Kluy M.I.	MODIFICATION OF OPTICAL PROPERTIES OF THIN FILMS OF TRANSITION METALS ON PYROELECTRICS BY ION IMPLANTATION	*ISP NASU, Kyiv* *KNU, Kyiv*
68.	Safonov I.M., Demaria F., Rinaldi F., Sukhoivanov I.A., *et al*	OPTICALLY-PUMPED VECSEL WITH TUNNEL-COUPLED QUANTUM WELLS	*KNURE, Kharkiv* *IO, Germany* *Gwangju IST, Korea* *SIS, Germany* *FIMEE, Mexio*
69.	Tkachenko G.V., Dyomin A.A., Tkachenko V.M., Sukhoivanov I.A.	THERMOOPTICAL FILTER BASED OF A FREE-STANDING POROUS SILICON FILM INFILTRATED WITH LIQUID CRYSTAL	*KNURE,Kharkiv* *CNR-INFM Lab Coherentia,Italia* *FIMEE, Mexio*
70.	Tyurin V.S.	MODEL OF THE LASER MEASURING INSTRUMENT OF DISTANCE	*KNURE, Kharkiv*
71.	Khakimov R.I., Staschuk V.S.	ADMIXTURE INFLUENCE ON OPTICAL PROPERTIES AND ELECTRONIC STRUCTURE OF COBALT	*KNU, Kyiv*
72.	Iakushev S.O., Shulika O.V., *et al*	SILICON NITRIDE – AIR CHIRPED MIRROR FOR ULTRASHORT PULSE COMPRESSION	*KNURE, Kharkiv*
73.	Yarko E.O., Khardikov V.V.	FAST ALGORITHM FOR SOLVING OF THE DIFFRACTION PROBLEM ON REAL OPTIC PERIODIC PLANAR STRUCTURES	*PI NASU, Kharkiv* *KHNU, Kharkiv*

POSTERS: OPTICS AND PHOTONICS

Lobby of the Council room **Thursday 13.12.2007** **11:00 – 11:30**

74.	Polyanskii P.V., Angelsky P.O.	INTEFERENCE-POLARIZATION TECHNIQUE FOR MEASURING WEAKLY ROUGH SURFACES	*CNU, Chernivtsi*
75.	Karbovnyk I.D., Lesivtsiv V.M., *et al*	OPTICAL-LUMINESCENCE AND SEM STUDIES OF BiI_3 CLUSTERS IN CdI_2 LAYERED CRYSTALS	*LNU, Lviv*
76.	Vitushkin L.V., Machekhin Yu.P, Zaveruha P.N.	PHOTONIC CRYSTALS USING FOR FORMING OF OPTICAL FREQUENCY STANDARDS ABSORPTION CELLS	*KNURE, Kharkiv* *SRIM, St. Petersburg*
77.	Rubass A.F., Kotlyarov K.I., Volyar A.V.	CONOSCOPIC PATTERNS OF THE OFF-AXIS SINGULAR BEAM IN A UNIAXIAL CRYSTAL	*TNU, Simferopol*
78.	Derbov V. L., Teper N. I.	LASER-INDUCED POPULATION DYNAMICS IN HYDROGEN ATOM	*SSU, Saratov* *SSTSE, Saratov*
79.	Shavrin I.S., Yablochkov S.M.	PYE UNICAM SP700A SPECTROPHOTOMETER MODERNIZATION PROJECT	*KNU, Kyiv*

SECTION: THEORETICAL AND EXPERIMENTAL ELECTROMAGNETICS - 1
Conference hall **Friday 14.12.2007 9:00 – 10:30**

80.	A.V. Plut, N. K. Sakhnenko, A.G. Nerukh	DURATION OF THE TRANSIENTS DURING ESTABLISHING OF WHISPERING GALLERY MODES OVER TIME	*KNURE, Kharkiv*
81.	I.V. Trofimenko, N.K. Sakhnenko, A.G. Nerukh	2D PROBLEM OF POINT SOURCE FIELD SCATTERING ON CIRCULAR TWO-LAYERED CYLINDER COMPOSED FROM MATERIALS WITH DOUBLE POSITIVE/NEGATIVE ε AND μ	*KNURE, Kharkiv*
82.	B.A. Kochetov, A.Yu. Butrym	THE EXACT SOLUTIONS TO ONE – DIMENTIONAL KLEIN – GORDON – FOK EQUATION WITH ARBITRARY PARAMETER FOR TRANSIENT PROBLEMS OF ELECTRODYNAMICS IN SPHERICAL COORDINATE SYSTEM	*KhNU, Kharkiv*
83.	A.Yu. Butrym, M.N. Legenkiy	EFFECTIVE MODE ABSORBING BOUNDARY CONDITIONS FOR FDTD	*KhNU, Kharkiv*
84.	A.A. Nosich[1], Y.V. Gandel[1], T. Magath	APPLICATION OF THE METHOD OF DISCRETE SINGULARITIES TO NUMERICAL DIFFRACTION SYNTHESIS OF A 2-D QUASIOPTICAL POWER SPLITTER	*KhNU, Kharkiv ETC-Panasonic, Lueneburg*
85.	Eskov A.N., Kazakov I.S.	CALCULATING METHOD OF THE ROD DIELECTRIC ANTENNA RADIATION CHARACTERISTICS USING ELECTRIC AND MAGNETIC FIELDS ON THE ROD SURFACE	*SNTU, Sebastopol*

SECTION: THEORETICAL AND EXPERIMENTAL ELECTROMAGNETICS - 2
Conference hall **Friday 14.12.2007 11:00 – 12:30**

86.	R.E. Chernobrovkin	INDIVIDUAL RADIATOR FOR WIDE BAND PHASE ANTENNA ARRAY WITH WIDE SCANNING SECTOR	*IRE NASU, Kharkiv*
87.	M.M. Khruslov	INFLUENCE MARGINAL EFFECT ON RADIATION PATTERN OF THE AXIAL-SYMMETRICAL PLANAR ANTENNAS WITH COAXIAL EXCITATION	*IRE NASU, Kharkiv*
88.	V. R. Dzhala, L.I. Kapko	MICROWAVE DIAGNOSTICS FOR PLANE-LAYERED DIELECTRICS	*PMI NASU, Lviv*
89.	S.G. Alexin, O.O. Drobakhin	IMPROVEMENT OF GEL'FAND-LEVITAN'S ITERATION PROCEDURE FOR PERMITTIVITY PROFILE RECONSTRUCTION USING BLOCK MATRIX INVERSION FOR SLAE SOLVING	*DNU, Dnipropetrovsk*
90.	I.A. Lojko, V.V. Scherbinin	RECTANGULAR WAVEGUIDE WITH AN IMPEDANCE FLANGE MATCHING CHARACTERISTICS IN MULTIMODE REGIME	*ASU, Barnaul*
91.	Galstyan S.G. , Perevertaylo R.A., *et al*	INCREASE OF EFFECTIVENESS OF INTERACTION BETWEEN MOBILE AND BASE STATIONS	*KNURE, JRIAF, Kharkiv*
92.	Krivopustenko V.V.	ELECTRODYNAMICS CALCULATION OF ELECTROMAGNETIC FIELDS IN A RECTANGULAR WAVEGUIDE WITH TWO L-SHAPED SEPTA	*SFU, Rostov-on-Don*
93.	V.I. Prytula [1], V.P. García [1]	COLLAPSE IN BOSON-FERMIONIC MIXTURES WITH ALL-REPULSIVE INTERACTIONS	*IMAC, Ciudad Real, Spain*

POSTERS: THEORETICAL AND EXPERIMENTAL ELECTROMAGNETICS
Lobby of the Council room Friday 12.12.2007 10:30 – 11:00

94.	R.V. Golovashchenko, O.V. Goroshko	INVESTIGATION OF DIELECTRIC LOSSES IN MINERALS AT MILLIMETER WAVELENGTHS AND OVER A WIDE TEMPERATURE RANGE	*IRE NASU, Kharkiv*

SECTION: RADARS AND WAVE PROPAGATION - 1
Council room Friday 14.12.2007 9:00 – 10:30

95.	Arkhipov A.D.	MATHEMATICAL MODEL OF AN ESTIMATION OF A NOISE SITUATION IN A GIVEN AREA. THE CALCULATING THE SITUATION ON THE TERRITORY OF DNEPROPETROVSK NATIONAL UNIVERSITY	*DNU, Dnipropetrovsk*
96.	Varyanitza-Roshchupkina L.A.	CHOOSING THE OPTIMUM SOUNDING PULSE DURATION TO DETECT THE DIELECTRIC CYLINDRICAL OBJECTS IN THE SOIL	*IRE NASU, Kharkiv*
97.	Vdovychenko Y.I.	MUSIC SPECTRUM ESTIMATION DURING MONITORING POINT REFLECTORS BY THE RETRANSMISSION METER	*KNURE, Kharkiv*
98.	Zakharenkova I.E., Afraimovich E.L., Shagimuratov I.I., Tepenitsina N.Yu.	ANALYSIS OF SPATIAL-TEMPORAL GPS TEC VARIATIONS PRIOR TO THE PERU SEISMIC EVENT OF 26 SEPTEMBER 2005	*IZMIRAN, Kaliningrad ISTP RAS, Irkutsk*
99.	Lutsenko V.I., Lutsenko I.V.	INFLUENCE OF AZIMUTH ANGLE OF ILLUMINATIONS ON POLARIZATION-SPECTRAL CHARACTERISTICS OF BACKSCATTERING FROM SHIP WAVES	*IRE NASU, Kharkiv*
100	Pitertsev A.A.	POLARIMETRIC APPROACH TO DETECTION OF PROBABLE AIRCRAFT ICING ZONES. EFFECTIVENESS ESTIMATION FOR DIFFERENT ICING DETECTION ALGORITHMS	*NAU, Kyiv*

SECTION: RADARS AND WAVE PROPAGATION - 2
Council room Friday 14.12.2007 11:00 – 12:30

101	Plotnikov E.V.	CLOUD FILTRATION TECHNIQUE OF BLACK SEA AVHRR DATA	*MГI NASU, Sebastopol*
102	Polikovskiy O.S.	RECEIVE-TRANSMITTING TELECOMMUNICATION APPARATUS WITH THE USE OF ULTRASHORT IMPULSE SIGNALS	*DNU, Dnipropetrovsk*
103	Radionov S.	BROADBAND SHF DIRECTION-FINDER	*IRE NASU, Kharkiv*
104	Tcherniak Y.V., Lysenko V.N.	OBSERVATIONS OF WEAK IONOSPHERE DISTURBANCES ON THE KHARKOV INCOHERENT SCATTER RADAR	*II NASU & MSEU, Kharkiv*

105	Shirokov I.B., Serdyuk I.V.	ANALYSIS OF DESTABILIZING FACTORS ACTION TO SYNCHRONIZATION OF REFERENCE OSCILLATORS THROUGH ATMOSPHERIC CHANNEL	*SNTU, Sebastopol*
106	Yakovleva D.V., Tolkachenko G.A., Holben B.N., Smirnov A.	OPTICAL FEATURES OF ATMOSPHERIC AEROSOL OVER BLACK SEA SINCE MAY 2006 TO JULY 2007 YEAR	*MHU NASU, Sebastopol NASA, USA*

POSTERS: RADARS AND WAVE PROPAGATION

Lobby of the Council room Friday 14.12.2007 10:30 – 11:00

107	Belozerov D.P.	COMPUTER WAY OF MODELING OF MEASURING TRANSFORMATIONS AT THE IONOSPHRIC SOUNDING BY THE INCOHERENT SCATTER TECHNIQUE	*II NASU & MSEU, Kharkiv*
108	Lutsenko V.I., Lutsenko I.V.	POLARIZATION - SPECRTAL AND SPATIAL CHARACTERISTICS OF MILLIMETER RADIO WAVES BACKSCATTERING FROM HYDROMETEORES	*IRE NASU, Kharkiv*
109	Lutsenko I.V., Lutsenko V.I., Khomenko S.I.	DIAGNOSTIC OF TROPOSPHERE REFRACTION BY PROPAGATION FACTOR OF VHF FIELD PROPAGATION OVER THE NEAR-SURFACE HORIZON PATHS	*IRE NASU, Kharkiv*

OSA Ukrainian Regional Student Chapters Meeting

organized in the frame of YSC-2007, IRE NASU, Kharkiv, Ukraine

Organized by :

Joint OSA/SPIE Student Chapters of

Institute of Radiophysics and Electronics NAS Ukraine

V. Karazin Kharkiv National University

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Preliminary Program of the Event

The aim of the Meeting is to get in touch with colleagues and enthusiasts from different parts of Ukraine, all those interested in the Science of Light, to find out more about OSA and SPIE resources and opportunities, and to share experience and plans for further chapters activities.

14:30 – 16:00 **Invited talks of the OSA Distinguished Lectures**

Four Centuries of Imaging Technology.
Prof. William T. Rhodes, Florida Atlantic University.

Opto-electronic devices behavior at the single-photon level.
Prof. Angela M. Guzman, Internat. Centre for Theoretical Physics, Vice President of the International Commission on Optics.

16:00 – 17:30 **OSA Ukrainian Regional Student Chapter Meeting**

in the format of "Round table"

Presentation of OSA : Resources, Activities & Funding opportunities. Prof. A.M. Guzman

Presentations of the Ukrainian OSA and SPIE Student Chapters : Activities & Achievements

- OSA/SPIE student chapter of IRE NAS Ukraine / Kharkiv
  - Michail Khodzitskiy, President of IRE OSA chapter
  - Maria Pashcehnko, President of IRE SPIE Student chapter
- OSA/SPIE student chapter of the Kharkiv National University / Kharkiv
  - Aleksii Galan, President OSA Student chaptera
  - Alexey Simachov, Tresuarer OSA/SPIE Student chapter
- OSA/SPIE student chapter of the Taurida National V. I. Vernadsky University / Simferopol
  - Alexander Rybas, Vice-president of the TNU OSA/ SPIE Student Chapters
- OSA/SPIE student chapter of Chernivtsi National University / Chernivtzi
  - Aleksiy Chernishov, President of the CHU OSA Student Chapter
  - Yuriy Tomko, President of the CHU SPIE Student Chapter
- OSA/SPIE student chapter of Taras Shevchenko National University of Kyiv / Kyiv
  - Roman Khakimov, Vice-president NUV SPIE student chapter
- SPIE student chapter of Ivan Franko National University of Lviv / Lviv
  - Sergey Velgosh, representative of NUL SPIE student chapter

Foods & Beverages from OSA

SOCIAL PROGRAM

In the frame of the YSC-2007 Conference the following Events will be organized:

Welcome Party : Food and Drinks. FREE for all registered participants - **Thanks to OSA** !

In the program of the Evening: Live Music and the Amateur Photo Exposition « **The World as it is seen by Scientists** ». All participants are invited to take part in the Exposition!

An entertaining Lecture on Astronomy at the Kharkiv Planetarium :

“ The Legends of the Universe ”

The Author of the lecture: **Michail V. Yakobi**

Banquet with music and dancing.

Bus City - Tour.

BONUS :

Photo Exposition – do not miss the chance to become famous ! ☺
It really easy: glance over your photo-archives, choose your favorite photo, and bring it with you !

Book of Abstracts

Plenary Session

Biophysics

Plasmas and Microwave Electronics

Solid State Radiophysics

Optics & Photonics

Computational & Experimental Electromagnetics

Radars, Propagation & Remote Sensing

ELECTRON SPIN RESONANCE TECHNIQUE FOR NANOPHYSICS

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The Electron Spin/Magnetic Resonance (ESR/EMR) technique is one of the most sensitive modern experimental methods to explore magnetic state and magnetic structure of solids. This method provides studies of dynamic behavior of the magnetic moment of atom/cluster by analyzing the absorption of electromagnetic waves in various types of magnets, starting from a para-, ferro-, antiferro- magnets and up to asperomagnets and spin-glass. Namely, such wide variety of potential objects for research makes the method rather prospective for the solving both fundamental and applied problems of nanophysics.

There are, at least, two main tasks among contemporary problems of nanophysics, which demand application of magnetoresonance methods.

The first problem [1] is study of "integrated" (or spatially averaged) magnetic features of the object/nanostructure. It is the fundamental kind of problem. But this problem has grown from practical needs of modern electronics. These needs reduce to necessity of development of nanostructures, which able to conduct effectively extra high frequency currents. The information-contained-parameters (current amplitude, spectrum) for these currents should demonstrate the spin-dependent character and/or they should be electronically-controlled. The discovery of this fundamental problem has been awarded with the Nobel Prize for 2007 [2]. The applied problems of development of such nanostructures, which can be used for design of telecommunications devices of GHz and THz clock frequency, electromagnetic field sensors, antenna technique (etc.) are in under development now [3]. Therefore, method of an Electron Spin Resonance permitting both research and creation a new types of such artificial magnetics with forecasted properties, is extremely demanded now.

The second problem is the research of "local" (inside the volume of specimen) magnetic properties of object/nanostructures. This problem has only applied significance on the first glance. Above mentioned magnetic nanostructures represent, as a rule, nanomagnetic particles (granules, planes, microwires) embedded into non-magnetic matrix. Their arrangement, shape, the type of intrinsic magnetic order for each nanoparticle, determines the "integrated" magnetic properties of whole nanostructure. Therefore, it is quite necessary to exam the spatial distribution of these parameters in the specimen. To solve these problems, the methods of the magnetic resonant *microscopy* (ESR-*microscopes*) are under design now [4]. The models such ESR-*microscopes* having resolution today tens-hundreds micrometers, allow to study properties of separate magnetic nanoparticles of the corresponding dimension. However, the contemporary nanophysics demands much higher resolution (about 2-3 orders higher). This problem is under intensive research now. It is obviously that success can be distinguished by usage not only applied sciences and technology, but first of all due to usage of the comprehensive fundamental knowledge in a solid state physics and electrodynamics.

[1] J. Gregg, et.al, "Spin electronics-a review", *J. Phys. D: Appl. Phys.,* vol. 35, pp.R121-R155, 2002.
[2] "Scientific Background on the Nobel Prize in Physics 2007. The Discovery of Giant Magnetoresistance", *The Royal Swedish Academy of Sciences*, website: www.kva.se., 2007.
[3] In book: Nanostructured magnetic materials and their applications, Kluwer Ac. Publ., 2004, 444p.: ("Magnetoimpedance of the novel magnetic nanostructures in extra high frequency band: Physics, technique and application", S.Tarapov, p.421-432)
[4] D.Belozorov, V.Derkach, G.Ermak, M.Nakihimovich, A.Ravlik, V.Samofalov, S.Tarapov, A.Zamkovoy, "New scanning millimeter waveband ESR-microscope with localized magnetic feld", *Intern. Journ. of Infrared and MMW*, vol. 27, no 1, pp. 107-116, 2006.

USING OF NANOPARTICLES IN THE MEDICINE

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Fig. 1. Procedure of photodynamic therapy

Modern science has an astonishing tendency to variety, improvement, miniaturization, comprehensive utilization of results obtained in different fields. Medicine has not remained without attention. From the very outset of human the being on the Earth, their primary problem was preservation of life. People always and everywhere were trapped by diseases of a different etiology. How to be saved from a mysterious enemy? How to reveal the pathogenic organism in time? What it is necessary to make for treatment? These questions were put and well by human being all the time.

Modern clinical medicine has a huge arsenal of diagnostic methods and procedures for production of the correct diagnosis. To assist the clinicians the experts one involving from different fields of science: the biochemists, biophysics, criminalists, engineers etc.

In the present work one of very actual and promising direction in clinical diagnostics – bionanophotonics was considered – the symbiosis of three scientific directions: biology (medicine, physiology, microbiology etc.), nanoelectronics and optics (fluorescence). One of the common "child" of mentioned directions are quantum dimension structures – quantum dots and fullerenes, and their derivatives – fullerenes nanotubes.

The basic utilization of quantum dots are: photodynamic therapy of cancer (Fig. 1); visualization of pathology regions (Fig. 2); detection of viral DNA (attaching of DNA chain to nanoparticle and its further detection through a scanning microscope); detection of substance, which concentration in an investigated sample is 10^{-9} mol/l and less; development of optical sensors which are based on quantum dimension structures.

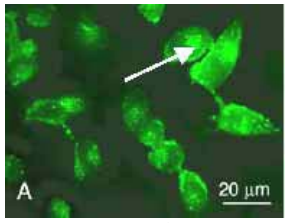

Fig. 2. Visualization of oncology cells

The molecules of fullerenes and their derivates are create mechanical obstruction for virus permeation in the cells of infected organism; they have property to bind free radicals which are arise under the influence of radiation; on a basis of fullerenes improve the implants can be improved; the skeleton from carbon nanotubes represents a ideal support for growth of bone tissues and etc. [1-3]. The utilization of quantum dots for optochemotronic sensor creation with the purpose of early diagnostics of infection diseases is considered also [4].

The present work was supported by the STCU Project 4180. (Project Manager prof. Rozhitskii M.M.).

1. Juewen Liu, Yi Lu. Colorimetric Biosensors Based on DNAzyme-Assembled Gold Nanoparticles *// J. Fluorescence.–200.– V. 14.– No. 4.–P.343-354.*
2. Yayoi Otsuka, Ken-ichi Hanaki, Jizi Zhao and et. *Detection of Mycobacterium bovis Bacillus Calmette-Guerin Using Quantum Dot Immuno-Conjugates // Jpn.J.Infect.Dis.– 2004.– №57. – P. 183–184.*
3. *Yayoi Otsuka, Ken-ichi Hanaki, Jizi Zhao et all. Jpn.J.Infect.Dis. –2004.– V. 5.– P. 183–184.*
4. *Galaichenko O.M., Rozhitskii M.M. Investigation of the Interaction of Amino Acids with Nanoparticles in Electrochemiluminescence Sensor // 3rd ECGEMS Meeting Electrochemistry in "Nanosystems and Molecules at Work" – Czech Republic.–2007.– pp. 40 (P 7).*

FOUR CENTURIES OF IMAGING TECHNOLOGY: 1607 – 2007

William T. Rhodes

Professor Emeritus, School of Electrical & Computer Engineering,
Georgia Institute of Technology,

and

Professor of Engineering and Associate Director of the Imaging Technology Center ,
Florida Atlantic University

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The history of the development of imaging technology combines important elements from scientific research, materials development, technology generally, and economic forces. All are examined in this talk, which describes important developments from the time of Galileo through recent developments in microscopy, television, and biomedical imaging.

William T. Rhodes, Fellow of the Optical Society of America (OSA) and a current member of the OSA Board of Directors, has spent his career teaching and conducting research in the areas of image formation, diffraction theory, and information optics. He is co-author, with D. C. O'Shea and W. R. Callen, of the now-classic textbook *Introduction to Lasers and Their Applications* and is working to complete a text on *Principles of Fourier Optics*.

Prof. William T. Rhodes has been invited to take part in the Conference (YSC-2007) by the joint IRE OSA/SPIE Student chapter in the frame of the OSA Traveling Lecturer Program.

The IRE OSA/SPIE Student Chapter would like to thank Prof. W.T. Rhodes for his kind agreement to speak at the YSC-2007 and to acknoledge the support of OSA which made his arrival possible.

MODELING METHODS FOR PBG STRUCTURES WITH APPLICATIONS

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An analysis of existing modeling methods for PBG structures is performed. Specifically two common methods in time and frequency domain are discussed. Time-domain method is presented by finite-difference time domain (FDTD) method [1] and modal approach in frequency domain is demonstrated by Rigorous coupled wave analysis (RCWA) [2]. Both methods have their pros and cons. FDTD can analyze as ideal PBG structure well as realistic quasi-periodic ones. RCWA is popular for modeling multilayer 2D and 3D dielectric periodic structures and obtaining transmission and reflection coefficients with respect to wavelength, polarization, angle of incidence of a plane wave, whereas FDTD successfully models of pulsed signal (ultrawideband) propagation through PBG structure. Particularly, two examples in time and frequency domain are considered: a linear and 3D defects in non-ideal periodic semiconductor structure for FDTD and slicing procedure for RCWA method. It is shown that hybrid time/frequency domain methods can provide a great flexibility for modeling of optical scattering from PBGs with defects. The field teleportation method is discussed too [3].

[1] A. Taflove, Advances in Computational Electrodynamics: The finite-difference Time-Domain Method, Artech House, 1988.
[2] M.G. Moharam, et al., Formulation for stable and efficient implementation of rigorous coupled-wave analysis of binary gratings. // J. Opt. Soc. Am. A, vol. 12, No.5, May 1995, pp. 1068-1076.
[3] I. Scherbatko, R. Diaz, A new hybrid FDTD field-teleportation approach for modeling radiating/scattering structures. 10th Int. Conf. on Mathematical Methods in Electromagnetic Theory, 2004, Sept. 14-17, pp.19-24.

NUMERICAL MODELING OF ACTIVE INTEGRATED OPTICAL ELEMENTS ON THE PHOTONIC CRYSTALS BASIS

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Photonic crystals (PhC) which are represented by optical media with periodic modulation of the refractive index are widely used today in telecommunication systems as reflectors, filters, resonators of laser sources and resonant cavity enhanced photo-detectors. PhC fibers are used for the compensation of dispersion and for the generation of supercontinuum, which is the radiation with ultra-wide spectrum. Moreover, unique properties of PhC such as the possibility to localize the radiation with certain frequency inside the defect of the periodic structure as well as the possibility to embed the nonlinear elements to the PhC which allow to produce active [1, 2] and passive [3, 4] components, provide the possibility to build all-optical integrated circuits with high elements packaging in nearest future.

The main problem on the way to the creation of the all-optical communication systems as well as PhC-based all-optical integrated circuits is the large price of their production. At that, the experimental investigations have crucial importance for the development of this area. In order to minimize costs needed for the optimization of the structures' parameters it is convenient to use numerical methods for preliminary modeling of the field distribution and the behavior of characteristics of active elements within the variation of external conditions.

Today, the most useful methods for the investigation of PhC characteristics such as band structures are the plane waves expansion method (PWE) and the finite difference time domain method (FDTD). For the modeling of the behavior of electro-magnetic field inside the elements on the basis of PhC as well as the behavior of the structure within the variation of external influences, the FDTD and finite elements method (FEM) are widely used.

In our work we present the computation methods which allow to obtain the field distribution and the transmission characteristics of active devices on the basis of PhC with introduced nonlinear elements. Methods are based on FDTD and FEM methods and allow to obtain static and dynamic characteristics of such devices with high accuracy. The comparative analysis of the efficiency, computation time and accuracy is given.

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AUOTOMATED MILLIMETER WAVE SCALAR AND VECTOR NETWORK ANALIZERS FOR RADIOPHYSIC INVESTIGATIONS

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The purposeful recent advancement in atomic and molecular spectroscopy and dielectric measurements toward the short-wave end of the millimeter band seeks high-resolution amplitude and phase measuring systems. It is known that the most successful systems of the kind are the scalar and vector network analyzers.

The result of development of an automated scalar and vector network analyzers with high resolution of frequency for investigation of resonant systems in millimeter wave band is described in this report. The scalar network analyzer is based on a standard 4-millimeter wave-band generator G4-142 and consist of the interface-card, software and personal computer. The system provides the 160 kHz minimal frequency step at the 53.57- 63.37 GHz tuning range and permits to measure the resonant systems with Q-factor of about $5\text{-}7*10^4$. The results of investigation of open resonator with thin-film teflon insertions is presented.

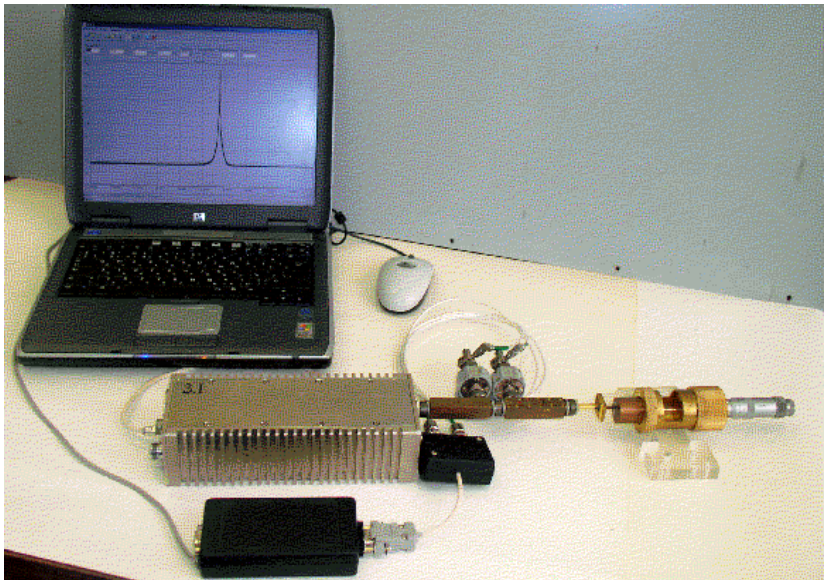

Fig. 1. Photo of the 2 mm wave scalar network analyzer with microwave source based on IMPATT diodes multiplying generator

The 2 millimeter-wave vector network analyzer (VNA) based on two active high-order IMPATT multiplying generators operating on the 22-th harmonics with the output power up to 13dBm was develop for investigation of dielectrics, high-Q resonators and spectroscopy. The multipliers were locked on the output frequency that allowed reducing the conversion loss of the mixers and increasing the dynamic range of the VNA. The VNA can operate at any band of the millimeter–wave range with suitable replacement of the IMPATT multipliers.

The investigation of the VNA has shown that it is possible to build a non-expensive small-sized coherent measuring systems on high-order IMPATT multipliers with performances better or comparable with the VNA based on another harmonic generators.

DUCTS AND RESONANT CAVITIES IN THE GEOSPACE

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The parameters of wave fields existing in the natural environment of our planet are essentially dependent on the degree of non-uniformity shown by the propagation medium. The presence of spatial domains where characteristic velocities of the waves prove markedly different may be a cause for guided propagation of the wave modes between the real or effective boundaries which separate such areas. The reflecting boundaries may also favor the appearance of standing wave patterns similar to those excited in optical Fabry-Perot resonators or open microwave cavities. The physical formations demonstrating wave guiding properties (known as natural ducts) are encountered in a great variety of environments and support wave modes of different kinds. Talking of the Earth's exterior, one can first explore lower layers of the electrically neutral atmosphere, then the entire gap between the surface and the ionized shell; next, the ionosphere itself and the vast plasma-filled cavity in the near space known as the magnetosphere.

The vertical non-uniformity of the troposphere is a principal factor to control terrestrial propagation of electromagnetic waves in the VHF and microwave range. The effective refractive index of the standard, or normal atmosphere is a roughly linear, growing function of height above the surface. Meanwhile, a number of physical mechanisms are known due to which the value may show an 'inverted' run over a few meters or tens of meters in height. Such non-linear profiles of the effective index are typical of 'evaporation ducts' and 'advection ducts' existing over vast water or flat land areas. Owing to refraction in such formations, centimeter-wavelength radio waves are propagated to very long distances beyond the visible horizon (which normally sets the limit).

Theoretically, the effect of guided propagation can be described in terms of motion of a mechanical or, better, quantum mechanical oscillator. The equation governing the behavior of the wave function is similar to the Schrödinger equation, with the square of the refractive index playing the part of the potential. Discrete eigenstates of the oscillator (representing its confined motion) correspond to low-attenuated wave modes in the duct. Using this analogy, one can easily see which of the environmental media can really be a duct or a resonant cavity for the waves of interest. (Of course, to make the evaluation one needs to properly bring the equations to a dimensionless form). What we need to find out is whether our equivalent oscillator will move through a potential well, and how deep and wide the well is going to be. Despite the great diversity in structure scale sizes, parameters of the filling medium, frequencies and physics of the wave modes supported, the dimensionless model equations are practically identical for many other ducts and cavities. A brief list is given below.

Up from the atmospheric surface layer we come across the Earth – ionosphere gap which serves as a waveguide for VLF and HF radio waves, supporting 'ordinary' modes very similar to such in technical waveguides. Interlayer ducts at higher altitudes in the ionosphere can also support electromagnetic 'whispering gallery' modes. Further on, we get in the area where ducting properties concern waves of a different physical nature. These are magnetohydrodynamic (MHD) waves which can exist only in magnetized plasmas. The lowest lying MHD ducting structure is formed along a magnetic tube between the lower ionosphere and the topside level where the characteristic hydromagnetic (Alfvén) velocity undergoes a sharp increase. It operates as a horizontally oriented duct for magnetosonic waves and a peculiar resonant cavity for the Alfvén mode. Still higher in the magnetosphere we find another whispering gallery (the magnetosonic duct near the plasmapause) and the large magnetospheric resonator responsible for spectrum formation of ULF geomagnetic pulsations.

LASER SCANNING MICROSCOPY OF SUPERCONDUCTORS

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Thin-film devices made from superconductors (SCs) are encouraging candidates for the improvement of existing electronics. Much attention has been paid to passive microwave devices, including delay lines, multiplexers, resonators and filters for mobile, cellular and satellite communications. However, despite their expected excellent performance, a number of specific problems (of both fundamental and technological origin) remain unsolved for SC structures at radio frequencies (rf). The *global* (integral) electronic properties of the devices under varied external conditions are strongly dependent on *microscopically* distributed inhomogeneities of SC parameters and local defects, which can cause the SC device to perform below expectations. Also, nonuniform current flow leads to nonlinear rf response of the devices even at modest microwave power. Finally, the investigation of the *intrinsic* sources of degradation and nonlinearity at high frequencies is important for finding the limiting characteristics of such SC devices. This is the main aim of the talk.

The work presents a review on various applications of low-temperature laser scanning microscopy (LSM) developed to probe the optical, structural and electronic properties of SC materials and cryoelectronic SC devices. We have shown earlier [1] that the use of the LSM allows confident search and identification of microscopic defects, individual grain boundaries, spatial irregularities of SC properties, and resistive regions of Ohmic dissipation. Additionally, the LSM was applied to analyze the spatial dynamics of resistive properties of SCs as a function of varying temperature, magnetic field, dc transport current and electromagnetic irradiation. In this review talk, we will illustrate some of the results obtained. Also, we will focus on the newly realized LSM possibilities such as using the rf imaging mode to picture the linear and non-linear SC responses, visualizing thermoelectric effects, probing the superconducting properties of the complicated SC circuits, and the development of two-beam microscopy as well.

In the LSM technique, a modulated laser beam is focused onto and scanned over the surface of a SC device to probe the spatial distribution of different thermo– or/and light-sensitive parameters. For example, the highly localized photo-induced change of the kinetic inductance of the rf device produces both a shift of the resonant frequency and change of the quality factor [2]. An image of these changes is recorded as the laser spot is scanned over the device. By using a newly developed procedure of spatially-resolved wave impedance partition, the influence of inhomogeneous current flow on the formation of nonlinear microwave response in planar rf devices is analyzed in terms of the independent impact from resistive and inductive components [3]. The capability of our method to probe the spatial variations of two-tone, third-order intermodulation (IMD) currents on micron length scales is used to find the 2D distribution of the local sources of microwave nonlinearities [4]. The result shows that the dominant sources of microwave nonlinearities are strongly localized in the resistive domains formed by the highest microwave current densities at the edges of the strips, structural defects like domain blocks and topological inhomogeneities including the edge shape and the inner corners of the resonator structure.

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Plenary Session

Biophysics

Plasmas and Microwave Electronics

Solid State Radiophysics

Optics & Photonics

Computational & Experimental Electromagnetic

Radars, Propagation & Remote Sensing

INVITED PAPER

VIBRATIONAL CIRCULAR DICHROISM SPECTROSCOPY AS A TOOL TO STUDY DNA STRUCTURAL CHANGES: EXPERIMENTAL AND COMPUTATIONAL APPROACHES

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Vibrational circular dichroism (VCD) is an infrared (IR) analog of the conventional electronic circular dichroism (ECD, or CD). VCD was first applied to investigate nucleic acids in 1987 [1] and since then was used successfully to study different aspects of DNA and RNA structure [2,3]. Similarly to IR, VCD provides detailed and well-resolved information on particular DNA functional groups, unlike UV/CD spectra, which arise from electronic transitions that are not group-specific and result in broad and less informative spectra. At the same time, VCD possesses stereospecificity, which is also the main advantage of CD and, arising from through-space coupling of the chromophores (nucleic acid constituents, such as nitrogen bases or sugar-phosphate backbone), are more sensitive to geometry than IR absorption. Additionally, current advances in both hardware and software development allows high level *ab initio* simulations of the VCD spectra of relatively large nucleic acid fragments. Such simulations provide a theoretical basis for explaining most of observed spectral features and lead to an improved understanding of nucleic acid structure.

Over the last several years we have engaged in an extensive research project dealing with study of nucleic acid interaction with metal ions and drugs by means of VCD. This research involved metal ion induced transition of synthetic $d(GC)_{20}$ oligonucleotides from right-handed B to left-handed Z form, metal ion and temperature induced transitions of poly(rA)*poly(rU) from double-stranded to triple-stranded and single-stranded forms. Other emphasis of the research was aimed at natural calf thymus DNA interaction with various metal ions (Mn^{2+}, Cu^{2+}, Cr^{3+}) resulting in DNA condensation, aggregation and denaturation. VCD appeared to be a very convenient and in some cases superior technique to monitor nucleic acid conformational transitions as well as DNA condensation, aggregation, and denaturation. Ab initio simulations allowed us to perform more detailed assignment of the spectroscopic features and understand more thoroughly their nature.

