

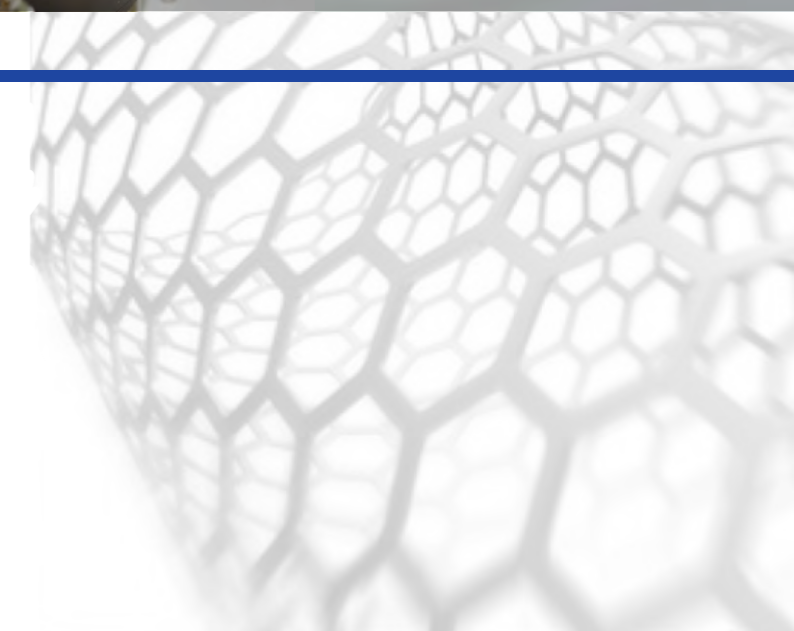
tel.: +375 17 293 80 55
mob.: +375 44 500 05 33 (Viber, Telegram, WhatsApp, WeChat)
www.bsuir.by / science@bsuir.by
F, VK, In, Instagram / sciencebsuir
BSUIR, 6, P. Brovki Str., Minsk, 220013, Republic of Belarus



Belarusian State University of Informatics and Radioelectronics



R&D ACTIVITIES



About us

We are a large state educational, scientific and innovation center in Belarus.

We are acknowledged as a Scientific Organisation by the Belarusian State Committee on Science and Technology and the Belarusian National Academy of Sciences.

We are a leading organization for research on protection against inadvertent interference and on electromagnetic compatibility of radioelectronics in Belarus.

