



Харківський національний університет
імені В.Н. Каразіна

V.N. Karazin Kharkiv National University

School of RadioPhysics, BioMedical, Electronics and Computer Systems

V.N. Karazin
Kharkiv National University

<http://www.univer.kharkov.ua/>



Contact us: SergeyShulga@karazin.ua



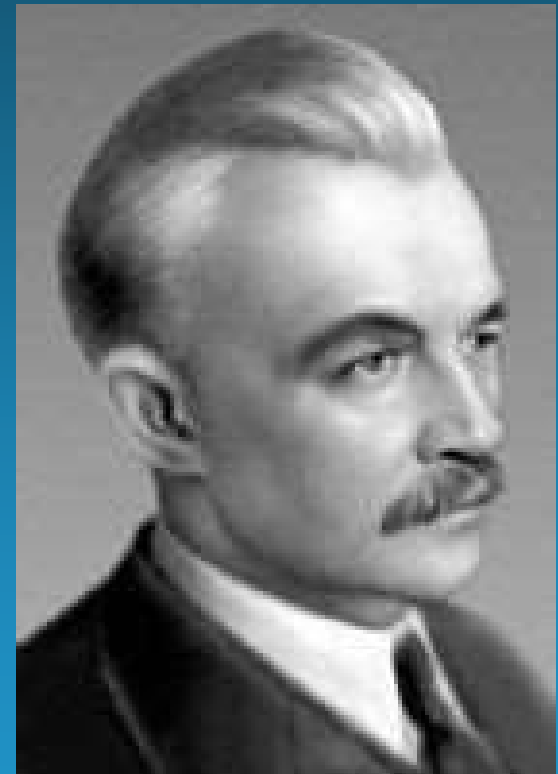
Харківський національний університет
імені В.Н. Каразіна

V.N. Karazin Kharkiv National University

School of RadioPhysics, BioMedical, Electronics and Computer Systems

The School of Radio Physics was founded in **1952**.

Corresponding Fellow of the USSR Academy of Sciences, Full Professor **D. Rozhanskyi**, Kharkiv University faculty member in 1911-1921, and his student **A. Slutskin**, Academician of the Ukrainian Academy of Sciences and the inventor of the magnetron and the radar, are recognized as the founding fathers of the Kharkiv School of Radio Physics. November 25, 2014 School of Radiophysics was renamed to the School of Radiophysics, biomedical electronics and computer systems.





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V.N. Karazin Kharkiv National University

School of RadioPhysics, BioMedical, Electronics and Computer Systems

The School of Radio Physics offers 4year bachelor degree programs in **Applied Physics and Electronics**, specialist degree programs in **Radio Physics and Electronics, Physical and Biomedical Electronics**, and master degree programs in **Radio Physics and Electronics** with majors in:

- Theoretical Radio Physics,
- Quantum Radio Physics,
- Radiophysical Measurements,
- Physical and Biomedical Electronics and Complex Information Technologies,
- UHF Physics,
- Space Radio Physics,
- Radio Astronomy,
- Antennas and Radio Wave Propagation;

and also specialist and master degree programs in **Biophysics** with majors in:

- Molecular Biophysics
- Applied Biophysics.



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Among the School's graduates are 39 Laureates of the State Prize for Science and Technology, 7 Academicians and 7 Corresponding Fellows of the Ukrainian National Academy of Sciences, over 120 doctors of sciences, and over 600 candidates of sciences. Some of the School's graduates now occupy positions of directors and leading specialists in academic and research institutes, manufacturing companies, universities, some are known as prosperous businessmen.



The graduates and staff members of the Faculty works all over the world



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The School enrolls more than 500 undergraduate and graduate students and 20 postgraduates. The academic process involves about 100 lecturers and researchers, including 17 Laureates of the Ukrainian State Prize for Science and Technology. The School's faculty consists of 40 full-time lecturers, among them 20 full professors, doctors of sciences, and 20 associate professors, candidates of sciences.





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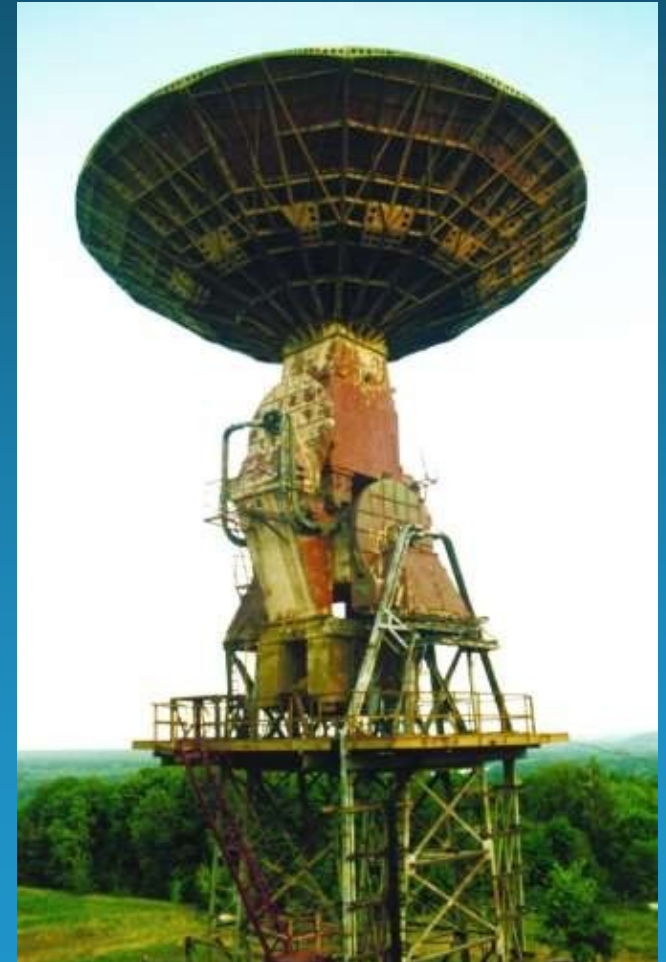
V.N. Karazin Kharkiv National University

School of RadioPhysics, BioMedical, Electronics and Computer Systems

The School of Radio Physics also has 5 research laboratories, and a radiophysical observatory.

It hosts two specialized councils for conferring doctor's and candidate's degrees in:

- Radio Physics;
- Physical Electronics;
- Physics of Instruments, Elements, and Systems;
- Astrophysics and Radio Astronomy;
- Biophysics.





V.N. Karazin Kharkiv National University

School of RadioPhysics, BioMedical, Electronics and Computer Systems

The School is organized into 7 Departments:

- Department of Theoretical Radio Physics
- Department of Quantum Radio Physics
- Department of Physical and Biomedical Electronics and Complex Information Technologies
- Department of Microwave Physics
- Department of Space Radio Physics
- Department of Applied Electromagnetics
- Department of Molecular and Medical Physics

Dean of the School: Sergiy N. Shulga, Doctor of Science, Full Professor. Tel: 707-54-62. E-mail: SergeyShulga@karazin.ua

Deputy Dean for Academic Work: Alexander N. Dumin, PhD, Associate Professor. Tel: 707-55-48. E-mail: dumin@karazin.ua



V.N. Karazin Kharkiv National University

School of RadioPhysics, BioMedical, Electronics and Computer Systems

Department of Theoretical Radio Physics

Head of the Department: Mykola M. Kolchihin, doctor of Physics and Mathematics, full professor, Laureate of the State Prize of Ukraine. Tel: 707-51-62.