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INVESTIGATION OF THERMAL DESTRUCTION MECHANISM OF NUCLEIC ASIDS.

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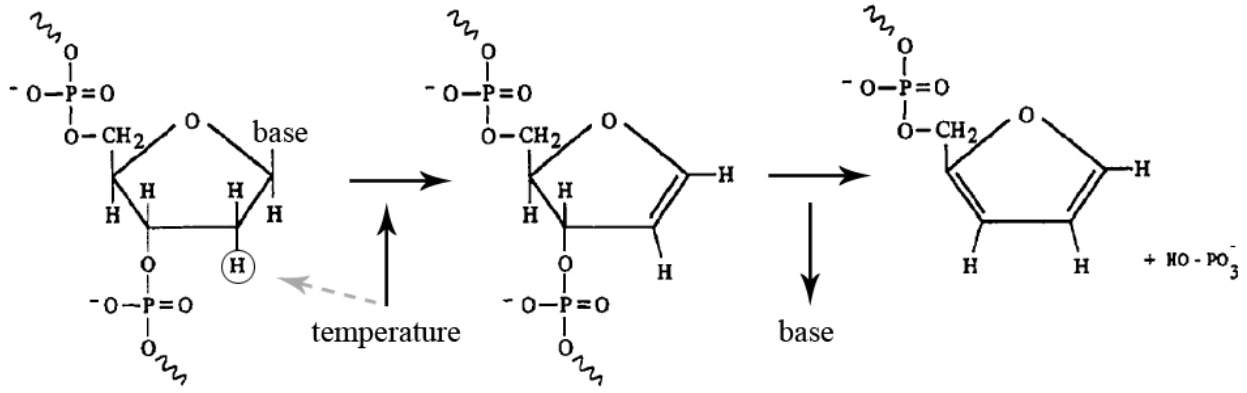
Earlier the investigations of processes that occurring at heating of solid samples natural DNA and of four types homogeneous polynucleotides (polyA, polyG, polyC, polyU) has been made with using of the differential scanning microcalorimetry method. It was obtained, that at temperature near 160^0C for DNA and at temperatures above 200^0C for homopolymers occur irreversible exothermic processes caused by thermal destruction of samples (pyrolysis). The main result is essential distinction of temperatures corresponding to the found processes of destruction.

For more detailed analysis of the thermal destruction processes, the calorimetric analysis of nucleic acids components (nucleotides, nucleosides and ribose) has been carried out. It was shown, that all structures under investigation have the same processes, and it was concluded that process of thermal destruction primarily connected with changes in ribose.

It is known, that one of the most informative method of the substance destruction mechanism research is the mass-spectrometry analysis. Therefore the review of results obtained with this method at research of nucleic acids has been made. The review shows that nucleotides and olygonucleotides pyrolysis products have a characteristic mass-spectrometry spectrum for each types of nitrogen base. As well as in our investigations, irreversible process in a sample occurred in temperature interval of 150-275^0C, and this temperature which correspond to a maximum yield of ions differed for various type of the nucleobase.

From the results received by us and with method of mass-spectrometry it follows, that hydrogen transfer from a sugar moiety to the base followed by break of glycoside bond is a primary process in the samples destruction. The loss of nucleobase render 3'-C–O bond extremely unstable leading to cleavage of this bond:



The suggested scheme of the thermal destruction mechanism probably is not unique and will depend on the conditions at which process is occurred. Generally, the mechanism of thermal destruction of ribonucleic acids to be the same as those operating for DNA. However, there are the differences caused by presence of hydroxyl 2 '-OH group: in contrast to DNA, cleavage of nucleobase result in phosphorane formation with the subsequent break of 5'-C–O bond and loss of a neutral molecule of water.

The proposed scheme allows to understand distinctions of the polynucleotides thermal stability containing various type of the nucleobase and to make assumptions about exothermic character of destruction process**.**

THE MOLECULAR MECHANISMS OF BINDING OF FLAVINMONONUCLEOTIDE TO DNA BY THE DATA OF RAMAN SPECTROSCOPY AND SPECTROPHOTOMETRY.

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One of main limiting factors of use of antitumoral antibiotics is their high toxicity which is reduced at the presence of Riboflavin (vitamin B_2) and its derivative flavinmononucleotide (FMN). FMN exhibits protective activity on DNA, displacing a ligand from its binding sites with a polynucleotide matrix [1].

To find out the molecular mechanisms of binding of FMN to DNA we have investigated complexing DAN-FMN at various concentration ratios of a polynucleotide and vitamin (P/D) using methods of a UV-VIS absorption spectophotometery and Raman spectroscopy.

The absorption spectrum of the free FMN has two absorption maximums: at λ_I=371 nm - the maximum of absorption of FMN monomer and at λ_{II}=442 nm - an absorption maximum of dimers of FMN. The different behavior of absorption curves of FMN-DNA mixtures at P/D=3 and P/D=20 testifies to formation of different types of complexes of vitamin on DNA matrix. Blue-shift of an absorption curve at P/D=20 was observed. This fact requires additional studies of dependence of changes of complex spectra from time.

Raman spectra of the free FMN and of vitamin-DNA mixtures have been obtained at same values P/D=3 and 20. Having analyzed Raman spectra we have concluded that spectra of complexes differ at various values P/D in vibration area of in-ring C-N, C=C and C-C groups, as well as from a spectrum of the free FMN. Hence, the previously spectrophotometric conclusion about formation of different types of FMN-DNA complexes at different concentrations of polynucleotide is confirmed. Also from Raman spectra it has been obtained that C=O groups of a chromophore of FMN are participated in formation of two types of complexes of vitamin with DNA.

Based on the UV-VIS absorption and Raman spectroscopic data the possible models of binding FMN to DNA are suggested.

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DETERMINATION OF BINDING PARAMETERS OF LIGANDS TO DNA BY DIFFERENTIAL SCANNING CALORIMETRY

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DSC is a straightforward method of determination of thermodynamic parameters of conformational transitions in biopolymers. This method is also help to determine binding parameters for ligands with large binding affinity when other experimental methods are ineffective. There are many approaches of calculation of binding parameters for protein – ligand interaction based on two state model. Applicability of these models for the DNA – ligands complexes has many limitations. In the present work we attempt to calculate binding parameters taking into account peculiarities of DNA melting and multimodal binding of ligands.

Calculation of the binding enthalpy was carried out in assumption that the melting enthalpy change of complexed DNA as compared with free polynucleotide ($\delta\Delta H$) is due to interaction of ligand with double-stranded DNA. The binding enthalpy (ΔH_b) of Act III with DNA for two types of complexes can be obtained by optimization of calorimetric data at different DNA – ligand ratio

$$\delta\Delta H = (-\Delta H_{b_1}) \cdot r_1 + (-\Delta H_{b_2}) \cdot r_2 ,$$

where ΔH_{b1} and ΔH_{b2} are binding enthalpies (per mole of ligand) for each type of complexes;
r_1 and r_2 are the amount of bound ligand (per mole nucleotide) in the composition of each type of complexes determined from spectrophotometric titration data.

To estimate binding constants of ligand with DNA we develop approach suggested by Barone G. et al. [1]. The two state model of DNA melting is valid only for cooperative unit of polynucleotide (m). Cooperative unit is calculated as ratio of van't Hoff to calorimetric enthalpies. It is suggested that ligand occupies n nucleotide on DNA matrix (n – binding size obtained from spectrophotometric data).

$DNA_n – L \rightarrow DNA_n + L$	$DNA_m \rightarrow 2mDNA$
Dissociation of the complex	Melting of the cooperative unit of DNA

Temperature dependence of binding constant is obtained from melting curve using van't Hoff equation.

We solve the system of equations of mass action law and concentration conservation law for ligand and DNA to calculate concentrations of all particles at each temperature and temperature dependence of excess heat capacity. Optimal binding constant is calculated by the standard deviation of theoretical dependence from experimental one minimization method in the wide range of DNA – ligand ratio.

It was shown that suggested models for calculation of binding parameters of ligand with DNA are limited. The ways for improvement of these approaches is considered.

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INVESTIGATION OF SUPERCOILED DNA STRUCTURE IN NUCLEOSOMES

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Investigation of supercoiled DNA presents special interest because in this state DNA is active in biological processes. Topological properties of circular DNA plays a major role in that case. To describ supercoiled state of closed circular DNA such geometrical parameter of space curve as writhe was introduced. Most of modern computer programs do not allow to calculate given parameter, that is why it is important to develop effective computer methodic, which allows to calculate supercoiled nucleosomal DNA topology. The object of this work was to obtain effective method which allows to investigate the nucleosomal DNA's writhe by means of numerical integrating with given nucleotide coordinates

To resolve the task we have used Konstantin Klenin's [1] algorithm, which computes the writhe with next formula :

$$Wr = \frac{1}{4\pi} \oint_C \oint_C \frac{(dr_2 \times dr_1) r_{12}}{r_{12}^3}$$

were $\mathbf{r}_1$ and $\mathbf{r}_2$ is points, throughout curve C follows, which represented imaginary molecule axis. $\mathbf{r}_{12} = \mathbf{r}_2 - \mathbf{r}_1$, $r_{12} = |\mathbf{r}_{12}|$.

To realize this algorithm following software were used: Compaq Visual Fortran V.6.1.0. Selection of Compaq Visual Fortran V.6.1.0. caused by simpleness of programming language and apparatus independence (because the programs of Compaq Visual Fortran V.6.1.0, are Windows applications).

According to mentioned algorithm we need to choose point of view on closed space curve. Given curve divided on determined number of vectors which directionally follows by curve relatively to chosen point, and do perform calculation of quantity of self-crossings. Actually we performed calculation of solid angle, measured in radians, which investigating curve makes from chosen point of view. In the case of DNA that value corresponds to quantity of molecular axis crossings i.e. writhing number. Method has been developed, which allows to calculate DNA writhe by base pairs centers coordinates. Success testing of obtained program was performed on ideal curves series. Results have good agreement with theoretical writhing properties. Analysis of this method and program shows that the writhe's values decrease when the helix step increasing with constant other parameters, and to large step helix it limits to zero. Writhe's values changes jump-vice, because only whole number of crossings can be. Writhe computation of series idealized and real nucleosomal DNAs taken from PDB with the same histon proteins but with different number of base pairs. Obtained data shows with high accuracy the main influence on nucleosomal DNA conformation exerts histons not nucleotide's sequence, because in investigated cases the value of calculated writhe was similar in each group. Computations were performed on artificial nucleosomal DNAs with histons of frog, human and so on.

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MODELING OF CONFORMATIONAL DYNAMICS OF A DNA SUGAR-PHOSPHATE BACKBONE IN PROTEIN-DNA COMPLEXES

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Conformational variety of nucleic acids is traced at all levels of the organization, from low-molecular components nucleic acids to it complexes with specific proteins. Functioning of biomolecules is depends on their conformation. The understanding of such dependence on detailed atomic level makes the research problem of modern structural biology. One of the actual problems in this area is analysis of databases containing protein-DNA complexes for definition of the common laws of protein-DNA recognition. In such recognition the important role is played by indirect mechanisms, resulting from the deformation of DNA. Therefore, particularly, it is important to investigate influence of conformational transitions in sugar-phosphate backbone of the DNA on protein-DNA recognition.

Purpose of the work was to investigate the influence of conformational transitions in sugar-phosphate backbone of the DNA on protein-DNA recognition: the configuration changes of torsion angle γ (*gauche*−/*gauche*+/*trans*) were studied. The protein-DNA complexes resolved by X-ray method were used in our research. The database of non-homologous structures taken from the Nucleic Acid Data Bank (resolution better than 2.6Å) was build. The calculation of DNA structural parameters for nucleotides interacting and non-interacting with protein was carried out by means of the special software. The following transitions were simulated: *gauche*+ ↔ *trans*, *gauche*− ↔ *trans*, and *gauche*+ ↔ *gauche*− by the molecular dynamic method (MMD) and the values of their free energy changes were received.

The analysis of protein-DNA complexes was shown, that local changes of torsion angle γ influence on molecular recognition in protein-DNA complexes due to change of polarity of surface DNA accessible to interaction with proteins.

The following results were also received:

1) The torsion angle γ is, mainly, in *gauche*+ conformation (85%). It is remarked that the *gauche*− (9 %) and *trans* (6 %) conformations for γ are highly disfavoured;
2) The MMD calculations of relaxation time for *gauche*− and *trans* conformation were shown that *trans* conformation is more stable, than *gauche*− conformation.
3) The correlation between a angle of pseudo-rotation of sugar P and torsion angle γ was obtained;
4) The analysis of the occurrence frequencies of various γ configurations in structures of the protein-DNA complexes resolved by X-ray and NMR methods, allows to determine that the greatest nucleotides fraction, taking place in *gauche*– conformation, make Thymins. In *trans* conformation the fraction of Cytosines is increased. Consequently, the dependence of preferable conformation of γ torsion angle from sequence of the DNA was shown.

Obviously, the conformation of sugar-phosphate backbone of the DNA plays the important role in protein-DNA recognition.

DYNAMICS OF DNA DODECAMERS OF DIFFERENT SEQUENCE

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The aim of this study was to investigate the influence of sequence on the dynamics of B-DNA using molecular dynamics simulation. Eight DNA dodecamers differing by the content of the central tetramer were investigated: $d(CGCGXXXXCGCG)_2$, where XXXX = AATT, AGCG, AGCT, ATAT, GTCA, TGCA, TGCT, TTAA. The simulation was carried out in the program package AMBER 9 with explicit representation of solvent and counterions. The coordinates of the initial structures were taken from the Nucleic Acid Database or were built in the Arnott B-DNA canonical form using NUCGEN module of AMBER 9 package. Three force fields from the AMBER family containing different parameters for sugar-phosphate backbone were used: parm98, parm99, and parmbsc0.

For each DNA dodecamer in each of three force fields, 10-ns molecular dynamics trajectory was obtained. The structure of dodecamers was rather flexible in the course of simulation: the mean root-mean-square deviation (RMSD) calculated with respect to the first trajectory frame was found to be 2.3-3.5 Å for different DNA trajectories. In some cases instantaneous values of RMSD were up to 4.5-5.0 Å. Nevertheless, the structure of double helix was well conserved, and the disturbance of the base pairing resulted from the disruption of connecting bases hydrogen bonds was observed only for the terminal pairs of nucleotides. During the simulation, α/γ transitions from canonical g^-,g^+ state into the g^+,t region were registered for several sugars. It is known that accumulation of non-canonical α/γ conformers seen in the long (>10 ns) molecular dynamics trajectories is an artifact of old versions of AMBER force field. In our case, there were from 1 to 4 irreversible α/γ transitions to the g^+,t state, mainly in sugars of terminal residues, in the simulations of different dodecamers with parm98 and parm99 force fields. The transitions of α/γ observed in trajectories obtained with the new parmbsc0 force field were reversible.

The analysis of trajectories by means of essential dynamics method showed that independently of sequence 90 % of motions of any dodecamer could be described by the first 45 eigenvectors of covariance matrix built from the molecular dynamics trajectory. In order to characterize quantitatively the similarity or dissimilarity of dynamics of different DNA dodecamers, we calculated absolute similarity indices for the motions of atoms of their sugar-phosphate backbones. The values of indices were found to be in the range of 0.7-0.9. This indicates that there is a common dynamics pattern for the sugar-phosphate backbone of B-DNA. The similarity indices calculated for trajectories of one and the same DNA sequence in different force fields were equal to 0.9. However the same high values of indices were obtained for different DNA sequences that had an identical initial structure of the sugar-phosphate backbone (were built in the NUCGEN module). To separate the influence of sequence on the dynamics of the DNA sugar-phosphate backbone from that of the initial structure, we performed an additional simulation of sequence $d(CGCGAATTCGCG)_2$ in the force field parmbsc0. Previously the initial structure of this sequence was taken from the databank, but in the additional simulation we built it as canonical Arnott B-DNA using NUCGEN module. The absolute similarity index calculated for two trajectories of $d(CGCGAATTCGCG)_2$ was equal to 0.7. Therefore we can conclude that on the simulated timescale (10 ns), the initial structure has much more influence on the dodecamer dynamics than the sequence of DNA.

MOLECULAR DOCKING OF ACTINOCIN DERIVATIVE AND DNA FRAGMENTS OF DIFFERENT SEQUENCE

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In this study, the influence of the DNA sequence on the binding of the anticancer antibiotic actinomycin D derivative with asymmetric side chains (actIII-II) to DNA was analyzed using molecular docking method. The initial structure of actIII-II was obtained as a result of the optimization using b3lyp method with the basis 6-31G* in the program Gaussian03. In order to determine actIII-II partial charges, the electrostatic potential was used that was calculated for the optimized conformation of actIII-II by Hartree-Fock method with the basis 6-31G* in the program GAMESS. To estimate the sequence specificity of actIII-II, 8 DNA dodecamers differing by the composition of the central tetramer were chosen as targets. Both AT and GC-rich sequences were considered including those that actinomycin D is known to bind to. The simulation of two types of binding of actIII-II to DNA was performed: intercalation and binding of the actIII-II in the DNA grooves. The molecular docking was carried out using Lamarckian genetic algorithm in the program package AutoDock 3.05. Upon the binding of the actIII-II in the DNA grooves, in addition to the ligand flexibility, the flexibility of target (DNA fragment) was also taken into account by representing it with a set of 7-9 rigid conformations. The most probable complexes were chosen using following selection criteria: the minimum energy of complex, the maximum number of hydrogen bonds in the complex between actIII-II and DNA, the good reproducibility of complex.

The simulation of the intercalation of the actIII-II into the DNA resulted in two types of complexes that differed by the arrangement of ligand side chains with respect to the target: in the intercalation complex of the first type, actIII-II side chains lied in the DNA minor groove; as for the second type of complex – they were in the DNA major groove. In both cases the preference of binding to the GC-rich DNA sequences was observed. Each type of complexes could be further separated on two subtypes depending on the orientation of the NH_2-group of ligand chromophore. However there was no well-defined correlation between the arrangement of the actIII-II NH_2-group and the energy of complex.

The incorporation of the actIII-II in the DNA minor groove was characterized by the formation of two main types of complexes: in the first type of complexes, the long axis of the ligand chromophore was perpendicular to the DNA minor groove; and in the second one, it was lying along the minor groove of the DNA. As in the case of the intercalation complexes, each minor groove binding complex type could be divided into subtypes based on the orientation of the actIII-II NH_2-group. The first type of minor groove binding complexes with the ligand chromophore NH_2-group being directed into the minor groove of the DNA was found to be the most energetically favorable. The increase of the binding energy in this case is obviously caused by the formation of the hydrogen bond between the NH_2-group of actIII-II and the DNA.

Upon the binding of the actIII in the DNA major groove, the great diversity of types of complexes was observed. Therefore it was not possible to choose any preferable type of complex. In each particular case, there was a good reproducibility of complex, and multiple hydrogen bonds between ligand side chains and donor-acceptor groups of DNA were registered.

EFFECTS OF Ni^{2+} IONS AND TEMPERATURE ON PHASE TRANSITIONS IN POLYNUCLEOTIDES CONTAINING ADENINE AND URACIL

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Research on transition metal ion complexes with polynucleotides in different conformations is conditioned with ecological problems as well as with a possibility of using such complexes for treating viral and oncological diseases [1].

Methods of differential UV spectroscopy (DUVS) and thermal denaturation were used to study Ni^{2+} ion and temperature effects on the conformational equilibrium of double-stranded polynucleotide polyA·polyU (AU) under conditions close to physiological ones (0,1M Na^+, pH7).

Ni^{2+} ions induce no changes in AU absorption spectra up to 0,01M Ni^{2+}, that may be caused with the formation of outer-spherical macrochelates (OSM) in which Ni^{2+} ions interact at one time with oxygen atoms of phosphate groups and (via water molecules) with N7 of adenines.

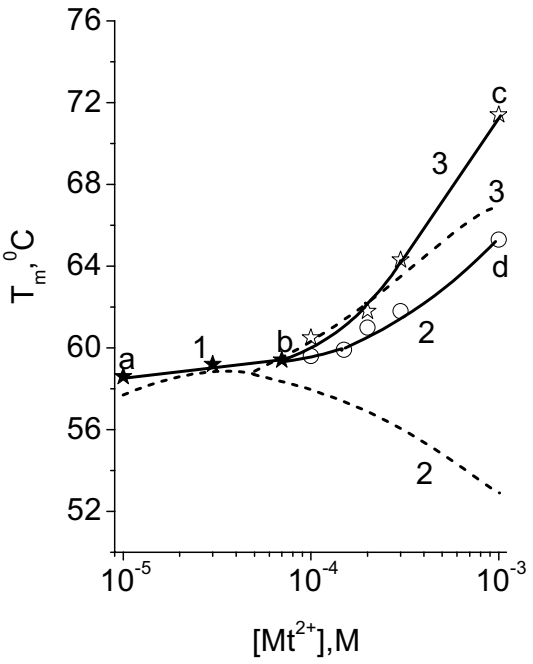

Figure 1. Phase diagram of Ni^{2+} ion complexes with AU at 0.1M Na^+.
1– $(T_m)_{21}$ (★); 2– $(T_m)_{23}$ (○); 3– $(T_m)_{31}$ (☆).
Dotted line is for phase diagram for AU+Mg^{2+}complex [2].

The phase diagram of the complex (Figure 1) falls to parts corresponding to 2→1 transitions at low concentrations of Ni^{2+} ions and 2→3 and 3→1 transitions at Ni^{2+} ion concentrations exceeding the critical one. Concentration dependences $(T_m)_{21}$ and $(T_m)_{31}$ are similar in quality for Mg^{2+} [2] and Ni^{2+} ions while, unlike Mg^{2+} ions lowering $(T_m)_{23}$ [2], Ni^{2+} ions increase the temperature of the 2→3 transition. Theoretical calculations show that a possible reason of this effect is a decrease of the difference between constants of Ni^{2+} ion binding to A2U and AU as well as a reduction of the number of Ni^{2+} ion binding sites upon 2→3 transition. One more possible cause is additional stabilization of AU because of the OSM formation absent in the case of alkali-earth metals.

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MONOVALENT IONS INFLUENCE ON THE ACTINOCIN DERIVATIVE BINDING WITH NATIVE AND DENATURATED DNA

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As is well known DNA is a highly negatively charged polyelectrolyte both in double-stranded ("native") and in single-stranded ("denatured") forms and displays considerable sensitivity to ionic surroundings during various structural transitions and in interactions with charged species. Spatially unlocalized positive charge ions (cations) which are in the solution as a buffer, added to the system and released in the process of DNA melting can act as competitive ligands for drug (cations) binding to polynucleotides.

As was shown earlier [1] actinocine derivatives can form two different types of complexes (intercalation and external complex in DNA groove) at binding to native DNA molecule. By example of actinomycin D derivatives we estimated influence some monovalent positive charge ions (counterions) on the multimodal drug interaction with DNA using competitive binding model of two ligands with polynucleotide matrix.

Using computer optimization program [2] permissive consideration of cooperative binding ability we calculated from spectophotometric concentration dependences spectral and thermodynamic (constants and site sizes of binding) parameters in the ligand – native polynucleotide and ligand – denatured polynucleotide systems.

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ELECTROSTATIC CONTRIBUTION TO COMPLEXATION ENERGY OF ANTHRACYCLINE ANTIBIOTICS WITH DNA

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Electrostatic contribution ΔG_{el} is one of the most important in complexation of biomolecules [1]. For now analysis of ΔG_{el} for different «protein-protein» and «protein-DNA» complexes has been performed in detail, however, as for the binding of aromatic intercalators to DNA, detailed study of the electrostatic contribution has only been accomplished just for few ligands [2]. In the present study by a method based on a solution of nonlinear Poisson-Boltzmann (NLPB) equation, a calculation and comparative analysis of electrostatic contribution into a total energy of complexation of anthracycline antibiotics daunomycin (DAU), nogalamycin (NOG) and their synthetic anthracenedione derivative novantrone (NOV) with DNA oligomers of different length N (from 4 to 16 base pairs) was made.

For NLPB solution and ΔG_{el} calculations we used Delphi 4.0 program [3]. The following contributions into total electrostatic energy were calculated: energy of interactions of solutes with counterions ΔG_i, energy of interactions of atomic charges with induced surface charges of boundary (solvation energy) of ΔG_s and energy of coulombic interactions between solute atoms ΔG_c. Complexation of intercalators with DNA was analysed as a process consisting of two stages: formation of intercalation cavity in DNA duplex and ligand insertion to unwound DNA.

Comparative analysis of the results obtained has enabled to conclude that total electrostatic energy of the complexation of anthracyclines with DNA is determined by a sum of big by value and opposite in sign terms ΔG_c and ΔG_s, whilst ΔG_i term appears to be very small. Electrostatic interactions are, as a whole, destabilize complexes «ligand-DNA» in water environment ($\Delta G_{el}>0$). The results also suggest that an unambiguous analysis of a contribution of different components of electrostatic energy must be performed using the lengths of oligonucleotide sequence $N\geq 8$.

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STUDY OF ACTINOCINE DERIVATIVE AND ETHIDIUM BROMIDE COMPETITIVE BINDING TO CALF THYMUS DNA

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In resent years because of evolution of combined chemotherapy it is necessary to study the competitive binding of several biologically active compounds or anticancer drugs with nucleic acids. Spectrophotometry is one of the most frequently used method for the analysis of the simultaneous interaction of several ligands with polyelectrolites. But some difficulties occur when both ligands absorb in the same wavelengths region. We propose the methodic in which analysis of the competitive binding is carried out in the isosbestic point in spectra of one of the ligands. In this case the absorption of this ligand stayed constant at all DNA concentrations. This allows to subtract it from the total absorption of the mixtures. Proposed methodic was tested on the system actinocine derivative – calf thymus DNA – ethidium bromide. Actinocine derivatives interact with DNA by both intercalation and groove binding. We had shown previously that presence of ethidium bromide decrease the amount of intercalated into DNA actinocine derivative [1]. In the present work we had calculated via DALSMOD optimization program the equilibrium composition of the mixtures actinocine derivative – calf thymus DNA – ethidium bromide. It is shown that in presence of ethidium bromide the amount of intercalated into DNA actinocine derivative is essentially decreased and the amount of the free dye in the solution is increased. On the other hand in presence of actinocine derivative the amount of intercalated into DNA ethidium bromide also decreased. The amount of displaced from DNA ligands is calculated. It is shown that proposed method is effective in the case of multimodal binding of one of the ligands and allows to calculate the values of binding constants, binding site sizes and the equilibrium composition of the triple systems with both ligands absorbing in the same wavelengths region.

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TETRAPOD PATTERN OF VERTEBRATES: AN INCIDENCE OR THE LAW ?

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The origins of the well-known pattern of tetrapod development remains unclear despite the considerable efforts of scientists. The existing theory describes in great details the phenotypic features of cells in developing limbs but fails to explain the exact mechanism that starts limb development and restricts the point of limb outgrowth to a certain locus on the lateral plate (Fig. 1 a). In the paper, we propose a physical interpretation of the processes that precede the limb development and answer the above questions.

Our theory considers the hydrodynamic flows in blastula and early gastrula, which give origin to four major vortices [1] and create the stress gradients that initiate the four limbs of the vertebrates (Fig. 1 b). The theory is confirmed by a systematic study of the stress gradients in the chicken embryo on different stages of development which is done by a unique self-developed instrument (high-resolution air-tonometer) capable of measuring in vivo the stiffness of living tissue by a non-contact technique. It is clearly revealed for the first time that the mechanical factors are the initiating source for limb outgrowth.

The proposed theory bridges the gaps in the available theory of the tissue development and highlights new possibilities for tissue engineering.

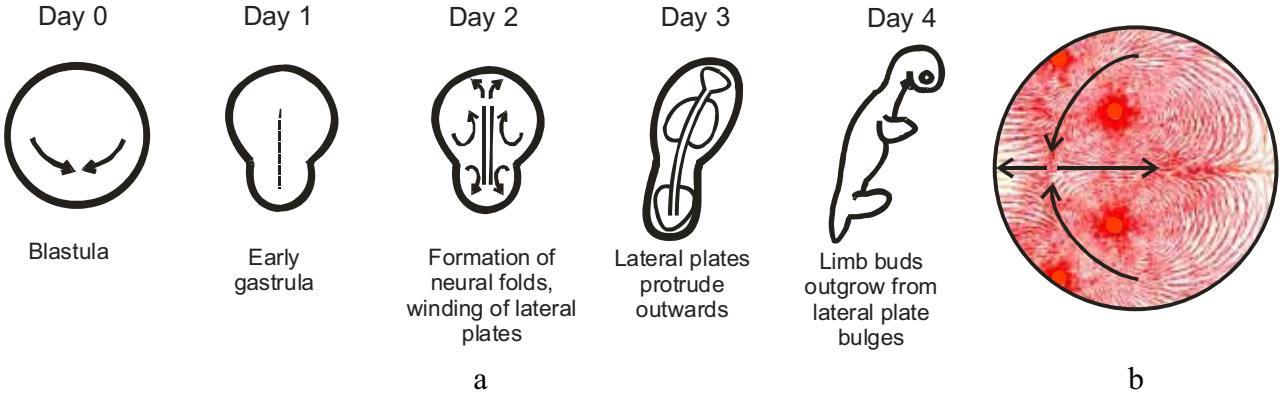

Fig. 1. Mechanisms of the limbs formation:
(a) – schematic summary of the events observed during establishment of the "bauplan" of the chicken embryo: day 0 – a circular blastula with a contracting Koller-Rauber sickle, day 1 – contraction of the sickle induces the blastula and the early gastrula to acquire a "figure 8" shape, day 2 – recirculation around the saddle point drives the ectoderm away from the saddle point in a cranial and caudal directions, day 3 – while the central part folds, the ectoderm in the presumptive lateral plates starts to protrude above the average plane of the embryo, day 4 – the limbs extend in the shape of paddles;
(b) – mathematical reconstruction of typical flow in blastula and early gastrula, where the centers of vorticity are the areas of reduced resistance of ectoderm and starting points of limb development

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INVESTIGATION OF INTERACTION BETWEEN MOLECULES OF IMIDAZOPHENAZINE BY IR ABSORPTION SPECTROSCOPY AND AB INITIO METHODS

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IR spectra of dye imidazophenazine were obtained in KBr pellet and low-temperature argon matrix in spectral range 400 – 1700 см$^{-1}$. The both spectra were fitted with the sum of Lorentzian curves. As a result, peak positions (cm^{-1}) and integral intensity of lines observable in fitting spectra were determined. The quantum-mechanical calculations of IR spectra of imidazophenazine molecule were carried out (by method DFT B3LYP with a basic set 6-31++G**). At comparison of position and intensity of experimental bands observable in a spectrum of imidazophenazine (KBr pellet) and calculated data, for the majority of the bands the certain fluctuation of a molecule has been put in conformity. However, for several bands such assignment based on current calculation was not possible to made well. Therefore the spectrum of investigated compound has been measured in further in low-temperature argon matrix with such proportions of concentration, when the molecule of imidazophenazine is in a matrix in the isolated monomeric form. At comparison of this spectrum with calculated one it is noted fairly good agreement between them. For the most intensive bands observed in the experimental spectrum it was possible to us to find the association with the certain type of fluctuations of a molecule.

For explanation the differences between experimental (KBr pillet) and calculated spectra we made series calculations of imidazophenazine in dimeric form. During the calculations geometry optimization, computation of binding energy, frequencies and intensities in IR spectrum were carried out. As a result, most energetically favorable there was a dimer structure in which 2 molecules are in a plane and are unwrapped from each other on 180° and form hydrogen bond between atoms of nitrogen and hydrogen of imidazol rings. At comparison of the calculations received for a monomer and dimer, shifts for some bands which were showed as a result of this bond have been established and shown in an experimental spectrum. So, for example, fluctuations a monomer on frequencies 412, 620 and 1074 cm^{-1} are observed for dimer on frequencies 600, 793 and 1120 cm^{-1} accordingly. First two of them correspond basically to fluctuations of N-H group, and the third is caused to fluctuations C-H of group imidazol rings. Using results of calculation of frequencies and intensities of dimmer bands IR spectrum, were fuller correlation of the most intensive bands observed in experimental spectra of microcrystals of imidazophenazine in KBr with certain fluctuations is executed.

ON FORMING THE GLASSY STATE IN AQUEOUS SOLUTIONS OF OXYETHYLATED GLYCEROL OF DIFFERENT POLYMERIZATION DEGREE

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Water has a special place among all known substances due to both its anomalous properties and a significant role in functioning biological systems. Ability of water molecules to form a branched network of hydrogen bonds in both pure water and solutions results in that aqueous solutions of some substances have a tendency to solidification in the amorphous state [1]. Depending on a solute, its concentration and cooling rate, a solute-water system hardens in the completely amorphous state or in the heterogeneous state including both crystalline phase and glass residue.

At the present time aqueous solutions of oxyethylated derivatives of glycerol (OEG) are used as components of cryoprotective media for low temperature preservation of biological objects. One of criteria of efficiency of a cryoprotectant is its ability to prevent formation of ice causing damage and death of biological cells. Therefore study of glass-forming tendency of cryoprotectant-containing aqueous solutions is of immediate practical importance. We have constructed supplemented phase diagrams of aqueous solutions of OEG of polymerization degree n = 5, 25 and 30 on the basis of DSC data. Temperature and concentration ranges of stable and metastable phases have been determined. Concentration dependences of a change in heat capacity reflecting transition of the systems or their part from the glassy state to the supercooled liquid state have been plotted. On the basis of the analysis of these curves one can conclude that the glass-forming tendency of the systems under investigation differs insignificantly in the region of low concentrations of OEG, it increases with n in the region of middle concentrations and it decreases with increasing n in the region of high concentrations.

Glass transition temperature of a mixture can be determined from the empirical formula [2]:

$$T_g = T_{g1}\omega_1 + T_{g2}\omega_2 + k\omega_1\omega_2 ,$$

where T_g is the glass transition temperature; ω_1, ω_2 are the weight fractions of each of the components; k is a proportionality constant depending on the components.

This formula is valid only in the case of solidification of the system in the completely amorphous state. Concentration ranges of the completely amorphous state have been determined and concentration dependences of glass transition temperature have been plotted for the systems under investigation. Approximation of the dependences to zero concentration of OEG allows estimating glass transition temperature of pure water. So far this value has not been determined experimentally because of impossibility to reach sufficiently high cooling rates.

Thus all the systems under investigation have high glass-forming tendency which is determined both the polymerization degree of the OEG molecules and their concentration in aqueous solutions.

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OZONE EFFECT ON THERMOSTABILITY OF HEMOGLOBIN AND MEMBRANE-BOUND PROTEINS OF RED CELLS

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A number of researchers have established, that effect of ozone on biological is dose-dependent: at low ozone doses physiological functions are stimulated, and at high doses they are inhibited. Investigation of this effect at the level of isolated proteins is important for understanding the mechanisms of biological effect of ozone.

In the present work we studied an influence of different ozone doses on thermodenaturation of hemoglobin and membrane-bound proteins of red cells using the method of differential scanning adiabatic calorimetry (DASM – 4, Puschino). Hemoglobin and ghosts were derived from the red cells according to standard procedure. Ozone was loaded in hemoglobin solutions and suspensions of ghosts by mixing with ozonated physiological salt solution in the ratio 1:2. Also we studied hemoglobin and membrane-bound proteins, derived from ozonated red cells, washed-out with ozonated physiological salt solution. A concentration of proteins was determined spectrophotometrically (Pye Unicam 8000, Great Britain).

The analysis of obtained thermograms has shown, that destabilizing effect of ozone on the molecules of ozonated hemoglobin starts to appear at the ozone dose of 6.7 g $(O_3)\times mole^{-1}$ of Hb, that corresponds to the final ozone concentration 1 mg $(O_3)\times L^{-1}$ of hemoglobin solution. When ozone dose increases, monotonic growth of half-width of the thermodenaturation peaks is registered. It can be explained by increase of contribution of methemoglobin. The shape of thermograms of hemoglobin denaturation at high ozone doses – 26.9 g $(O_3)\times mole^{-1}$ of Hb (4.3 mg $(O_3)\times L^{-1}$ of solution) and 38.7 g $(O_3)\times mole^{-1}$ of Hb (6 mg $(O_3)\times L^{-1}$ of solution) gives grounds for assumption about decondensation of hemoglobin molecules. Thermodenaturation of hemoglobin, derived from ozonated red cells, does not undergo significant changes even at the ozone dose of 9 mg $(O_3)\times L^{-1}$ of cell suspension. Thermograms of red cell membranes contain the information about the changes of state of membrane-bound proteins, resulted from ozone effect. If the ghosts are exposed to ozone dose 0.13 mg $(O_3)\times g^{-1}$ of protein (0.2 mg $(O_3)\times L^{-1}$ of ghosts suspension), all the transitions - A, B, C, D, - typical for non-ozonated ghosts of red cells, are registered. Transition A corresponds to the melting of spectrin and ankirine, transition B – to actin melting, C – to the melting of the band 3 protein (aniontrnsporting protein) and the bands 4.1 and 6 proteins, D – the tropomyosine melting. Exceeding of ozone dose 1.23 mg $(O_3)\times g^{-1}$ of protein (2 mg $(O_3)\times L^{-1}$ of ghosts suspension) results in decrease of the intensities of peaks, which correspond to above mentioned transitions, and at the ozone dose of 5.29 mg $(O_3)\times g^{-1}$ of protein (7.4 mg $(O_3)\times L^{-1}$ of ghosts suspension) endothermic peaks, which correspond to the transitions A and D are expressed weakly, meanwhile the transitions B and C are not registered. Thus, we can make the conclusion about the total denaturation of actin and the proteins of bands 3, 4.1 и 6 after ozone effect as a result of oxidative destruction. On the thermograms of ghosts, derived from ozonated red cells (0.2 mg $(O_3)\times L^{-1}$ of cell suspension), the transitions do not differ from those on the thermograms of ghosts of red cells, not exposed to ozone. When ozone dose increases to 9 mg $(O_3)\times L^{-1}$ of cell suspension the structure of membrane-bound proteins maintains, however intensities of melting peaks decrease.