Facts and figures

15 000 + students

10 faculties

30+ academic departments

30+ B.Sc. programs

14+ M.Sc. programs

30+ PhD programs

Educational support

10 international educational centers

45+ joint educational, research and production laboratories

9 branches of academic departments at the Belarusian manufacturing companies

BSUIR in international rankings

129th in QS EECA

804th in SIR

3281th in Webometrics

BSUIR science

10+ research areas

250+ researchers

40+ R&D labs and groups

400+ international research projects

1000+ scientific publications in WoS and Scopus

300+ patents

20+ international scientific conferences

70+ partner countries

BSUIR innovations

EMC technologies and software

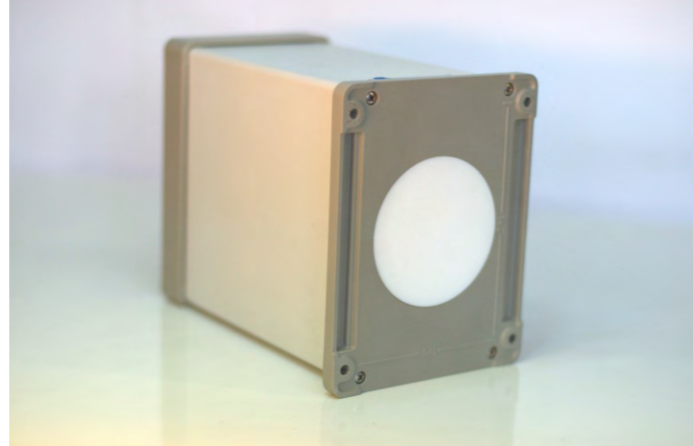
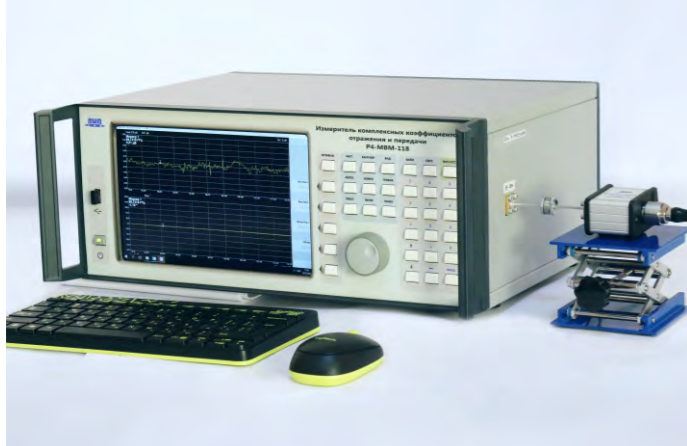
Measuring SHF devices

Ultrasonic technologies and devices

Hardware and software for information security

Speech signals processing technologies and software, etc.

More at www.science.bsuir.by/en/



www.mwmlab.com

Control, measurement and testing SHF equipment (0.01...220 GHz)



■ MWMLab offers customized design, production and delivery of the following equipment:

- Vector network analyzers.
- Scalar network analyzers.
- Signal generators.
- Microwave power meters.
- Field-intensity meters.
- Contactless radiowave vibro sensors/level meters.

■ MWMLab offers the following services:

- Metrological support at development, production and exploitation stages.
- Remote calibration of automated measuring devices and systems.
- Modification of measuring facilities according to client's requirements and special production conditions.



These devices are in demand in CIS, Europe, East Asia, and South America.

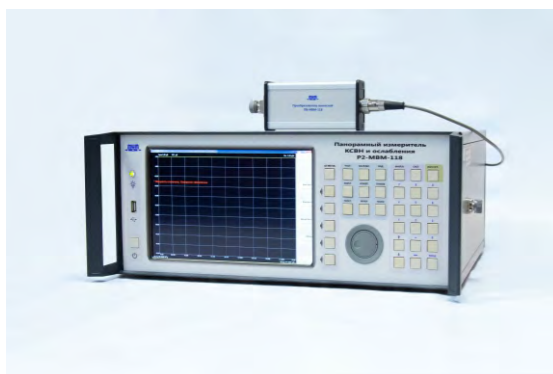
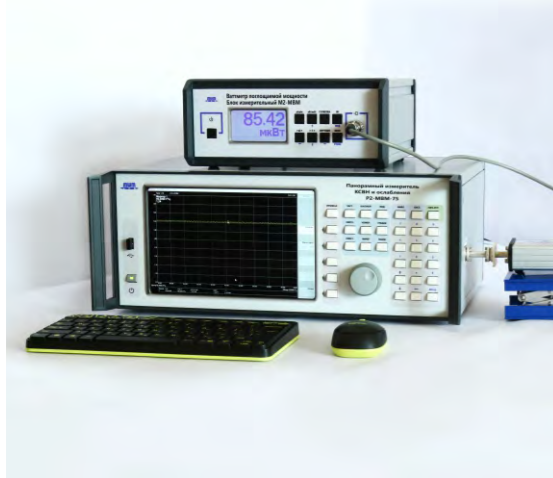
info@mwmlab.com
tel.: +375 17 293 84 96
+375 17 293 84 42
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus



SHF devices are included into the Belarusian and Russian State Registers of Measuring Facilities.

Equipment delivery time is min. six months.





www.mwmlab.com

Measuring systems and standards

DEVELOPED AND PRODUCED:

- Power unit standard in the frequency range from 37.5 to 178.4 GHz (certification, calibration, verification of measurement wattmeters and converters).
- Attenuation unit standard in the frequency range from 37.5 to 178.4 GHz.
- Power flux density unit standard (certification, calibration, verification of antennas and power flux density meters).