Areas of research: characteristics of electromagnetic waves scattering on complex shape objects; ultrashort pulse interaction with complex objects; design and simulation of antennas for pulse signals; methods of protection against electromagnetic radiation and control devices; and electromagnetic compatibility, magnetocardiography

<http://www-radiophys.univer.kharkov.ua/theor/index.htm>



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Department of Theoretical Radiophysics was founded in 1960. Its founder and creator of Kharkov scientific radiophysics school was an Academician of Ukrainian National Academy of Sciences V. P. Shestopalov.

For the period of its existence 10 Full Professors and 86 PhDs have been awarded.

Graduates of the Department work successfully in different countries: Russia, USA, Canada, Great Britain, Denmark, the Netherlands, Finland, Australia, Turkey, Israel.

Presently 5 Full Professors and 9 PhDs work at the Department.

Head of the Department is N. N. Kolchigin. He is a Full Professor, Laureate of the State Prize of Ukraine, IEEE honorary member, Corresponding member of the Ukrainian Academy of Sciences, President of Kharkov IEEE Chapter, Head of International Conference Series on Antenna Theory and Techniques (ICATT) and UltraWideBand and Ultra Short Impulse Signals (UWBUSIS).

Main research directions of Theoretical Radiophysics Department

- ***Ultrawideband and ultrashort impulse signals and their application.*** Fractal ultrawideband signals. Development of equipment for formation and processing ultrawideband signals. Ultrawideband location. Radiotomography and wideband probe of biological tissue with the aim of early diagnostics of growth.
- ***Generation and reception of electromagnetic waves,*** application of complex signals in communication systems and radiolocation. Signal generation and processing in wide frequency range. Discrete and digital systems of information processing, statistical physics and antijamming.
- ***Artificial materials, metamaterials, nanomaterials in radiophysics and electronics.*** Calculation and optimization of metamaterials in optical range (Frequency Selective Surfaces, Chiral Materials, Double Negative Media).

Methods and tools for measuring electromagnetic characteristics of materials at Microwaves.

Creation of radioabsorbing materials. Development of portable devices for measuring local reflected coefficient of complex objects.





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Magnetocardiography (MCG)

Magnetocardiography is a relatively new medicine tool for diagnostic of heart diseases. It is based on measuring magnetic fields over patient's chest in order to determine parameters of heart electric activity.

At the department a new methods for signal processing and solving inverse problems of magnetostatics are developed.





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Remote diagnostics of environment.

Direct and inverse problems of the theory of electromagnetic wave propagation. Reception (registration), analysis and processing of fields and signals at researching of natural media, phenomena and objects. Impedance tomography. Methods and algorithms of digital processing of biomedical signals. Development of precision methods of nonlinear electromagnetic diagnostics of media and creation of nondestructive control systems. Modeling radiophysical methods of remote sensing of objects and media.





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School of RadioPhysics, BioMedical, Electronics and Computer Systems

Department of Quantum Radio Physics

Head of the Department : Vyacheslav A. Maslov,
doctor of Physics and Mathematics, full professor, Tel: 707-51-57.
Areas of research: molecular and atomic spectroscopy;
terahertz lasers; laser power measurements.

http://quant.univer.kharkov.ua/ua/index_ua.htm



Scientific directions of the Department

- Quantum generators of infrared and submillimeter wavelengths and their application in plasma diagnostics, semiconductor and research of biological objects.
- Molecular radiospectroscopy of millimeter and submillimeter wavelengths.
- Spectroscopy of Rydberg atoms.
- Measurement of space-energy and polarization parameters of a wide-intensive laser radiation.





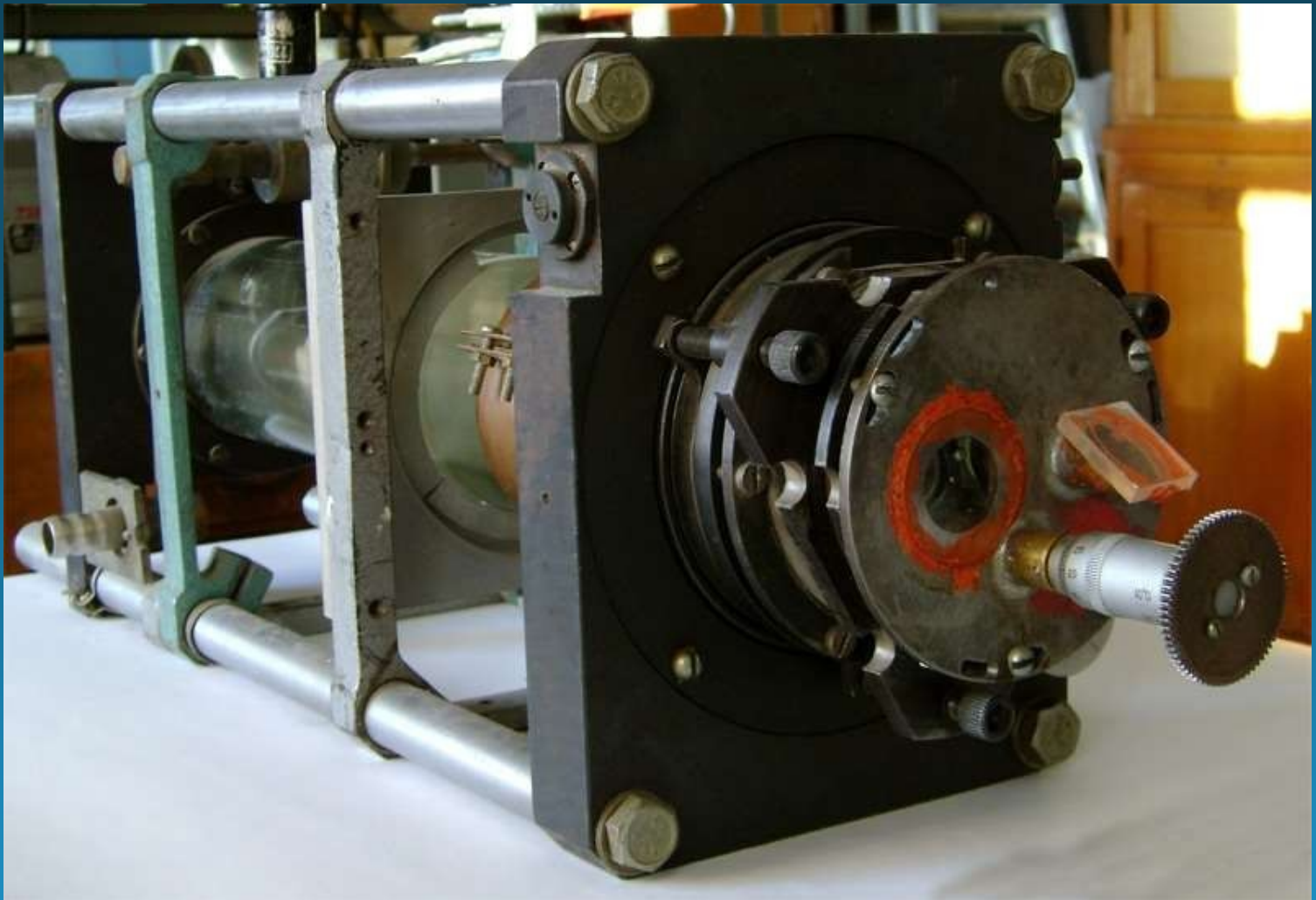
Prof. V.A. Svich, prof. S.F. Dyubko and senior researcher V.G. Gerasimov are carried out experiments on microwave spectroscopy of Rydberg atoms