Thus, when hemoglobin and isolated membranes of erythrocytes are exposed to ozone, the most susceptible to ozone are the proteins, melting of which corresponds to the peaks B and C on the thermograms. Thermal stability of hemoglobin and ghosts, derived from ozonated erythrocytes, is significantly higher than stability of ozonated proteins. We suppose this effect to be explained by the activity of red cells' antioxidant system.

POLARIZATION SINGULARITIES OF BIOLOGICAL TISSUES IMAGES

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The ways to the polarization singularities of the biological tissues (BT) images of various morphological structures have been theoretically analyzed. The coordinate distributions of singly and doubly degenerated polarization singularities of the physiologically normal and pathologically changed BT have been experimentally examined.

It is shown in [1] that points of optical field singularity form its structure, determining in such a way its polarization properties. That is why the search for conditions of forming polarization singularities by biological objects and experimental investigation of the peculiarities (statistical, stochastic or fractal ones [2]) of the structure of the coordinate distributions of the polarization singularities of the BT representations for the purpose of a possible usage of such information in the diagnostics of their physical state.

The efficiency of matrix model of polarization properties of BT is theoretically substantiated and experimentally proved in [3]. BT is regarded as a two-component amorphous crystalline structure. The amorphous component is optically isotropic. The crystalline (architectonic) component is formed by optically uniaxial protein fibrils.

As the objects of the investigation there have been used optically thin ($\tau \le 0.1$) histological sections of a healthy and pathologically changed kidney (an early stage of collagenous disease).

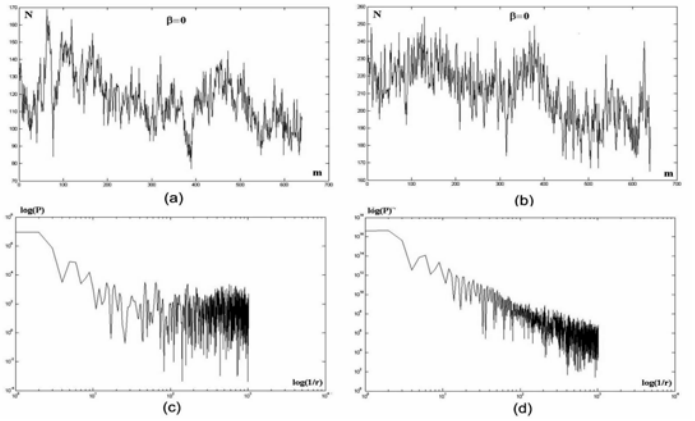

Fig. 1. Linear density of singularity points of kidney tissue polarization images of healthy (a) and pathologically changed (b) kidney tissues; (c) and (d) - log-log dependencies of power spectra of the number of singular points of polarization images of healthy and pathologically changed kidney tissues appropriately.

Tissue pattern statistics	Norm (37 patterns)	Pathology (36 patterns)
M_N	$0.634 \pm 5\%$	$0.706 \pm 7\%$
σ_N	$0.198 \pm 4\%$	$0.149 \pm 6\%$
A_N	$2.689 \pm 12\%$	$21.75 \pm 15\%$
E_N	$3.8 \pm 14\%$	$46.8 \pm 18\%$

Table №1. The statistics of the 1st-4th orders of the polarization singularities linear density of the kidney tissue images.

It was determined that the coordinate structure of the polarization singularities of the physiologically normal BT image is random while the coordinate structure of the pathologically changed BT is a self-similar (fractal) one (Fig. 1).

It has been shown that the third and the fourth statistical moments of the linear density of the singular points of polarization are the most sensitive toward the optical-geometric structure of the BT (table №1).

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COMBINED MAGNETIC FIELD EFFECT ON DIFFERENT BIOLOGICAL OBJECTS REGENERATION AFTER SHOCK CAUSED BY LOW TEMPERATURE

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There are rather many works that showed that the combined magnetic field helped the biological objects to regenerate their biological properties after the negative influence of some external factors. But the results didn't coincide between themselves.

To obtain good reproduction of results the method of shielding of external magnetic field and artificial creating of the magnetic field with the needed characteristics in the work volume was used.

The plant and silkworm were used as the biological objects because they have very small dimensions.

It was shown that the longitude action of combined magnetic field with the AC component adjusted to the cyclotron frequency of calcium on the different biological objects that had been cooled to the low temperature beforehand caused the essential increasing of organism regeneration. The effect was observed for the objects both of the plant and of the animal origin.

UPDATING PARAMETERS THREE-ELECTRODES ENERGY FILTER TWO-SIDE TYPE WITH END APERTURES

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For measuring of isotope ratio specifically with applying of small-size monopole mass-spectrometer for diagnostic systems *Helicobacter pylori* by ^{13}C-urea breath test (13C-UBT) one required to increase abundance sensitivity of device. One of decisions is using energy filter for decreasing of energy spread of ions.

Current work presents optimize parameters three-electrode two-side type energy filter with end apertures and its matching with monopole.

The acceptance energy of the energy filter have been computed. Calculations was made by program for numeral simulations SIMION.

ELECTROCONDUCTIVITY OF BOVINE SERUM ALBUMIN SOLUTIONS AT VARIOUS pH

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In the work electroconductivity of bovine serum albumin (BSA) solutions at the different values of pH was studied. The dielectric properties of buffer solutions of serum albumin was investigated by the VHF-dielectrometry method. This article being of interest because of conductivity of serum albumin essentially depend on pH of the environment.

The buffer solutions with pH=3.6; 4.6; 7.4 were prepared by blending in necessary proportions of the solution of the citric acid in concentration 0.2 M and the solution of the hydrophosphate sodium in concentration 0.1 M. The buffer solutions with pH=2.63; 6.15; 7.35 prepared by the mixing initial solutions of the citric acid and hydrophosphate sodium in 4 times by the distilled water. The solution of BSA prepared by dissolving dry preparation of BSA (produced by DIA – M, USA) in the buffer solutions. The concentration of the protein in solutions was 10 mg/ml. Specific electroconductivity of the buffer and BSA solutions was measured in temperature interval of 5-40°C by the bridge method.

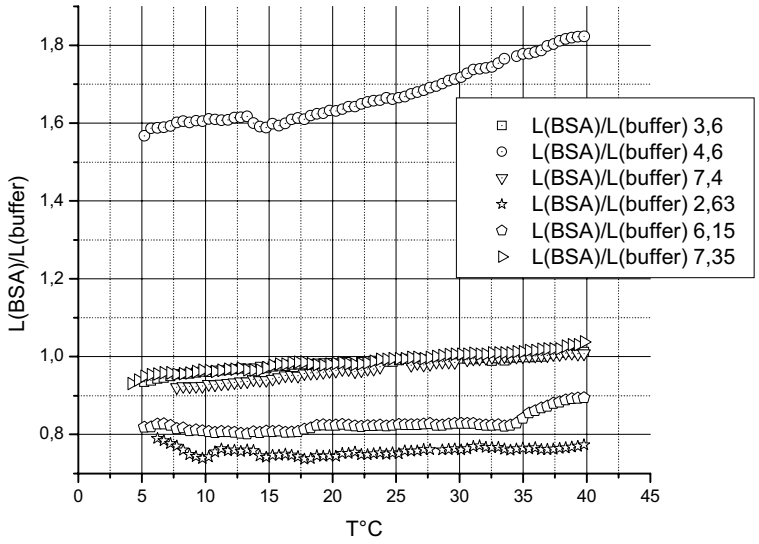

Fig. 1. Temperature dependences of the ratio of specific electroconductivities of the ternary and buffer solutions with pH 2.63; 3.6; 4.6; 6.15; 7.35; 7.4

The temperature dependences of specific electoconductivities of ternary system relatively corresponding buffer solutions were received (fig. 1). The substantial increase of specific electroconductivity of the ternary solution with pH 4.6 in comparison with appropriate buffer was shown. The temperature interval of isoconductivity for solutions of BSA with pH 3.6; 7.35 and 7.4 was founded.

The values of real part of the permittivity ε', static permittivity ε_s and the values of the frequency of the dielectric relaxation of water molecules f_d for buffer and ternary solutions with pH 2.63; 6.15 and 7.35 were obtained by the VHF-dielectrometry method. It was found by the comparing of the values of static permittivity that for investigated solutions the hydration of serum albumin has minimum at pH 6.15.

SOFTWARE-HARDWARE COMPLEX FOR PHOTODYNAMIC DYAGNOSTICS AND THERAPY

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Photodynamic diagnostics and therapy (PDDT) is a new method of diagnostics and treatment of cancer tumors and also skin diseases (e.g. psoriasis) and virus infections. PDDT differs from traditional methods of treatment by absence of surgical operation, difficult local and system complications of treatment and high selectivity of action. Photodynamic diagnostics and therapy is a treatment of malignant tumors that uses a drug, called photosensitizer or photosensitizing agent which is absorbed by cells all over the body, but stays in cancer cells longer than it does in normal cells. Each photosensitizer is activated by light of a specific wavelength. It absorbs the light in tumor and produces an active form of oxygen that destroys nearby cancer cells. During photodynamic diagnostics and therapy damage to healthy tissue is minimal. Intensity of photosensitizer fluorescence determines the extent of its accumulation in tumor, size, shape and location of tumor and allows determining the necessity of carrying out of PDDT [1-4].

Developed software-hardware complex for PDDT is a multicolour diagnostic and therapeutic device with light-emitting diodes connected with PC by USB-interface, which allows carrying out photodynamic diagnostics and therapy. Built-in WEB-camera with high resolution and the set of interference filters allow to observe fluorescent image and to determine the boundaries of parts with increased accumulation of photosensitizer. For light radiation dosimetry the circuit of measuring on the base of optron with open optical channel and automatic correction of zero level drift and background light was put into software-hardware complex. The control of the level of radiation power, time of exposition, radiation spectra and other parameters is carried out by microcontroller scheme at the command of PC in dialog mode. It is planned to add necessary databases into complex software and to develop expert system.

To study photosensitizers reradiation and spectral characteristics of light-emitting diodes and for carrying out other spectral investigations modernized plant for spectral analysis on the base of monochromator MDR 23 is used. Complex for PDDT is going to be applied both in scientific investigations and in laboratory works on biological and medical physics.

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SOFTWARE AND ANALYTICAL CLASTER FOR PSYCHOPHYSICAL RESEARCHES

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Relevance of the development, production and using of the instrumental inspection tool psychophysical and psychophysiological person's condition factors are theoretically motivated and practically proved by its practical application for wide range of scientific and practical problems solving.

Work in close conditions and sometimes in extreme condition demands some personal quality, nervous system flexibility, adaptation possibilities, good memory, quick reaction and skills to make decision at the deficit of time. The estimation of the professional fitness for performing to that or another functional duty is a complex problem. The software and technical complex that has been created solves this problem since it combines hardware and software methods of the psychophysiological testing, and because of it conscious checking are useless during physiological processes investigation, the received results become more reliable.

Created software and analytical claster for psychophysical (or psychophysiological) investigations corresponds connected by interface (RS-485, USB, Ethernet) software and technical facilities in complex with PC, which executes parallel or different problems on psychophysical testing, allows relatively simple technical and software expansion and possessing possibility of the parallelization of the solved problems.

Claster concludes upgradeable set of microcontroller boards "Psycho-test". The schemes are realized with the aid of microcontrollers, and are really specific computers. Each separate instrument "Psycho-test" can be used in local modes. Thereto main software modules were burned into microcontroller's ROM. Software includes the user's interface, drivers of the data exchange, database for keeping, processing and experimental data analysis.

Software and analytical claster is intended for use in scientific and practical study in the centre of the employment of the population, educational institutions, psychological centre, power structure, in athletic medicine.

MEMBRANE INTERACTIONS OF AMYLOID-SPECIFIC DYE CONGO RED

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A phenomenon of abnormal protein aggregation currently attracts ever growing attention due to its involvement in etiology of a number of so-called conformational diseases, including neurological disorders, type II diabetes, prion diseases, etc. It extends far beyond pathophysiology, encompassing both fundamental and applied problems associated with protein misfolding. There is a hypothesis that structural transformation of a polypeptide chain into partially folded conformation is a critical prerequisite for fibril formation [1,2]. One factor that can initiate such a transformation in vivo involves protein adsorption at interface. Lipid bilayer, a basic structural element of biological membranes, may act as an catalyst of fibrillogenesis

In the present study our efforts were concentrated on elucidating the nature of CR interaction with the model lipid membrane. We examined CR binding to four types of lipid vesicles prepared from zwitterionic lipid phosphatidylcholine, and its mixtures with anionic lipid cardiolipin, cationic detergent cetyltrimethylammoniumbromide and cholesterol.

It was found that CR can effectively interact with PC, PC:Chol and PC:CTAB bilayers. The observed shifts of absorption maxima suggest that the dye is capable of penetrating into interfacial region of uncharged model membranes, while remaining at the bilayer surface in positively charged membranes. No CR binding to negatively charged bilayers has been detected. Differential absorption spectra of the lipid-bound dye exhibited maximum at 524 nm, the value different from that characteristic of amyloid-bound dye (545 nm). The finding that CR absorption spectra are insensitive to the presence of negatively charged liposomes facilitates the use of this dye in detecting the amyloid aggregates induced by anionic lipids. Likewise, CR differential absorption spectra in liposomal suspensions are featured by extremum positions distinct from that characteristic of amyloid fibrils. Accordingly, CR-based spectroscopic criterion can be effectively employed to monitor amyloid growth in protein-lipid systems.

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CONGO RED INTERACTIONS WITH PROTEINS

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It is known that the abnormal conformation and misassembly of proteins are responsible for a number of diseases, including prion diseases, Alzheimer's and Huntington's, type II diabetes, spongiform encephalopathies, systemic amyloidosis, which are generally termed as conformational diseases. General structure of amyloid-like fibrils is characterized as a cross-β structure consisting of β-strands assembled with hydrogen bonds along the fibril axis. In vitro, fibrillization-favoring conditions are created by lowering pH, elevating temperature, adding organic solvents or denaturants, etc., while in vivo, abnormal partial unfolding or folding may arise from mutations, oxidative or heat stress or destabilization of the protein structure upon its adsorption at interfaces. Amyloid fibrils are usually detected by several techniques including Thioflavin T (ThT) fluorescence, Congo Red (CR) birefringence or spectrophotometric assay. While employing amyloid-specific agents such as ThT or CR one should bear in mind that these dyes may form complexes not only with fibrillar structures but also with monomeric protein species. Clearly, the implications of such a property should be evaluated in each system under investigation. In view of this, the present study was focused on examining the interactions between CR and a set of well-characterized proteins including hemoglobin (Hb), ribonuclease A (RNase) and human serum albumin (HSA). Formation of CR complexes both with native and denaturated proteins was followed by the long-wavelength shift (about 10 nm) of absorption maxima being indicative of chromophore transfer to the environment of lower polarity. The binding parameters for native proteins – association constant (K_b) and the number of binding sites (n) – were found to be: K_b – 2.6×10^5 M^{-1}, 2.7×10^5 M^{-1}, 5.1×10^5 M^{-1}, n – 1.45, 2, 2.05 for Hb, RNase and HSA, respectively.

The differential absorption spectra of CR associated either with native or denaturated Hb exhibited similar absorption maxima but different spectral contours, thereby providing arguments in favor of Hb fibrillization. Thermal denaturation of Hb resulted in the change of CR-Hb binding isotherm from Langmuir-like to sigmoidal. This effect was interpreted in terms of preferential dye association with aggregated protein. It was assumed that there exist two types of CR binding sites, located at monomeric and aggregated protein species, respectively. Degree of oligomerization is supposed to increase with total protein concentration, so that the number of the centers of different types appears to be dependent on protein amount. A tentative model for CR location within the Hb molecule has been suggested according to which the dye tends to reside in hydrophobic cavity between Lys16 and Lys60 serving as anchors for two negatively charged CR sulfonic groups.

CR binding to denatured RNase was found to be followed by protein precipitation. This finding can be explained by the fact that CR *per se* has been reported to cause protein aggregation not associated with fibril formation. Apparently, attractive electrostatic interactions between negative CR and cationic RNase neutralize partly protein charge creating conditions which favor protein-protein interactions.

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MAGNETIC NOISE EFFECT ON AMPLITUDE AND SPECTRUM OF MAGNETIC FIELD NOISE GENERATED BY PLANTS DURING THEIR GROWTH AND THE GRAVITROPIC REACTION OF PLANTS ROOTS

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It is known for a long time that the magnetic field and its fluctuation (magnetic storm for instance) influences on a lot of alive organisms from the simplest sea weeds and until human being and animals.

The first purpose of the work was the registration of the irradiation generated by model biological object during its growth (the plant was used as the sample because of its small dimensions). The second purpose was the investigation both the amplitude and spectrum of generated irradiation changes and gravitropic reaction changes on the external electromagnetic field level.

To obtain well reproducible magnetic conditions for experiment the shielding technique was used including superconducting magnetic field with worm work volume for experiment. The magnetic field with needed level of magnetic field noise was created in the shield by artificial way. In the case of μ-metal shield using the magnetic field was created by solenoids, in the case of superconducting field it was created by freezing of the remained magnetic field during the shield cooling.

The magnetic field parameters were controlled during the experiment by flux gate magnetometer and SQUID magnetometer.

The essential increasing of magnetic field noise level in the shield was registered during the experiment. It was shown that the effect obtained was connected with the generation of added magnetic shield by growing wheat and cress seeds. The spectrum of magnetic noise generated by plants was investigated at different levels of external magnetic noise created in the shield by artificial magnetic field.

The magnetic noise spectrum depended on the amplitude of external magnetic field noise level. And some frequency depended maximums were found in the magnetic field noise spectrum at low frequencies when the magnetic noise level of external magnetic field exceeds the definite level. We need to notice here that the location of maximums observed coincided very well with the cyclotron frequencies. That is some effect analogous to the Liboff's one was observed.

The changes of the curve of dependence of biological effect on the ration of AC component of combined magnetic field to the DC component were investigated. It was shown that the form of the curve investigated depends essentially on the level of external magnetic field noise (Nyquist one) even at the amplitude level 5 $nT/Hz^{0.5}$. This effect has to be taken into attention during the interpretation of experimental results.

FLUORESCENCE PROBE STUDY OF LANTHANIDE EFFECT ON STRUCTURAL STATE OF MODEL MEMBRANE

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Development of liposomes, spherical, self-closed structures formed by one or several concentric lipid bilayers with an aqueous phase inside and between the lipid bilayers, for the pharmaceutical application currently represents one of most rapidly growing research areas. Extensive employment of lipid vesicles in drug delivery is explained by a vast majority of their advantages including, particularly, biocompatibility, complete biodegradability, non-toxicity, ability to carry both hydrophilic and lipophilic payloads and protect them from chemical degradation and transformation, increased therapeutic index of drug, flexibility in coupling with targeting and imaging ligands, improved pharmacokinetic and pharmacodynamic profiles compared to free drugs, reduced side effects, etc [1]. Of particular importance is the development of liposomal formulations of new classes of antineoplastic drugs with alternative mode of cytotoxic action and nonoverlapping mechanisms of drug resistance. One of such classes is represented by lanthanide coordination complexes which have been reported to possess high cytotoxic potential. The present study is directed towards the investigation of the effect of two newly synthesized Eu(III) coordination complexes, referred to as V3 and V4, on a structural state of model lipid membranes composed of zwitterionic lipid phosphatidylcholine (PC) and its mixtures with cholesterol using membrane probe pyrene. V3 and V4 are asymmetric Eu(III) coordination complexes with diverse O-containing chelate ligands. The intensity ratio of monomer peaks at 374 and 384 nm, which is reported to be related to the alterations in membrane polarity, remains virtually unchanged upon V3 and V4 association with all types of lipid vesicles under study. This finding suggests that the drugs do not affect the distribution of pyrene monomers and exert no influence on polarity of PC and PC:Chol lipid bilayers. In contrast, formation of drug-lipid complexes resulted in the changes in pyrene excimer-to-monomer intensity ratio (E/M), a parameter which reflects the rate of probe lateral diffusion within membrane plane. Specifically, V3 and V4 encapsulation into PC liposomes led to the increase in E/M values being indicative of increase in membrane free volume and decrease degree of lipid packing. However, presence of Eu-complexes in PC:Chol vesicles resulted in ambiguous changes in E/M. V3 was found to reduce E/M in PC:Chol (10 mol%) and PC:Chol (60 mol%) membranes and increase E/M in PC:Chol (30 mol%) liposomes. V4 exhibited opposite behavior – increased E/M ratio in the vesicles with low and high percentage of sterol, and decreased extent of pyrene excimerization in PC:Chol (30 mol%). Apparently, the above effects may be explained by the balance of two competing processes – drug influence on bilayer structural state and modifying effect of Chol on membrane hydrophobic region [2]. Opposite sign in E/M changes induced by V3 and V4 is likely to originate from the differences in their structures. Overall, the present study strongly suggests that newly synthesized anticancer drugs V3 and V4 can be efficiently entrapped by the lipid phase of the vesicles, thereby paving the way for the development of their liposomal formulations.

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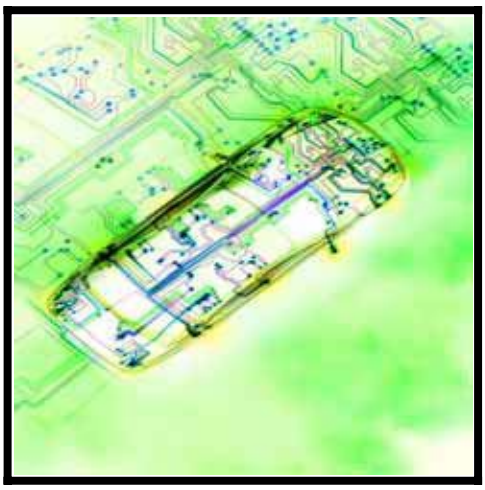

Plenary Session

Biophysics

Plasmas and Microwave Electronics

Solid State Radiophysics

Optics & Photonics

Computational & Experimental Electromagnetic

Radars, Propagation & Remote Sensing

RESEARCH OF THE ALMOST NEWTONIAN SPEED-UP ALGORITHM OF SEARCH OF PERIODIC MODES

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The design of nonlinear high-durable unautonomous electronic charts with the use of traditional numeral methods requires the considerable expenses of machine time on the calculation of transitional process which, at the high values of good quality of contour, many ten periods of entrance signal can last. In with accumulation of errors during integration of plenty of periods, to get and analyse the set mode, with the set exactness, is it is impossible. Because of these circumstances, at research of high-durable charts use the methods of speed-up search of the periodic modes which expect the periodic mode walking around transitional process. These methods are accepted to divide into gradients, extrapolations and almost newtonian. Their task is determination of vector of initial conditions, which answers the periodic mode.

Researches showed that in subsystems modelling, which use non-obvious numeral methods, optimum there is the use of almost newtonian algorithms, as for their work it is possible to use the information got during integration of equalizations of mathematical model.

The results of research of algorithm are represented in the lecture, the Aprill-Trick ideas lie in basis of which [1]. He works in a pair with the algorithm of decision of the Coshi task by the non-obvious method of Euler [2] for a mathematical model which is built in the co-ordinate base of state variables:

$$\frac{dX}{dt} = f(X,t) \tag{1}$$

Such presentation of mathematical model provides its minimum size and openness to application of all classes of numeral methods.

Prognosis of vector of the initial conditions X_0, which answers the periodic mode of mathematical model (1) with the T period, was executed in obedience to a iteration process:

$$X_0^{(k+1)} = X_0^{(k)} - [E - \frac{dX(X_0^{(k)},T)}{dX_0^{(k)}}]^{-1} \cdot [X_0^{(k)} - X(X_0^{(k)},T)] \tag{2}$$

where k – of iteration, E – matrix. (2) is got as a result of application of the method Newton to equalization of immobile point:

$$X_0 - X(X_0,T) = 0 \tag{3}$$

In the developed software the matrix of transition of the state is calculated automatically. Exactness of calculations and invariability from a period to the period of terms of its receipt act very important part in providing of qualities of prognosis of vector of state variables. The special algorithm of choice of step of integration h of the system (1), which provides a maximally exact output on the end of period, is used in this connection, and reiteration of law of choice and change of step h on next periods [3].

After a theory the convergence of almost Newtonian algorithms is quadratic. Researches showed that this convergence in a considerable measure depended on the choice of initial conditions that resulted in the necessity of introduction of damper coefficient for a formula (2). In the lecture the resulted results of researches of algorithm of search periodical of the modes electronic of charts of different complication.

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ADIABATIC INVARIANTS OF MOTION IN FREE ELECTRON MASER

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Devices with curvilinear electron beams, which are operated under the strong Doppler effect, are called free electron masers (FEM) [1]. Usually the technical realization of the devices is as follows: a (weakly)relativistic electron beam propagates in a waveguide thought the nonuniform magnetic pump field which consists of a spatially periodic transversal (undulator) and an uniform longitudinal magnetic fields. FEM are capable to generate and amplify the electromagnetic radiation almost all over the spectrum from the radiowaves to the x-range. Due to such unique property FEM is very promising source of the coherent radiation for millimeter and submillimeter ranges. Although the efficiency is not enough high (<20%) the producible power can be giant (up to several GW) thanks to use wide (up to 140 cm) sheet electron beams [2].

The development of the theory of electron-wave interaction in FEM has been continued since the early 1980s, but the achieved progress is incomplete. The complexity of FEM analysis is caused by the enough complex (in comparison with other microwave devices) dynamics of the electrons in pump magnetic field. For example, the electron stochastization occurs for some system parameters [3] even though a microwave field is absent. At the same time it is clear that the development of self-consistent nonlinear theory of FEM is not possible without a deep insight into electron dynamics in pump magnetic field. Therefore in the present paper the variables action-angle for nonlinear system – electron in the pump magnetic field of FEM – are built by using the rigorous expressions for the trajectories of electrons. The studied nonlinear system is nonintegrable, so the actions are calculated approximately with the help of the first Poincare invariant and irreducible contours of invariant tore, on that conditionally periodic trajectory of motion is wind around in the moving frame.

It is well known fact that the variables actions are almost adiabatic invariants, i.e. they persist for the most initial conditions in the case of slow change of parameters. The practical importance of adiabatic invariants is the possibility in principle to obtain the low of optimal magnetic field enhancement of entrance undulator section and to determine the condition of undulator profiling for the purpose to increase the efficiency by means of providing long-time resonance of electrons with microwave field. Also using the variables actions and resonance perturbation theory one can develop the analytical nonlinear theory of planar FEM with taking into account two combined nonlinear resonances: the “particle-microwave field” resonance and the “particle-magnetic pump field” one.

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PROCESS STABILIZATION OF ULTRATHIN METALL NITRIDE AND OXYNITRIDE FILMS ION-BEAM SPUTTER DEPOSITION

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Nanoscaled films synthesis process relates with stringent requirements to the derivable films structure quality, their stoichiometry, properties stability and purity. It shouldn't be inertial; operation factors have to be controlled for geometrical and physicochemical films behavior repetitive; there have to be an ability of pretreatment and surface cleaning directly before the synthesis process for undesirable compounds and structures on the film-substrate interface not to appear. One of the perspective thin films synthesis methods, what meet these requirements, is the ion-beam sputter deposition in the controlled vacuum environment [1]. As a result of ion-beam deposition, emitted by target and influencing on the surface during the condensation particles with relatively high energies have a great effect on the nucleation, growth, formation and the result film behavior [2, 3]. To the other important ion-beam sputter deposition method advantages relates the possibility of substrate surface cleaning, several targets with different composition sputtering and ion-beam assisted deposition process ability using the one ion source only [4].

Formation of stable ultrathin continuous film with given stoichiometry and thickness using ion-beam sputter deposition is the polyvalent and non-trivial objective, which can be solved only with the aim of experimental or technological plant operating mode tight control and synthesis process parameters software control. The aim of the present work was the integrated monitoring, control and ion-beam deposition process stabilization system elaboration, and synthesis parameters optimization of nanoscaled titanium and chromium nitride and oxynitride films and heterostructures. Both developed monitoring, control and ion-beam deposition process stabilization microprocessor system structure scheme, its blocks basic circuits and obtained nitride and oxynitride nanoscaled titanium and chrome films results are presented in the report.

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THE VARISTORS DEGRADATION ELECTRICAL PARTICULARITY CONTAINING BORON OXIDE

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One of the problems connected with the improvement of metal oxide varistors production is the study of the degradation processes of their electric characteristics in the conditions of the long flow electric current (density J_d). This reveals itself in leaving of the classification voltage $\Delta U_c/U_{c0}$, retiring nonlinearity factor β of the current-voltage characteristics, the temperature factor of voltage (TFV) changing [1, 2]. The special role in stabilities increasing belongs to one or another stabilizing additive which are introduced into chemical solution.

However, till the present moment the estimation dug of one or another degradation mechanism and its relationship with chemical solution of varistors are obstructed. This is given, to some extent, by the absence of necessary repeatability of experimental results and the general insufficient research of physical processes responsible varistoral characteristics degradation of oxide varistoral ceramics.

This work produces the comparative results (table 1) of the research of kinetics of the change of the main electric parameters of metal oxide varistors with the absence (I) and presence (II) of additive of boron oxides.

Table 1

Solution	Degradation time, hour	J_d, mA/cm^2	Direction of measurement relative to J_d	$\Delta U_c/U_{c0}$, %	β/β_0	TFV, %/K
I	150	0,02	coincident	-1,4	0,55	–
			opposite	-4,1	0,17	–
		0,1	coincident	-1,4	0,24	-0,02
			opposite	-4,3	0,06	-0,07
	500	0,02	coincident	-1,8	0,33	–
			opposite	-7,7	0,097	–
	1000	0,02	coincident	-2,0	0,25	–
			opposite	-12,3	0,09	–
II	150	0,4	coincident	3,4	0,95	0,09
			opposite	1,6	0,85	0,09
		1,6	coincident	3,2	0,89	0,01
			opposite	0,6	0,79	0,008
	500	0,4	coincident	3,7	0,95	–
			opposite	1,9	0,81	–
		1,6	coincident	3,5	0,85	–
			opposite	0,6	0,75	–

How follows from tables, in explored range is temporary the degradation an increase J_d practically does not influence upon reduction of classification voltage U_c, brings about significant reduction of nonlinearity factor β (in 2 times and more) and negative TFV for composition of varistors (I). For composition (II) growing J_d practically does not influence upon growth U_c toward current of degradation J_d. The trend of reduction of care U_c exists toward opposite J_d, small decreases the value b, but TFV – positive.

Increase to duration flow J_d leads to reinforcement of described trends for both compositions.

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THE PROGRAM AND TECHNICAL COMPLEX FOR GAS-DISCHARGED PLASMA OPTICAL DIAGNOSTICS

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The research of effects, that occur in plasma, is of interest not only as a direction of the fundamental investigation, which allows to understand the material's building bases deeper, but also in a connection with purely practical aims, first of all, for the receiving a controllable thermonuclear reaction. The controllable thermonuclear fusion, magnetohydrodynamic transformation from the heat energy to the electric one, vacuum-plasma technology of the material processing, which is used for the giving them new unique properties, - all of that demand the creation and using of the contemporary diagnostic and control facilities. The task of the optical diagnostics device's development for the contactless remote method of gas-discharged plasma parameters determination becomes actual. Information-measuring systems, created earlier, don't satisfy all today's requirements, maintained to the up-to-date physical experiment neither in hardware or, in particular, in program-analytical component of the equipment.

The aim of the work is to develop modern computer informational-analytical complex, allowing to resolve the tasks, connected with the optical diagnostics of gas-discharged plasma subject to the recent tendencies in gathering, storing and performance of the information.

The program-technical complex had been organized on the basis of monochromator MDR-23, intended for the carrying out the spectral researching of the radiation sources and receivers, working in ultraviolet, visible and nearby infrared spectral regions. Gathering, preprocessing of the measuring data and a spectrums' scanning controlling were implemented on the developed programmable logical controller, that's kernel was a microconverter ADuC812 (Analog Devices) [1]. Microprocessor's characteristics ensure enough speed of performance, simplicity of turning on and reasonable correlation of the price and a quality.

The process of receiving information about the ion density, ion and electron component's temperature and other arc and glow-discharge plasma's parameters were studied because of the tuning works on the complex. Nowadays complex's hardware and program components are adapting for the tasks of the arc discharge's researching during the development of the fullerenes' production technology, optical spectrometry of fullerenes and other nanoobjects, based on the carbon. Also complex is supposed to be used for the performance of laboratory works about the plasma's optical diagnostics, including one with the remote access [2].

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HI-EFFICIENCY F-CLASS BROADBAND AMPLIFIER

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Hi-efficiency of amplifiers in SHF band is one of the most actual problems of the microwave electronics. Although a great progress in this sphere, there are many problems to solve. One of them is the resonance nature of F-class amplifier output circuit, which decreases the operating range of the amplifier. The circuit provides a necessary mode (merely active resistance at the reference frequency, short circuit at even harmonic components and the idling on the odd ones), which is described for F-class in many scientific sources including [1], but at one operating frequency only, were the high efficiency may be observed, and efficiency coefficient decreases during the frequency offset because of the matching failure.

In this work it has been done the calculation, the simulation and the experimental research of hi-efficiency F-class SHF amplifier with MOSFET CLY5 which output circuit provides high efficiency in the frequency range. The principal advantage of the class is the parameter calculation simplicity and output circuit realization, the high coefficient of efficiency, the possibility of the amplifier using in SHF band. The method presented in [2] allows to consider the parameters of nonlinear device to receive the higher efficiency coefficient when making output circuit calculations.

One of the ways to solve the problem under consideration, mentioned in [3], is to create such output circuit with the output impedance, at the reference frequency, and if possible at harmonics, be close to optimal loads for F-class.

To find parameters of such output circuit it has been composed and numerically solved the system of nonlinear equations, which connects circuit parameters at necessary frequencies with optimal values calculated according to [2]. The computed values were re-calculated in geometrics of PC board layout (wave impedance and lengths of matching stubs and flexible lines).

The amplifier with calculated output microstrip circuit has been produced, adjusted and experimentally researched according to design values. The received experimental dependences for the output power and the efficiency coefficient coincide with the theoretical ones. In operating range the amplifier ensures the maximum drain efficiency of 62%, at frequency of 1.05 GHz and supply voltage of 5 V.

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THICKNESS DETERMINING OF VACUUM EVAPORATED THIN FILMS BY RESONANCE METHOD

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Thin films inflicting on metallic and non-metallic materials allows to improve their properties greatly. They are used for studying of structure changes, observed in them while implantations (radiation materials science), creating nanostructures and different nanoobjects, studying of diffusion processes in constructional materials (absorption method), receiving of geterostructures is applied in the most latest fields of the microelectronics. Nearly in all cases is necessary careful thickness control of films.

There are different methods to determine thickness of films (acoustic, electroresistant, metallographical. In current work is developed structure scheme of vacuum evaporation thin films, and also worked out control resonance method of current film thickness, speed of the evaporation, absolute frequency of sensor, changing velocity per layer while inflicting.

As object of receiving are chosen nickel films (with purity 99,98), evaporated in vacuum lower than 10^{-3} Pa on metallic substrate in a way of evaporation from solid phase at the temperature 1050-1500 K. While evaporation Ni on quartz sensor its resonance frequency changes at the expense of mass $\Delta f \propto \Delta M$. The sense of experiment was in determination of the thickness of precipitated films with accordance to change in resonance frequency of the quartz sensor. Resonator is consists of thin plate of quartz with electrical contacts connected to both sides of it. Such resonator is connected to electronic scheme of the generator. Attaching variable electric field brings to appearing of quartz plate oscillations in thickness. Was Received dependency of quartz sensor frequency changing on film thickness, that was changing from 10 to 100 nm. Accuracy of film thickness determining depended on inaccuracy of analytical scale and quartz thickness measurer. Electrophonograme decryption showed structure of the film to be according to necessary metallic Ni (FCC, a=0,352 nm).

Was received curve of dependency of the Ni thickness on resonance frequency changing of the quartz crystal, by means of which possible to control the necessary thickness of the film per layer while inflicting. With help of computer modeling was received theoretical curve of Ni film thickness dependency on changing of resonance frequency of quartz crystal which agrees with the experimental data.