MWMLab offers:

- Development and production of standard (etalon) systems for SHF measurements (i.e. measurements of power, flux density, frequency, VSWR, reflection and transmission coefficients).
- Testing of SHF devices within the lab's accredited sphere.
- Calibrating of EHF and SHF measuring devices.
- Design, production and repair of SHF measuring facilities within the frequency range from 0.01 to 220 GHz.



MWMLab comprises the following units:

- Testing laboratory of microwave measuring facilities.
- Calibrating laboratory of microwave measuring devices.
- R&D Lab on Radioengineering systems and technologies of millimeter wave range.

The calibrating laboratory is accredited according to the Accreditation System of Verification, Testing and Calibrating Laboratories in the Republic of Belarus.

info@mwmlab.com
 tel.: +375 17 293 84 96
 +375 17 293 84 42
 BSUIR, 6, P. Brovki Str., Minsk
 220013, Republic of Belarus

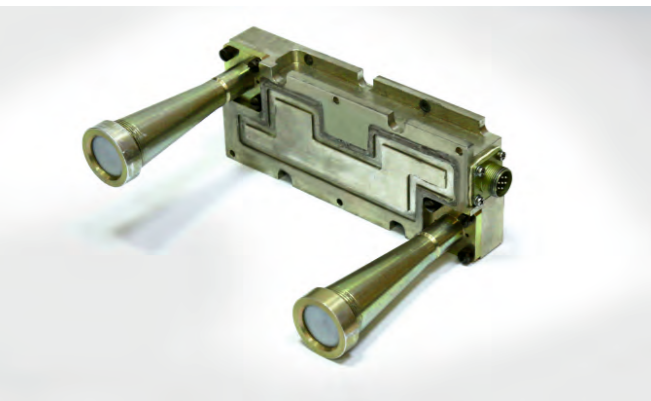
MWMLab is ready to develop, produce and deliver the following special-purpose equipment at customer's request:

- Radar transmit-receive modules in the frequency ranges 9...18, 25...36, 94 GHz.
- Radar frequency synthesizers.
- Digital signal processing units.
- Low altitude radio altimeters in the wave length range of 8 mm and 2 mm for high-speed carriers and unmanned aerial vehicles (UAV).
- Radars including those based on active phased antenna arrays in the ranges 9...18, 25...26, 94 GHz.
- Automated multifunctional radar testing systems.
- 3D mobile radars.