Senior Researcher A.N. Topkov, As. Prof. A.V. Degtyarev and researcher O.V. Gurin are carried out experiments on study of the characteristics of terahertz lasers



Researcher B.V. Safronov, researcher V.P. Balkashin and researcher I.A. Priz are carried out experiments on measurement of the energy characteristics of pulsed laser



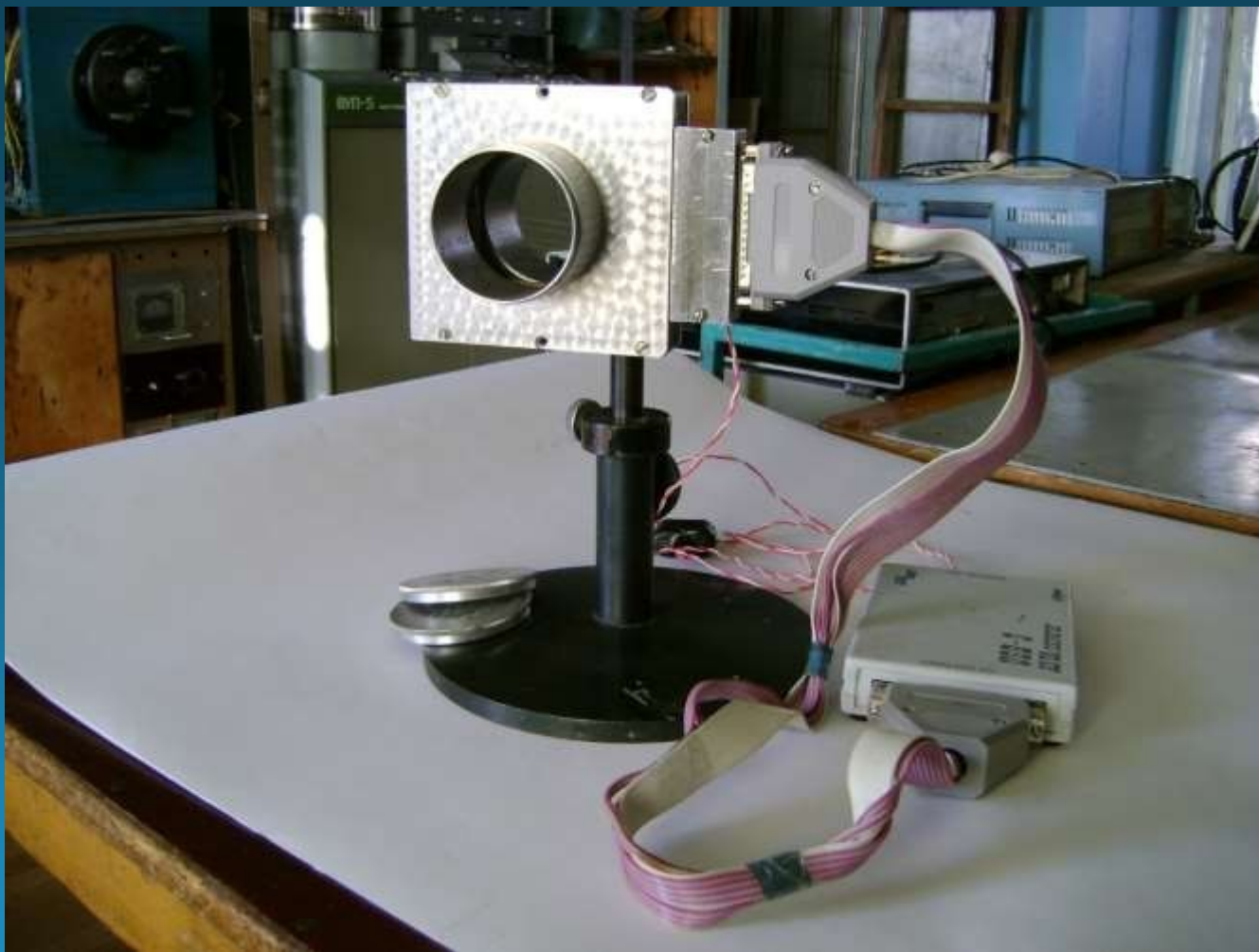
Compact terahertz laser created at the
Department of Quantum Radiophysics



A unique microwave spectrometer for the study of atoms in Rydberg states



Calorimetric measuring instrument of energy
of high-power laser



Bolometric measuring instrument of energy characteristics of high-power lasers



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Department of Physical and Biomedical Electronics and Complex Information Technologies

Deputy Head of the Department: Berdnik Sergey, Phd in Physics and Mathematics, assistant professor.

Tel: 705-12-61. Areas of research: physical phenomena and processes in semiconductors and their compounds in powerful electric fields and under UVR/GR; design and research in MM-generators characteristics; physical and mathematic models of interactions of non-stationary electromagnetic waves with biological tissues.

<http://fbme.univer.kharkov.ua/>

Monographs and Textbooks

- Solid-state Electronics
- Biomedical Electronics
- Applied Electrodynamics
- Computational Methods of Electrodynamics