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TWO-PLANIMETRIC UPDATING GENERATOR CHUA FOR DIRECTLY CHAOTIC SYSTEMS OF TRANSFER INFORMATION

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The chaotic generator Chua, which is a base model for the generators of chaos in directly chaotic communication networks, forms oscillation from attractor of type „Double scroll" (DS). He is by one of the simplest generators and contains the minimal number of jet elements necessary for infringement of chaotic movements. However chaos in the generator Chua rather poorly advanced, and his complication at preservation principle of job is represented rather expedient. In work, influencing of new shake is additionally analyzed to the contour on character of vibrations [1].

The circuit of two-planimetric updating of the generator Chua is shown in a fig. 1. She differs from the usual circuit by presence of an additional oscillatory contour on elements L_2, C_3, R_9, connected to the generator through the resistor of connection R_7. Thus losses in the basic oscillatory contour also are taken into account.

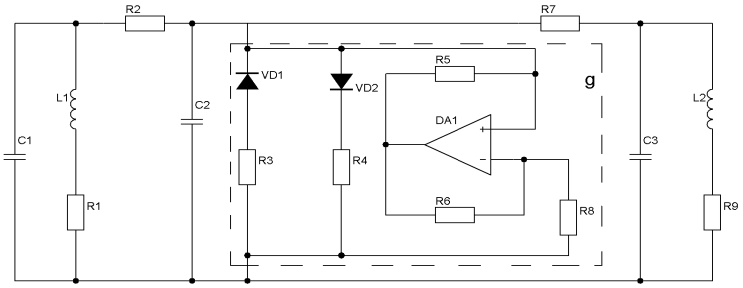

Fig. 1. The circuit of two-planimetric updating of the generator Chua.

Schemetechnical modeling of the generator was spent with use of the program MultiSim 2001, that in connection with reliability of results, received with her help, permits in a number of cases to replace physical experiment. At schemetechnical modeling the two-planimetric generator is assembled according to the specified circuit (see fig. 1). Importance of parameters, which characterize fluctuation in the usual generator Chua, following: $R_2 = 1.3\ k\Omega$, $C_1 = 0.0058\ \mu F$, $L_1 = 8.4\ mH$, $C_1 = 0.058\ \mu F$; thus the losses in an inductive element L_1 are determined by resistance $R_1 = 4\ \Omega$. The sizes of parameters of an additional contour are elected approximately equal to the appropriate parameters of the basic contour, namely $L_2 = 8.41\ mH$, $C_3 = 0.059\ \mu F$, $R_9 = 4.2\ \Omega$. Resistance of the resistor of connection $R_7 = 18\ k\Omega$. The circuit of a nonlinear element is assembled on a microcircuit of type LM324A [2].

The results of schemetechnical design are presented testify to possibility of receipt in two-planimetric modification of generator of more developed chaos, than in the ordinary generator of Chua, which promotes efficiency of passing to information with the help of the determined chaos. With the help of an additional oscillatory contour it is possible to operate chaotic fluctuations of the two-planimetric generator, and also to operate structure of fluctuations.

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HIGH-FREQUENCY HIGH-EFFICIENCY CLASS E/$F_{2,3}$ PUSH-PULL POWER AMPLIFIER

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At present time with rapid development of information technologies, innovations in communication systems an interest in research and development of high-efficiency high-frequency power amplifiers (PA) has been highly increased. Switching PA's with maximally achievable efficiency of 100% such as class E and class F are widely used [1]. The main advantages of class E PA are simple topology and that output capacitance of transistor can be considered as a part of output network. In class F PA peak values of drain current and voltage can be lowered. However these PA's have their drawbacks: in class E configuration high values of drain current and voltage are presented, also large value of transistor output capacitance can limit working frequency. Class F PA has complex configuration of output network and efficiency is slowly rising with increase of number of tuned harmonics.

In this paper design and simulation of high-frequency class E/F have been carried out. This class of PA has advantages of class E – simplicity of output network and including transistor output capacitance in that network, and class F – decrease of RMS drain current and peak drain voltage. The family of class E/F amplifiers is characterized by set of tuned harmonics *m, n* and marked by indexes E/$F_{m,n}$. In presented work high-frequency class E/$F_{2,3}$ PA on microstrip lines using MESFETs CLY5 was designed and simulated. When second and third harmonics are properly tuned, peak values of drain current and voltage are decreased that helps to prevent transistor's breakdown. Output network consists of microstrip lines and stubs which allow an independent impedance tuning on main frequency, second and third harmonics. At the same time all higher harmonics are loaded on capacitance. The second and third harmonics are tuned similarly to inverse class F amplifier (infinite impedance on the second harmonic and zero impedance on the third) taking into consideration all parasitic elements of transistor. The main frequency impedance is defined from given output power, supply voltage and output capacitance of transistor and is resistive with series inductive reactance. In this work a push-pull PA configuration that allows addition suppressing of even harmonics at the load and to simplify a topology of output network in comparison with single-ended PA is considered. Since push-pull configuration requires symmetrical load, ring-hybrid baluns were used for matching with non-symmetrical input and 50-Ohm load. The simulated performance parameters are: 3.8 W of output power with PAE of 72% on 1GHz with 6 V of supply voltage.

The PCB topology has been developed and investigating of fabricated PA is planned.

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MAGNETOSTATIC NARROW BAND FILTER

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The phenomenon of wave front reversal (WFR) can be used for the signal processing in broad band of applications [1]. The resonance WFR for the case of magnetostatic waves and dipole-exchange spin waves in yttrium-iron garnet films (YIG) was investigated recently. Mostly, the geometry of backward volume magnetostatic waves (BVMSW) was realized in the experiments.

In our current work we theoretically proposed and experimentally realized the active magnetostatic narrow band filter. The non-resonance WFR phenomenon was used [2]. In the non-resonance case the condition $\omega_s = \omega_p / 2$ is not fulfilled and the WFR effectivity decreases with the frequency shift $\Delta\omega = \left|\omega_s - \omega_p / 2\right|$ increasing. According to theoretical prediction the WFR frequency range (and correspondingly filter band) composes a few megahertz and central frequency is equal to the half pumping frequency. The width of such filter determines by pumping power and duration.

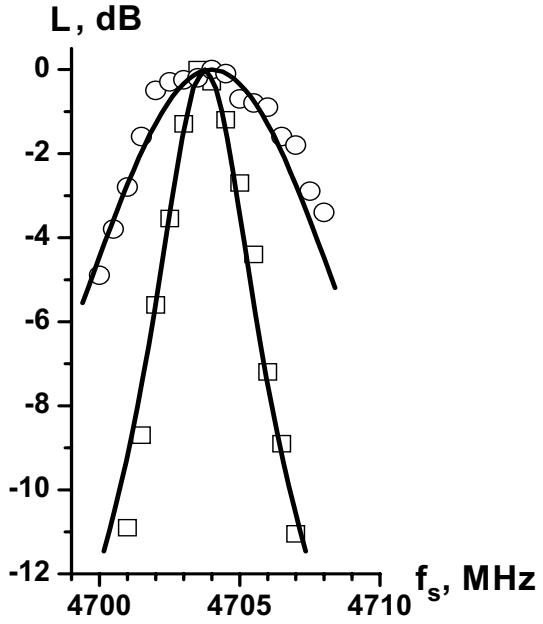

***Fig. 1**. The amplitude-frequency characteristic of magnetostatic active filter for different pumping power P_p (□ - P_p=12 dBm, τ_p=500 нс; ○ - P_p=26 dBm, τ_p=100 нс)*

The experimental setup consist of an YIG film, the middle part of which was placed in a rectangular opening dielectric ($\varepsilon \sim 80$) resonator (ODR) which was used to supply pumping pulses at the fixed frequency $\omega_p / 2\pi = 9408$ MHz. The monochromatic signal having frequency ω_s, close to the $\omega_p / 2$, was supplied and BVMSW were excited and received by the single microstrip antenna. The pumping pulse of the durations $\tau_p = 100$ ns and 500 ns, the different power P_p was supplied to the ODR. Herewith condition $V_k h_{p1} \tau_{p1} = V_k h_{p2} \tau_{p2}$ must be performed. For theory correspondingly $V_k h_p$ = 1 MHz and 5 MHz.

We realized non-resonance WFR and observed resonant dependence of the reverse pulse power on the signal frequency (Fig. 1). Maximums on the figure correspond to coincidence of a half pumping frequency $\omega_p / 2$ with a signal frequency. Figure shows that the active magnetostatic filter frequency band depends on the pumping power. Experimental results have got good agreement with theoretical prediction. It was shown, that non-resonant WFR can be used for the microwave signals amplification.

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THE STRIP ANTENNA FOR BASE STATION OF MOBILE COMMUNICATION

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In modern systems of mobile communication for organization of base station panel antennas with the sector radiation pattern are usually used. It is known, that beam of the radiation pattern of such antennas should have small width in a vertical plane (usually no more than 15 … 20°) and the required width in a horizontal plane (about 60 … 120°). It is also desirable, that the design of the antenna to provided an opportunity of formation of radiation patterns maximum with a small deviation from a horizontal plane (usually 5 … 10°). Antennas of such purpose have high enough cost and a complex design as are usually realized on the basis of phased antenna arrays [1].

In the given work the opportunity of use for an object in view of the antenna as a piece of a strip line is analyzed. Radiation of such antenna is provided with the modulation of wave resistance which is carried out by periodic change of width of strip. Similar antennas possess a significant amount of advantages:

— Simplicity of a design — strip with periodically changing width, it is located on the fixed distance from a shielding surface;

— Refusal of necessity of inclusion of jet loadings for maintenance of modulation of wave resistance, that in turn reduces active losses and allows to realize antennas with the sizes up to several tens lengths of waves;

— An opportunity of realization of wide class of radiation patterns, including an opportunity of formation of a maximum of radiation with a required inclination in a vertical plane without a physical inclination of the antenna;

— The simple circuit of excitation of the antenna, not demanding use of circuits of division of capacity, phase shifters, etc.

In the report results of calculation and the analysis of the strip antenna are submitted. Precomputation of characteristics has been carried out with the help of a package of mathematical programs MathCAD 11 for antennas with the sizes equal 2,5; 5 and 10 lengths of waves for a range of frequencies of 2,4 GHz. Entrance characteristics and antenna patterns of the strip antenna are determined. The detailed electrodynamics analysis of antennas model in size equal ten lengths of waves has been carried out in system of electrodynamics modeling HFSS (High Frequency Structure Simulator), with definition of S-parameters and an electromagnetic field of radiation of the antenna. For the decision of the equations of electrodynamics in HFSS the method of final elements is used [2].

Results of the analysis evidently prove an opportunity and expediency of construction of strip antennas with the modulated wave resistance. Direction radiation pattern in a vertical plane, the opportunity of reception of a necessary direction of a maximum of radiation, and also relative simplicity of a design confirm opportunities of application of such type of antennas in mobile communication.

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LABORATORY STAND FOR RESEARCH OF TEMPERATURE AND RADIATION STABILITY OF COMPOSITIONAL MATERIALS

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The behavior of composition materials in hard external environments depends on speed of diffusion processes which flowing in them. Therefore diffusion parameters determination in such materials is of interest, foremost to control in future properties of materials directly in their creation process. There is of particular interest a class of materials, able to save the strengthening and mechanical properties in the conditions of radiation, thermal and mechanical influences up to undermelting temperatures. Therefore the task of development of laboratory equipment for research diffusion process at different terms in such materials is actually.

The purpose of work is development of the modern measuring informational and analytical system, allowing deciding tasks, related to determination of diffusion parameters in metals and alloys at different influences, both by the method of radio-active isotopes [1] and by an isotopic method.

A laboratory stand for the study of thermal and mechanical influence is realized on the vacuum research setup for crystals growth and homogenizing annealing. During an experiment the studied example is exposed to heating at the different modes. Information gathering and processing of the got data, and also control and complex management is carried out continuously by a local network of universal controllers.

For the study of radiation influence the industrial implanter «Maestro» is adapted [2]. The probed example is exposed to ions bombardment of reactive and rare gas in the different modes with the controlled integral dose of irradiation.

At present time the tuning and debug both software and hardware of analytical system are carried out. The stand universalization for expansion of probed materials class is supposed. It is also assumed to use a laboratory stand for conducting of laboratory works on physical materials science, including the remote controlled from distance access via the internet.

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DOHERTY AMPLIFIER CONSISTING OF CLASS-E AND CLASS-B AMPLIFIERS

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In connection with using CDMA signals in wireless communications, good linearity has become important figure of merit for power amplifier (PA). Such efficiency enhancement technique as Doherty amplifier is successfully used.

The Doherty architecture (Fig.1) consists of two amplifiers operating in different classes; the carrier amplifier (typically in class B or AB), and the auxiliary amplifier (typically in class C). In this paper a relatively new configuration of this amplifier, where carrier amplifier operates in class E mode, and auxiliary amplifier – in class B is considered. Outputs of both amplifiers are combined with the quarter wave length transmission-line, which acts as impedance inverter. The main goal of this work was studying of the energy and informational characteristics of such configuration.

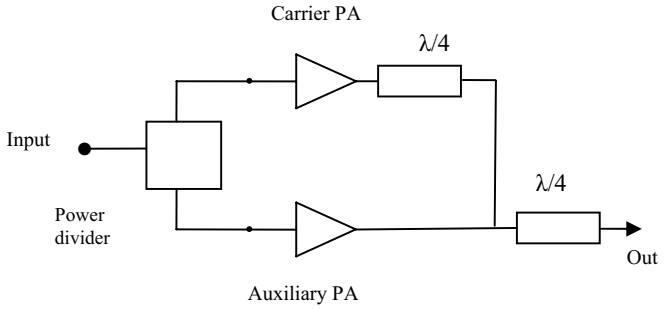

Fig.1. Basic configuration of Doherty PA

In this paper the 800-MHz class-B power amplifier is designed and simulated using harmonic balance method and Materka-Kasprzak MESFET nonlinear model. Experimental prototype with using MESFET CLY5 was built. Experimentally obtained characteristics were in good agreement with simulation.

Results for the class-E PA was taken from [1].

According to the simulation of Doherty amplifier, its efficiency is maintained high over wide range of input power.

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PARTICLE AND POWER BALANCE IN FUSION PLASMA WITH DIFFERENT FUELING SCENARIOS AND HELIUM ASH REMOVAL

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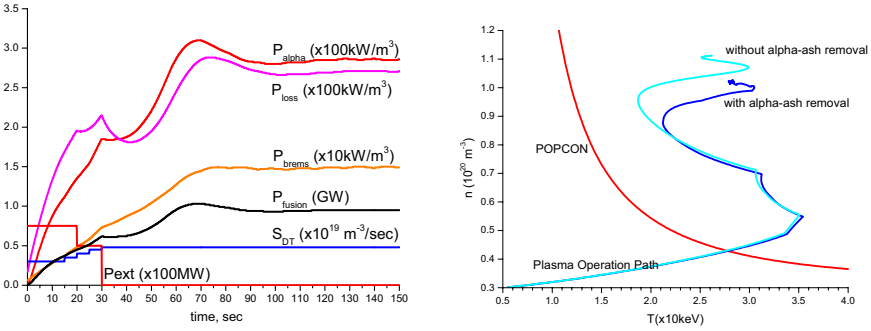
Achieving the fusion power in tokamak JET in the operation with the deuterium and tritium mixture plasma and the possible next step in the controlled fusion device ITER stimulate the further study of the fusion plasma in a toroidal magnetic trap of the reactor scale. Among many problems there is an unsolved question about the role of cold alpha-particles in power and particle balance of fusion plasma. Here we consider the effect of the removal of the cold alpha-particles on the achieving of the steady state and plasma parameters in steady state. We model the removal of cold alpha-particles inducing the rule of the cold alpha-particle confinement time evolution during the plasma discharge. We suppose that τ_α is not constant but is the harmonic function of the time.

In present paper we obtain dependence of plasma ignition boundary from plasma parameters: density, temperature, fraction of alpha-particles, and operation pass (plasma parameters evolution in time) for different ignition regimes.



The careful control of the plasma density by fuelling S_{DT} is necessary. Real time measurements of plasma density and ion temperature during the heating phase are needed to get the desirable operating point on the n-T plane (POPCON). The thermally stable ignition regime can be reached by control of alpha particles fraction and plasma ion temperature. When the alpha ash confinement time changes, the alpha ash density and plasma density changes together. Without diagnostics which plasma parameters, like alpha ash fraction or energy confinement time, are changed during ignition and ignited operation it's easier to operate plasma ignition pass by the feedback control of heating power and fuelling of deuterium and tritium by monitoring fusion power. Plasma parameters evolution (left figure) and operation paths (right figure) (plasma density versus plasma temperature) on the background of the POPCON shows us the consequence of the stages of the plasma heating and density increase due to fuel coming and heating.

For investigation of time evolution with time dependent law for alpha-ash removal we use next expression

$$\tau_\alpha = 0.75 + \frac{0.4}{\pi}\sum_{j=2n}^{\infty}\frac{j}{j^2-1}\sin jwt$$

The effect of the removal of cold alpha-particles on the plasma parameters is demonstrated here. We get some reduction of the bremsstrahlung losses and that in the steady state the plasma parameters are more stable in time under the removal of the cold alpha-particles. The fusion power is more "flat", i.e. more "equalized" in time (do not change in time so strongly). Another important fact is found here. This is the effect of the change of the fuel source S_{DT} dynamics in time on the plasma parameters in the steady state. We should notice that in the case of the smaller fuel rate the steady state is established on the level of the lower value of the helium ash. The fusion power is some smaller in the case of the smaller fuel rate in comparison with the power in the previous case. Plasma operation paths can distinguish noticeably under the different scenarios of fueling.

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MICROWAVE DISCHARGE EXCITATION IN SINGLE CONDUCTOR LINE

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Microwave waveguide-coaxial model for the excitation of UHF torch discharge at the edge of Goubau single-conductor line is presented in this work. The model construction allows one to vary a length and a form of outer conductor. Typical UHF torch discharge at the edge of tungsten conductor with the length 320 mm is shown in Fig. 2.

There are several outer conductors 6 in fig. 3. In all four cases there was an excitation of microwave torch discharge at the edge of conductors with sufficient curvature. In support of the fact that electromagnetic field localizes in thin near-surface layer on the air-conductor boundary there is the photo in fig. 4. In the photo the spiral heated conductor in double power mode of magnetron is clearly evident.

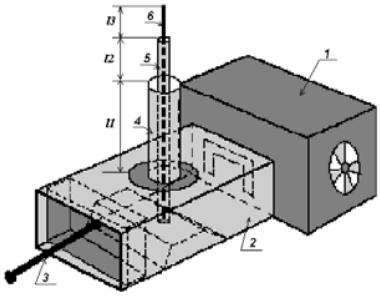

Fig. 1. Microwave model scheme consists of: 1- CW magnetron M105, 2- a resonator, 3- plunger, 4- coaxial line with a length 130 mm, 5- single-conductor line, 6- outer conductor.

Fig. 2. Torch discharge in single-conductor Goubau line

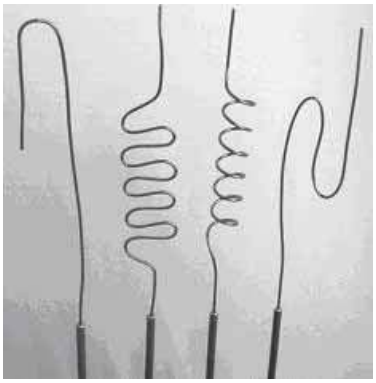

Fig. 3. Several forms of single-conductor Goubau line

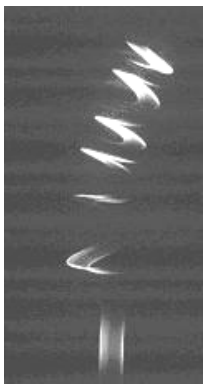

Fig 4. Boundary of plasma formation around conductor with length 32 cm

Detected properties of microwave energy propagating along single-conductor line show the complex transforming dynamics of spatial mode in surface wave at very short distance from waveguide coupling window.

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Plenary Session

Biophysics

Plasmas and Microwave Electronics

Solid State Radiophysics

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DEGRADATION PHENOMENA IN VARISTOR CERAMICS ON THE BASIS OF WO_3

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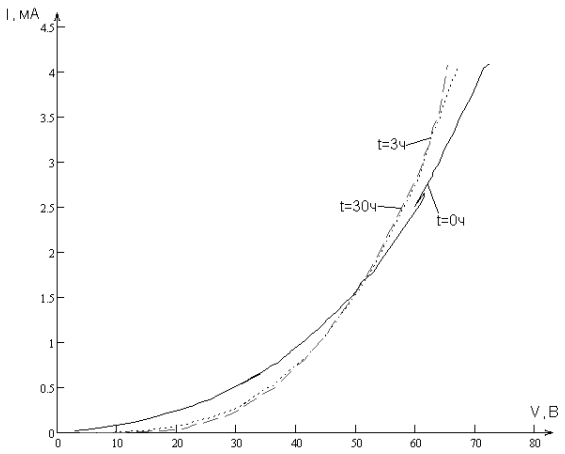
Ceramics on the basis of oxide of tungsten possess nonlinear current–characteristics (CVC) in area of low tensions and there is perspective material for non highvoltage varistors.

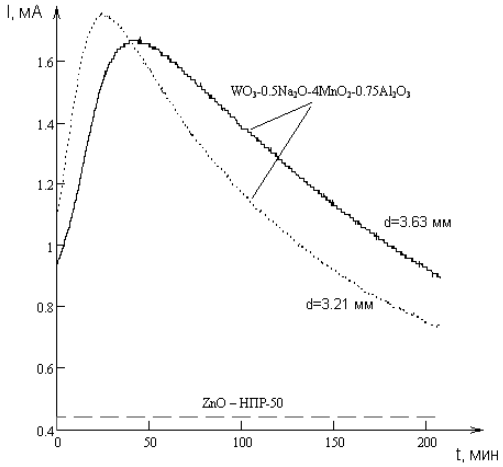
The results of research degradation of the field dependence of conductivity and nonlinear coefficients β varistors on the basis of WO_3 with the additions MnO_2, Al_2O_3 are represented in the actual work.

The standards of ceramics were made on standard ceramic technology by burning at temperatures from ~ 1100 to ~ 1250°C in the flow of 2 hours. The ceramics of the following composition were used in work: WO_3-0.5Na_2O-4MnO_2-0.75Al_2O_3 with the temperature of burning 1200^0 C, WO_3-0.5Na_2O-0.5MnO_2-0.5Al_2O_3 with the temperature of burning 1150^0 C , varistor on the basis of ZnO – НПР-50.

Results of measuring of the CVC ceramics of the composition WO_3-0.5Na_2O-4MnO_2-0.75Al_2O_3 (pic.1.a), and also dependence of varistors current from time (pic.1.b).



Pic.1.a



Pic.1.b

On results of CVC measuring were been calculated nonlinear coefficients.

Table 1. Results of measuring nonlinear coefficients

	β in t=0h	β in t=3h	β in t=30h
WO_3-0.5Na_2O-4MnO_2-0.75Al_2O_3	2.49	3.83	4.26
WO_3-0.5Na_2O-0.5MnO_2-0.5Al_2O_3	2.1	2.67	3.32
ZnO – НПР-50	3.73	3.66	3.56

Morally the processes of degradation in ceramics on the basis of WO3 are related to oxygen desorbsys from the region of grain contact and migration ions of oxygen.

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ADAPTATION OF NEURAL NETWORK FOR TASKS OF SEMICONDUCTOR SENSORS GAS ENVIRONMENT ANALYSIS

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The primary goal at the analysis of data received from semi-conductor gas sensor controls, consists what owning only the information on change of their electroconductivity (σ), to do conclusions about structure of an atmosphere surrounding the gauge. Such problem arises as at the analysis of temperature dependences gassensitivity, and hour characteristics and σ (t) at constant temperature of the gauge.

In work some results of studying of conductivity of semi-conductor ceramics of system ZnO-Ag2O in pairs methyl, ethyl, propyl, isopropyl, butyl, isobutyl, amyl and isoamyl spirits are stated.

Samples were produced from powders ZnO and Ag2O the submicronic size. Substances carefully mixed up in ethyl spirit. The quantity of an impurity of oxide of silver made up to 2 % behind weight. Dry charge pressed at pressure of 10 atmospheres in the form of disks thickness of 2-4 mm and by diameter 12 mm Baking it was spent in air at temperature 900°C during one hour. Electrodes put a method burn-in silver paste at 700°C.

Experimental temperature dependences of electroconductivity are received have an individual appearance for each of spirits. Gassensitivity sensor controls to pairs spirits grew with growth of their molecular weight. Thus, it is possible to draw a conclusion, on an opportunity of the analysis of a gas environment according to change of electroconductivity of ceramic sensor controls.

Detailed survey of approaches concerning a problem of the decision of problems of classification for the analysis of a gas environment of sensor controls is lead. The decision of this problem is offered to be carried out by means of classification with use of artificial neural networks. The user will have an opportunity:

- to adjust perceptron, a layer and a network with different configurations that does model of more universal;
- to spend the comparative analysis of neural networks of return distribution, a network on the basis of genetic algorithms, neuralevolutionary and likelihood;
- to check adequacy of models.

The purpose of work is designing of computing technology and the software of the analysis of a gas environment of sensor controls. Formally statement of a problem of classification has a following appearance. The set of objects (experiments) $\Omega_N = \{\omega_1,\ldots,\omega_N\}$, is given, where each object is characterized by a vector of attributes $\omega_i = \{x_{i1}, x_{i2},\ldots ,x_{iM}\}$, ($i = \overline{1,N}$), ($x_{ij}$ $(i = \overline{1,N};\ j = \overline{1,M})$), which components show material numbers. Educational sample $\Omega_K = \{\omega_1,\ldots,\omega_K\}$, $K < N$, and a vector of results is given $\Psi_R = \{\psi_1,\psi_2,...,\psi_R\}$.. In a problem of classification it is necessary for each object $\omega_i \in \Omega_N$ to put in conformity any decision $\psi_j \in \Psi_R$, where $R < \infty$, on the basis of data of educational sample $\Omega_K = \{\omega_1,\omega_2,...,\omega_K\}$.

Obtained results testify to perspective and importance of adaptation of the neural network approach at the analysis of data received from semiconductor gas sensor.

THE MODELING AND ANALYSIS OF CLUSTER STRUCTURES IN CdI_2 CRYTSTALS

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The characteristic properties of CdI_2 layered crystals concerned with the existence of overstoichiometric cadmium atoms, which are mostly localised in the Van der Waals gaps. In our previous article [1] metallic clusters were detected in gaps in case of high deviation from stoichiometry ratio (0.1 mol% Cd) [1]. Besides, the fact of fractal structures [2] formation from metallic clusters was established, properties of which are strongly dependent on the crystal growth technique.

The software package was developed for the determination of clusters' parameters, which includes following functions:

- edit and adaptation of images for further analysis;
- obtaining elements of interest;
- measurement of fractal dimension of various objects;
- clusters vectorization and characteristics measurement [1].

It allowed us to determine value of mean cluster radius, which equals $\overline{R} = 0.085\mu m$ for cystals grown from melt and $\overline{R} = 0.122\mu m$ in case of crystals grown from vapour. Correspondingly the mean distances between clusters' centers are $\overline{R}_N = 0.622\mu m$ and $\overline{R}_N = 0.489\mu m$. By means of box counting method the fractal dimension of aggregates in CdI_2 crystals grown from vapour was established to be approximately $D \approx 1.73$.

The various models of fractal objects formation were built and studied. On the basis of these models appropriate conclusions about structure and aggregation process of fractals in CdI_2 were made. Two models of fractal aggregate growth in crystals from vapour were studied: the cluster-cluster model and particle-cluster model [3]. The fractal dimension of these models correspondingly $D \approx 1.44$ and $D \approx 1.70$. The approximate equality of dimensions of real aggregate and particle-cluster model indicates the existence of growth centers. These centers can be formed on relief features in crystal.

The model of cluster structures formation was also built using the method of molecular dynamics [4]. The modeling was made for particles with Van der Waals interaction in the canonical ensemble. The results of simulations revealed formation of compact quasiordered structure without fractal properties under such conditions. This results is in total correspondence with the existence of analogous structures in CdI_2, formed from atoms.

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MINORITY CHARGE CARRIERS PARAMETERS IN BASE CRYSTALS OF SILICON SOLAR CELLS

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To the main electronic parameters which determining the efficiency of solar cells (SC) with p-n homojunction, concerns minority charge carriers (MCC) life time τ and diffusion length L in their base crystals (BC) [1]. Until recently at the development of Ukrainian silicon SC values of τ_n and L_n in their BC of p-type conductivity practically were not controlled, what prevented from detailed finding-out of the reasons which reduced of such SC efficiency in comparison with the best foreign analogues. Therefore earlier [2] we carried out the research of abovementioned parameters at various stages of Ukrainian SC construction-technological solutions optimization using the technique of τ_n and L_n determination on SC open-circuit voltage decay after illumination of their frontal surface cut-off [3]. The universal light-emitting diode illuminator, radiating rectangular pulses of monochromatic light in 370-960 nm wavelengths range was used as a light flow source.

The SC with n^+-p-p^+ structure on the base of BC from SHB-10 mark silicon with planar (111) and (100) surfaces as well as with area of 8 cm^2 were investigated. These BC had the thickness $t = 300 \pm 120$ μm and were cut out from single crystalline ingots with initial $\tau_n \geq 100$ μs. The time τ_D of n^+- and p^+- layers thermodiffusion formation from phosphorus and boron sources in argon and oxygen flowing environment consisted from 1 till 2 hours at 1000 ^{O}C. These SC were made in Scientific Research Technological Institute of Instrument Engineering (Kharkiv) [2]. The values of τ_n and L_n, mentioned in [2], are equals 17-74 μs and 231-482 μm, respectively. However in [2] the influence of n^+-p homojunction barrier capacity on the experimental dependence of the SC open-circuit voltage decay from time after illumination cut-off was not taken into account.

At the present research the improved technique of MCC parameters determination, taking into account influence of n^+-p homojunction barrier capacity as well as ensuring more accurately analytical processing of the initial experimental data have been used. As a result of new approach using for same SC the refined MMC parameters are received. Their values are in the following intervals: $8 \leq \tau_n \leq 69$ μs and $159 \leq L_n \leq 465$ μm. The carried out research of τ_n and L_n dependences from t and τ_D has allowed also to establish, that reduction of BC thickness up to $t \leq 180$ μm by deep chemical etching, at which it is possible to achieve practically full clearing BC from rather deep microcracks inherited as a result of a cutting from a single crystalline ingots, are one from the optimal solutions for increase of effective MCC life time in SC base crystals. Accordingly to [1] latest will allow to essentially increasing efficiency and power-mass characteristic of Ukrainian single crystalline silicon solar cells.

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EXPERIMENTAL RESEARCH OF INFLUENCE OF THE EXTERNAL MAGNETIC FIELD ON CHARACTERISTICS OF DISTRIBUTION OF SURFASE WAVES IN THE SEMICONDUCTOR

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Research of influence of an external magnetic field on characteristics of distribution of surface waves in the semiconductor is of interest from the point of view of studying properties of semiconductor plasma.

In the report results of experiments on research of influence of an external magnetic field on characteristics of distribution of surface waves in a semiconductor sample from InSb in 2-mm a wave range are resulted at temperature of the semiconductor 77 K. The rectangular wave guide in part filled with the semiconductor is placed in an external magnetic field which magnitude of an induction can vary from 500 up to 10000 Gs. The technique is used, allowing measuring simultaneously phase constant and a attenuation constant at various values of a magnetic field. Existence of area magnetic field of values at which effective interaction of a transmitted microwave with a surface wave in the semiconductor is observed is experimentally confirmed, thus phase speed of a wave becomes essentially smaller speed of light. The received experimental data will well be submitted to results of calculation.

Results of the carried out experiments can form a basis for the further development of researches in this direction.

NONLINEAR RESPONSE OF LAYERED SUPERCONDUCTOR TO SYMMETRIC ELECTROMAGNETIC EXCITATION

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High temperature ($Bi_2Sr_2CaCu_2O_{8+\delta}$) superconductors have a layered structure in which superconducting CuO_2 layers are coupled by the intrinsic planes Josephson effect through the block dielectric layers. This structure favors the propagation of the electromagnetic waves (EMW), called Josephson plasma waves (JPW) [1], through the layers. These waves are of considerable interest because of their Terahertz frequency range which is still highly reachable for both electronic and optical devices.

The unusual optical properties of the layered superconductors, including reflectivity and transmissivity, caused by the JPW excitation, were studied in, e.g., Ref. [2]. A lot of works on this problem have focused on the bulk waves propagation, that is possible in the frequency range *above* the Josephson plasma frequency, $\omega > \omega_J$, only. The presence of the sample boundary can produce a new branch of the wave spectrum below the Josephson plasma frequency, $\omega < \omega_J$, i.e., a surface Josephson plasma waves (SJPW), [3]. Recently, the existence of nonlinear JPW in layered superconductors in same frequency range ($\omega < \omega_J$) was predicted [4]. In close analogy to nonlinear optics, the nonlinear plasma waves exhibit numerous remarkable features [4], including the slowing down of light, self-focusing effects, and the pumping of weaker waves by stronger ones. However, the nonlinearity of electromagnetic waves in layered superconductors is quite different from optical nonlinearities. This allows one to expect quite unusual properties of the nonlinear Josephson plasma waves.

In this work it was theoretically studied the nonlinear response of layered superconductor to the symmetric electromagnetic excitation. The fact is that when think slab of layered superconductor is symmetrically irradiated by plane monochromatic electromagnetic waves jumps in the reflected wave phase versus the incident wave amplitude dependence are observed. This effect arises due to nonlinearity of layered superconductor and has no analogs in other nonlinear media.

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EFFICIENCY OF SILICON SOLAR CELLS WITH VERTICAL P-N JUNCTIONS AT CONCENTRATED SOLAR IRRADIATION

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Now the efficiency of serial Ukrainian monocrystalline silicon solar cells (SC) for space application with horizontal p-n-junction, which orientated perpendicularly to lighting, at 25 ^{o}C and illumination by extra-atmospheric solar irradiation (AM0 illumination regime) is at a level about of 14 %, and one of the factors limiting it is the open-circuit voltage U_{OC} value, which on the various physical-technological reasons does not exceed 635 mV. Among radical ways to increase the silicon SC efficiency it is perspective to use them in the concentrated solar radiation conditions, which allows to achieve large increasing not only power, but also weight SC output [1]. The best results can be achieved by using the high-voltage SC of «photovolt» type which consist of a package of multitude diode cells with vertical p-n junctions stuck in series [1] instead conventional SC with horizontal p-n junction. Therefore we carry out the researches to study of output parameters of a «photovolt» type SC with standard design depending on a degree of solar irradiation concentration K_I on its frontal surface, the result of which in ultima analysi should be the creation of upgraded specified type SC with essentially improved energy and power-mass characteristics.

In connection with above-mentioned the silicon SC of «photovolt» type by foreign manufacturer, with area of a frontal surface 2 cm^2 and consisted from 32 stuck in series elementary diode cells (EDC) with n^+-p-p^+ structure and 150 μm of thicknesses have been investigated experimentally. The output parameters of investigated SC were determined by loading illuminated current-voltage characteristics measuring at 25 ^{o}C and $1 \le K_I \le 500$ in radiation of a xenon flash-lamp with a spectral composition (distribution) approximate to extra-atmospheric solar irradiation. It has been established that U_{OC} of investigated SC essentially grows with K_I increasing, reaching 23.9 V at K_I = 500. In agrees with [2] the marked U_{OC} increasing provides the growth of investigated SC parameters such as efficiency and maximum power which is given back by SC mass unit, which reaches 26.5 % and $7.8 \cdot 10^4$ W/kg, respectively, in all range of K_I values.

Taking into consideration these results we have been analyzed the possible variants of improved «photovolt» type SC development on the basis of EDC with a rectifying Schottky barrier for which formation it is supposed to use a contact of silicon with highly-doped layers of transparent conductive oxides (in particular with the indium-tin oxide) or with metal (nickel, cobalt) silicides having relatively low formation temperature.

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DETERMINATION OF MOISTURE CONTENT IN A GAS COMPOSITION USING OSCILLATION OF 'WISPERING GALLERY' TYPE IN CILINDRICAL RESONATOR

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Measuring of humidity of transporting gas is independent problem and maintainability and turbines shoulders life of gascompressor unit is depend on solving above-mentioned one. For determination of natural gas humidity by measuring of dielectric parameters of machining medium is transporting along pipeline resonator development problem solving and methods of its powering is actual. And such resonators are preferred to fit in constructively in line of supply pipeline and to provide possibility of parameters measuring directly under the pressure with-in the gas in pipelines is transporting (about 7.5 Mpa) and forced feed from underground storage (8-16Mpa).

To use the metal open cylindrical resonator shape of it let to fit easy enough into supply pipeline construction were proposed for this purpose.

The high-Q oscillations in such resonators are conditioned on strong reflections of waveguide waves from resonator open ends at that radiant loss is minimal [1]. Investigations were carried out on "whispering gallery" oscillations. The spectrum of the open cylindrical resonator eigenfrequencies was found richer as for example the spectrum of shielded dielectric resonator [2].