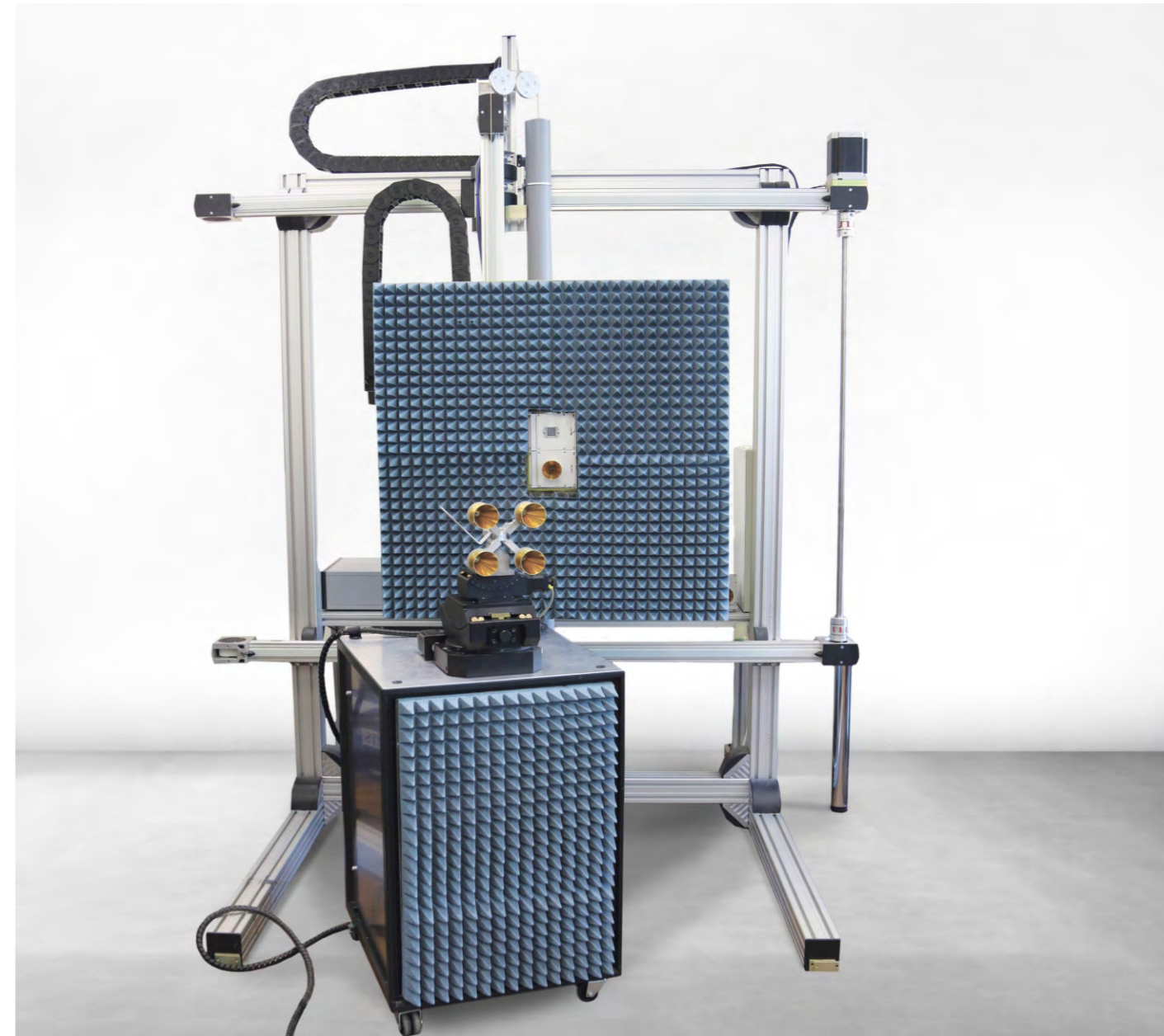
info@mwmlab.com
 tel.: +375 17 293 84 96
 +375 17 293 84 42
 BSUIR, 6, P. Brovki Str., Minsk
 220013, Republic of Belarus



3D mobile radar



Low altitude radio altimeter for high-speed carriers



Automated multifunctional radar testing system

■ **We offer customized development of:**

- Onboard radars of centimeter and millimeter wavelength ranges.
- Space onboard radars with synthesized aperture for the Earth surface monitoring.
- Self-contained functional SHF units and digital processing units of radioelectronic systems.
- Antenna systems:
 - phased antenna arrays
 - digital antenna arrays
 - small-sized dual-reflector dish-shaped antennas with dielectric hybrid mode radiator (including scanning antennas)
 - monopulse antenna systems
 - biconical omni-directional antennas.
- Software for antenna systems simulation.
- Vibration-proof functional units for onboard radioelectronics.
- Acousto-optic devices.