mm-band Semiconductor Microwave Generators

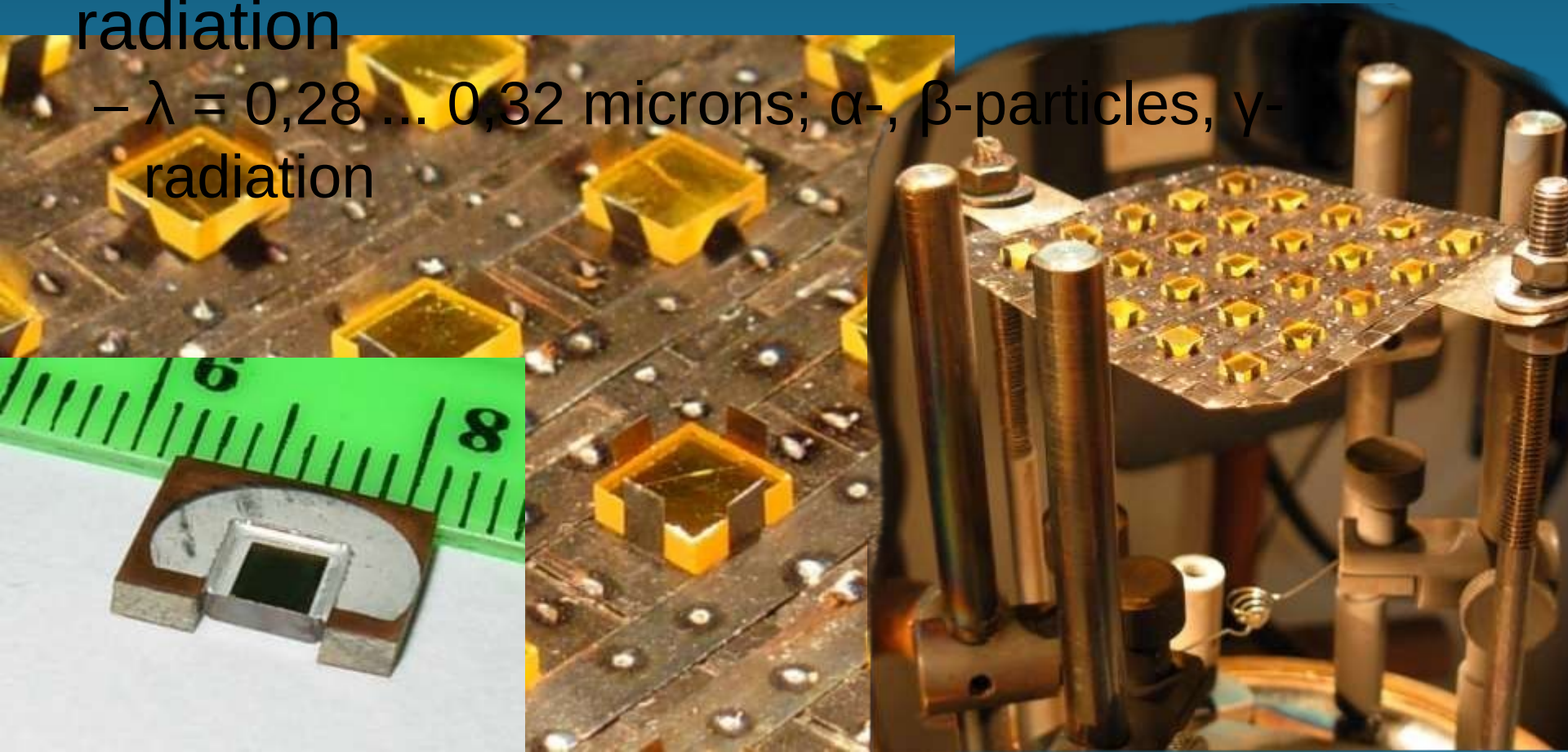
- Generator's chambers and Gunn diodes
- Emission wavelengths are 3 mm, 4 mm, 8 mm
- Modeling and design of semiconductor devices



Detectors of UV and ionizing Radiation

- Manufacturing techniques of semiconductor sensors of UV and ionizing radiation

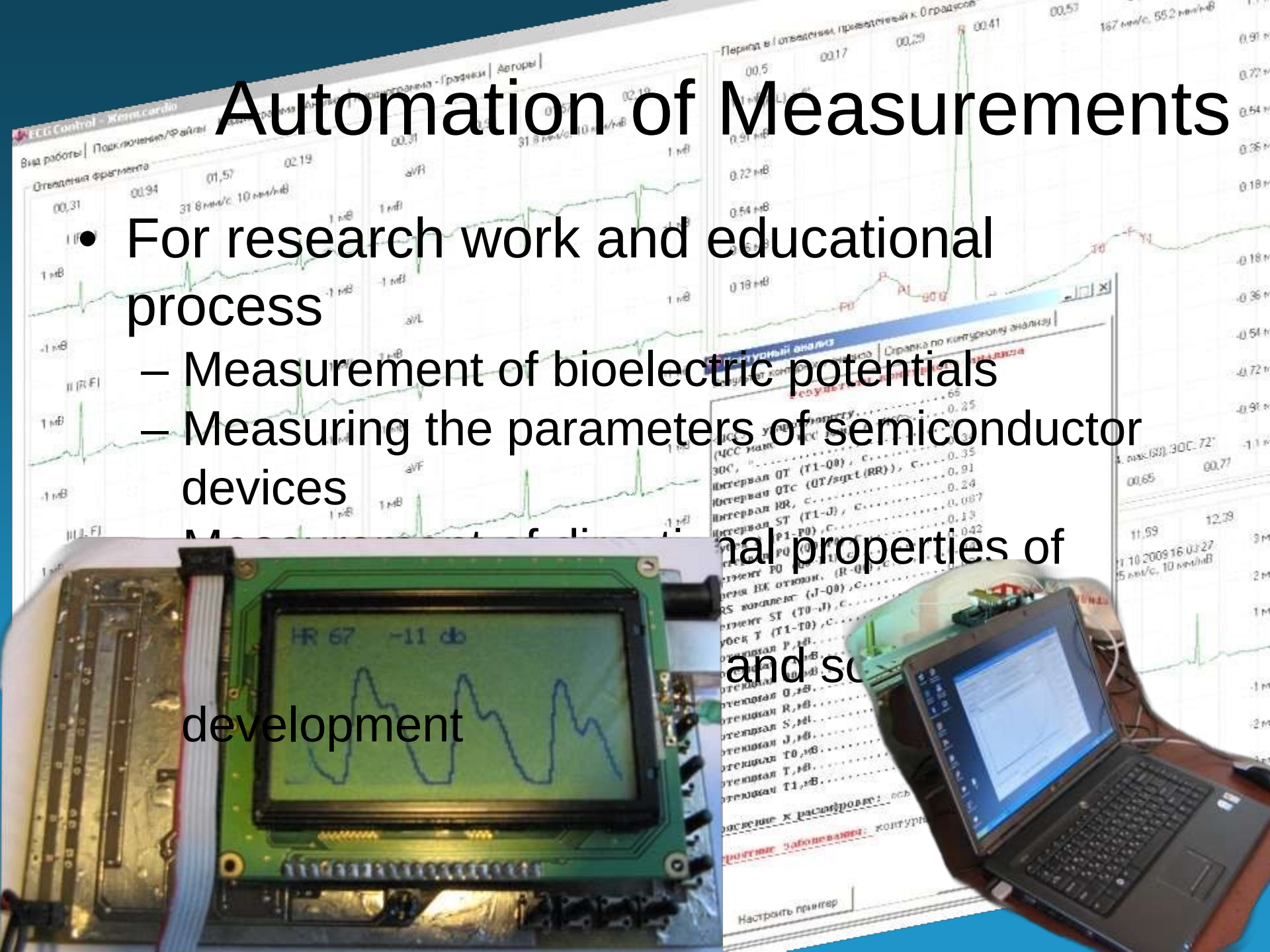
– $\lambda = 0,28 \dots 0,32$ microns; α -, β -particles, γ -radiation



Automation of Measurements

- For research work and educational process
 - Measurement of bioelectric potentials
 - Measuring the parameters of semiconductor devices

Measurement of the physical properties of
and so
development



Emitting and Receiving Systems

- Antenna systems for:
 - Underwater communication
 - Aircraft applications
 - Special services
 - GSM and GPS equipment



Bactericidal Systems

- System for the disinfection by the complex influence of ultraviolet radiation, ozone and ultrasound



Technical Equipment and Technology

- Equipment for the machining of semiconductor materials
- Technologies and equipment for deposition of thin films
- Equipment for microscopy and controlling





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School of RadioPhysics, BioMedical, Electronics and Computer Systems

Department of Microwave Physics

Head of the Department: Anatoliy O. Zvyagintsev, candidate of Physics and Mathematics, associate professor. Tel: 707-53-19.
Areas of research: theoretical and experimental research in the resonance physics in waveguiding rooting with isotropic and anisotropic inclusions; energy-saving methods of processing substances for various technological processes.