The wave field distribution in the resonator volume by method of small perturbing discontinuity is inserted in resonator field is investigated [3].

The possibility of "whispering gallery" type oscillations excitement by capacitive slit in the open cylindrical resonator is investigated experimentally. Wave field distribution in resonator volume by method of small perturbing discontinuity is inserted in resonator field is investigated. Q-factor of resonator self-oscillations is determined. Frequency response versus amount of moisture in the resonator is investigated.

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RESEARCH OF PROPERTIES OF NANOPARTICLES OF SEMICONDUCTOR MATERIALS IN AN ORGANIC MATRIX

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The samples of materials which contained semiconductor nano-sized particles were probed in work.

Researches were conducted on the standards of organic glass[1], which showed by itself thin plates with the overall sizes of 10 x 20 x 1.5 mm^3. Nano-particles were implanted in the superficial layer of organic glass. The depth of their penetration made a few microns.

Material for the receipt of nano-particles showed by itself the pieces of monocrystals of ZnS-Mn. The subsequent grinding down of the raw material was conducted by the mechanical grinding of crystal pieces in the porcelain mortar during a few hours. For more detailed grinding, in the porcelain mortar two-bit of ethyl alcohol were added. After the process of the mechanical grinding down, raw material was thermally dried.

Material was ultrasonically ground at a mechanical contact with a ferrite magnetostrictive vibrator too. At the same time, the zinc sulfide crystal and the magnetostrictive vibrator were in a liquid environment (in our case in dichloroethane).

Nano-particles were got by the method of extorting in an organic solvent (dichloroethane). Implantation was conducted as follows. After the gravitation division of nano-particles in a solvent, during twelve hours, an overhead layer was carefully collected. To got suspension, the finely ground up organic glass was added. After it, the got mass was abandoned for a few hours, for complete dissolution of organic glass and evaporation of surpluses of solvent. This operation was conducted for the increase of concentration of nano-particles in the suspension. The got mixture was inflicted on a substrate from organic glass. Researches of properties of the got stratified structure were conducted according to the methods of optical spectroscopy.

At the detailed research of spectrums of photoluminescence of got composites and massive monocrystals of ZnS-Mn were found out some differences which can specify on being in got composites of nano-particles [2].

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THE TEMPERATURE DEPENDENCE OF THE CONDUCTION OF WO_3-BASED CERAMICS.

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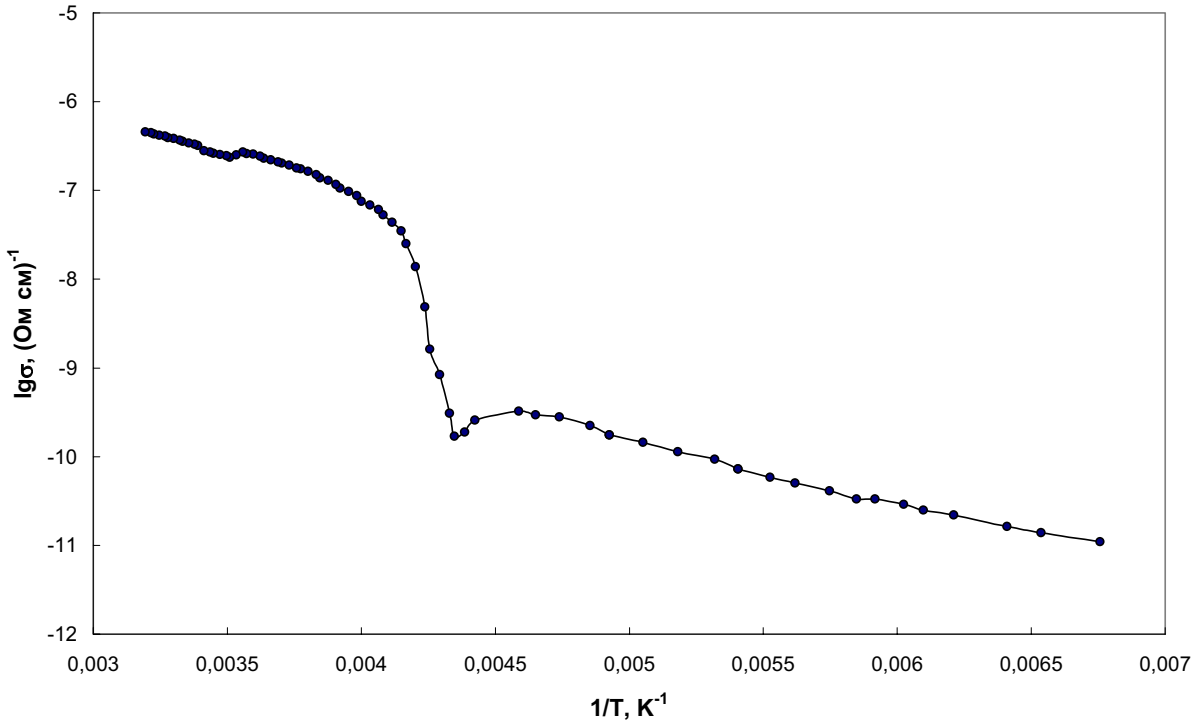
The Tungsten oxide ceramics have non-linear electrical properties and these ceramics are also a promising material for the manufacture the low voltage varistors. The temperature dependence of the conduction of the ceramics WO_3-0.5Na_2O-1.5MnO_2 was measured in the interval of the temperature in the condition of heating within 320-120 K. As we can see on the picture, in the field of temperature 230-260 K, the uneven increase of the conduction on the two orders is occurred. The conduction activation energy changes from 0,06 eV (in the interval of 150-230 K) to 0,21 eV (in the interval of 260-290 K). Besides, while heating to the over-room temperature there can be observed another phase transition at 300 K and at the same time the conduction activation energy becomes equal to 0,18 eV within the temperature above 300 K.



Pic. The temperature dependence of the conduction of the ceramics WO_3-0.5Na_2O-1.5MnO_2 in the condition of heating

The observed leaps of the conduction correspond quite well with the literature data [1] of WO_3 crystals in which the phase transition of the monoclinic-triclinic phase within the temperature of 230 K is occurred at the same time as a sharp change of the conduction on the 2-3 orders and a second phase transition without sharp change of the conduction in the case of the 300 K temperature can be occurred. In the case of the phase transition within the temperature of 230 K a sharp change of the energy gap width is occurred and a metal-semiconductor transition within the conduction can be also seen.

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EFFECT OF Nb_2O_5 ON THE ELECTRICAL PROPERTIES OF TIN DIOXIDE BASED VARISTOR CERAMICS

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The modern varistors are manufactured using semiconductor ceramics with a sharp dependence of electrical conductivity on the electrical field strength. Industrial zinc oxide based ceramics exhibit a high nonlinearity of current-voltage characteristic (CVC), high dissipated power and small leakage current. Electrical and a thermal degradation (deterioration of electrical parameters with thermal treatment and long current flow) are the disadvantages of zinc oxide based varistor ceramics. However until recent time it was not possible to obtain a high nonlinearity of CVC in other materials, which are distinct from zinc oxide based ceramics. The situation has changed with obtaining of the high nonlinearity in tin dioxide based varistor ceramics, which is comparable with the nonlinearity in commercial zinc oxide based ceramics [1].

In this work electrical properties of tin dioxide based ceramics in the system SnO_2-0,5 mol. % Bi_2O_3-0,5 mol. % Co_3O_4-0,05 mol. % Cr_2O_3 with variable Nb_2O_5 addition are studied.

The current-voltage characteristics of obtained ceramics are non-linear, nonlinearity coefficient ($\beta = \rho_c / \rho_d \approx \Delta \lg j / \Delta \lg E$, where ρ_c and ρ_d - static and differential ceramics resistivity) is changed from 35 to 48 with variation of Nb_2O_5 content. The conduction mechanism in obtained materials is controlled by a complex of electron processes in the regions of grain boundaries, where potential barriers for the majority charge carriers are formed during sintering [2].

It is observed that the increase of Nb_2O_5 content from 0.05 to 0.1 mol. % leads to the decrease of the nonlinearity coefficient from 48 to 35, the electric field E_1 (at current density 1 mA cm^{-2}) from 3200 V cm^{-1} to 2300 V cm^{-1} and the activation energy of electrical conduction $E_a \approx 0{,}2\,\Delta(\lg\sigma)/\Delta(10^3/T)$ from 0.9 eV to 0.65 eV.

In the crystalline lattice of SnO_2 (the band gap of SnO_2 is about 3.6 eV) singly and doubly ionized oxygen vacancies and such impurities as Nb^{5+}, Sb^{5+}, As^{5+} and others are known as donors with different values of the ionization energy in the range of 0.024-0.72 eV. Thus Nb can be the donor impurity in the crystalline SnO_2 grains. It means that the activation energy with the accuracy of 0.1-0.2 eV is equal to the grain-boundary barrier height. Therefore increase in Nb_2O_5 content gives a decrease in the barrier height.

In accordance with [2] it is convenient to describe the non-Ohmic properties of varistor materials by means of normalized nonlinearity coefficient $\beta_E = \beta / E_1$, because β value depends on ceramics static resistivity. The decrease in the nonlinearity coefficient β and the electric field E_1 in obtained ceramics is occurred in such a manner that the normalized nonlinearity coefficient $\beta_E = 0.0154\ см\ В^{-1}$ practically is not changed with the variation of Nb_2O_5 content.

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PHENOMENOLOGICAL MODELING OF THE MAGNETIC ORDER IN GRANULAR NANOSTRUCTURE $(SiO_2)_{100-X}Co_X/GaAs$.

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The goal of the given work is the modeling of processes of electron magneto-resonant absorption in the granular magnetic nanostructures. As an example it has been chosen the heterostructure $(SiO_2)_{100-x}Co_x/GaAs$ [1]. Notice that there is already a number of the works devoted to the decision of the tasks about the influence of structural parameters on magneto-resonant properties of a granular sample. In particular the valuable information about magneto-resonant absorption over the extra-high frequency range has been received in the experiments described in the works [2, 3], and also in a number of works of other authors. Nevertheless, in the modeling of processes of Electron Spin Resonance (ESR) there is a number of the non-authorized tasks. The given work is the next step in studying of the ESR properties in complex media such as the magnetic granular nanostructures.

The hypothesis assumed that the magnetic particles in the granular sample have the form of ellipsoid oblated along the normal to the plane of the sample (fig. 1) has been constructed.

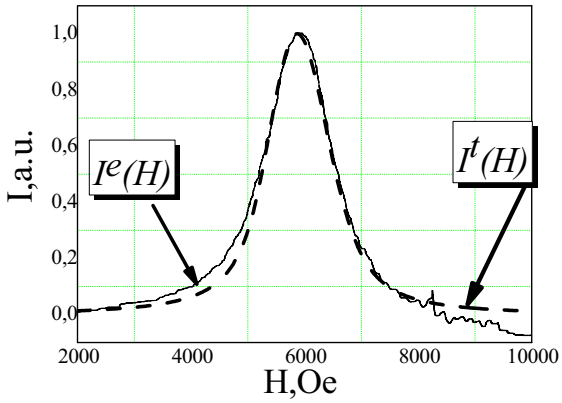

Fig. 1 Experimental $I^e(H)$ and settlement $I^t(H)$ line of a spectrum FMR for a sample $(SiO_2)_{100-x}Co_x/GaAs$ at x = 85%., ν_{res} = 25,695 GHz, H_{res} = 5926Oe, T = 300K.

Thus, on the basis of results of FMR investigations of granular nanostructure, the forms of magnetic clusters in the structure under study were determined. It is shown, that the form of magnetic clusters depends on concentration of magnetic phase and may be approximated by ellipsoids of rotation. Thus, than below the magnetic order in nanostructure, the more form of clusters tends to spheroid-like one.

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VOLT-AMPERE CHARACTERISTIC OF POTENTIAL BARRIER FORMED IN COMPOSITE MATERIAL BASED ON SRTUCTURE POLYETHYLENE-GRAPHITE

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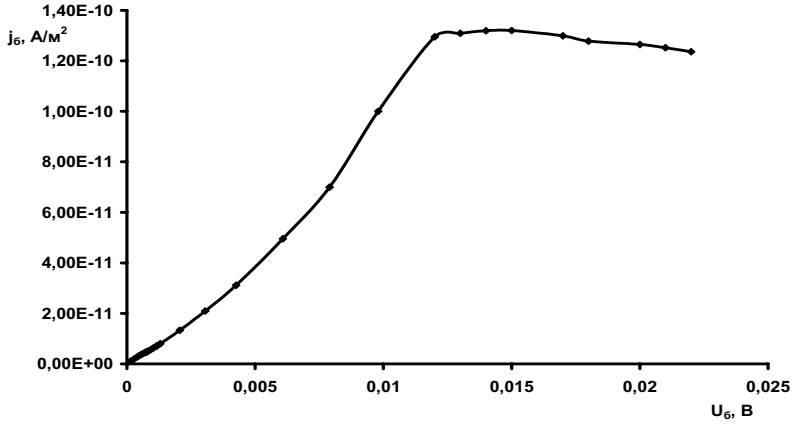
Conductive polymer composite materials based on the structure of polyethylene filled graphite have a pozistor's features. As result their volt-ampere characteristics (VAC) are non-linear. Due to low concentrations of conductive filler (less then 50%) the distance between particles is greater ($d \sim 10^{-7}$m); particle size l is about 1 μm. One of the most possible mechanisms of following current via the potential barrier (graphite particle – polyethylene – graphite particle) is running conductivity throw local centers, which are placed in dialectical layer [1]. The distance between conductive particles is different, because the polyethylene-graphite structure is nonhomogeneity, so only a part of composite is formed conducting channels.

At the present paper is considered a field dependence of a current of contact barriers, which are formed by graphite particles and polyethylene. According to percolation theory [2], preset structure is corresponded to lattice cube model of the bond problem. Here knot is particle, and bond is potential barriers. Solving this task, using the literature [2,3], can be received dependences for current following via the barrier and barrier voltage drop

$$U_á = B \cdot l \cdot f(\xi_c)^{-\nu} E \quad , \quad j_á = A \cdot l \cdot f(\xi_c)^{-\nu} U_á \sigma \quad ,$$

where A,B – constant is about 1; $f(\xi_c)$ – distribution's density of effective height of potential barrier, σ – conductivity, υ – the correlation radius' index of the percolation theory (υ = 0,9). As result we received a dependence $j_б(U_б)$, which was shown on the figure below.



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DEVELOPMENT OF NON-LINEAR COMPOSITE RESISTORS WITH POSITIVE TEMPERATURE COEFFICIENT OF RESISTANCE

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Today in electronic and electrical engineering are commonly used non-linear devices. Their operating characteristic has a non-linear functional dependence. An asymmetrical potential barrier is the main structure characteristic of modern semiconductor devices, and it's also the main reason of asymmetrical volt-ampere characteristic (VAC). One of the important tasks in electronic is an energy absorption of switching pulsation to protect devices and voltage stabilization. This problem is required to design the non-linear resistors which have a great dissipated power and symmetrical VAC.

In contrast to traditional semiconductor devices (thyristor, diode, voltage-reference diode) varistors have a polycrystal structure, which have a lot of elementary energetical potential barriers between material's grains. Due to such device's structure energy absorption of electrical pulses is distributed in the varistor's volume more uniformly then in traditional devices based on polycrystal. That's way such devices can dissipated a great power.

But current following throw the varistor's section isn't homogeneous. As results a local overheat is appeared in the semiconductor material, density current is avalanche grown and then an electrical breakdown is occurred.

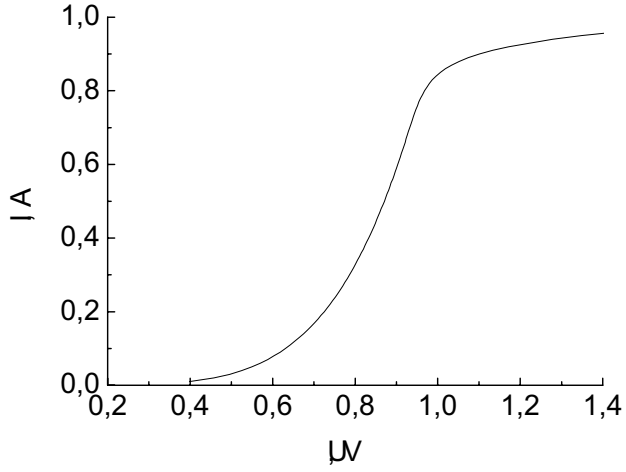
The effect of current limitation can be achieved if material with positive temperature coefficient of resistance and varistor ceramic will be mixed. And current's distribution throw the cross-section of the ceramic element will be steadier.

At the preset paper results of electrical features modeling of such device are given. This element is combined varistor's and thermoresistor's characteristics simultaneously.

We can consider our element as two resistors connected in series. Their volt-ampere characteristic can be described as

$$I_1 = U_1^{\beta_1}, \; U_2 = I_2^{\beta_2}.$$

Using of these expressions is allowed to make, perhaps, non-linear device, which has VAC is shown on Figure below.



INVESTIGATION OF MAGNETIC PROPERTIES OF MANGANITE FILM $La_{0.775}Sr_{0.225}MnO_3$ BY ESR TECHNIQUE AT TEMPERATURE OF 4.2 K

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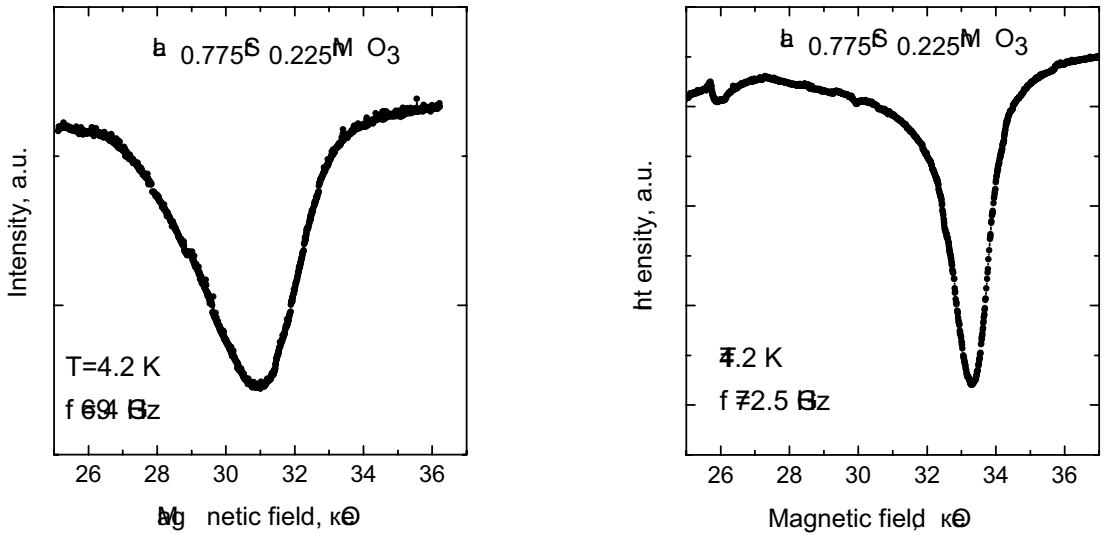
The heightened interest to studying of magnetic properties of manganite films of system $R_{1-x}A_xMnO_3$ (R - a rare earth element, A=Ba, Sr, Ca, etc.) is attributed, first of all, to colossal magnetoresistance effect [1] and the opportunity of testing of the existence of negative refraction in ferromagnetic metals due to metal ferromagnetic state of manganites below the Curie temperature [2].

In the given work the manganite film $La_{0.775}Sr_{0.225}MnO_3$ (the sizes of the film of 20 mm x 20 mm x 540 nm) has been studied. Magnetic properties of the manganite film were investigated by the method of Electronic Spin Resonance (ESR) over the frequency range of 66-75 GHz at temperature of 4.2 K with the help of the automated radiospectrometer "BURAN". The ferromagnetic resonant (FMR) absorption lines were registered at various frequencies. The skewness of form of FMR absorption line and the dependence of linewidth on Q-quality of a resonant mode of the open resonator have been found out and analyzed. The dependence of resonant frequency on resonant magnetic field has been plotted. The saturation magnetization of manganite film was calculated. The range of magnetic fields, in which the real part of magnetic permeability of manganite has a negative sign at constant frequency, has been determined.



a) b)

Fig. 1 – The FMR spectra of the manganite $La_{0.775}Sr_{0.225}MnO_3$ at temperature of 4.2 K (a) at frequency of 69.4 GHz (b) at frequency of 72.5 GHz

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CHANGE OF STATIC DISLOCATIONS CHARGE IN ZNS-CRYSTALS BY EXCITATION OF ELECTRONIC SUBSYSTEM.

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It is known, that the dislocations, which are moving in the time of a plastic strain of II-VI compounds crystals have an electric charge. The presence of electric charge on moving dislocations is cause of origin in these semiconductors of a series of interesting and important physical appearances, such as dislocation currents, a deformation luminescence, photo- and electroplastic effects etc. However till now of any similar effects it was not revealed for a static case. Moreover, the long time did not exist of methods for definition of magnitude of a charge of fixed dislocations. For the first time it was made for ZnS-crystals, at study by a method EPR of change of charge states of paramagnetic ions in electric fields of fixed dislocations. Extending these researches we have detected, that at an operation of a ultraviolet light the equilibrium concentration of photosensitive paramagnetic centres Fe^{3+} in volumes of Rid's cylinders is more, than after its switching off. The duration of process of relaxation after termination of excitation makes 20-30 minutes. We explain this by dependence of magnitude of a charge of fixed dislocations from a state of an electronic subsystem of the crystals. It is quite probable, as the charge of dislocations depends not only from ionic component, but also and from a degree of filling of an electronic dislocation level. If we are right, similarly to photoplastic effect which have place in the field of a plastic strain, the influence of a light on elastic properties of ZnS crystals should be revealed. The diagram of a strain in the field of elasticity does not feel effect of excitation owing to its smallness. But we had success to detect it during study of spectrums EPR of ions Mn^{2+} under an elastic axial compression of ZnS crystals. As was shown earlier changes of spectrums EPR allow to register in these crystals reversible moving of dislocations in elastic area. In this report are submitted the experimental results which testify to adequacy of modifications of "kinetics" of such moving of dislocations to a conclusion about influence of ultraviolet excitation on their charge.

INFLUENCE OF MAGNETIC PHASE CONCENTRATION ON STATIC AND DYNAMIC MAGNETIC CHARACTERISTICS OF Co-SiO_2 GRANULAR NANOSTRUCTURES

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Granular nanostructures are the promising materials for application in the spintronic and EHF-devices. The applied properties of such materials are conditioned by their inner structure. It is possible to obtain the information about structure of such objects using the indirect methods based on analysis of static and dynamic (the FMR method) magnetic characteristics.

In this work the Co_x- $(SiO_2)_{1-x}$ granular nanostructures with concentration of magnetic phase from 20 to 85 at.% have been studied. The samples were produced by ion-beam sputtering.

The static measurements were carried out by high sensitive vibrating sample magnetometer in the magnetic fields up to 5 kOe at room temperature. The resonance frequency- resonance field dependences were registered in the frequency band of 22-27 GHz (Fig.1).

It was found that the increase of magnetic phase concentration lead to the changes of saturation magnetization, hysteresis loops shape and coercivity. The samples containing of 70 and 85 at.% Co were ferromagnetic and had the clear output to saturation in the fields of 1.5 kOe. The broadening of hysteresis region was observed for the films with 60 at.% Co. The sharp drop of magnetization was occurred in the concentration interval of 50-55 at.%. The values of magnetization calculated using Kittel formula [1] on the basis of FMR method information coincide well with the data of static measurements. In the range of small concentrations the shape of hysteresis loops indicated an existence of superparamagnetic phase. Thus the interval of 50-55 at.%Co is the region of change of the magnetic state and is characterized by the smallest sizes of magnetic particles. This supposition was confirmed by the calculations of magnetization for the systems having different sizes of superparamagnetic particles (Fig.2).

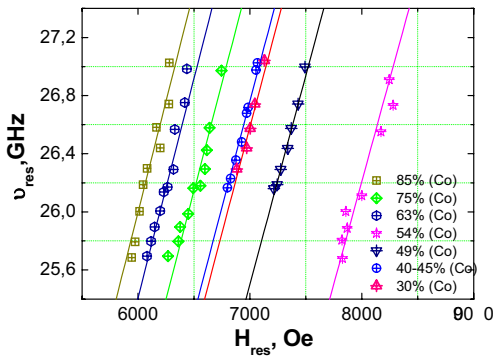

Fig.1

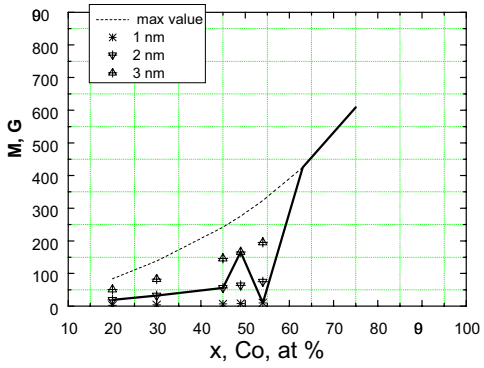

Fig.2

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Plenary Session

Biophysics

Plasmas and Microwave Electronics

Solid State Radiophysics

Optics & Photonics

Computational & Experimental Electromagnetic

Radars, Propagation & Remote Sensing

RESOLVENT OPERATOR OF MAXWELL EQUATIONS FOR 6-DIMENTIONAL FIELD VECTOR IN THE HALF-SPACE

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Current development of technologies requires investigation of non-stationary electromagnetic fields in complex organic mediums (e.g. chiral mediums, moving mediums, artificial mediums, metamaterials etc.). Modeling of corresponding phenomena requires solution of complex initial-boundary electromagnetic problems with explicit accounting for time dependence of fields that is usually nonharmonic. Moreover, in such tasks it is necessary to account for the essentially vector structure of electromagnetic field. Furthermore it is often impossible to separate material equations into independent electric and magnetic components. In such cases it is necessary to consider essentially 6-dimensional structure of electromagnetic field.

Along with differential approach to description of electromagnetic field there exists a new powerful and rapidly growing tool for temporal modeling of electromagnetic processes in complex structures – integral equations [1]. Development of analytical investigation methods and creation of analytical and numerical investigation schemes on their base is of considerable importance. Those methods allow analysis of electromagnetic waves propagation in complex mediums that has theoretical and practical importance.

Formulation of integral equations in time domain regardless of further solution method requires knowledge of explicit form for spatial-temporal Green functions. In work [2] there was considered full Green function of free space for Maxwell equations in time domain. Green function is derived using propagation operators method (propagators) that are common for quantum mechanics but relatively seldom used in classical electrodynamics.

In this work there is given general approach to investigation of initial-boundary problem for Maxwell equations in uniform medium and in plasma in time domain by their reduction to integral Volterra equation of the second kind for 6-dimensinal field vector. This is attained using derived Green function in 6-dimensional formulation in time domain. The integral equation is equivalent to Maxwell equations and contains initial and boundary conditions. It gives unified definition of field in the whole space including non-stationary region of irregularity and ambient space. There was obtained resolving operator for this equation which was used for investigation of plane wave transformation and emission of point source in the unbounded medium with sharp time variation of parameters, in plasma and the half-space. Arbitrary non-stationary of the medium can be approximated by sequence of such sharp variations of its parameters and for each variation there is calculated exact analytical solution obtained using resolvent method.

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PHYSICAL PRINCIPLES OF THE BUILDING OPTICAL COMMUNICATIONS SYSTEMS ON BASE OF FEMTOSECOND LASER

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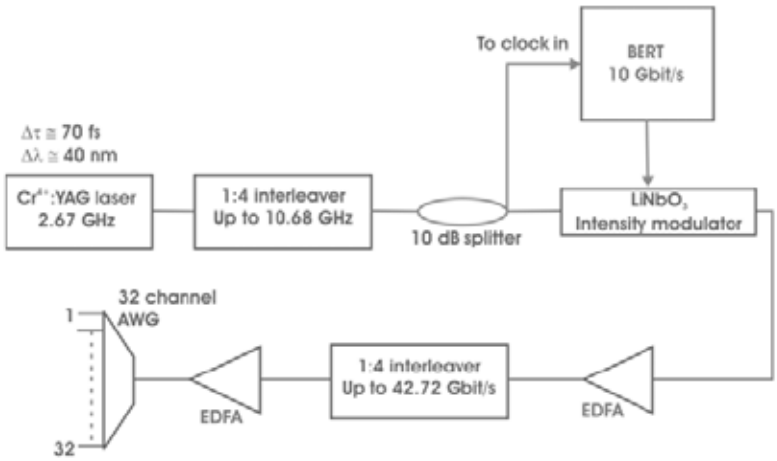
Nowadays wire and mobile communications system and data transmission are the most claiming on the market of the information services. These communications systems are found in constant development, because increasing volumes of information require the unique information rate. One of the main trends of the information rate is an increasing optical channel in existing optical main line of communication.

The purpose of the work is concluded in decision of the fundamental questions of the using for DWDM systems[1] laser sources with broad discrete optical spectrum of the radiation. The explored direction of the development high-speed fiber-optic communication line (FOKL) will allow to provide by means of one laser several thousand (in perspective hundred thousand) optical communications channels for acting DWDM systems.

In this work are considered main technologies, using in data communication system on fiber-optic communication line, as well as design of the femtosecond laser on base Cr^{4+}: YAG. The example of the structure of the data communication system, in which is used femtosecond laser source, is a scheme [1], brought on pic.1. The explored direction of the development high-speed FOCL will allow to provide by means of one laser several thousand (in perspective hundred thousands) optical communications channel for acting DWDM systems. Such systems in project is offered name FLN (Femtosecond Laser Network).



Pic. 1

The existing emission sources of DWDM systems are the most trouble spot, which limits further development of transmission capacity and information rate.

This work presents the results of the efforts directed on decision of the fundamental questions of the using laser sources for DWDM systems with broad discrete optical spectrum of the radiation.

[1] Андрэ Жирар. Руководство по технологии и тестированию систем WDM. – М.: EXFO, 2001. – 252 с.

MODELLING OF MAGNETOFIELD CHARACTERISTICS OF 1D PHOTONIC CRYSTAL (SEMICONDUCTOR-DIELECTRIC) IN MILLIMETER WAVEBAND

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The investigation of spectral properties of magnetophotonic crystals (MPC) is an actual fundamental task. Specifically MPC formed by semiconductor elements is a promising object from the theoretical point of view [1] as well as experimental one [2].

In this work the calculation of the of the electromagnetic waves zone spectrum for 1D MPC (InSb-quartz) is presented. Spectra of given MPC were analyzed in 8 mm waveband for various magnitudes of external magnetic field. The vector of magnetic field in the structure was directed parallel to the surface of the layers and perpendicularly to direction of the wave vector. The wave vector directed perpendicularly to the surface of the layers and matched with direction of z axis. As well the calculation of electric field component distribution along the axis of propagation of the electromagnetic wave has been made. Transmission and refractive indexes of electromagnetic wave were calculated. The transfer matrix technique for millimeter waveband have been applied.

In this work the dependence of width of the transmission band gap on value of magnetic field intensity has been analyzed (fig. 1). On fig. 1 solid line corresponds magnetic field intensity 0 kOe and dashed line – magnetic field intensity 1 kOe. It is shown that this value is equal to 2.5 GHz/kOe for InSb. Thus the value of the transmission band gap can be efficiently driven with the static magnetic field. For large values of the collision frequency breaking zone structure of spectrum occurs because wave attenuation has been appears. It has been detected that magnitude of transmission index in the band gap is inversely to the damping constant of the electromagnetic field along z axis. It has been shown that the band gap appears because forward and back traveling waves are in antiphase on boundaries of the layers. The wave attenuation that happens along z axis in the band gap has been analyzed, as well.

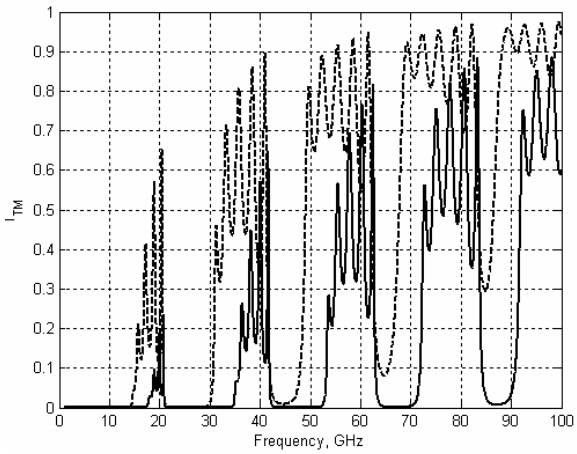

Fig. 1 – Dependence of the transmission spectrum of the photonic crystal from magnetic field intensity

1. A.A. Bulgakov, O.V. Shramkova “Investigation of reflection coefficient from semiconductor superlattice placed in a magnetic field”, Physics and technique of semiconductors, 2000, vol. 34, 6
2. H. Shimizu, M. Miyamura and M. Tanaka, 2001, Appl.Phys. Lett., **78**, 1523

CALCULATION THE QUANTUM EFFICIENCY SPECTRUM OF RESONANT CAVITY ENHANCED PHOTODETECTOR WITH TOP MIRROR DEFECT

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During few past years resonant cavity enhanced photodetectors (RCE PD) are promising devices for optical interconnects, optical sensing applications, and metrology. Inserting a photosensitive active medium into cavity results in enhanced quantum efficiency (QE) due to multiple reflections between mirrors. As mirrors distributed Bragg reflectors (DBRs) can be used. RCE PD possesses high-speed operation and wavelength selectivity and is proper device for data transfer systems. The presence of the cavity leads to a narrow bandwidth determined first of all by the cavity length and reflectance of mirrors. However, for the certain applications the receivers with the broad-band flat-topped spectral response are required. In this paper, we investigate an opportunity to creation ideal flat-topped spectrum of a quantum yield using defect in periodic structure of the top mirror. We present the QE spectra of the PD.

The schematic of the $In_{0.2}Ga_{0.8}As/GaAs$ RCE PD is in Fig.1. $In_{0.2}Ga_{0.8}As$ absorbing layer sandwiched between two GaAs spacer layers. The top and the bottom mirrors are quarter-wave stacks of $Al_{0.65}Ga_{0.35}As/GaAs$ designed for high reflectance at 980nm center wavelength.

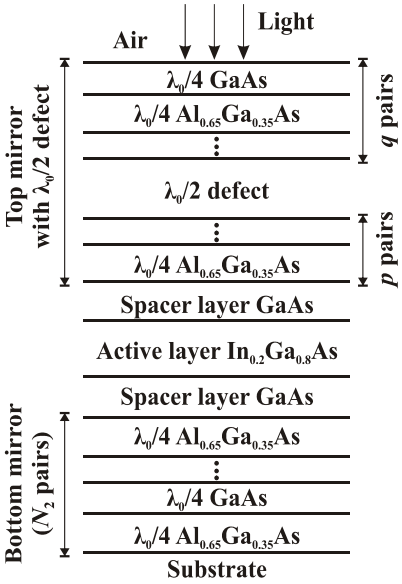


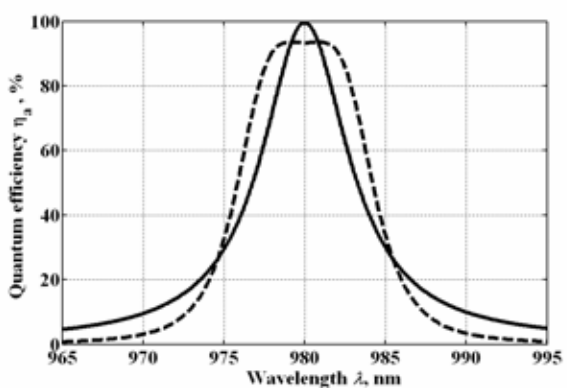
Fig. 1 Schematic model of the RCE PD with a λ/2-defect.

The QE of RCE PDs can be calculated by reflection and transmission spectra when we can neglect losses in mirrors and spacers. From the energy conservation, the reflectivity R, the absorptance A, and the transmittance T must satisfy the following relation:

$$R + A + T = 1.$$

Since the absorption outside $In_{0.2}Ga_{0.8}As$ layer is negligible, the QE, η_a, is almost the same as the absorptance A.

QE calculation for InGaAs/GaAs RCE PD was made by transfer matrix method. By using an λ/2-defect mirror in place of the DBR as top mirror we have achieved flattopped condition and high QE. A design with a maximum QE of 93.5% and 3 nm flattop width are presented.



[1] Unlu M. S., Strite S. Resonant Cavity enhanced photonic devices. J. Appl. Phys. 1995. Vol. 78, № 2. P. 607–639.