Biconical omni-directional antennas



Transmit-receive module of X-range

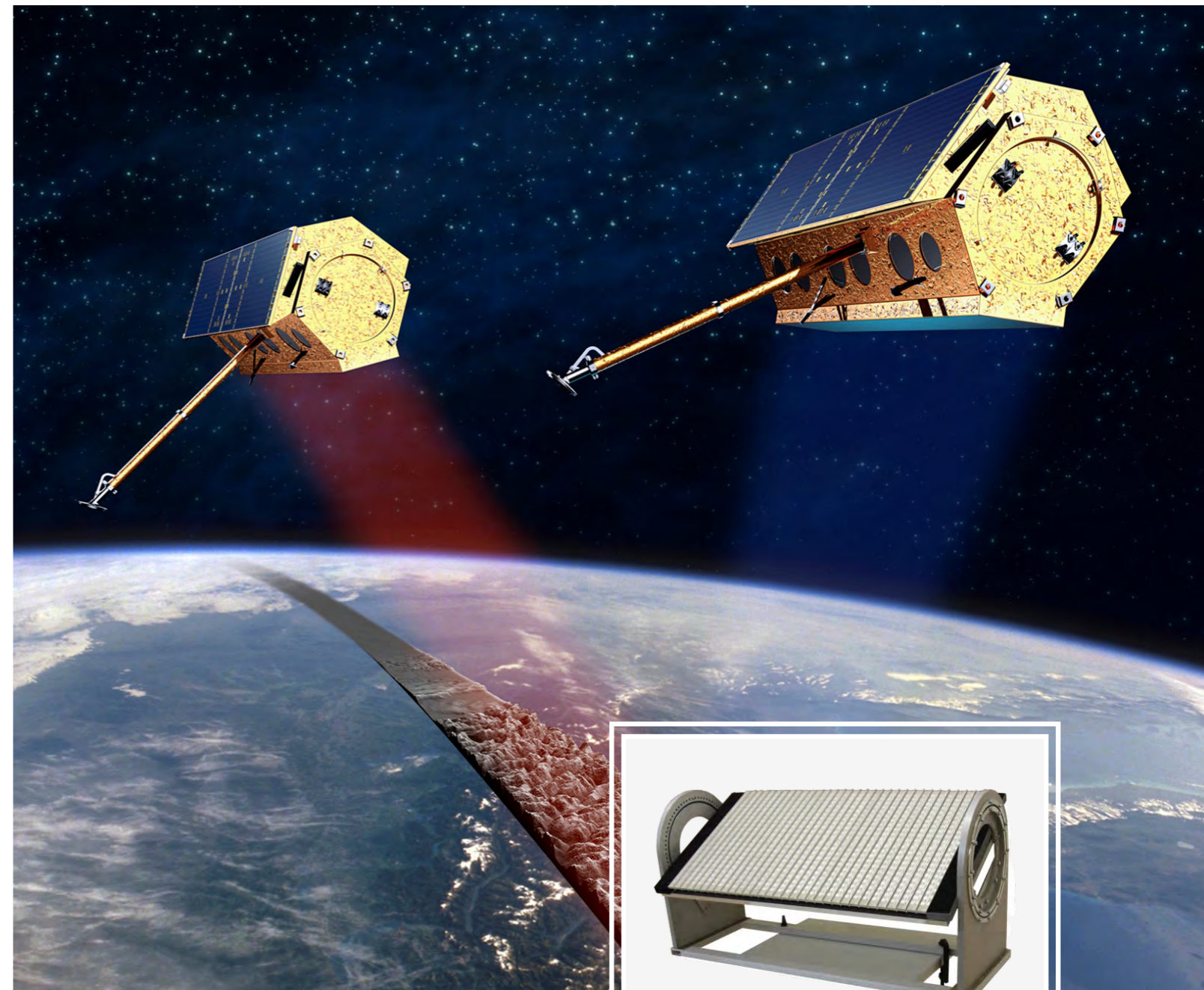
■ **We offer the following services:**

- Development and delivery of experimental models and prototypes with design and engineering documentation of the developer.
- Customized training on production technology.

These products are in demand in [China](#).

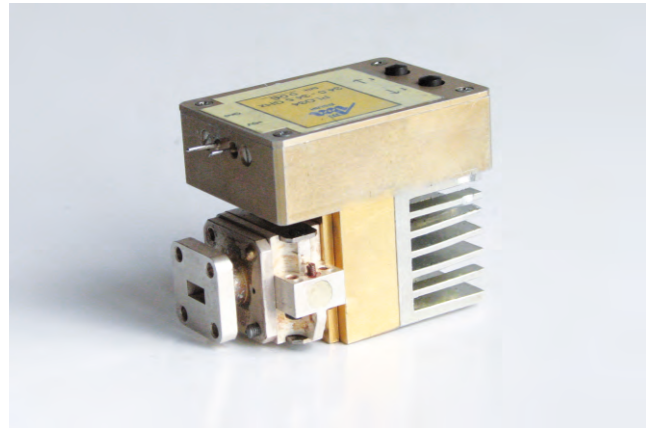
center1.6@bsuir.by
tel.: +375 17 293 88 71
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus

Radioelectronic systems of centimeter and millimeter wavelength ranges



Base panel of an active phased antenna array of a radio locator with synthesized X-range aperture, including for space devices

Basic devices, components and modules for microwave and EHF ranges

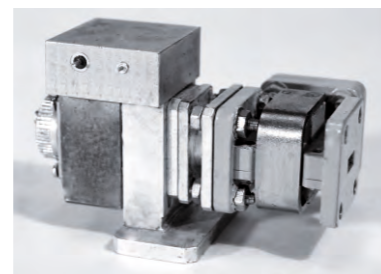
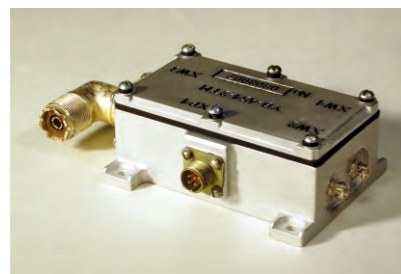
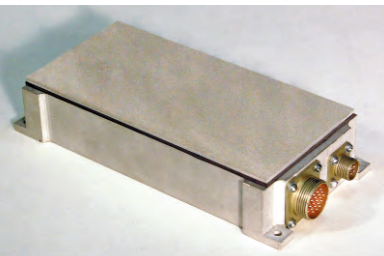


■ We offer customized development of:

- Balanced mixers, frequency transducers.
- Pin-switches, modulators, signal limiters.
- High-stable frequency synthesizers.
- Low-noise signal converters for satellite receiving station.
- Microwave low-noise amplifiers.
- Microwave transistor power amplifiers.
- Magnetron transmitters, signal generators.
- Radar for subsurface probing (georadar).

These products are in demand in *Russia, China, India.*

rubanik@bsuir.by
tel.: +375 17 293 84 27
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus



■ To meet specific customer requirements, we develop:

- Balanced mixers.
- Mixers on harmonics.
- Detector heads.
- Directional waveguide couplers.
- Measuring cells.

info@mwmlab.com
tel.: +375 17 293 84 96
+375 17 293 84 42
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus

■ We offer the following services:

- Development of basic devices, components and modules of SHF and mm-wave range.
- Development of SHF facilities for civilian and special purposes to be used in radionavigation, radiolocation, communication, aviation and space.

Electromagnetic compatibility. Electromagnetic security. Electromagnetic protection and ecology. Technologies. Software. Testing and expertizing



■ EMC Lab services:

- Research and development activities related to analysis and finding solutions for the problems of electromagnetic compatibility, electromagnetic safety, electromagnetic protection and electromagnetic ecology of onboard and local ground-based groupings of radioelectronic facilities, territorial groupings of radio systems of various services and geographically-distributed radio networks.
- Development of technological solutions, software, special-purpose expert systems and specialized automated test complexes for electromagnetic compatibility, electromagnetic safety, electromagnetic protection and electromagnetic ecology challenges.
- Applied research on analysis and support of electromagnetic compatibility, electromagnetic safety, electromagnetic protection and electromagnetic ecology. Finding customized solutions for the problems in related areas.
- Expert analysis of electromagnetic compatibility (BSUIR is a principal organization of the Republic of Belarus authorized to conduct research on problems of electromagnetic compatibility of radioelectronic facilities).
- Technology transfer, export of software and services in the areas related to analysis, testing and solutions development for electromagnetic compatibility, electromagnetic safety, electromagnetic protection and electromagnetic ecology.
- Detailed examination of radio receivers and radio frequency components by dual-frequency testing method.
- Testing of electronics of various purposes on susceptibility to powerful ultrashort electromagnetic impulses.