<http://www-radiophys.univer.kharkov.ua/shf/index.html>



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Non-Destructive methods for measuring local dielectric permittivity.

The construction of measuring section for nondestructive investigation of local dielectric permittivity discontinuities of substrates for integrated circuit packages is built. Technical characteristics:

- measuring interval for ϵ ; 2...100,
- local region's size; 1 cm,
- accuracy measuring for ϵ ; ± 0.2 ,
- section sensitiveness for ϵ measuring; 300 MHz/sin,
- sensitiveness for anisotropy; 0.1%,





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School of RadioPhysics, BioMedical, Electronics and Computer Systems

Department of Space Radio Physics

Head of the Department: Oleh F. Tyrnov, candidate of Physics and Mathematics, full professor, Laureate of the State Prize of Ukraine. Tel: 705-12-51. Areas of research: distance research in circumterrestrial space by radio physical methods; influence of circumterrestrial space on various radio technical systems and human health.

<http://www-radiophys.univer.kharkov.ua/space/>

<http://www-space.univer.kharkov.ua/>

Research Topics

- **The near-Earth space response to high-energy sources of natural and anthropogenic origin (earthquakes, volcanic eruptions, avalanches, space vehicle launch, high-power radio waves)**
- **Space weather**
- **Ultra-wideband signals and processes**
- **Mesospheric electrodynamics**

Radiophysical Observatory

is operated by the Department of Space Radio Physics

<http://www-space.univer.kharkov.ua/index%20NE.htm>



Instrumentation

1. **Fluxgate magnetometer** (the internal noise level varies in the 0.5--550 pT range in the 1³-s period range)
2. **MF radar** (2--6 MHz frequency band, 10--100 MW effective radiated power, phased array of 22 active physical apertures, pulse length of 25 μ s, 100 km height range).
3. **HF Doppler radar** (1.3--30 MHz frequency band, 1 kW peak power, pulse length of 0.5 ms, 100--400 km height range).
4. **LEO and GPS navigation satellite radio beacon receivers** (150/400 MHz, 1.2/1.6 GHz, 100 -- ~ 20000 km height range).

Kharkiv V. N. Karazin National University Radiophysical Observatory



MF radar transmitter

Kharkiv V. N. Karazin National University Radiophysical Observatory



**MF radar data acquisition and data processing system
($f=1.5 - 6$ MHz)**

**Kharkiv V. N. Karazin
National University
Radiophysical
Observatory**



**Elements of the MF radar
antenna array.**

**Phased array of 22 acre
physical aperture.**

Kharkiv V. N. Karazin National University Radiophysical Observatory



PS data acquisition and data processing system

Kharkiv V. N. Karazin National University Radiophysical Observatory



**LEO satellite data acquisition and
data processing system (150/400 MHz)**

Kharkiv V. N. Karazin National University Radiophysical Observatory



Fully-steerable 15-meter UHF radar antenna for probing the ionosphere (2000 MHz)

Main results

- 1. **Techniques for investigating mesospheric electrodynamics**
[e.g., Manson, A.H., Meek, C.E., Martynenko, S.I., Rozumenko, V.T., Tyrnov O.F. (2006) VLF Phase Perturbations Produced by the Variability in Large-Scale Mesospheric Electric Fields in the 60 – 70 km Altitude Range. In Characterising the Ionosphere (pp. 8-24). Meeting Proceedings RT04-056, MP-IST-056, Paper 8. Neuilly-sur-Seine, France: RTO. Available from <http://www.rto.nato.int/abstracts.asp>.]
- 2. **The identification of precursors to earthquakes**
[e.g., Bogdanov Yu.A., Zakharov I.G., Tyrnov O.F., Hayakawa M. Electromagnetic effects Associated with Regional Seismic Activity during the Interval July-August 2002 // J. Atmospheric Electricity. 2003, No. 2. P. 57-67.
- 3. **Physics-based models of the response to high-energy sources of natural and anthropogenic origin** (earthquakes, volcano eruptions, avalanches, space vehicle launch, high-power radio waves)
- 4. **Spectral analysis of ordinary and UWB signals and processing based on systems theory approach**



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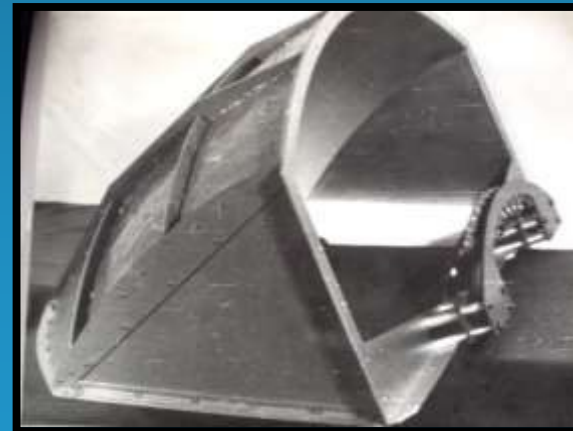
Department of Applied Electromagnetics

Head of the Department: Mykola M. Horobets, doctor of Physics and Mathematics, full professor. Tel: 707-51-75.

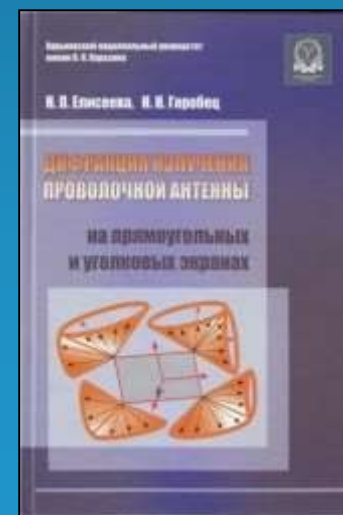
Areas of research: physics and technology of electromagnetic wave radiation and aerials; radio wave propagation and diffraction in media and microwave devices; aerials for aerospace and transportation vehicles.