THE METHOD FOR CHROMATIC DISPERSION CONSIDERATION IN PLANE WAVES EXPANSION METHOD

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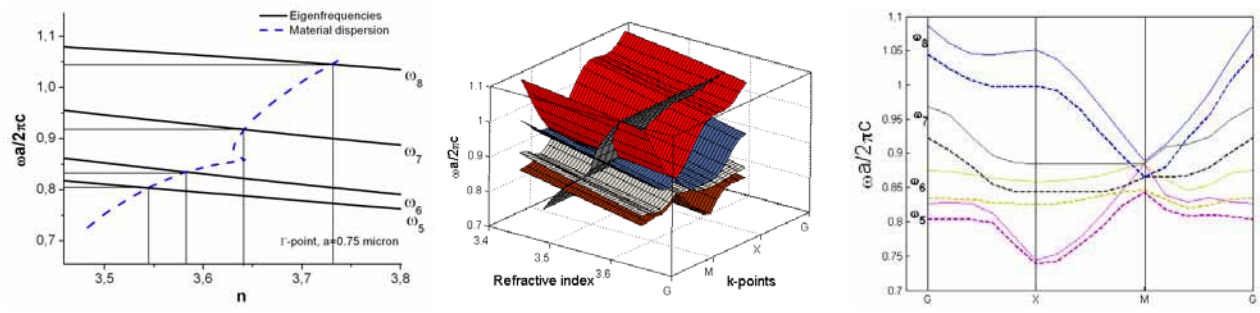
Computation techniques generally used for the computation of band structures of photonic crystals (PhC) are the plane wave expansion (PWE) method and the finite differences time domain (FDTD) method. However, both these techniques have quite important disadvantages. PWE method does not allow to treat for chromatic dispersion and losses. However, FDTD method can cause the loss of some solutions and it has comparatively large computation time.

In our work we propose the method that allows to consider chromatic dispersion in the PWE method. In order to show the necessity of the chromatic dispersion consideration, we compare band structure obtained by the PWE method and by the proposed method.

The proposed methodology is based on the multiple solution of the eigen-problem for the Helmholtz equation [1]. During the each of PWE computation, the refractive index of the PhC-material is changed in accordance with the chromatic dispersion. After that one searches for the intersection of the surfaces obtained by PWE method and surface formed by the repetition of the chromatic dispersion curve translated over all of k-points of the band structure. The intersection between chromatic dispersion surface and the surface of the band gives us a new band with a glance of chromatic dispersion. Fig. 1 shows an example of such computation for PhC made of GaAs. As is seen from fig. 1c, significant frequency shift of the band structure is observed due to the chromatic dispersion.



a) b) c)

Fig. 1 – (a) The dependence of eigen-frequencies at Γ-point on the refractive index (solid lines) and chromatic dispersion of GaAS (dashed line) [2]; (b) Surfaces formed by the chromatic dispersion line and by the PhC band structure; (c) comparison between the band structure with (dashed) and without (solid) consideration of chromatic dispersion

[1]K. Sakoda, *Optical Properties of Photonic Crystals*, Springer Series in Optical Sciences Vol. 80, SpringerVerlag, Berlin, 2001

[2]Ioffe institute official web-site (reference data on semiconductors properties): http://www.ioffe.rssi.ru/SVA/NSM/Semicond/GaAs/optic.html

REGIONAL ANALYTICAL ALGORITHM OF CLOROPHYLL CONCENTRATIONS RETRIEVING FROM SEA REFLECTANCE SPECTRA

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Reflectance is the most convenient hydrooptical characteristic for global biooptical investigation of surface waters. Upwelled radiation spectrum depends on optical properties of dissolved and suspended substances in sea water, at that the amount of unknown characteristics essentially exceeds the number of measured ones. Estimation of water mass characteristics using reflectance spectrum is a classical inverse problem.

The aim of the work is to retrieve spectral absorption of phytoplankton and other water constituents from sea reflectance data. Data used in this work were obtained from SeaWiFS, level 1 and 2, and from subsatellite measurements on the oceanographic platform near South Coast of Crimea, Black Sea, in summer 2002 – 2004.

Mathematical model of reflectance was build, depending on scattering and absorption properties of optically active components, such as phytoplankton pigments, dissolved organic matter and nonabsorbing suspended particles. Iteration algorithm allowing to retrieve concentrations and absorption spectra of pigments was devised. Algorithm originality is that concentration of each substance is determined on that spectral site where its absorption is shown most essentially in comparison with influence of other components.

With the purpose to adjust standard methods of atmospheric correction of satellite reflectance data it is proposed to consider reflectance values at the ends of measurement range as constant. Usage of such correction was shown to decrease sensibility of the model to input data errors and variations of initial parameters.

Using this algorithm, phytoplankton pigment concentrations were obtained from satellite and surface data. Chlorophyll distribution maps for investigated region were plotted. Values of pigment concentrations obtained are typical for coastal zone of Black Sea in summer period, and pigment distribution well correspond to real hydrological situation in period of investigations. Compared with OC4 [1] empirical calculations obtained chlorophyll concentrations are in best correlation with data of biological measurements. Also algorithm allows to calculate chlorophyll absorption spectra. The restored spectra of phytoplankton pigments absorption are obtained under model assumptions, so they could not be considered absolutely reliable. But they have local maxima, containing the additional information on absorption of sea water in situ which is difficult to obtain by standard methods.

[1] *O'Reilly J.E., Maritorena S., Siegel D. et al.* SeaWiFS Postlaunch Calibration and Validation Analyses, Part 3. NASA Tech. Memo, Vol. 11. / Eds. S.B. Hooker and E.R. Firestone. – NASA Goddard Space Flight Center. – 2000. – 49 p.

A METHOD OF MODULATION LASER SPECTROSCOPY FOR DETECTING METHANOHYDRATES ON THE BOTTOM OF THE BLACK SEA

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The potential of sea methane hydrates reserves using as sources of natural gas is considering now as one from perspectives of world energetics.Referring to rough estimate natural gas reserves of the Black sea could contain more than 60 - 75 trillion cubic meters with the Ukrainian consumption less than 85 billion cubic meters per year. The gas field searches, high accuracy estimation of reserves are among priorities in this area.

This project is directed to investigate essential physical fundamentals of work of remote laser spectroscopy method which is having prospects for searching and detecting methane hydrates and light hydrocarbons in water under great pressure. The project includes the investigation of methane hydrates and water soluted light hydrocarbons spectra in the spectral region fiber transparency (from 1.2mkm to 1.35mkm and from 1.45 to 1.65mkm (not well studied). It's also includes the investigation of conditions which provide interaction between laser beam and absorbent as well as to provide data transfer for long distances.

Reflector chamber will be used for the purpose of interaction between laser radiation and substance. The reflector chamber comprises a half ellipsoidal first reflector surface and planar second reflector surface. A window is formed in the second reflector surface Irradiating means includes first input optical fiber disposed close to primary focus and second output optical fiber connected with an exit window(Fig. 1). In operation the radiation emanating from the primary focus proceeds, either directly or after one or more reflections off of the first reflector surface and/or the second reflector surface, through the window for subsequent processing and analysis.

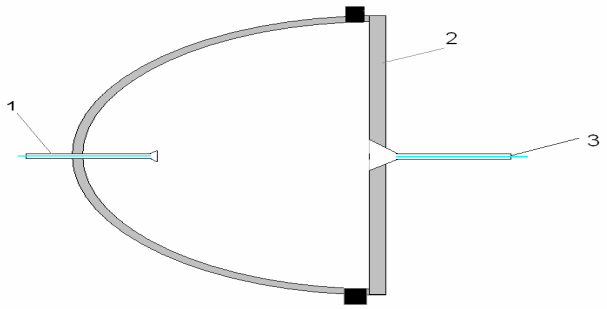

Fig. 1 Reflector chamber
1-input optical fiber, 2- reflector surface, 3-output optical fiber

The present research would result in being able to create a method of modulation laser spectroscopy in cooperation with fiber optic system for remote detecting of methanohydrates in water.

PLANE WAVES EXPANSION METHOD FOR COMPUTATION OF THE BAND STRUCTURE OF 1D PHOTONIC CRYSTAL

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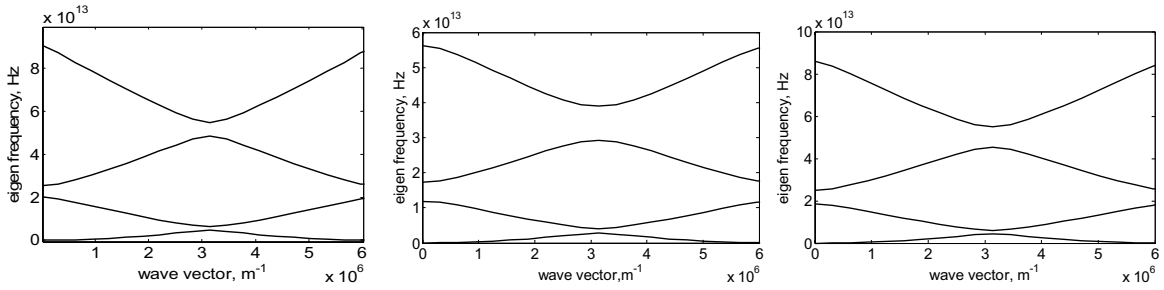
Photonic crystals represent the class of optical media which have two main properties. The first one is periodical modulation of dielectric permittivity with period of the order of wavelength. The second one is the presence of photonic band gap caused by the periodicity of the crystal. It means that inside the certain spectral range, radiation cannot pass through the sample within any of possible propagation directions.

This work is dedicated to the computation of band structure of 1D photonic crystal which is one of main characteristics describing its optical properties. The computation was carried out by the plane waves expansion method. This method consists in solution of eigen-problem formulated for 1D Helmholtz equation. As a result, the set of eigen-frequencies of photonic crystal was obtained for each value of wave vector within the limits of the first Brillouin zone. The analysis of band gap variation due to the variation of photonic crystal parameters was made.

The computation was carried out for the photonic crystal having two types of layers with different values of permittivity and width. The results of the band structure computation for 1D photonic crystals is given in figure 1. The values of the layers' permittivity and width was taken as follows: a) $\varepsilon_1 = 1$, $\varepsilon_2 = 3$, $a_1 = 0.33\mu m$, $a_2 = 0.66\mu m$; b) $\varepsilon_1 = 1, \varepsilon_1 = 9$, $a_1 = 0.33\mu m, a_2 = 0.66\mu m$; c) $\varepsilon_1 = 1, \varepsilon_1 = 9$, $a_1 = 0.33\mu m, a_2 = 2\mu m$



a) b) c)

Fig. 1 – Results of the band structure computation of 1D photonic crystals with different parameters

As a result, there was observed the photonic band gaps broadening with the growth of permittivity of high- ε layers. On the other hand, photonic band gaps tend to narrow when the high-ε layers thickness grows.

[1] V.A. Kosobukin, "Photonic crystals" The window to the microworld, No. 4, 2002

[2] K. Sakoda, *Optical Properties of Photonic Crystals*, Springer Series in Optical Sciences Vol. 80, SpringerVerlag, Berlin, 2001

MODIFICATION OF OPTICAL PROPERTIES OF THIN FILMS OF TRANSITION METALS ON PYROELECTRICS BY ION IMPLANTATION

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LiNbO3 is very popular material for pyroelectric detectors owing to high stability, long time of operation and high pyroelectric coefficient, what enables to use it for high-precision measurements, in case of power laser radiation, for space physics and air defence. But existing absorbing layers such as Ni-Cr, Ni, Mo and other metallic films, golden black, etc. (for increasing sensitivity of detectors) have small value of adhesion to the pyroelectric what is not allowed to use photodetectors for measurement of high-power laser radiation due to low damage threshold.

Investigations of surface structure of thin Ni, Mo and Pd films (15-40 nm) on lithium niobate substrate [1] (100 μm) implanted by Ar^+ ions with energies 50-150 keV and doses $5*10^{15} – 10^{16}$ cm^{-2} by Electron Microscopy and Atomic Force Microscopy have shown that ion implantation sufficiently modify surface structure of the samples differently for different metallic layers. Optimal ions energy and dose were calculated by Monte-Carlo method in case of peak of distribution function of stopping ions corresponds to the interface “film - substrate”. After ion implantation smooth surface become coated by bubbles for Ni film and by cavities for Pd film. The optical properties (reflection, transmission, and absorption) of thin Ni, Mo and Pd films on lithium niobate substrate implanted by Ar^+ ions were measured in wide spectral range (0.25-15 μm). A difference up to 70% between implanted and nonimplanted systems in reflectance and absorption spectra was observed for Pd films (40 nm thick) on lithium niobate and the less difference for Ni films on the same substrate [2]. This effect is explained by surface structure changes during implantation, modification of material properties (hardness, homogeneity, etc.), and some other effects such us blistering, peeling of sub-surface layers, case-hardening, etc. Besides, ion implantation has strongly improved adhesion of thin metallic film to the substrate (~2 orders) what is in direct proportional to optical damage threshold. So described systems can be successfully used for registration of power laser radiation where characteristics of existing pyroelectric detectors [3] don’t satisfy to the mentioned requirements.

[1] Ниобат лития: дефекты, фоторефракция, колебательный спектр, поляритоны, Сидоров Н. В., Волк Т. Р., Маврин Б. Н., Калинников В. Т., Наука, 255 С, 2003.
[2] V.O. Lysiuk, V.S. Staschuk, M.I. Kluy, O.V. Vakulenko, L.V. Poperenko[1], Influence of ion implantation on near-surface structure of thin Ni and Pd films on lithium niobate and lithium tantalite, Semiconductor Physics, Quantum Electronics and Optoelectronics, Vol.10, No. 2, P. 76, 2007.
[3] John Lehman, Evangelos Theocharous, George Eppeldauer and Chris Pannell, Gold-black coatings for freestanding pyroelectric detectors, Meas. Sci. Technol. Vol. 14, P. 916-922, 2003 .

OPTICALLY-PUMPED VECSEL WITH TUNNEL-COUPLED QUANTUM WELLS

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Optically-pumped vertical-external-cavity surface-emitting lasers (VECSELs) are the systems consisting of active area in the cavity formed by Bragg mirrors, additional mirror forming external cavity, pump laser and cooling system. In the cavity standing wave patterns with lasing and pumping wavelengths are presented. To provide effective interaction of the generated field with active medium, quantum wells should be placed in maxima of the generated field. For the efficient absorption, quantum wells should be placed in maxima of pumping field. However, due to the pump and laser wavelengths' difference, maxima of the standing wave patterns do not coincide, that is why it is difficult to reach effective absorption and gain simultaneously, and as a consequence, losses increase, the structure heats up, and output power decreases.

In the work, it is proposed to use a superlattice or asymmetrical multiple quantum wells in active area. In this case, some quantum wells provide effective absorption, then generated curriers tunnel through barriers to quantum wells providing light generation. It is proposed several designs of structures, which provide simultaneously good carriers confinement, high gain and effective carriers transport due to tunnelling (obtained tunnelling time is more than an order of magnitude smaller than Auger recombination time. One of realized designs of an active area is shown in Fig. 1.

Experimental investigation has shown that such an approach gives record values of the efficiency of the transformation of pump energy to laser energy among optically-pumped VECSELs and provides high values of output power. Fig. 2 illustrates possible variants of GaAs/AlGaAs-based superlattices which can provide required confinement and tunneling time.

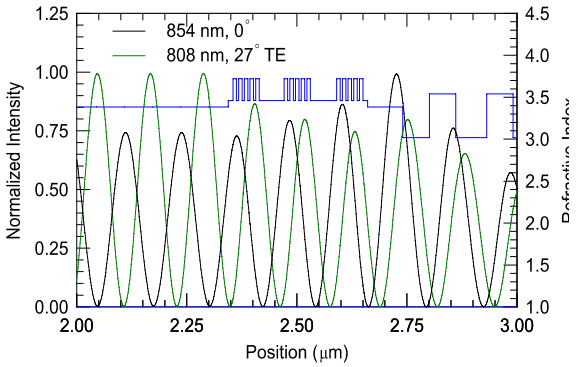

Fig.1 – Refractive index profile in active area and fields' distribution

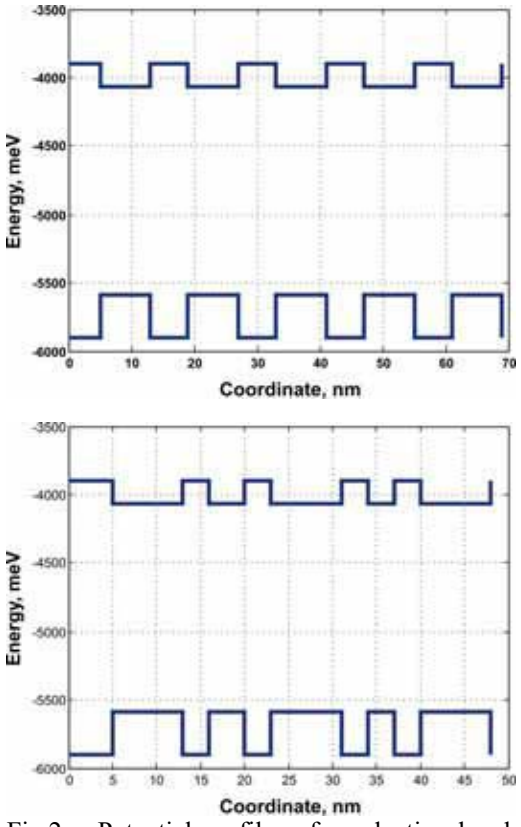

Fig.2 – Potential profiles of conduction band and valence band for experimentally realized variants

THERMOOPTICAL FILTER BASED OF A FREE-STANDING POROUS SILICON FILM INFILTRATED WITH LIQUID CRYSTAL

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With the development of optical communication systems, the designing of active optical filters and switches becomes an important problem. One of solutions of the problem is the utilization of liquid crystals (LC) as an active element. Photonic crystals on the base of porous silicon (PS) filled with LC have been a significant research topic of photonics nowadays as their optical properties can be tuned by external influence (electric, thermal, etc.).

In this paper, we present the design of an active optical filter for the near-infrared range based on a free-standing PS film infiltrated with a nematic LC. PS film has the layered structure and contains a half wave microcavity bounded with two distributed Bragg gratings. The pores with a mean diameter of 50 nm were obtained by electrochemical etch and were infiltrated with nematic LC mixture E7. The film was placed into a planar cell. The scheme of the cell is shown in Fig. 1, where 1 – glass plate; 2 – PS film with Bragg gratings; 3 - half wave microcavity; 4 – nematic LC mixture E7; 5 – mylar spacer; 6 – ultraviolet-adhesive polymer glue Norland NOA68. The direction of the incident light propagation is parallel to the pores axes. Operation of the filter is based on the variation of LC molecular configuration and on the increase of its effective refractive index while being heated [1]. Fig.2 represents the transmission spectra of the cell, measured at 27ºC (solid line) and 57ºC (dashed line). The temperature growth causes the red-shift of the resonant wavelength by 13 nm. The resonance shift dependent on the temperature is shown in Fig.3. We have found out that this dependence is increasing with temperature according to an exponential law (the red line represents the interpolation of the experimental points). As may be seen, the increase of the resonance shift stops at 57ºC, since this temperature corresponds to the point of LC E7 transition from namatic phase to isotropic one.

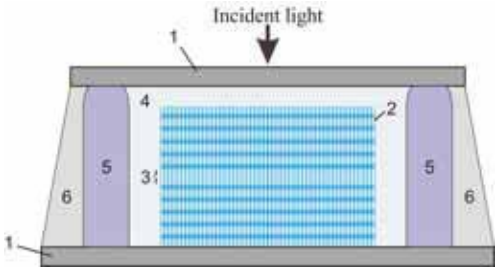

Fig. 1 Scheme of the experimental cell

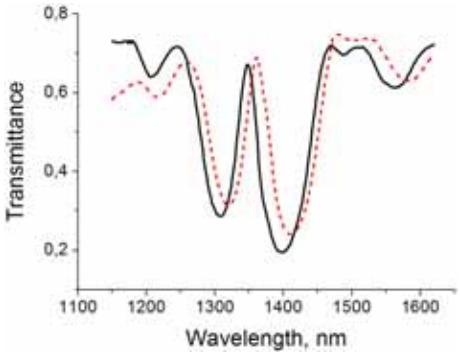

Fig. 2 Temperature effect on the transmission spectrum

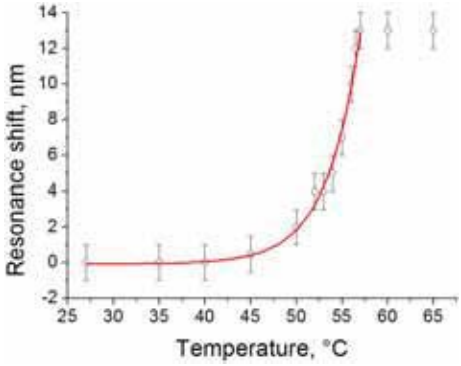

Fig.3 Resonant wavelength shift vs. temperature

[1] S.M. Weiss, et. al., "Electrical and thermal modulation of silicon photonic bandgap microcavities containing liquid crystals," Optics Express, vol. 13, no. 4, p. 1090, Feb. 2005.

MODEL OF THE LASER MEASURING INSTRUMENT OF DISTANCE

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Now one of the most actual problems in the laser ranging is necessity of increase of accuracy of measurements and optimization of parameters of laser measuring devices in conditions of continuous three-dimensional change of attitude position of observable objects and limited time of processing of the information.

Accuracy of measurements in such devices extensively depends on characteristics of the measuring channel and parameters of a signal. At the same time, the greatest influence on accuracy of measurements render fluctuating processes in receiving, passing and atmospheric channels. For increase of efficiency of methods of decrease in influence of various factors on accuracy of measurements it is necessary to develop universal models of processes of the signal formation, taking into account changes of parameters of devices and conditions of measurements.

With this purpose the model, which adequately describing the process of measuring signal formation in a pulse semi-conductor laser range finder has been developed. This model is constructed on the basis of an applied package of subprograms SIMULINK of program system MATLAB. The structure of model includes the blocks - subsystems joint by algorithm of functioning of a range finder and having difficult internal structure.

The subsystems which are included in structure of model, realize the mathematical operations describing the work of a laser measuring instrument of distances. Each block has the panel of input and correction of initial parameters, allows to realize according to algorithm internal mathematical transformations, and also to investigate its functionalities. The model also provides an opportunity of visualization of all output signals of blocks with the help of the oscillographs included in its structure. The result of measurement of a distance is fixed by the display device.

A result of modeling of the work of a pulse laser semi-conductor range finder in different conditions and at the various initial data allows to optimize parameters of elements and to develop requirements to their configuration. Also the developed model allows to estimate a degree of influence of various factors on results of measurements. One more practical importance of model is that it can be used by development, testing and the analysis of functioning of the various laser systems.

The estimated accuracy of measurement of distances on range up to 350 meters and time of processing up to 50 milliseconds makes +/-1 centimeter.

ADMIXTURE INFLUENCE ON OPTICAL PROPERTIES AND ELECTRONIC STRUCTURE OF COBALT

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Studies of ferromagnetic metal internal structure are great importance due to their potential applications in magnetic sensors, data carriers. It is essential to understand how the admixture influences to the electronic structure in metals.

Optical properties of solid solution on basis of Co with a touch of 10% Cr have been studied by means of spectroscopic ellipsometry. We have investigated the optical conductivity $\sigma(h\nu)=4\pi\varepsilon_0 n\chi\nu$ (fig.1) of bulk samples of alloy within the wavelength range 0.2-3.0 μm (0.45–5.4 eV). We also compare results with that of the bulk material (Co, Cr).

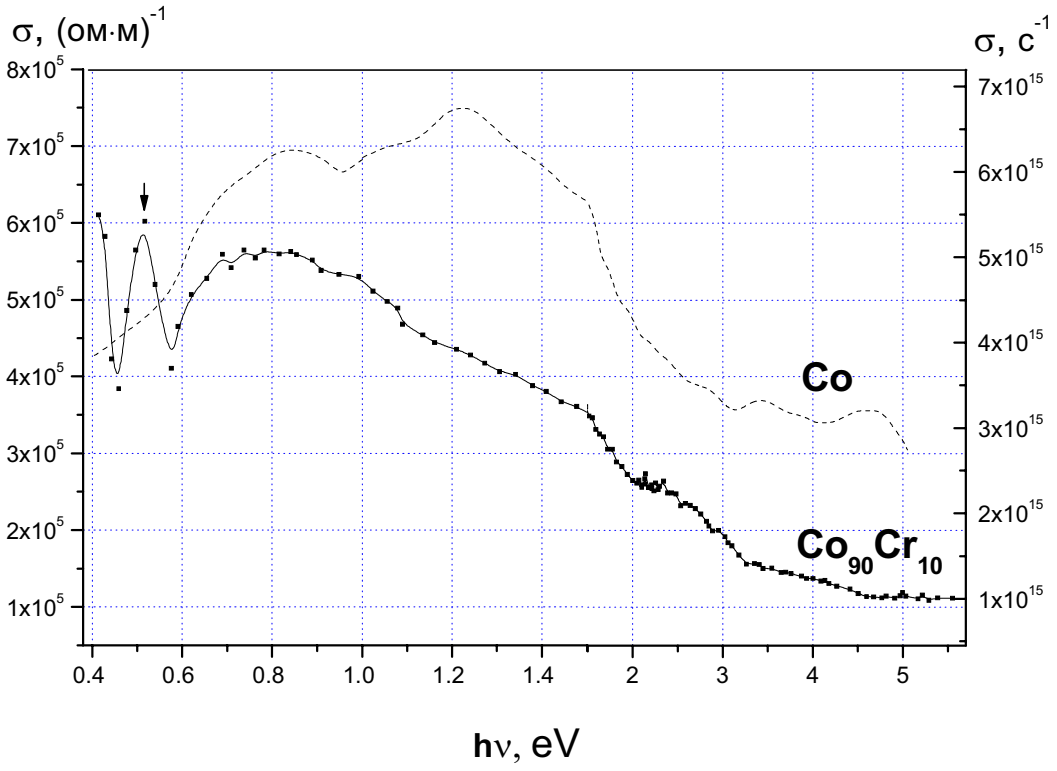

Fig.1. Optical conductivity spectra of $Co_{90}Cr_{10}$ alloy

Analysis of the optical conductivity spectra of alloy is a show of new absorption band. This band is related to admixture energy states which formed by Cr. Admixture band is localized above Fermi level and fit with 3d-electrons of this metals. The electronic structure of alloy was characterized using density of states distributions for pure components.

SILICON NITRIDE – AIR CHIRPED MIRROR FOR ULTRASHORT PULSE COMPRESSION

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Chirped mirrors (CMs) are widely used for dispersion control and compression of ultrashort pulses. Recent applications of CMs such as operating on few-cycle pulses (pulse duration involves only few periods of electrical field) require broader bandwidth and precise dispersion control [1]. Titanium dioxide (TiO_2) and silicon dioxide (SiO_2) are used traditionally for CMs designing. But titanium dioxide has significant absorption below 500 nm. Therefore new materials and design approaches are desirable.

In this paper, we propose design of chirped mirror based on silicon nitride (Si_3N_4) instead of titanium dioxide. Silicon nitride has low absorption and continuous refractive index in the wide spectral range from visible till near infrared. Recently we've shown that silicon nitride is suitable as alternative material with high refractive index for design of CMs instead of titanium dioxide [2]. However, silicon nitride has smaller refractive index (2.5 and 2.0 at 800 nm respectively) as compared to titanium dioxide. In order to increase refractive index contrast we substitute layers of material with low refractive index for air interlayers. Fig. 1 shows spectral characteristics of designed CM. Mirror's bandwidth covers wavelength range 450-1200 nm. The amount of group delay dispersion (GDD) is about $-20\,fs^2$ at 800 nm. Time domain analysis shows that designed CM is suitable for compensation of dispersion in Sapphire crystal with 2.15 mm length, Fig. 2. However, pulse reconstruction is incomplete due to affect of third-order dispersion.

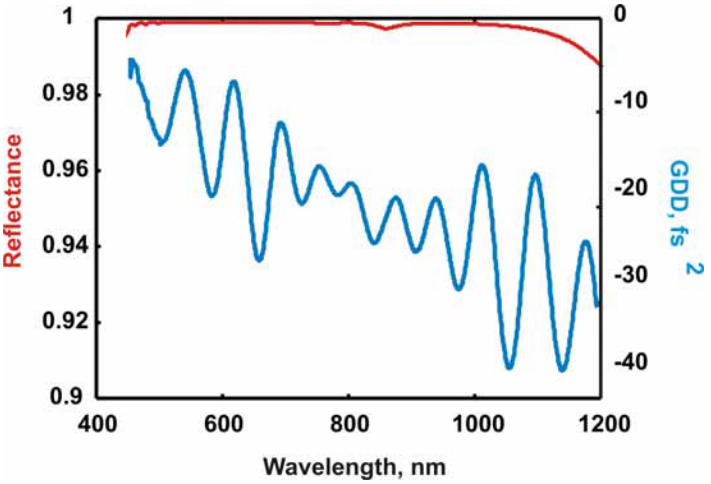

Fig. 1. Reflectance and GDD of designed CM (50 layers).

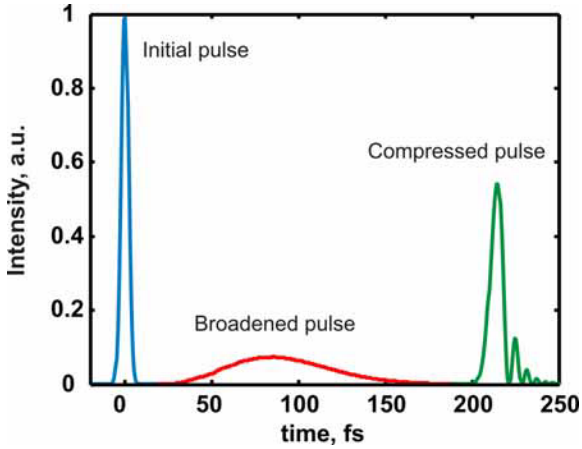

Fig. 2. Waveforms of incident, broadened, and compressed pulses.

[1] 1.5-octave chirped mirror for pulse compression down to sub-3 fs, V. Pervak, A.V.Tikhonravov, M.K. Trubetskov, S. Naumov, F. Krausz, A. Apolonski, Appl. Phys. B, Vol. 87, pp. 5–12, 2007.

[2] Comparison of Titanium Dioxide and Silicon Nitride Chirped Mirrors for Femtosecond Pulse Compression, O. V. Shulika, I. A. Sukhoivanov, A. V. Kublyk, S. O. Yakushev, Frontiers in Optics 2007 and Laser Science XXIII collocated with Organic Materials and Devices for Displays and Energy Conversion, September 16-20, 2007, San Jose, California, USA, Paper FTuL4.

FAST ALGORITHM FOR SOLVING OF THE DIFFRACTION PROBLEM ON REAL OPTIC PERIODIC PLANAR STRUCTURES

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Today planar structures with hundred nanometers period can be fabricated. In [1-2] it was shown that a planar periodic structure with complex shape of metal strips manifests such interesting physical effects as polarization rotation, light reflection without changing in electric field phase, high-Q resonance due to closed modes, etc. Thus there is possibility to create metamaterials for optical frequencies. The differences between permittivity of metals in microwave and optic ranges may result in weakening or full disappearance of desired physical effects, which were observed in microwaves. At the same time new physical effects can arise in light diffraction by planar periodic structures at optical frequencies. We need to develop a fast technique for solving the direct diffraction problem. As a basis for such fast numerical algorithm we choose the mapped Pseudo-Spectral Time Domain (PSTD) method [3]. Such PSTD technique allows reducing the Gibbs phenomenon which appears on boundary of high contrast materials. PSTD allows easy taking into account periodicity conditions in cross section and noticeably decreasing the number of mesh points. Unfortunately PSTD technique can't be effectively applied for the real planar optical structures consist of array of thin metal strips placed on top of very thick transparent dielectric substrate because the number of mesh points and the simulation time are very large. Thus the main aim consists in development and approbation of effective methods for solving problems of diffraction by real optical planar structures accounting for thick substrate and real media dispersion with minimal time of simulation. So we combine the numerical time domain simulation of the non-uniform region in strips vicinity with analytic frequency domain transmission matrix method for the thick uniform layer. Scattering coefficients of planar periodic structure determine by multiplication matrix of uniform region in strips vicinity by the transmission matrix of the dispersive dielectric layer which has thickness and by matrix describing diffraction by interface with free space behind the substrate.

To illustrate effectiveness of the proposed method, we calculated the reflection coefficient of planar periodic structures with different shape of metal strips (metal dipoles, C-elements) As the frequency range of interest in such metamaterials usually corresponds to wavelengths greater than array period in this case only zero Floquet mode propagates in the substrate, i.e. the planar structure can be considered in single-mode regime. For single-mode regime we can observe a good agreement between the results obtained by direct time domain calculation of the whole structure and by using transmission matrices method for the uniform layer. Given method can takes into account propagation higher Floquet mode and can be effectively used for multilayer structure, which includes a number of grids separated by the dielectric layers.

[1] P. Mladenov, S. Prosvirnin, S. Tretyakov, S. Zouhdi. Planar arrays of wavy microstrip lines as thin resonant magnetic walls, Proc. of the 2003 AP-S/URSI Conf., Vol. 2, PP. 1103-1106, 2003.
[2] S. Prosvirnin, S. Zouhdi, Resonances of closed modes in thin arrays of complex particles, *Advances in Electromagnetics of Complex Media and Metamaterials*, S.Zouhdi et al.(eds.), Kluwer Academic Publishers, Printed in the Netherlands, 2003, pp. 281-290.
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INTEFERENCE-POLARIZATION TECHNIQUE FOR MEASURING WEAKLY ROUGH SURFACES

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A new technique for rough-surface diagnostics based on the measurement of the boundary-field phase variance, providing high speed, high accuracy and the sensitivity threshold 2 $\mathring{A}$ is presented.

A weakly rough surface is considered as an infinitely extended phase object, what assumes a direct relationship between the statistical parameters of an object and the scattered light. Interference of two coaxial interfering waves, one being a quasi-plane phase-modulated object wave and the other being a plane reference wave, results in the zero interference fringe modulated in intensity. The in variance of the boundary object field, $\sigma_{\varphi_0}^2$, and, consequently, on the root-mean-square deviation tensity characteristics of the resulting wave and its components contain the data on the phase of the surface profile from a mean surface line, R_q.

If two interfering waves of equal intensity are orthogonally circularly polarized, estimation of $\sigma_{\varphi_0}^2$ is reduced to the measurement of rotation of the polarization azimuth of the linearly polarized resulting wave rather than to the measuring of intensities. In this case, spatial phase modulation of the object wave is reproduced in spatial distribution of the azimuth of linear polarization. Accuracy of measurement at the level of a few angular seconds provides high sensitivity and accuracy of the measuring device.

OPTICAL-LUMINESCENCE AND SEM STUDIES OF BiI_3 CLUSTERS IN CdI_2 LAYERED CRYSTALS

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This work deals with absorption, luminescence and SEM investigations of BiI_3 clusters embedded in CdI_2 layered crystals.

The BiI_3-CdI_2 samples were grown from melt containing 1 mol.% of BiI_3-phase. SEM studies show the inhomogeneous distribution of BiI_3-phase in the samples. There are dark-red and yellow areas with high and low concentration of BiI_3-phase respectively.

Absorption spectra were investigated in 77-300 K temperature range. In the spectra of "dark-red" samples absorption bands at 3.25, 3.05, 3.0, 2.4-2.5, 2.35 eV and the most intensive at 2.0 eV were observed. Peaks positions showed slight dependence upon temperature. Contrariwise, there were no peaks in the absorption spectra of "yellow" samples.

There were found three bands in the cathodoluminescence spectra of BiI_3-CdI_2 system. The first and the third band which are centered around 2.1 eV and 3.1 eV, respectively, exhibit no temperature dependence while the second one shifts from 2.3 to 2.9 eV during temperature increasing.

In our opinion, bands that are apparent in absorption and cathodoluminescence spectra could be concerned with the BiI_3 clusters. To confirm this fact, surfaces of BiI_3-CdI_2 samples were photographed in fluorescent lighting and the luminescence of small (linear dimension ~ 1-5 μm) areas/clusters were observed from these photographs.

PHOTONIC CRYSTALS USING FOR FORMING OF OPTICAL FREQUENCY STANDARDS ABSORPTION CELLS

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In connection with development of standards of time, frequency and length, telecommunication and GPS, requirement to frequency references and standards in radio and optical range are increasing. Optical frequency (wavelength) standards now have a general attention. This standards based on frequency references as a absorption lines of gases or steams of substances. Now for perspective frequency reference may be used artificial created absorption cells. The caesium fountains used in standards of frequency of a radio range concern such cells.

The Doppler and Lorents width of absorption lines are a basic obstacle for achievement limit accuracy under formation of optical standards of frequency. Then for decrease the width of absorption lines need to slow down moving of molecules and atoms.

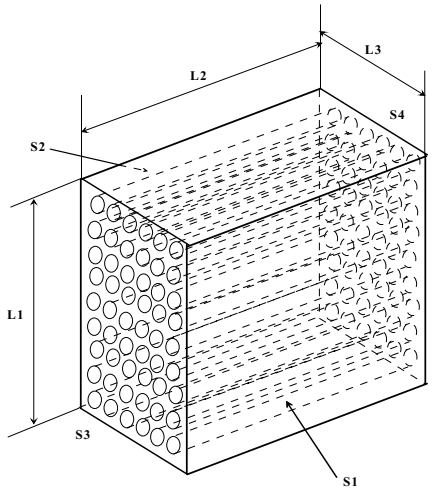

Fig. 1

In the present report discuss method of slow down moving of molecules and atoms by way of distribution molecules and atoms in nanotubes of photonic crystals as a transparent optical cell (Fig.1). In report present method of using nanotubes of photonic crystals with iodine I^{127} for prepare absorption cell for lasers with stabilization of frequency by using high narrow absorption lines in iodine I^{127}.