■ EMC Lab INNOVATIVE TECHNOLOGIES:

– DLA EMC Technology for discrete linear analysis of intrasystem electromagnetic compatibility of complex onboard and ground radioelectronic systems

The technology is based on the integral system criteria of electromagnetic compatibility, and unique models and methods of discrete linear analysis of electromagnetic compatibility of radioelectronic devices operating in severe electromagnetic environments, as well as on the unique interactive procedures for refining pessimistic models of potentially dangerous parasitic electromagnetic communications (antenna – antenna, antenna – wire, wire – wire, etc.).

– DLA EMP Technology for discrete linear analysis of electromagnetic protection of complex onboard and ground radioelectronic systems against strong electromagnetic interference

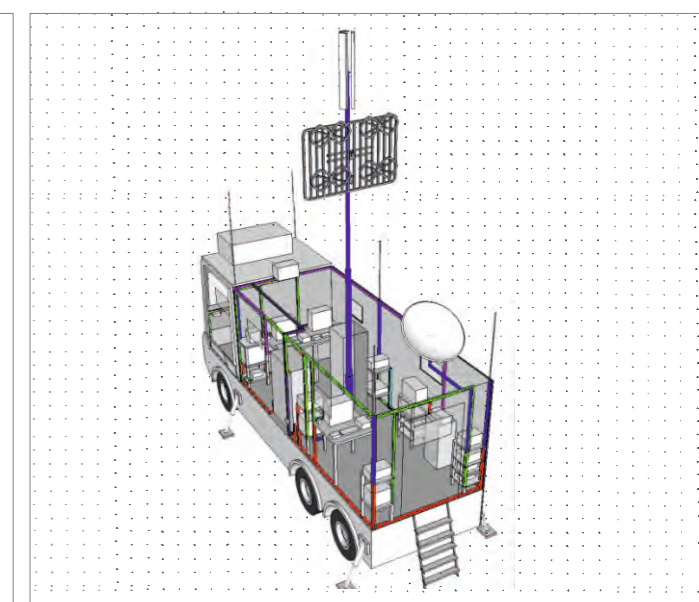
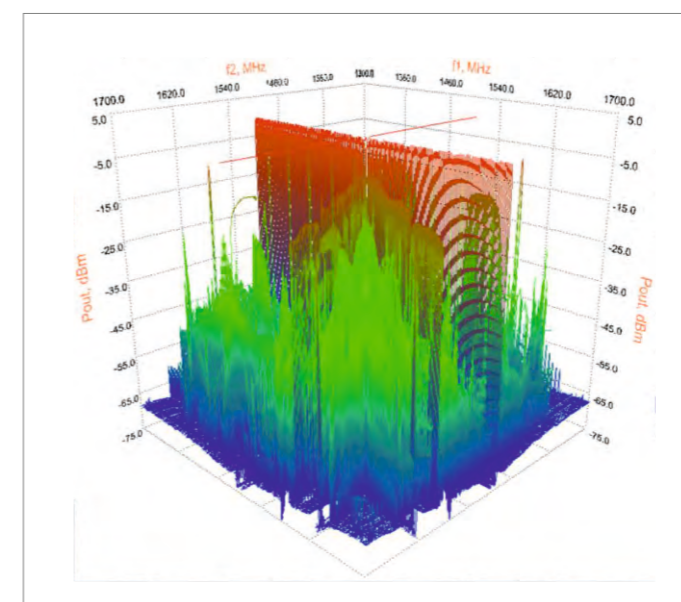
The technology is based on the electromagnetic protection criteria for the frequency and time domains, and unique models and methods of discrete linear analysis of electromagnetic protection, as well as on the unique methods and algorithms for electromagnetic protection system design and testing. This technology provides a smart solution for the design and analysis of the protection system for onboard and ground radioelectronic systems against strong continuous and impulse electromagnetic interference.