Antennas



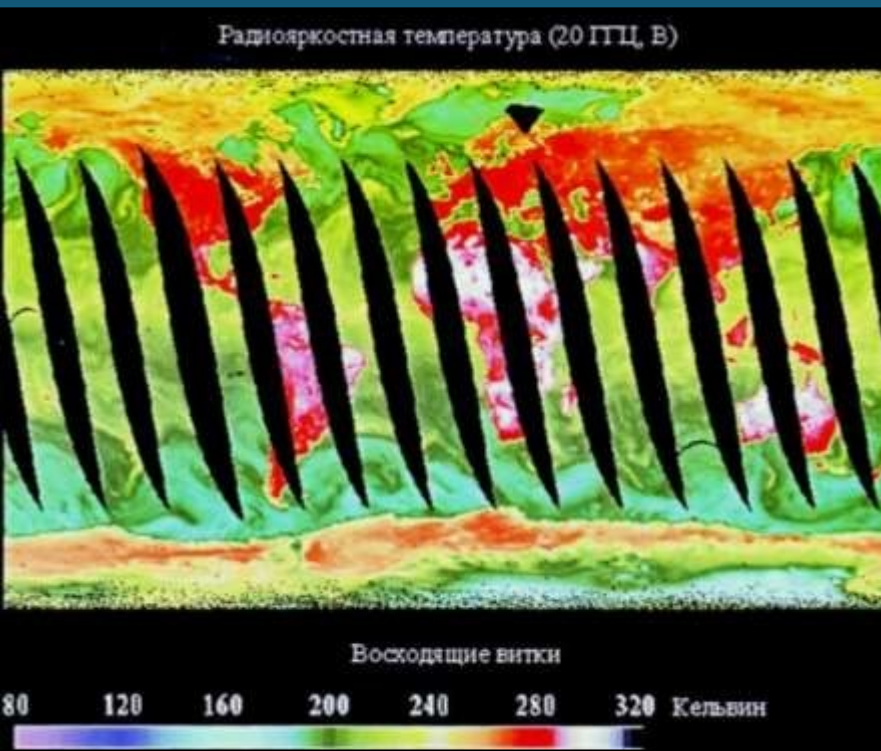
Monographs



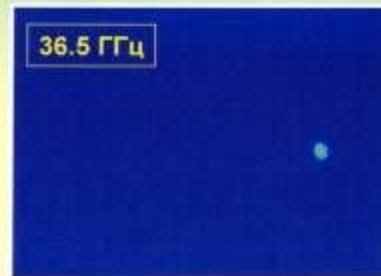
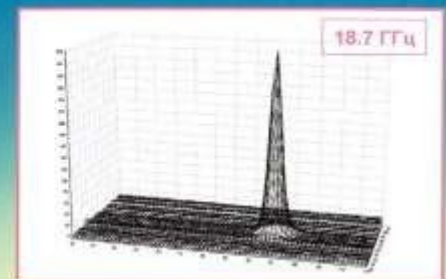
Space Instruments



Results

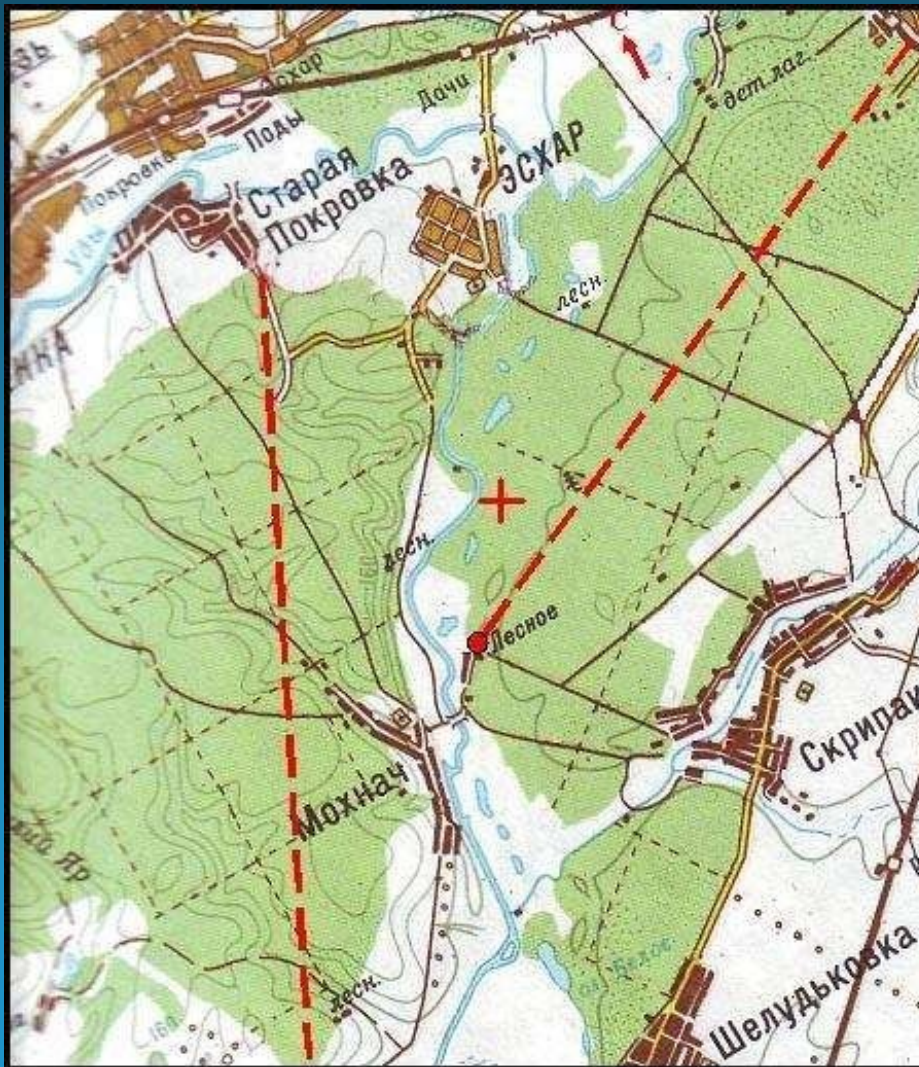


СВЧ-изображения Солнца по данным МТВЗА-ОК КА «Сич-1М»,
виток №1290, 18.03.05г. БЛИВ 113:15-114:12



3 К Антенная температура 300 К (18.7 ГГц) 600 К (36.5 ГГц)

GROUND SERVIS AND METROLOGICAL SUPPORT OF EARTH OBSERVATION FROM SPACE



schematic map of the landfill

Patents





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School of RadioPhysics, BioMedical, Electronics and Computer Systems

Department of Biological and Medical Physics

Deputy Head of the Department: Berest Vladimir, candidate of Physics and Mathematics, assistant professor. Tel: 707-52-12. Areas of research: DNA and albumens intermolecular interactions with bioactive substances and medicines; nanotechnologies in biology and medicine.

http://www.univer.kharkov.ua/en/departments/radiophysics/chair/biological_and_medical_physics



Department of Biological and Medical Physics

“Studying life for the future”



We teach

» Masters in

Biophysics (about 20 students)

and

Medical Physics (15 students)

for Applied Physics Program

» we also provide

***Biophysics and Life Science
disciplines***

for Schools of Medicine, Biology and
Ecology

Department of Biological and Medical Physics

We study

1. MOLECULAR BIOPHYSICS

- molecular dynamics simulations of DNA-proteins interactions
- interaction of biological active substances with DNA
- influence of hydration on conformational dynamics of biological macromolecules
- effect of ionizing radiation on macromolecule associations

2. CELL BIOPHYSICS

- protein-lipid interactions in model membrane systems (liposome)
- influence of ionizing and electromagnetic radiation on alive systems
- non-embryonic stem cells
- cryo-biophysics

3. MEDICAL PHYSICS

- novel methods for express blood diagnostics (using microwaves) e.g. platelet aggregation and erythrocyte sedimentation rate.
- development of new composite materials for orthopedic implants

We have developed method of very-high frequency dielectric studies of water solutions

- *High precision*
- *Suitable for almost all biological liquids and foods (e.g. winery)*
- *Small sample volume*
- *Automated sampling and analysis*

Differential VHF-dielectrometer (9.2 GHz)