CONOSCOPIC PATTERNS OF THE OFF-AXIS SINGULAR BEAM IN A UNIAXIAL CRYSTAL

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In our work we illustrate an unexpected phenomenon for singular beams in a uniaxial birefringent medium manifesting itself on the background of conventional *conoscopic patterns*[1]. Here we demonstrate that a single fundamental vortex beam may emerge as four separate beams: two in each polarization field component. This phenomenon may be called *quadrefringence* (from quadru-refringence or double birefringence[2]). The necessary conditions for the generation of such splitting are theoretically determined and experimentally verified. Furthermore we propose the resolution criterion whereby the four beams become distinguishable.

We found a particular solution to the paraxial wave equation in a uniaxial anisotropic medium in the form of a set of off-axis beams bearing optical vortices with different topological charges. We theoretically and experimentally analyze the singular structure of the beams with lower-order optical vortices plotting the vortex trajectories and mapping the polarization states for different propagation directions of the vortex-bearing beam at the crystal input. Each circularly polarized component of the off-axis singular beam in the crystal splits into two beams with different propagation directions so that a total number of beams are equal to four. A little variation of the incident angle α_{in} at the crystal input comes to sharp variations of light intensity in the polarized components caused by dislocation reactions. As the result, the vortex trajectories (fig.1) in each polarized component have very complex structure consisting of two branches: the general and transversal ones. The trajectories of these beams do not intersect but there are a series of reconnections along each individual branch. These reasons do not permit to distinguish the individual beams. We found the indistinguishability limit for the angles $\alpha_{crit}^{(-)}$ behind which the individual beams in E_- component can be observed separately. These critical angles correspond to the points where the general and transversal branches of the vortex trajectories are reconnected. We showed that there is a set of the beam waists w_0 and the angles α_o for which the beams are undistinguished at any crystal length.

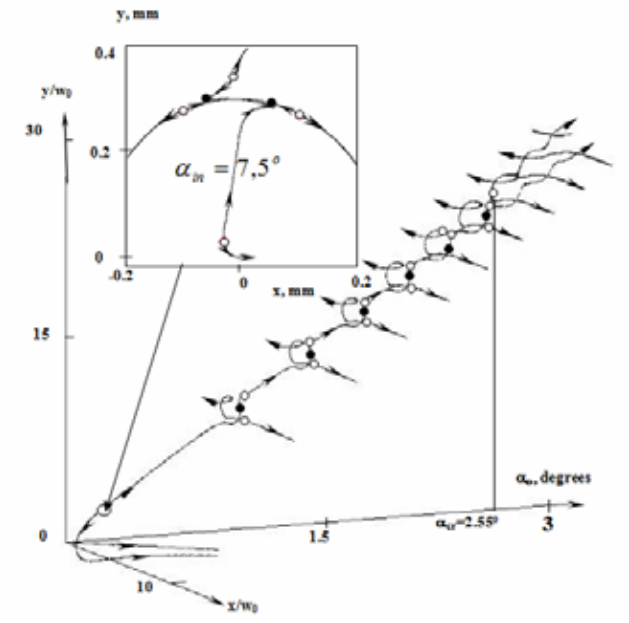

Fig.1. The vortex trajectories for E_- component

[1] Yu.Vasylkiv, Yu. Nastishin and R.Vlokh "Conoscopic Patterns for Optically Uniaxial Gyrotropic Crystals in the Vicinity of Isotropic Point", *Ukr. J. Phys. Opt.* Vol. 7 no.3, pp. 89-100, 2006

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LASER-INDUCED POPULATION DYNAMICS IN HYDROGEN ATOM

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We consider the possibility to produce the wave packet, containing high orbital and magnetic quantum number Rydberg states of hydrogen atom, using excitation by strong laser field.

The wave packet representing superposition of Rydberg states of hydrogenlike atom, such that quantum numbers in all degrees of freedom must be large, is well localized in space, and can to move along classical Kepler orbit at a great distance from a kernel under action of a various configuration fields.

Such states with large values of principal quantum number in consequence of the correspondence principle, is a classical limit of atom. Dynamics of such wave packet will find out both classical and quantum properties. For such wave packets the uncertainty product is minimal for coordinates and momentum, therefore they are well approximation of a coherent states.

The possibility to create the wave packet with high values of orbital and magnetic quantum numbers was discussed in numerous publications and has attract attention of the big number of researchers: various ways of the theoretical description of such localized states [1] and methods of their experimental producing [2-3] have been suggested.

In our model the possibility of producing high orbital and magnetic quantum numbers states by laser pulse, be explored by solving the Schrödinger equation in large number of basis states: discrete hydrogen eigenstates and continuum states. To keep a finite number of equations, the continuum has to be given a discrete representation [4], using certain number of states, divided by defined energy range.

The laser field is circularly polarized. The pulse envelope is given a Gaussian shape.

The obtained populations dynamics of considered states is investigated. The shape of wave packet and his properties are analyzed.

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PYE UNICAM SP700A SPECTROPHOTOMETER MODERNIZATION PROJECT

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In our time is hardly imagin modern laboratory without automatic equipment. Automatization in science play a vital part, it accelerate and simplify process for data accessing and automatic data processing. In optical experiment many operations can be realized by automatic. For example for investigation of light absorbtion we can simple automatize such operations as changing of monochromator wavelength simultaneously with data accessing about light absorbance, also if need it can automatic change slit width for hold energy of beam on different source emission wavelengths .

This report contains modernization project of Pye Unicam SP700A spectrophotometer.

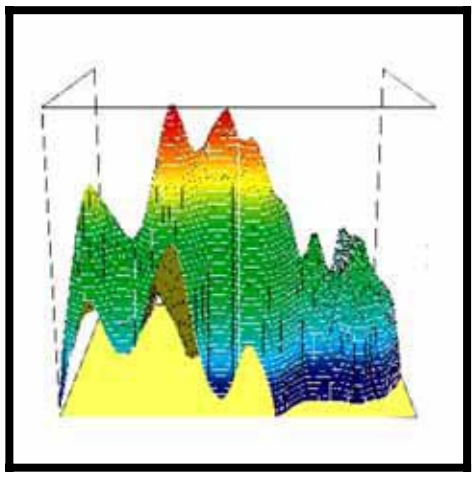
Pye Unicam SP700A spectrophotometer was built on antiquated vacuum tubes. Find new elements such as vacuum tubes instead of broken is impossible because it no longer produce by manufacturer. Equipment also was built for using with 110V mains, but it require a bulky transformers for using with 220V mains. On the other hand optical characteristics and parameters are sufficient now. Base on stated above we decide to modernize this spectrophotometer.

Project requirements:

- to provide spectra changing methods: automatic or by hand; automatic changing the slit width;
- equipment will be connect and transfer data to computer for analysis and further processing;
- equipment will be controlled by computer or controls console;
- use for modernization only prevalent electronic components;
- electronic system must be divided on functional blocks for maintainability assurance.

According to this requirements the electronic control system of spectrophotometer will be build on microcontoller for interaction with computer, and simplify circuit using computing power of microcontroller for some task solutions by program methods.

Now we have already made automatic power source for low voltage deitherium lamp, it lamp and glow lamp used in spectrophotometer as optical sources. Also we have made test mockup of microcontroller block.



Plenary Session

Biophysics

Plasmas and Microwave Electronics

Solid State Radiophysics

Optics & Photonics

Computational & Experimental Electromagnetic

Radars, Propagation & Remote Sensing

DURATION OF THE TRANSIENTS DURING ESTABLISHING OF WHISPERING GALLERY MODES OVER TIME

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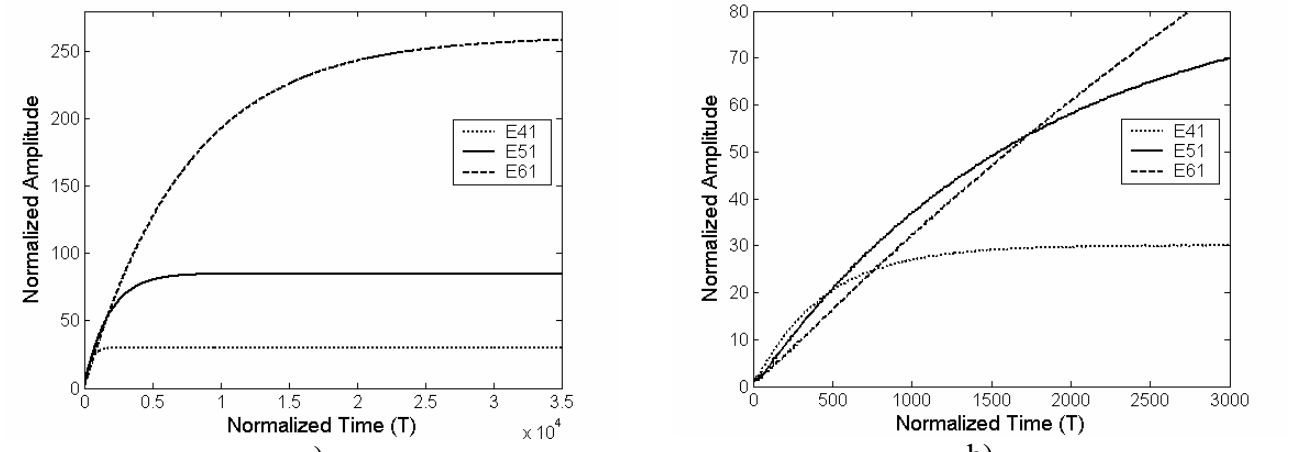
Whispering gallery mode resonators have been the subject of significant interest in recent years as they exhibit properties ideal for a wide range of potential applications including optical filtering [1], bio-sensing [2] and low-threshold micro-lasers [3].

2D problem of transient source illumination of a circular resonator of radius ρ_0 is considered. Attention is focused upon the establishing of the whispering gallery modes over time. An analytical solution is obtained in the Laplace transform domain. Inversion into the time domain is carried out by virtue of evaluation of the residues and the integral along the branch cut.

Fig. 1 shows growing of the amplitude in time into two different scales. The observation point is located inside the resonator on the distance $0.1\rho_0$ from the boundary ($T = c/\rho_0\, t$, c is the light velocity in vacuum). The source is located outside the resonator at the distance $0.5\rho_0$ from the boundary. Time dependence of the source is $\exp(i\omega t)\Theta(t)$ ($\Theta(t)$ is the Heviside function).

The frequency of the source coincides with a real part of eigenfrequencies of $E_{4,1}, E_{5,1}$ and $E_{6,1}$ modes respectively. The refractive index of the cavity is 3.44. It is obvious that the process of establishing of oscillations with a high quality factor is more time consuming (Fig. 1a).

The time period of the field establishing coincides with the life time of the corresponding mode. Fig. 1b presents the same phenomena for early times of transients.



a) b)

Fig. 1. The amplitude of the electric field versus the normalized time.

[1] B.E. Little, S.T. Chu, H.A. Haus, J. Foresi and J.P. Lain, "Microring resonator channel dropping filters", *J. Lightwave Technology*, Vol. 15, pp. 998-1005, 1997.

[2] R. Boyd, J. Heebner Sensitive disk resonator photonic biosensor, *Applied Optics*, Vol. 40, pp. 5742-5747, 2001.

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2D PROBLEM OF POINT SOURCE FIELD SCATTERING ON CIRCULAR TWO-LAYERED CYLINDER COMPOSED FROM MATERIALS WITH DOUBLE POSITIVE/NEGATIVE ε AND μ.

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Media with the negative refractive index that corresponds to the simultaneously negative values of the permittivity ε and the permeability μ [1] have got a great amount of researcher's interest recently. In the case of the negative refractive index the inversion of the phase velocity occurs, the focusing lenses become scattering ones and vise versa, high dispersion of optical properties is observed near the point of the negative refraction.

Theoretical results of the harmonic point source field scattering on the two-layered cylinder that is placed into vacuum (ε_0, μ_0) is presented. The operation source wavelength is λ. It is supposed that the permittivity and the permeability of materials can be considered positive or negative. The geometry of the problem is presented in Fig. 1.

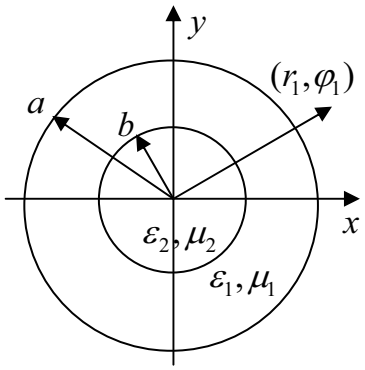
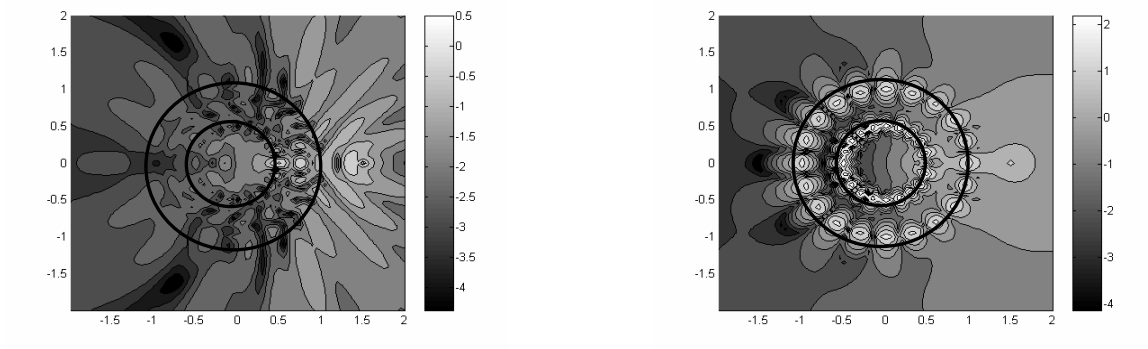


Fig. 1. Geometry of the problem.

Analytical solution of the problem is obtained in the form of the eigen functions expansion. Near and far field patterns are considered. Effects of the negative refraction and the features of the focusing radiation are investigated. Fig. 2a presents the near field distribution corresponding to the case of re-focusing of the radiation in the outer layer of the structure with both negative ε и μ. Fig. 2b shows the subwavelength resonant behaviour [2] of the structure with the negative parameters.



a) $\lambda = 2a$ b) $\lambda = 0.2a$

Fig. 2. Near field distribution for the following values of the parameters: $\varepsilon_1 = -2\varepsilon_0$, $\mu_1 = -\mu_0$, $\varepsilon_2 = 2\varepsilon_0$, $\mu_2 = \mu_0$, $b = 0.5a$, $r_1 = 1.5a$, $\varphi_1 = 0$.

[1] V.G. Veselago, "The electrodynamics of substances with simultaneously negative values of ε and μ.", *Usp. Fiz. Nauk*, vol. 92, no. 3, pp. 517-526, 1967.

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THE EXACT SOLUTIONS TO ONE – DIMENTIONAL KLEIN – GORDON – FOK EQUATION WITH ARBITRARY PARAMETER FOR TRANSIENT PROBLEMS OF ELECTRODYNAMICS IN SPHERICAL COORDINATE SYSTEM

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Separating variables in Maxwell's equations in the spherical coordinate system within the framework of Mode Base Method one arrives to the evolutionary equation, which describes the dependence of modal field amplitudes on longitudinal (radial) coordinate and temporal variable. This equation can be reduced to the following one-dimensional Klein – Gordon – Fok equation with separation parameter $b > 0$ [1, 2]:

$$\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial r^2} + \frac{2}{r}\frac{\partial u}{\partial r} - \frac{b}{r^2}u(r,t), \quad r \in [0,+\infty),\ t \in [0,+\infty). \tag{1}$$

The general solution to this equation is known only if the parameter $b = n(n+1)$, $n-$ is a natural number [3]. In such case methods of integral transforms (Weber, Laplace) can be successfully used for solving some boundary problems for equation (1).

The values of parameter $b = n(n+1)$ correspond to a narrow class of modal description of field propagation in free space. If we take into consideration more general class of problems including conical lines composed of dielectrics and metal surfaces then parameter b in equation (1) is arbitrary $b \neq n(n+1)$ in general case. The general solution for this case is unknown. The integral transformation method is also ineffective in this case since the solution cannot be obtained in the form of convolution operator, and thus it is useless for numerical calculations.

So we apply group analysis to the equation (1). As a result, all symmetrical properties of the solutions to equation (1) were found, i.e. all point transformations assumed by the equation were built. The assumed point transformations map a solution to the equation into another solution. This property of point transformations was used for obtaining new exact solutions, i.e. the formulas for generation of solutions was obtained. In particular, a nonstationary solution can be obtained from a stationary solution. For example, the following nonstationary solution $u(r,t) = \left(\frac{4r}{a^2t^2 + 4at - a^2r^2 + 4}\right)^{-\frac{1+\sqrt{1+4b}}{2}} \frac{4}{a^2t^2 + 4at - a^2r^2 + 4}$ was obtained from the trivial stationary solution $u(r) = r^{-\frac{1+\sqrt{1+4b}}{2}}$, where $a-$ is some real number, constrained by the range of r where the solution is built. It should be noted that the nonstationary solution was obtained by the symmetrical analysis alone.

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EFFECTIVE MODE ABSORBIGN BOUNDARY CONDITIONS FOR FDTD

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In order to solve diffraction problems in waveguides and periodic structures using FDTD one needs some absorbing boundary condition (ABC) that imitates semi-infinite waveguide (or Floquet channel). Using as such condition the commonly known perfectly matched layer (PML) or the exact absorbing condition proposed by Sirenko Yu.K. [1] results in significant errors near cutoff frequencies of a waveguide [2]. Ideal absorption can be achieved only by using method of diakoptics [3], which meanwhile is time and memory consuming.

In this paper we demonstrate a new ABC based on hybridization of method of diakoptics [3] with Liao's extrapolation ABC method [4], at this we reformulate the exact ABC [1] so that they are expressed via a finite duration convolution. This new ABC allows significantly reduce the reflection error below and at the cutoff frequency.

It is well known that the mode amplitudes in two waveguide cross-sections are related by the following transport operator expressed via Bessel function

$$I(z,t)=\left[\delta(t-z)-\eta(t-z)\,z\,\lambda\,J_1\left(\lambda\sqrt{t^2-z^2}\right)\Big/\sqrt{t^2-z^2}\right]*I(0,t),$$

where λ is the cutoff circular frequency for the mode, η is Heaviside step function, J_1 is Bessel function of the first kind of order 1, $I(z,t)$ is the mode amplitude. It was revealed that using a linear combination of such operators describing propagation at distances Δz, $2\Delta z$, $3\Delta z$ …, it is possible to obtain an operator that is "compact" in time (i.e. it almost vanishes after time of several time steps). Using such a "compact" in time operator in order to calculate the convolution one needs to store the mode amplitudes in some cross-section (being at several cells apart from the boundary) just at several preceding time steps (in contrast to diakoptics where all the history should be stored). Thus it requires just a little additional storage (6 time steps) and just several additional multiplications per time step (9). As a result we obtain an ABC, which is highly effective for numerical calculations.

The performance of the described ABC was tested for FDTD solution of Klein-Gordon equation with a time step being at the Courant stability limit. The sampling for the compact operator was obtained using numerical deconvolution as in diakoptics. For this case the reflection error was found to be $(\Delta z/\lambda_c)^5 \sim 10^{-8}$ (–160 dB). For the time step less than the stability criterion a significant dispersion error at high frequency range requires applying another method for determining the discrete convolution operator based on numerical approximation with SVD. As a result it was possible to achieve reflection error at $-120 \div -125$ dB ($5\cdot10^{-7}$) for any sampling frequency $\Delta t / f_c$ from 15 till 200+.

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APPLICATION OF THE METHOD OF DISCRETE SINGULARITIES TO NUMERICAL DIFFRACTION SYNTHESIS OF A 2-D QUASIOPTICAL POWER SPLITTER

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A new diffraction synthesis method is proposed for computing quasioptical 2-D reflectors in the *E*-polarization case. It is a combination of a numerical gradient (NG) optimization and an efficient analysis method based on singular integral equations (SIEs) which are discretized using a fast and accurate numerical Nystrom-type method of discrete singularities (MDS) [1]. The idea is if the objective function is the deviation of the near field from a given function on a certain open or closed contour, it is possible to derive a separate SIE for the gradient of the objective function and to solve it with MDS as well. This speeds up the synthesis process and guarantees accuracy. The results of such technique are shown for a design of a 40-λ quasioptical 5-beam power splitter, obtained from an offset parabolic reflector fed by in-focus complex-point beam source (CSP).

The considered synthesis problem is, assuming that the incident field is given in the whole space, determine a smooth open contour S_1 of the PEC reflector, for which the total field differs as little as possible from the prescribed field on a smooth comparison contour S_2 (Fig. 1). The comparison contour S_2 is taken as a straight line, with five isolated intervals, A to E, on which the field of the synthesized reflector is to be focused. The aim is to match the magnitude (or intensity) of a prescribed field on S_2. The prescribed field function on this contour is taken as a superposition of 5 Gaussian functions. As an initial guess, we take an offset parabolic contour S_1 of the fixed size of 40λ. The CSP feed is also fixed and placed at the S_1 geometrical focal point, having the intensity of kb=8. It is aimed at the center of the reflector and provides –10 dB edge illumination. The described synthesis process resulted in shaping S_1 able to provide clear focusing of the beam into 5 intervals A-E (Fig. 2).

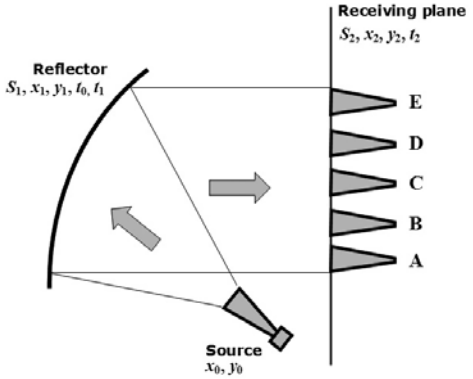

Fig. 1 Considered power splitter geometry.

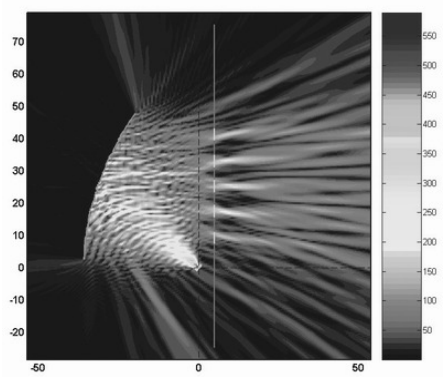

Fig. 2 Near field of an offset optimized 40λ surface for the antenna on Fig. 1

The proposed technique has been implemented in *MATLAB*. It took 90 minutes of an Intel Centrino Duo 2.1GHz CPU time and 700 surface variables to generate the results. These parameters can be greatly reduced if choosing initial-guess contour S_1 and comparison contour S_2 in optimal way.

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CALCULATING METHOD OF THE ROD DIELECTRIC ANTENNA RADIATION CHARACTERISTICS USING ELECTRIC AND MAGNETIC FIELDS ON THE ROD SURFACE

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In microwave range widely use antennas which are raised by superficial waves. The greatest distribution was received by dialectical rod superficial waves antennas. Dielectric antennas belong to the class of antennas of a running wave. There are advantages of such antennas: high frequency range (limited by raising system), simplicity of a design, and small size [1].

Modern methods of dielectric antennas radiation pattern (RP) calculation contain a number of the assumptions simplifying calculation, it is connected with absence of the computers with necessary speed by the moment of superficial waves antennas radiation theory formation. Moreover, the rod form is not considered in general. Generally it is necessary, that the rod has the cylinder form (in case of a conic rod average diameter on all length of structure is simply used). For modern computers similar calculations are not a problem. In this report one of methods of the dielectric rod antenna RP calculation is considered. This method entirely considers the form of a rod which can be general theoretically, but there are two restrictions [2, 3]:

— Diameter of a rod on all extent should not exceed critical value that is necessary for maintenance of an one-wave mode;

— The rod should be a rotation body.

The structure of the field raised in a rod of the limited length, difficultly gives in to the strict analysis. However approximately it is possible to believe, that field structure in this case same, as field structure in infinitely long dielectric wave guide. In general *H* and *E*-type waves are raised in a rod, extending along a rod axis. The rod end has a reflection. Field intensity created in the dielectric antenna, can be defined or through the currents of displacement flowing in a dielectric rod and currents of the activator, or through electric and magnetic fields on a rod surface. Using the second method it is possible to define a field in a distant zone, in the simplified kind the formula for intensity of an electric component of a field will look like

$$E_R = \int_F f\left(\overline{H}, \overline{E}\right) \mathrm{d}F ,$$

F — an integration surface (a surface of a dielectric rod);

$\overline{H}, \overline{E}$ — electric and magnetic field vectors on the rod surface.

This report contains the basic settlement formulas, results of calculation and the analysis of the dielectric antenna, and also results of an experimental research (the coordination and radiation characteristic) of the dielectric antenna model with the frequency range 2 … 3,5 GHz. The presented results confirm legitimacy of the developed technique.

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INDIVIDUAL RADIATOR FOR WIDE BAND PHASE ANTENNA ARRAY WITH WIDE SCANNING SECTOR

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The current progress in communication systems and multi function radars (where several antenna functions integrated on the one aperture) demands the new wideband phase antenna arrays with wide scanning angle [1].

The following requirements imposed to individual radiators of the antenna array should be satisfied, namely:

1. antenna array should ensure the scan angles more than $\pm 45^0$ in both principal planes;
2. the element bandwidth should be more than 20%;
3. the element size should be less than $\lambda/2$;
4. the radiation pattern of the elementary radiator should be omnidirectional;
5. the polarization should be linear.

The main goal of this paper is the computational modeling and experimental investigation of the novel individual radiator for the phase antenna array. Also computational modeling of the antenna array with a wide beam steering is presented.

The individual radiator is low-profile reduced open-ended waveguide filled with a dielectric (Fig.1). Dielectric filling allows us to increase size of the radiator less than $\lambda/2$. The bottom of the open-ended waveguide is decreased for putting feed system and feed probe. The individual radiator optimization was leaded with the following goals: decrease bandwidth, symmetrization the radiation pattern in E and H-planes. The experimental investigations of the individual radiator characteristics are showed good agreement with numerical one. The individual radiator bandwidth is 30% and the beamwidth in the E and H-plane equal 130^0.

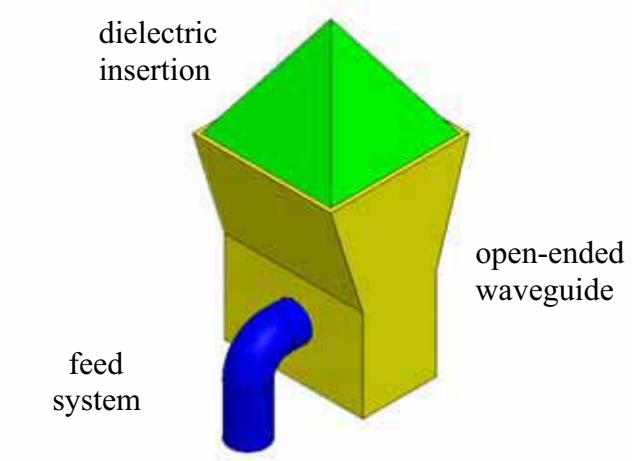

Fig. 1. The individual radiator prototype.

In this work computational modeling of the 10x10 phase antenna array is presented. In our calculations we assume that the individual radiators are isolated from other radiators. With the help of the operations known as pattern multiplication we can calculate the radiation pattern of the antenna array. We note that this antenna array has a beam steering in the angle sector $\pm 50^0$. And the highest level of the side lobes is less then -12dB.

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INFLUENCE MARGINAL EFFECT ON RADIATION PATTERN OF THE AXIAL-SYMMETRICAL PLANAR ANTENNAS WITH COAXIAL EXCITATION

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The interest to axial-symmetrical planar antennas remains high on the last years. This class of antennas are widely used in various areas such as WLAN [1], geophysical exploration [2]., and biomedical telemetry. Following the results of experimental investigation and numerical modeling the appropriate approaches of different radiation pattern formation have been suggested and analyzed with reference to the axial-symmetrical coaxial antennas. Based on the analysis of theoretical and experimental results concerning the processes of electromagnetic field formation near the antenna under study a contribution of EM fields scattered by its component elements in the radiation pattern has been shown. It has been shown that the using dielectric framing brings to expansion of the mainbeam of the radiation pattern. But using the dielectric disk as additional element, allows to get the radiation pattern with maximum radiation near the azimuth plane. As a result of this investigations the perspective antenna for use in the most latest communications network and data communication (standard IEEE 802.16) such as WiMax is presented.

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MICROWAVE DIAGNOSTICS FOR PLANE-LAYERED DIELECTRICS

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Extensive development and application of dielectric and composite materials and products need creating the new means for their nondestructive testing (NDT) and diagnostics, particularly for studying their electro-physical and geometrical characteristics. Classical methods of radio-wave NDT enable us to carry out the flaw detection and estimation of some object parameters in the narrow range of their changing. However, modern dielectric materials and products have the complex geometry and internal structure. That complicates the mathematical models and demands to solve the diagnostics inverse problems. That is, in turn, specify the new requirements for measurement systems and testing devices. The aim of this work is development the technique and creation the work-bench for complex reflection coefficient (CRC) measurement of electromagnetic wave from the plane-layered dielectric structure and estimation their electro-physical parameters and layers thickness.

The structure of automatized workbench for multi-frequency measurements of damping and CRC in 5-mm wave-length range is considered. The technique for CRC estimation, based on magic T-joint and circuit model of workbench (see Fig. 1) [1], is proposed. In this model, the magic T-joint is represented as the eight-terminal network, and the antenna – as the transmission quadripole. The model of plane wave is used for description the interaction between sounding field and layered structure. Scattering parameters of magic T-joint and transmitting-receiving horn antenna are observed experimentally with using the reference termination. The CRC target value estimates on the basis of frequency dependence of magic T-joint output signal.

For verification of the method, the CRC frequency dependencies of one-layer plates are measured. It can be seen on Fig.2, that experimental data correlate with CRC theoretical dependence for plane wave. The inverse problem for determination the location, thickness and complex permittivity for one-layer plate is solved.

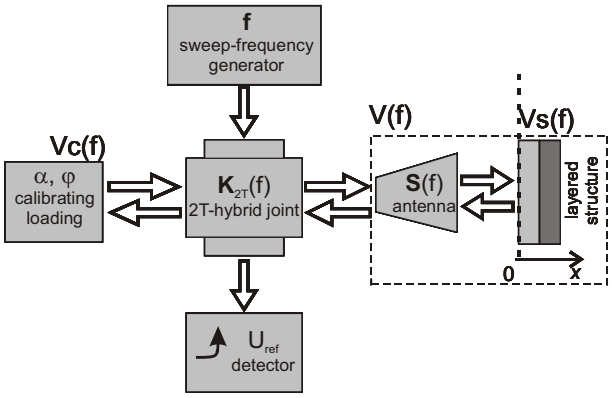

Fig. 1. Circuit model of workbench.

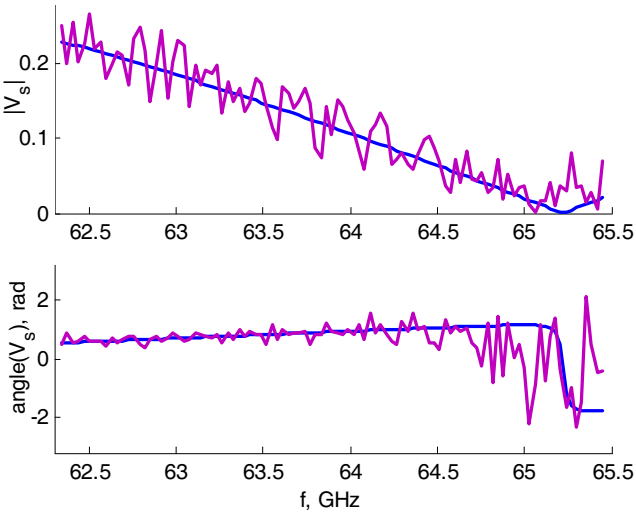

Fig. 2. CRC of teflon plate $V_s(f)$ (h = 8,0 мм, ε = 2,07, tgδ = 0,4×10^{-3}): — experiment; ⁗ the CRC for plane wave.

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IMPROVEMENT OF GEL'FAND-LEVITAN'S ITERATION PROCEDURE FOR PERMITTIVITY PROFILE RECONSTRUCTION USING BLOCK MATRIX INVERSION FOR SLAE SOLVING

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The reconstruction of permittivity profile $\varepsilon(x)$ is one of the general problems in radiophysics. Since ε depends on mechanical and chemical properties of material, so on the basis of ε profile reconstruction there is the possibility to detect defects such as an air insertion between adjacent layers, a deviation of layers' electrical properties from norms and others. This possibility is important for the non-destructive testing of the composite dielectric materials. The microwave reflectometric methods are used for one-side access providing. They allow the one-dimensional ε profile to be reconstructed on the basis of reflection coefficient measured experimentally in frequency domain. The problem of ε profile reconstruction mathematically is the inverse problem of electrodynamics. Its complexity has brought many approaches of its solving. One of such methods is the known Gel'fand-Levitan's method [1]. The feature of this method is that it restores the profile of permittivity not on basis of the frequency dependence of reflection coefficient, but on basis of the impulse characteristic of reflection connected with it by the pair of Fourier's transforms. In some situations it is easily to synthesize the impulse characteristic using the methods of spectral analysis of the results of reflection coefficient measurement on the some frequency grid. The other feature of Gel'fand-Levitan's method consists in necessity of the equidistance discretization of impulse characteristic.

There is the successive processing of impulse characteristic samples and successive, layer by layer, reconstruction of permittivity profile in depth by iteration procedure. At every iteration the SLAE has to be solved, the order of SLAE is determined as the iteration number. It causes that the iteration becomes more and more slow. The complete number of iterations has to be done reaches some hundreds that corresponds to well-detailed impulse characteristic and as a result the reconstruction of permittivity profile takes long time. But only one unknown coefficient is interested by and the complete SLAE solving brings ineffective spending of computer resources.

The novelty of this work consists in the improvement of the iteration procedure that makes the reconstruction process faster. The feature of coefficients matrix of SLAE is that this matrix on k^{th} iteration includes matrix on iteration $(k - 2)$ which allows applying of the block matrix inversion [2] with dividing of the coefficient matrix by 9 blocks. Using the block matrix inversion the equation for unknown coefficient interested has been found thus complete solving of SLAE is not necessary anymore. Two parallel iteration procedures have to be done; these procedures correspond to odd and even iterations respectively. In addition the equation for determinant of coefficient matrix has been found and the conditions of its degenerating have been specified.

The Gel'fand-Levitan's method was realized numerically and the speeds of reconstruction were compared for the block matrix inversion and the Gauss method of SLAE solving. The decrease of iteration duration for the few times was noted.

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RECTANGULAR WAVEGUIDE WITH AN IMPEDANCE FLANGE MATCHING CHARACTERISTICS IN MULTIMODE REGIME

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Waveguide antenna arrays have wide practical application in microwave technology. They can be applied to telecommunication, radiolocation, medical diagnostics and other purposes. Such antennas main advantages are simplicity for manufacturing and high mechanical durability as a consequence of projecting parts absence. In this paper problem of radiation from open-ended rectangular waveguide with an impedance flange radiates into homogeneous isotropic magnetodielectric.

Fields into waveguide can be represented as infinite waveguide eigenfunction series and the field in the dielectric half-space can be written as Fourier integral of the plane waves continuous spectrum. The tangential fields continuity on the waveguide aperture and impedance type boundary condition on the flange allows to construct the integral equation for considered problem. This equation can be solved using various approximate methods such as variational method in particular. The considered problem has been solved using variational method in single-mode approximation in [1, 2]. In this paper the multimode approximation of variational method has been applied to considered problem. A stationary functional existence allows to use approximate field distribution on the aperture as waveguide modes finite linear combination. Consequently it allows transforming the integral equation to linear algebraic equations set for waveguide modes on the aperture.

The rectangular waveguide excitation by main mode H_{10} has been numerically investigated for example. Numerical results for reflection coefficient absolute value have been analyzed. These results have been obtained for the waveguide with the walls ratio $a / b = 1.0$ using the single-mode and multimode approximations. The comparison of the obtained results with the numerical results from the paper [3] has been carried out. Only the modes $H_{2n+1,2k}$ and $E_{2n+1,2k}$ (where n and k are the arbitrary integer numbers) has been taking into account because other higher modes has not been exited by the main mode.

In the higher part of the main-mode frequency band the variational method in the single-mode approximation gives the results which have not satisfied correspondence to the results by moment method in [3]. Increasing the number of the considering modes to four ($H_{10}, H_{30}, H_{12}, E_{12}$) allows to tangibly improve the results accordance. This improvement allows to make the conclusion about variational principle multimode approximation advisability for the waveguide with the impedance flange matching characteristics computation.

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INCREASE OF EFFECTIVENESS OF INTERACTION BETWEEN MOBILE AND BASE STATIONS

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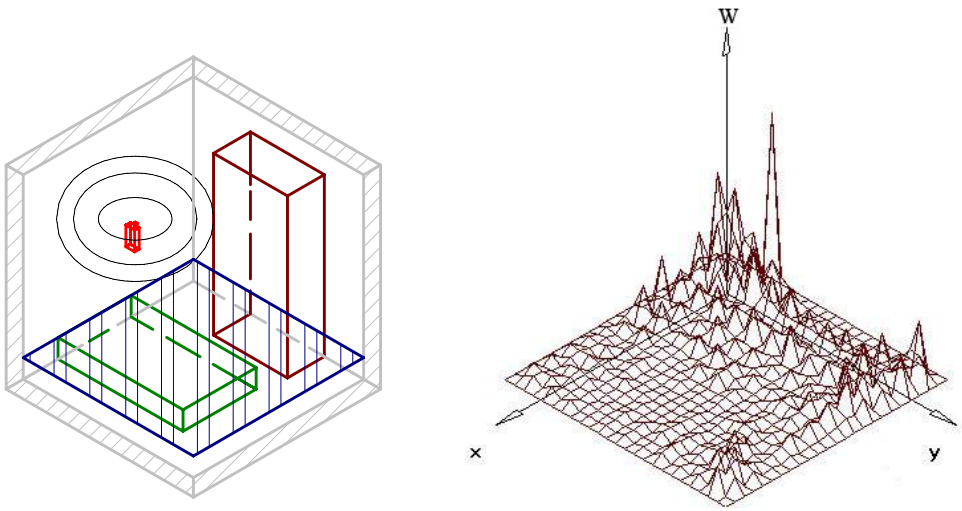
Nowadays society actively uses opportunities and advantages of mobile communications. In urban conditions, where mobile communications is very important, situation becomes complicated, because of a lot of noise and reflected signals from buildings walls in the environment. It is known, that there are zones, in which communication is reliable enough, and zones in which it is absolutely absent.

The purpose of work is in determine of the most rational arrangement mobile and base station for improvement of characteristics of a covering of space at minimization of the general electromagnetic background.

The calculations of the distribution of radiation energy of mobile and base stations are based on solving of Maxwell equations with help of Finite-Difference Time-Domain Method (FDTD). As approach, it is considered, that all values, are constant within a cell of the four-dimensional grid [1].

In the given work the electrodynamics model of a room (Fig.1 a) is developed and the distribution of radiation energy of a mobile phone in random shaded section is calculated. Distribution of radiation energy in the room of a base station is obtained.



a b

Fig.1

By results of calculations it is shown, where is the maximum of radiation energy in the room from a mobile phone and the maximum of radiation from a base station in which it is recommended to place a mobile phone for increasing reliability and quality of communication.

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ELECTRODYNAMICS CALCULATION OF ELECTROMAGNETIC FIELDS IN A RECTANGULAR WAVEGUIDE WITH TWO L-SHAPED SEPTA

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This work is devoted to calculation of electrodynamics parameters of TE-waves in air filled rectangular waveguide with two L-Shaped septa without losses.

Owing to the complex of advantages such waveguides allows to create elements and knots with modern demands, surpassing by the parameters analogs created on rectangular and circular waveguides.

The rectangular waveguides with two L-Shaped septa discussed in this work has series of properties which are in a big theoretical and practical interest. It has wide region of homogeneous distribution of electromagnetic fields and a bandwidth greater than in other waveguides of complex cross-section [1].

For calculation of cutoff wave numbers and components of electromagnetic fields of this structure the method of partial regions including field singularities at the edge is used. It allows with minimum calculation time to receive the maximum exact solution in comparison with other methods and to write down the electromagnetic fields in analytic form.

According to this method the cross-section of this waveguide is separated on seven no overlapping regions.

For each region the equation, which is the solution of Helmgolts equation for each region for z component of magnetic Hertz-vector is derived in a form of infinite series with unknown coefficients by eigenfunction of partial regions .

Eigenfunction of partial regions are given according to boundary conditions and unknown coefficients for field components are derived through the values of unknown functions proportional to Ey component for TE waves and given on separation line of partial regions [2].

The system integral equations with kernel includes logarithmic singularity is derived from the condition for Hz component for TE wave on boundaries of partial regions.

The systems of integral equations are solved by Galerkins method and as a result the systems of linear equations are received.

When the determinant of this system is equal to zero the transcendental equation for calculation eigenvalues for TE waves is received.

The calculation results of cutoff wave numbers shows that such waveguides could be a good alternative to other ridged waveguides for example as an element of antenna arrays.

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COLLAPSE IN BOSON-FERMIONIC MIXTURES WITH ALL-REPULSIVE INTERACTIONS

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The achievement of Bose-Einstein condensates (BECs) [1] has pushed the field of degenerate quantum gases to become one of the most active areas of Physics. After the condensation of different bosonic species, degenerate mixtures of bosonic and fermionic atoms were created [2] providing a highly controllable tool for study of systems of mixed quantum statistics.

Several interesting nonlinear phenomena have been studied in the context of boson-fermion mixtures. First, the fact that interspecies interactions may result in attraction among bosons, implies that solitons could also appear in quasi-one dimensional boson-fermion mixtures. Also, collapse of the atomic induced by the interspecies attraction in boson-fermion mixtures was observed experimentally and studied theoretically. The usual scenario of collapse in single-species quantum gases corresponds to a BEC which collapses because of its attractive self-interaction.

This phenomenon had been long known in mathematical physics [3] but the theoretical description of its specificities for BECs has motivated a lot of theoretical research. In boson-fermion mixtures, it is the attractive interspecies interaction what drives the blow-up of the atomic cloud.

In this paper we describe new blow-up scenarios in degenerate quantum gases, namely in boson-fermion mixtures, when *all interatomic interactions are repulsive.* More specifically we will describe the phenomena of *early* collapse and of *super-slow* collapse of the mixtures.

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INVESTIGATION OF DIELECTRIC LOSSES IN MINERALS AT MILLIMETER WAVELENGTHS AND OVER A WIDE TEMPERATURE RANGE

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Investigation of processes of absorption of electromagnetic energy in materials is promising for clarification of mechanisms of losses in dielectrics. The technique of measurement of dielectric properties by using a Whispering Gallery Mode Disk Dielectric Resonator (WGM DDR) is one of the most precise techniques for today [1]. WGM DDRs are made of materials under test directly. WGMs are characterized by the large number of variations of a field in azimuthal direction and confine a prevailing part of electromagnetic energy inside dielectric. The losses on radiation become insignificant, and the loss tangent of a sample can be defined simply by inversion of Q-factor Q_0 ($\tan\delta=1/Q_0$). At millimeter wavelengths investigation of samples in cryogenic systems of small volume is possible owing to small sizes of DDRs. In the majority of cases the WGM DDR technique is used for determination of dielectric parameters of materials with ultra-low losses of energy in synthesized crystalline materials. We applied this technique for investigations of natural materials with rather low losses – minerals, which composition and structure are very often variable.

Following minerals were studied: chrysoprase, opal, jadeite, rhodonite, calcite, fluorite, topaz, carnelian, chalcedony, agate. For calcite and fluorite also the temperature dependences of their synthesized single-crystal modifications are investigated. Measurements were carried out by means of the automated cryodielectrometer (cryocomplex) [2] in the frequency band of 50 – 80 GHz and the temperature range of 1 – 300 K. The resonators were placed in the vacuumize chamber, in which regimes of variation and stabilization of temperature were provided. Dependences of loss tangent of materials on temperature are obtained. The topaz sample has possesses the lowest losses in a wide temperature range among the investigated minerals. Parameters of the sample: diameter is 18.01 mm, height is 1.02 mm. Loss tangents depending on temperature are $1.76\text{x}10^{-5}$ at 1 K, $1.90\text{x}10^{-5}$ at 4.2 K, $2.54\text{x}10^{-5}$ at 100 K, $16.58\text{x}10^{-5}$ at 300 K. Results of measurements can be applied for research of dissipation of electromagnetic energy in dielectrics with the complex composite structure and for determination of the content of their components [3].

The investigation was performed on “Cryomagnetic radiospectroscopy complex of the millimeter waveband”, having the status of National Scientific-Related Property/Treasure, directive of Cabinet of Ministers of Ukraine on 27.12.2006 No. 665-p.

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Пленарні доповіді

Біофізика

Plasmas and Microwave Electronics

Solid State Radiophysics

Optics & Photonics

Computational & Experimental Electromagnetic

Radars, Propagation & Remote Sensing

MATHEMATICAL MODEL OF AN ESTIMATION OF A NOISE SITUATION IN A GIVEN AREA. THE CALCULATING THE SITUATION ON THE TERRITORY OF DNEPROPETROVSK NATIONAL UNIVERSITY

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Satisfaction of an electromagnetic compatibility of telecommunication wireless systems is an important problem in the designing new systems and the optimization of the exist ones. The quality of the service of new and exist telecommunications – a signal/noise ratio, a power level of a signal, a bit error ratio, etc. depends on a noise situation. To obtain the qualitative parameters of telecommunication channels it is necessary to estimate the electromagnetic situation within a consideration area with taking into account the influence of new systems on the exist telecommunications.

The development model is based on analytic, empiric and semi-empiric relations. It takes into account fading of a signal in a free space, inhomogeneity of Earth surface, building influence, climate conditions, and intensity of precipitations. The model also takes into account the distortion and subdistortion disturbance, the intermodulating interaction, and the moire components. Wide-band and narrow-band telecommunication systems, radio relay lines, aviation navigation systems, transmission facilities are taken into account in the model. Other kinds of disturbances are considered in the work as a white noise.

The pair and group estimates of the electromagnetic compatibility are developed by using deterministic and probability approach.

The test calculation of the electromagnetic situation on the territory of the Dnepropetrovsk National University is carried out for purpose of testify the model. The territory of DNY is under influence of three GSM base stations and two CDMA base stations (CDMA 95 and CDMA 2000 x 1). We have determined the electromagnetic field intensity of the base stations, the effect of each base station on the signal to noise ratio of other ones, the total disturbance level of the mobile communication systems, the noise due the radio relay systems, and an influence of all these noises on the quality rating of the communication channels. The pair and group estimates of the electromagnetic compatibility of the three GSM base stations are provided. The field insensitivity distributions for each base station are given in the graphic form, the signal to noise ratios for each station are found, the parts of each base station radiations in total noise situation are obtained.

This model allows us to estimate satisfaction of an electromagnetic situation to the international standards and the sanitary codes.

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CHOOSING THE OPTIMUM SOUNDING PULSE DURATION TO DETECT THE DIELECTRIC CYLINDRICAL OBJECTS IN THE SOIL

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Detection of illegal incuts in pipelines of various purposes is important both for environment saving and for protection of economic interests of the pipeline proprietor. Frequently the illegal incuts become the cause of the damages which lead to considerable losses of natural resources and large-scale environmental pollutions.

It is well known that ecologically safe UWB georadar (GPR) techniques [1, 2] are the most promising for the subsurface objects detection. The state of the art of GPR technique allows to use widely signals of nanosecond duration, that frequently is sufficient for pipes location. However small radar contrast of the buried in soil plastic pipes could lead to the idea that it is expedient to use shorter signals. It seems that if sounding pulse duration gets smaller, then probability of required object detection increases. However, as it has been shown with carried out researches, it is not always true. The given report provides estimations of radar contrast for the buried pipes and their dependences on such parameters as pulse duration, soil conductance and others.

As far as short pulses of electromagnetic field are commonly used for the GPR sounding and the object is located at quite small distance from antenna system, the most promising way for the problem computer simulation is the finite – differences time – domain method (FDTD) [3]. This method is very attractive because of its universality allowing to simulate any practical electrodynamic problems without any restrictions regarding profile complexity and a signal shape.

In the course of research a number of calculations for scattered field amplitudes versus sounding pulses duration were performed. The obtained results have allowed to estimate the radar contrast of the pipes. It is shown, that decrease of a sounding pulse duration leads to increase of amplitude of the signal reflected from the pipe. However, it takes place only until some moment, after which incremented attenuation, proper for signals of small duration propagating in the dispersive media, affects more and more. As a result, the signal attenuation in the media becomes leading tendency with respect to gain of reflected signal amplitude from the explored object that is typical for more and more short signals.

The obtained results allows to simplify essentially requirements to equipment for pipes detection as far as shorter impulses are not always optimum as it has been shown above.

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MUSIC SPECTRUM ESTIMATION DURING MONITORING POINT REFLECTORS BY THE RETRANSMISSION METER

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The distance diagnostic retransmission measurement method posses of the high special selection and can be used on the short distances to the controlled objects. The radio waves reflected from the other objects in the working zone, and the amplitude, angular and speed noise which is defined by the object rotating and moving according to the system diagnostic antenna, and all this restricts the precision measurements of the values. The upgrade of the retransmission measurements radio system by realization the principles of statistical theory of radio systems enabled us to take into account errors made during the measurements. The MUSIC algorithm proposed by R.Schmidt is one of the most popular DOA estimation techniques. This super-resolution method has the ability of resolving two closely spaced sources. It is a subspace-based algorithm, i.e., it uses the concepts of signal and noise subspaces. Signals are supposed to be not correlated. DOA estimation is important in many sensor systems such as radar, sonar, electronic surveillance and seismic exploration. This method bases on the computation of the sample correlation matrix, finding the eigenvalues and eigenvectors of the matrix, and evaluating the MUSIC spectrum. The correlation between the signals in the antenna array is changed in different way in the retransmission and radar meters. The curve of changing the spatial correlation between the signals is shown in the figure 1. The retransmission meter signal amplitude spatial correlation (curve 1) differs from the radar case (curve 2). When the MUSIC algorithm spectrum of the retransmission meter is observed, its spectral amplitude higher and thiner then the radar one. This retransmission spectrum statistically more constant then the radar one. The objects resolution better in the retransmission measurement case.

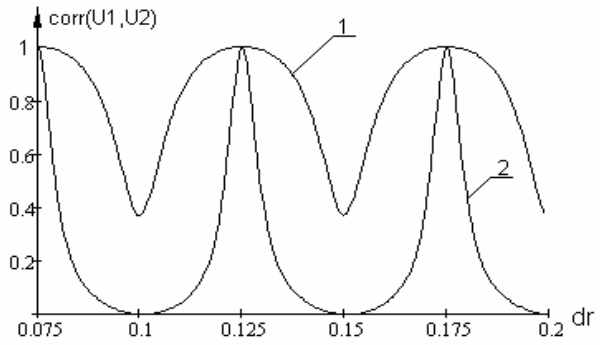

Figure 1 – The signal amplitude spatial correlation

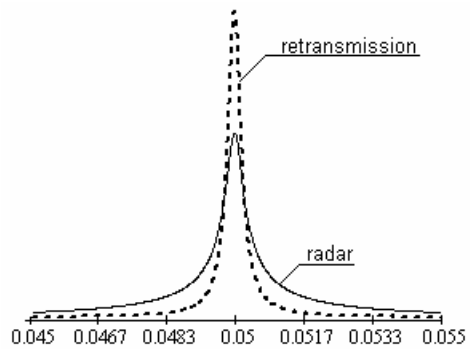

Figure 2 – The MUSIC algorithm spectrum for the retransmission and radar meters

In the presence of coherent signals MUSIC estimator performs poorly. The synthesis of two measurement methods leads to creation of a new super-resolution approach.

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ANALYSIS OF SPATIAL-TEMPORAL GPS TEC VARIATIONS PRIOR TO THE PERU SEISMIC EVENT OF 26 SEPTEMBER 2005

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This paper investigates the features of spatial-temporal modification of equatorial ionosphere for American longitudinal region prior to the strong Peru earthquake (M=7.5) of 25 September 2005 that was registered at 01.55 UT (LT=UT-5h). Geographical coordinates of the epicenter were (5.67°S, 76.41°W), geomagnetic - (4.55°N, 355.33°). The possible influence of the earthquake preparation processes on the main low-latitude ionosphere peculiarity – the equatorial anomaly – is discussed.

In the last years the monitoring of the ionospheric effects of different origin is related with using of global navigating systems (GPS / GLONASS) signals. By means of measurements of the signals temporal delays it is possible to do the mapping of total electron content (TEC) in a column of unit cross section through the Earth's ionosphere and investigate its temporal evolution depended on the variations of electron concentration (NmF2) in the F2 ionosphere region.

To estimate spatial sizes and temporal dynamics of seismo-ionospheric anomaly the global TEC maps (Global Ionospheric Map) were used. These maps at the IONEX format are generated routinely by the IGS community with resolution of 5° longitude and 2.5° latitude and temporal interval of 2 hours. The Latitude-Time TEC plots and meridian sections (λ=75°W) of TEC spatial structure were constructed. Analysis of the LTT maps has shown that modification of the equatorial anomaly occurred a few days before the earthquake. In previous days, during the evening and night hours (local time), a specific transformation of the TEC distribution had taken place. This modification took the shape of a double-crest structure with a trough near the epicenter; it means the intensification of equatorial anomaly and extension of the anomaly "tail" part into the evening time. The difference of TEC values in crests and trough reached the value of 16-18 TECU. Analysis of GIM TEC for 3 months has revealed that it is rather atypical situation for the given region and season, usually in this time the restored normal latitudinal distribution with a maximum near the magnetic equator is observed.

Then for more detailed study of features of the ionosphere diurnal behavior we consider the regional TEC maps, created with spatial resolution of 1° and temporal interval of 1 h on the base of LPIM (La Plata Ionospheric Model). Measurements of more than 50 GPS stations located in this region were used to create TEC maps. Analysis of LPIM maps confirmed the presence of modification of TEC distribution and enabled to do more accurate estimation of numerical characteristics of the effects observed.

Formerly the similar effects of equatorial anomaly transformation were found out on the base of measurements of ground based vertical sounding as well as topside vertical satellite sounding (Alouette-2, Intercosmos-19). These peculiarities of foF2 behavior were interpreted in frames of adopted model of natural ionospheric processes like "fountain-effect" but stimulated by electric fields of seismogenic origin, - i.e. by process of equatorial anomaly intensification in the near-epicentral area.

INFLUENCE OF AZIMUTH ANGLE OF ILLUMINATIONS ON POLARIZATION-SPECTRAL CHARACTERISTICS OF BACKSCATTERING FROM SHIP WAVES

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Angular RCS and scattering spectra dependences on scattering from ship waves at different polarizations were experimentally studied.

Investigation was carried out by use of two-frequency CW radiation mode polarimeter of X-band and Ka-band.

It has been found for the scattering from sea waves RCS azimuth anisotropy is less than for the object body and does not exceed 6dB. Greater depolarization of the scattered signal (0-7dB) than for excited above-water objects – (8-9dB) is typical for them. Ratio between object body RCS and ship waves is (10-16dB) at parallel and (4-10dB) at cross polarizations.

Angular dependencies of scattering from the system of ship waves diverged at semi aperture angle 18,5° from body satisfactorily described by Moor relations for the sea roughness. Its mean RCS could reach to square meter.

POLARIMETRIC APPROACH TO DETECTION OF PROBABLE AIRCRAFT ICING ZONES. EFFECTIVENESS ESTIMATION FOR DIFFERENT ICING DETECTION ALGORITHMS

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Aircraft icing is a dangerous meteorological phenomenon. Most important conditions for growing of ice coating on aircraft body or wings are presence of Supercooled Water Drops (SLW), high humidity and negative temperature of air. Remote sensing of the clouds with the help of polarimetric radar can detect the SLW in cloud. It can be used to avoid dangerous situations during the flight. Mathematical modulation of microwave backscattering from ice crystals of different forms and water drops in rain and clouds have been done. Estimation of different icing detection algorithm is included in this article.

Hydrometeors, such as water drops and ice crystals, scatter incident electromagnetic waves. Polarization of backscattered field depends on the shape, size, orientation and type of the particles.

The microstructure of clouds and precipitation can be characterized by physical and statistical properties of the individual particles. Liquid cloud without rain consists of small droplets, which are practically spherical in shape. That is why polarization does not play any role at scattering on such clouds. Rain is characterized by ordered droplet orientation in vertical plane. In case of crystals, there is no clear relation between size and shape of scatterer as it was observed for raindrops. Besides, an important feature of crystal cloud in comparison with rain consists in more chaotic particles orientation in space. Key point in this paper was placed on the possibility of polarimetric weather radar to determine the type of hydrometeors in case of homogeneous medium (scatterers of one type). Results of calculations and simulations as well as few available measurements clearly show that polarization parameters have great potential for detection probable aircraft icing. We considered only application of linear (horizontal-vertical) polarization basis, however, similar techniques are valid for the circle or other polarization bases.

Icing Detection Algorithms whose efficiency has been investigated are follows:

1) Logical polarimetric algorithm
2) Neural Network Based Algorithm
3) Fuzzy logic based algorithm.

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CLOUD FILTRATION TECHNIQUE OF BLACK SEA AVHRR DATA

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Cloud filtration is an important part of the sea surface temperature retrieving from IR satellite measurements. As a rule clouds detection methodologies are based on threshold algorithms using specific features of the upward radiation formation in different spectral ranges. Regionally adopted for the Black Sea area method is described in the presented work.

On the base of the AVHRR data for the Black Sea existed algorithms [1-4] were tested and modified for day and night time measurements. Similar algorithms, being the set of successive filters using texture and spectral features of images, underlay the developed method. Methods efficiency was estimated by processing satellite data set for 2005 and 2006 years. Lacks and advantages of the method are described. Situations with unsatisfactory filtration are discussed. Methods for algorithms improving are suggested.

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RECEIVE-TRANSMITTING TELECOMMUNICATION APPARATUS WITH THE USE OF ULTRASHORT IMPULSE SIGNALS

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The modern state of ultrawideband telecommunication (UWBT) and prospects of its development are considered. Basic information about receiving-transmitting UWBT apparatus and UWBT antennas is given. The calculation of distance of action and rate of data is executed with the use of nanosecond impulsive signals. Distance of communication goes down with the increase of rate of data. Thus, it also diminishes at diminishing of duration of supershort impulse. By these dependences, mainly, an application of UWBT domain is determined. The low speed systems can be utillized for the hidden exchange by information there are to a few kilometers on distances, highly speed – for into an office exchange by information and exchange by information at a speed of order of hundreds of MBt/s between mobile devices. It is suggested for UWBT to apply ultra wideband turnstile arrays of circular polarization with the included capacity elements and loop antennas, executed on the basis of cold plasma of gas discharge. Work is executed under the direction of professor departments of Electronic facilities of telecommunications of Ovsyanikov V.V.

BROADBAND SHF DIRECTION-FINDER

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Nowadays the radio systems operating at frequencies higher 1 GHz are widely used. The advancement to the state-of-the-art backbone links such as WiMAX standards-based technology compels moving to the higher frequencies. In this respect, the suitable broadband mobile direction-finders are in grade demand.

The main goal of this research is the designing and manufacturing the compact broadband direction- finder prototype using "zero-amplitude" technique.

We propose the novel reflector antenna design for direction-finder, which consists of the main reflector and the primary source as a monopole antenna, located in the focus of the main reflector. We measured the radiation characteristics of the reflector antenna prototype in radiating and far-field regions. Based on the experimental results we have chosen the optimal parameters of the direction-finder antenna. The measurements carried out in the far-field region have shown that the given reflector-type antenna produces the mono-beam conic radiation pattern in the frequency band from 6 to 11 GHz.

There are two operation modes of the direction-finder, namely: the rough determination of the source location on the maximum level of the receiving signal and the accurate determination of the source bearing angle. The need in such the operation modes is caused by the display algorithm of the received signal, which is realized by means of the light-emitting diodes disposed to V-like shape on the working board of the control unit. The light-emitting diodes arrangement simulates the aforementioned bearing algorithm indicating the global minimum which just determines a bearing angle of the source.

The functional layout of the controller has been designed using MSP-430 microcontroller realizing the algorithm of signal registration with the level displaying on the working board.

We have carried out the model experiments on the SHF sources bearing by means of the aforementioned direction-finder prototype. The open-ended X-band waveguide as the external source was located at a distance around 20m from the latter. In this case the accuracy of the source bearing equals to 4°.The results of model experiments demonstrate the capability and benefits of the proposed direction-finder prototype.

OBSERVATIONS OF WEAK IONOSPHERE DISTURBANCES ON THE KHARKOV INCOHERENT SCATTER RADAR

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The ionosphere plasma characteristics are responding on variations of solar and magnetic activity, evince of the wave phenomena caused by high-power processes in the Earth atmosphere and lithosphere. The research of an ionosphere structure and dynamics is important as for understanding physics of processes, proceed in it, and for radiophysical problems solution. The method of incoherent scatter (IS) of radiowaves allows determining experimentally as regular variations of electronic concentration N_e and concomitant ionosphere parameters, and their behaviour during natural and antropogeneous origin disturbances. The equipment and measurement technique accuracy, developed by authors, allow obtaining certain data about behaviour of ionosphere during various origin and intensity ionosphere perturbations. In the paper observations results of main parameters IS of signal and ionosphere plasma during weak magnetic storm, solar eclipse, ionosphere disturbances caused by start of the high-power rocket, seismic activity are presented.

Experimentally obtained on the Kharkov IS radar altitude-temporary dependences of disturbed ionosphere plasma parameters during weak intensity magnetic storm 04 -06 April 2006 (Kp = 5, Dst = -100 нTl) were adduced. During a main phase storm the positive perturbation was observed (N_e is increased in 1.3 times), April 5, at maximum Dst - negative perturbation (N_e is decreased in 1.6 times), April 6 - positive perturbation (the second positive storm phase - N_e was increased at 1.33 times). During negative ionosphere storm the height of a F2 layer maximum was increased on 30-40 km, ionic temperature in the day is increased on ~ 150K, electronic temperature is increased on ~ 600K.

For date 29.03.2006, when take place partial Sun eclipse (disk shadow factor ~ 73 %), daily dependences of N_e, temperatures of ionosphere plasma charged particles at ionization maximum and higher were adduced. The fast response of electronic concentration and temperatures of electrons value on change of Sun eclipse phase was observed. The altitude-temporary N_e distribution and ionosphere plasma cross-section (proportional N_e) in altitude range 100-300 km with height resolution of 20 km were adduced. The decreasing of these parameters up to a 1.5 times at heights of 120-80 km was observed. For the first time at the finish stage an eclipse a magnification of appearance frequency a sporadic layer E_s, similar observed in evening period was observed. That can be initiated by wave processes caused by an eclipse of the Sun like to the evening terminator.

During launch heavy class rocket “Proton - K” december 25, 2006 from Baikonur cosmodrome (distance up to a view point of 2500 km) the perturbations in close space were observed. By measurements results of ionosphere plasma cross-section two disturbed areas were registered. First was observed through 8 mines, and second - through 60 mines after start of the rocket. The altitude-temporary diagrams of ionosphere plasma cross-section distribution were adduced.

The appreciable magnification of ionosphere plasma electronic concentration (up to 1,4 times) was observed in nighttime 25-26, December 2004. In this period of geomagnetic perturbations did not happen (Dst ~ -30 nTl). This anomalous was hypothetically associated with high-power earthquake (M 9.1) in Sumatra region at december 26, 2004.

ANALYSIS OF DESTABILIZING FACTORS ACTION TO SYNCHRONIZATION OF REFERENCE OSCILLATORS THROUGHT ATMOSPHERIC CHANNEL

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The results of calculation atmospheric channel influence to harmonic reference oscillators synchronization accuracy are presented in the work. This problem has been solved within the bounds of the work by homodyne measurer design of amplitude and phase progression fluctuations on microwave line-of-sight links [1, 2]. For this it is required to transfer the initial phase of low frequency oscillations (4 kHz) from one oscillator to another through atmospheric channel, by using tone frequency modulation. The carrying oscillation wave-length was chosen equal to 2 m. A testing link had length equal to 3 km. A problem of oscillators synchronization was solved by using phase locked loop system for voltage-controlled oscillator tune on receiving side. As reference oscillators were chosen temperature-stabilized quartz oscillators with relative instability of frequency equal to 10^{-7}. Receiver type was chosen superheterodyne with two frequency transformation.

As a result of carried out investigations influence channel factors fluctuations to transfered synchronization signal and voltage-controlled oscillator stability were calculated. Factors that influence to voltage-controlled oscillator stability were analyzed and optimal features of synchronizing system were found.

Following destabilizing factors influence to synchronizing system: reference oscillator instability, atmospheric channel complex transfer ratio instability, additive noise at the receiver input, receiver heterodyne instability. Thus, all destabilizing factors, that influence to phase locked loop system, can be come to next: additive noise and phase noise (frequency instability).

The analytical study of influence separately additive noise and phase one to synchronizing system performance quality was carried out. As shown in a result, in referred above synchronizing system characteristics the phase noise influence to a synchronizing system work can be neglected. Probability density of phase control error for phase locked loop system was found: by initial detune 0,1; 0,3; 0,5; 0,7 and 0,9 from holding range, as well as by signal / noise ratio at phase locked loop system input 6; 12; 18; 32 and 42 dB.

As a result of carried investigation it is shown, that it is necessary to ensure signal / noise ratio at phase locked loop system input equal to 42 dB for phase difference mean-square distance between slave oscillator and reference one decreasing to a value 2,5°.

Thus based on results of theoretical investigations and computer simulation was shown that a simple phase synchronizing system of two reference oscillators through atmospheric channel, for homodyne measurer amplitude and phase progression fluctuations on microwave line-of-sight links design can be realized.

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OPTICAL FEATURES OF ATMOSPHERIC AEROSOL OVER BLACK SEA SINCE MAY 2006 TO JULY 2007 YEAR

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Aerosol properties of atmosphere to a considerable extent affect upon the climate of the Earth, that's why their study is spared emphases. Knowledge of spatial and temporary variation scales of aerosol optical features is required for evaluations of aerosol on climate change. One of the most efficient overland networks of the atmospheric aerosol measurements is a network AERONET has been collecting near-real time data over hundred sites covering many important regions worldwide for more decade. The advantage of this network is that all of the measurements were made with standardized sun/sky radiometers CE-318, company production CIMEL Electronique (France)., which are a part of the AERONET global network. To measurements of the optical features of the aerosol on program AERONET Marine Hydrophysical Institute of the NAS Ukraine to proceed with May 2006 and from this time in Sevastopol marketed unceasing monitoring of the optical features of the atmospheric aerosol.

The aim of this work is a study of main optical features of atmospheric aerosol in Sevastopol since may 2006 to september 2007 as of solar photometer measurements CIMEL 318. Major way to determine the main optical features of atmosphere and its variable components (aerosol optical depth (AOD), water vapor W (precipitable water, cm) and Angstrom parameter α to range of wavelength 440-870 nm)- is extinction measurements in atmosphere of spectral composition of direct solar radiation. Monthly averages means of parameters were defined by way of the averaging daily means, maximums and minimums - as the most and the least from daily averages maximums and minimums, and dispersion was calculated on whole day array of data.

Measurements in Sevastopol by the AERONET program of spectral aerosol optical depth, precipitable water and Angstrom parameter (α) were made. The graphic and histograms of dependence of Angstrom parameter and precipitable water, α and AOD were analyzed, and spectral dependency of AOD was plotted. All measurements presented graphic and in tables. Daily and monthly means of general parameters are described. Results allow to reveal regional particularities of optical features of atmospheric aerosol over Black sea in the Sevastopol region and their temporary variability.

Data can be used for studying radiation balance, processes of transfer a radiating, modeling of optical areas in the ocean-atmosphere system and correcting the satellite evaluations of optical features of aerosol in problems of remote determination bio-optical features of water of World ocean.

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COMPUTER WAY OF MODELING OF MEASURING TRANSFORMATIONS AT THE IONOSPHRIC SOUNDING BY THE INCOHERENT SCATTER TECHNIQUE

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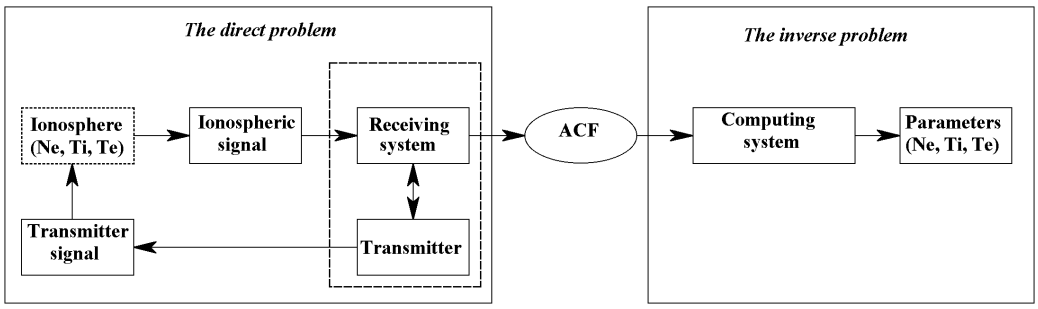
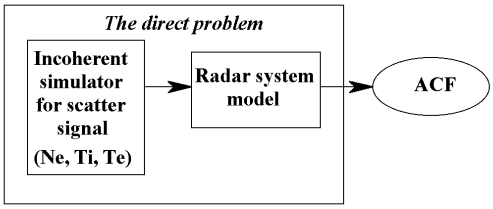
The incoherent scatter technique of radiowaves allows receiving information about ionospheric structure and its processes (electron and ion temperatures, electron density, velocity of plasma drift etc.) at altitudes from 100 up to 3000 kilometers. The incoherent scatter radar solves both direct and inverse problems. The direct problem is solved by measuring of incoherent scatter signal spectrum and autocorrelation function (ACF). The inverse problem is solved through the method of multiplex solving of the direct problem for theoretical predetermined parameters. The least-squares method is used for the purpose of comparison of the theoretical autocorrelation function or spectrum with the experimental autocorrelation function or spectrum [1] (Picture 1).



Picture 1. General scheme of activity of the radar system

It is impossible to maintain verity of obtained results at real measurements of ionospheric parameters since we do not know the initial parametrical value. The computer model of measuring transformations at ionospheric sounding by pulse is proposed to be used for the radar operating control. (Picture 2).



Picture 2. General scheme of activity of the model

The model consists of the program simulator for incoherent scatter signal and the computer model of incoherent scatter radar operation. The program simulator for incoherent scatter signal contains the ionospheric parametrical information. The computer model replicates the algorithm for the data processing [2]. The active algorithms of the computation system and the measuring equipment are supervised for specifications of various results of ionospheric probing.

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POLARIZATION - SPECRTAL AND SPATIAL CHARACTERISTICS OF MILLIMETER RADIO WAVES BACKSCATTERING FROM HYDROMETEORES

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The recognition of nature of the hydrometeors is relatively new field of the radiometeorology, as a result, the investigation of the stable informative signatures is considered a very pressing way of the investigations

Experiments on investigation of spatial parameters of scattering from hydrometeors were carried out using coherent- pulse measuring radar systems at 2cm, 8mm and 4mm wavelengths.

For polarization-spectral parameters measurement CW measuring radars were used: 3-frquency 10sm, 8mm and 4mm wavelengths homodyne polarimeter, 2-frequency 3sm and 8mm wavelengths polarimeter and 8mm wavelength polarimeter using sinusoidal FM of radiated signal.

Experimental investigations were carried out on sea shore and continental land zone. This allows investigating precipitations fall character around sea and dry land regions and detecting precipitation influence on polarization parameters of backscattering from sea surface and dry land regions covered by vegetation.

Spatial coherence of signal scattered from hydrometeors, depolarization coefficients of independent spectral components and the signal in whole are investigated. The method of scattered signal structure description by correlation coefficient matrix of spectral components at orthogonal polarizations is proposed.

DIAGNOSTIC OF TROPOSPHERE REFRACTION BY PROPAGATION FACTOR OF VHF FIELD PROPAGATION OVER THE NEAR-SURFACE HORIZON PATHS

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For troposphere refraction diagnostics Belgorod TV centre radiation was used. The transmitter is located out of radio-optical line distance from Kharkov.

Carrying out the around-the-clock measurements in period from 2000 up to 2007 years permitted to determine that in about 15-20 percent of cases daily variations of refraction coefficients were not observed, in 45-50 percent of cases the increase of propagation factor at 10 dB after sunset and till sunrise caused by superstandard refraction at surface layer of troposphere was observed. In 30-35 percent of cases the interference phenomena in propagation path channel caused by presence of inversion layers and variation of height of their disposition in the morning and evening hours with the depth of fading amount to 40 dB were observed.

Recalculation of the propagation factors in gradients of refraction coefficients allowed studying dynamics of observation of different refraction situations in various seasons. It was obtained by dividing all of the refraction situations observed in the troposphere by the type of the received signals into three groups:

1. **Standard refraction.** During 24-hours insignificant changes less than 3 dB of the signal level are observed;
2. **Superstandard refraction.** During 24-hours the significant change (more than 3dB) in the received signal level takes place, as a rule in the morning and evening hours;
3. **Superstandard refraction with elevated inversion layers** significant changes of the signal level are observed during 24-hours. It is mostly in the evening and morning hours that these changes happen and they gain oscillating nature.

The estimation of the oscillation depth and period allows determining the refraction coefficient and the layer movement velocity.


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