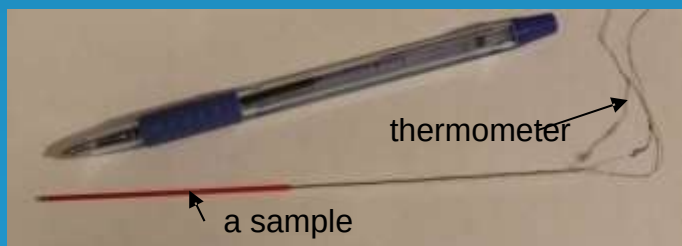
Resonators in invar
monoblock

Examples of the resonators

The resonator for measures
at room temperature



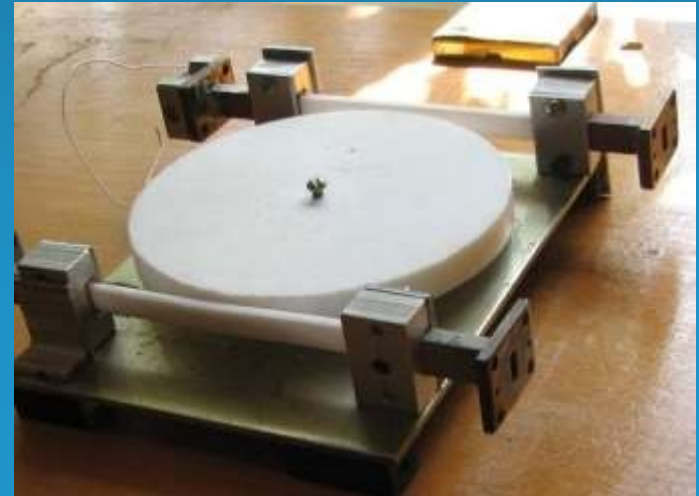
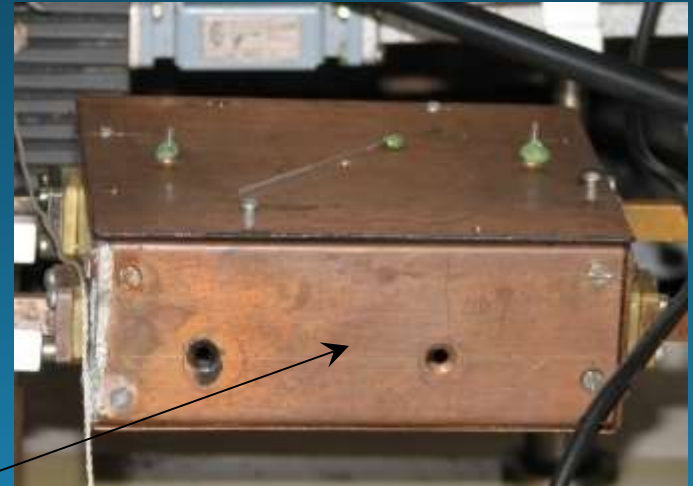
The capillary



The resonator
with thermostat shell



Microwave dielectric permittivity meter (37.5 GHz)



Our papers and patents:

- Gorobchenko O.A., Gerodes A.G., Nardid O.A., Nikolov O.T. Dielectric properties of human ovary follicular fluid at 9.2 GHz. **Bioelectrochemistry**. – 2010. – V. 79. – P. 193-197.
- Zozulya V.N., Ryazanova O.A., Zhigalova N.N., Blagoi Yu.P. Effect of Ni²⁺ and Cd²⁺ ions on thermally induced conformational transitions in poly(dA)-poly(dT) system. **Biomaterials**. – 2010. – V. 23, N 6. – P. 1191–1201.
- Gorobchenko O.A., Nikolov O.T., Gatash S.V. Conformation transitions of blood proteins under influence of physical factors on microwave dielectric method. **Journal of Quantitative Spectroscopy & Radiative Transfer**. – 2006. - V. 102. – P. 18–24.
- Hackl E.V., Gatash S.V., Nikolov O.T. Using UHF-dielectrometry to study protein structural transitions. **J. Biochem. Biophys. Meth.** – 2005. –V. 63, No 2. – P.137–148.
- Gatash S.V., Styopin L.D. Dielectric permittivity of heterogeneous disperse systems. **Telecommunications and Radio Engineering** – 1999. – V. 53, No. 7-8. – P. 200-203.
- Gatash S.V. Very high-frequency dielectrometer for the study of dynamical processes in disperse water systems. **Radiophysics and electronics**. – 1999. – T. 4, №1. – P. 129-132.
- Berest V.P., Gatash S.V. Conformational dynamic of fibrinogen by dielectric spectroscopy. **Polymers and Liquid Crystals**. – 1999. – V. 4017. – P. 74-77.
- Tolstorukov M.Ye., Gatash S.V. Self-organization and nonlinear dynamics of nucleic acid-water system. **Int. J. of Bifurcation and Chaos**. – 1999. – V. 9, No. 2. – P. 371-381.
- Russian Federation **Patent** N 5043040/14 (024596), MKI G 01 N 33/483, 33/48. Method of investigation of blood cells sedimentation. / V.V. Lemeshko, S.V. Gatash (Ukraine). – 02.07.95. - 6 p.
- Ukraine **Patent** N 4776069/14, MKB G 01 N 33/48. Apparatus for investigation of the platelets aggregation. / V.V. Lemeshko, S.V. Gatash, O.T. Nikolov, M.M. Rumiantsev (Ukraine). – 30.09.96. – 4 p.

UNCOMMON DEPARTMENT'S ACTIVITIES

*We guide
Specialized Defense Council for Doctoral
Degrees
in speciality “biophysics”*

*We publish scientific journal
“Biophysical Bulletin”*

*We perform monthly Scientific seminars
of the Kharkiv Branch of
the Ukrainian Biophysical Society*

Vise-president Prof. Vladimir Maleev



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School of RadioPhysics, BioMedical, Electronics and Computer Systems

Laboratory of Quantum Biology and Quantum Medicine

Head of the Laboratory: A.M. Korobov, PhD.

Areas of research: Study regularities and mechanisms of action of electromagnetic radiation of optical spectrum on biological objects;
Development of phototherapeutic apparatus and methods of treatment and prevention of most common diseases by using photonic technology.

lblm@univer.kharkov.ua



V.N. Karazin Kharkiv National University

School of RadioPhysics, BioMedical, Electronics and Computer Systems

The innovative projects:

- Prevention and treatment of flu and Korobov hardware complex "Barva-Therapist/ORVI" for project realization.
- Prevention and treatment of cardiovascular diseases (the myocardium heart attack, the stroke, the hypertension, the hypotonia, etc.) and Korobov hardware complex "Barva-Therapist/SSS" for project realization.
- Prevention and treatment of tuberculosis and chronic obstructive diseases of lungs and Korobov hardware complex "Barva-Therapist/TB" for project realization.
- Prevention and treatment of diseases of the central nervous system and Korobov hardware complex "Barva-Therapist/CNS" for project realization.
- Prevention and treatment of diseases of urinogenital system and Korobov hardware complex "Barva-Therapist/UGS" for project realization.
- Prevention of oncological diseases and Korobov hardware complex "Barva-Therapist/Onco" for project realization.
- Hardware complex of superearly diagnosis of human diseases.



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Photonic matrixes





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School of RadioPhysics, BioMedical, Electronics and Computer Systems

Probe





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School of RadioPhysics, BioMedical, Electronics and Computer Systems

Massager





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School of RadioPhysics, BioMedical, Electronics and Computer Systems

Sun



Solarium





Харківський національний університет
імені В.Н. Каразіна

V.N. Karazin Kharkiv National University

School of RadioPhysics, BioMedical, Electronics and Computer Systems

Laboratory of Radiofrequency and Optical Holography

Head of the Laboratory: V.P. Titar, PhD.

Areas of research: Study by holographic methods of polarization, and nonlinear resonance effects of electromagnetic fields in the radio and optical wavelengths with the substance and the development of holographic devices to obtain information on the studied biological and nonbiological objects.

<http://www-radiophys.univer.kharkov.ua/?lang=r&id=15&lin=3>

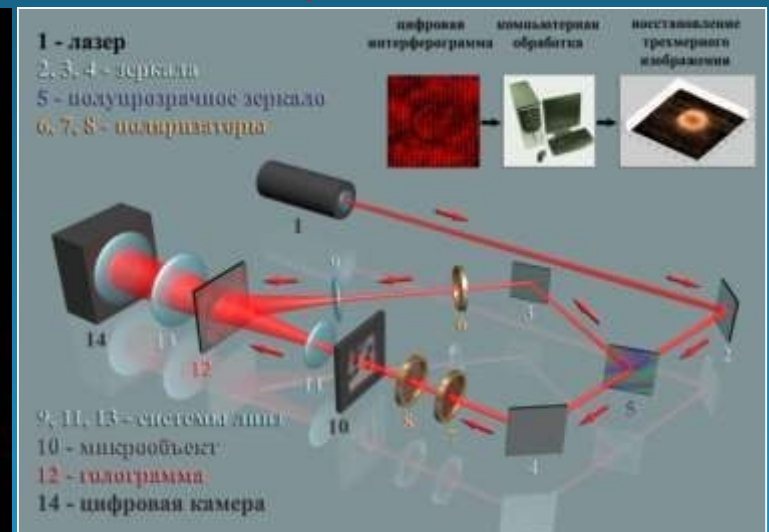


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Digital holographic interference microscope DHIM





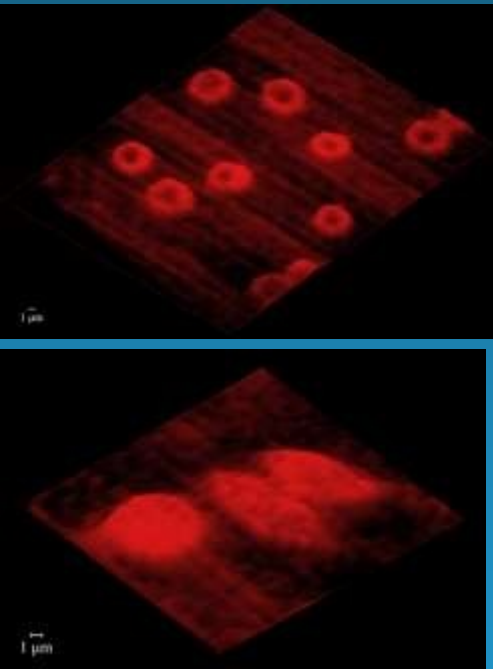
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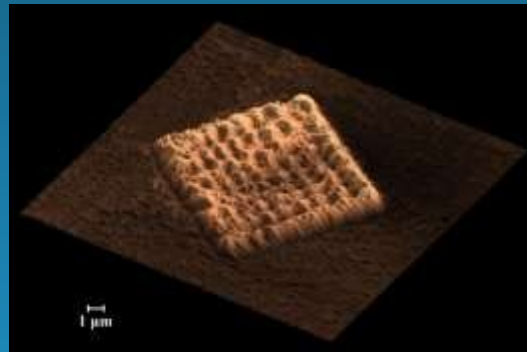
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Applications of DHIM

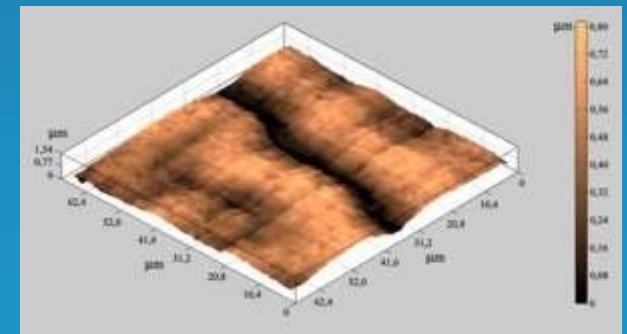
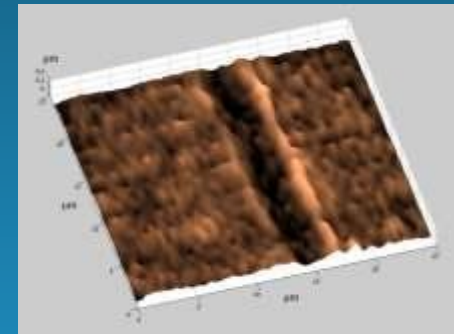
Blood cells



Anisotropic micro objects
(salt crystal)



Testing transparent film surface





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Airborne laser gas analyzer (ALGA)



ALGA is designed to detect and locate leaks of methane from gas pipelines. ALGA can be mounted on helicopters and unmanned aircraft.

On-board analyzer with air patrols can perform the following tasks:

- Rapid detection in real-time of remote defects of gas pipelines;
- Determination of the concentration of explosive mixtures in the vicinity of leaks;
- Determine the level of excess concentration above background around industry objects, pumping stations and other facilities.
- Determination of hydrocarbon deposits on the analysis of the background component of methane.

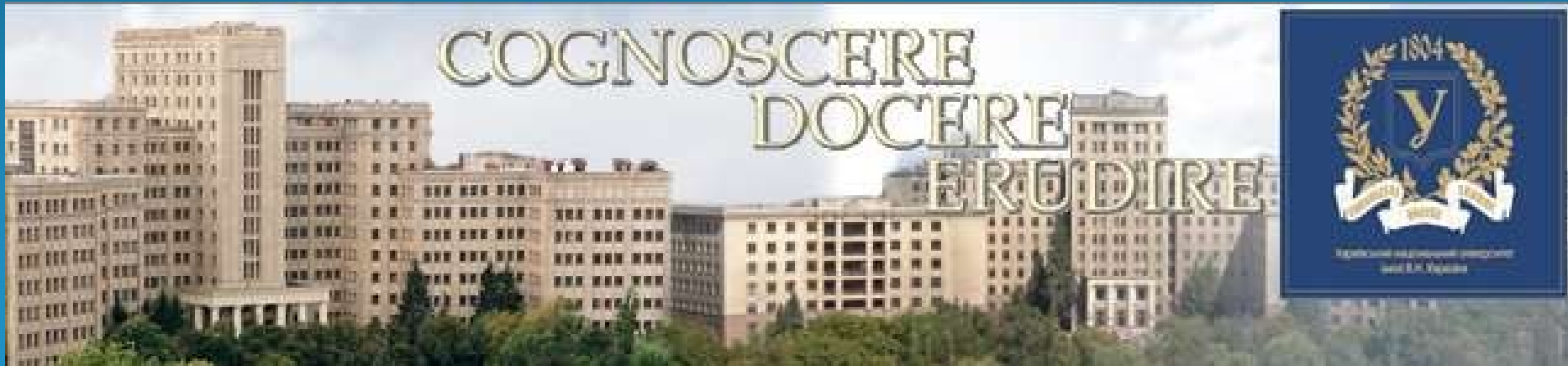


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Thank you for attention



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