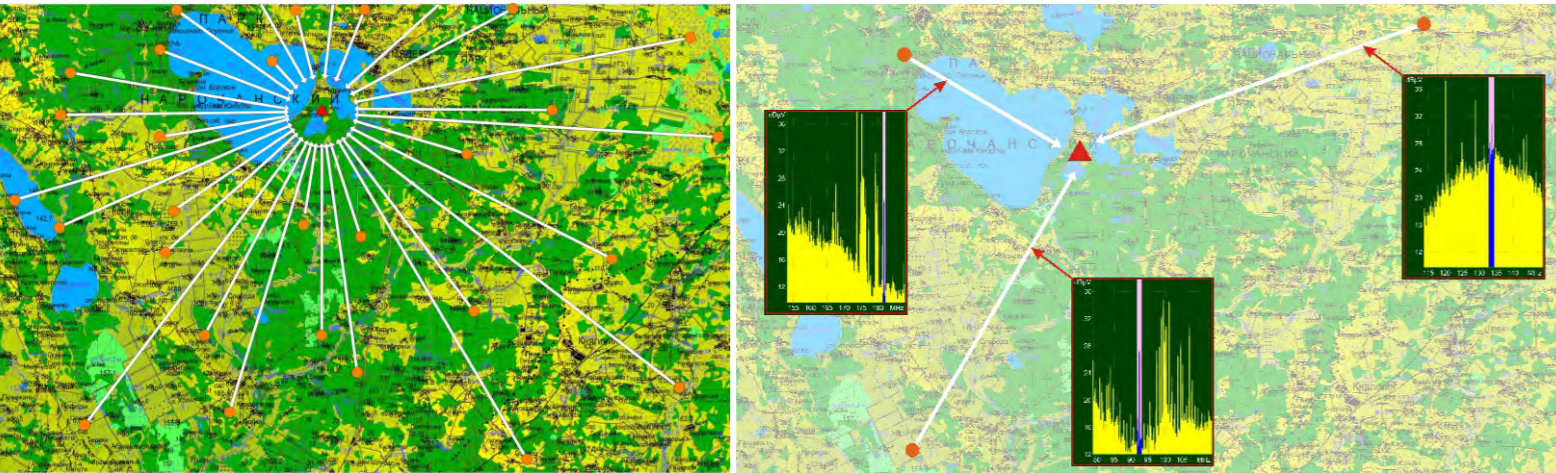
EMC Lab has successfully completed over 100 customized projects related to analysis and solutions development for electromagnetic compatibility, electromagnetic safety, electromagnetic protection and electromagnetic ecology of complex onboard and ground-based groupings of radioelectronic facilities.

Their customers came from *China, the USA, Canada, Israel, the UK, Italy, Russia, India, and Germany.*

EMC Lab is ready to redesign their products on customer request, as well as to supply customized products and technologies with the development documentation.

emc@bsuir.by
tel.: +375 17 293 84 38
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus





– ADFTT
Technology for automated dual-frequency testing of radio receivers and components

The technology is based on two testing signals sweeping in frequency, unique methods for processing and 2D/3D visualization of the test results. It enables obtaining comprehensive information about all really existing channels and possible damage effects on radio receivers at the antenna input, as well as information about the nonlinearity of the tested units.

– GIS-RF
Specialised geo-informational technologies for electromagnetic environment simulation, analysis and support of electromagnetic compatibility for large territorial groupings of radio systems

Technologies are based on digital maps of the respective area, geo-informational platforms, and the ITU-R Recommendations on radiowave propagation models in various conditions. These technologies provide smart solutions for a wide range of tasks, such as radio spectrum management, analysis and support of intersystem electromagnetic compatibility, frequency-spatial planning in various frequency ranges, as well as of tasks related to electromagnetic safety, electromagnetic protection and electromagnetic ecology.

– DNA EMC
Technology for discrete non-linear analysis of radio systems electromagnetic compatibility

The technology is based on refined higher-degree polynomial models to describe the nonlinearity of radio receivers and radio frequency components (i.e. radio frequency amplifiers, mixers, etc.), as well as on discrete models and unique high-performance algorithms for non-linear modeling of radio receivers and RF components behavior under complex multi-signal undesirable interference.

– Technology for system analysis of electromagnetic ecology and electromagnetic security of mobile (cellular) communications in 2G, 3G, 4G, 5G, ...

The technology is based on a unique methodology for the assessment of electromagnetic background intensity generated by the cellular communications equipment of the base station and its subscribers. Initial data for the assessment of the electromagnetic background intensity can be taken from the forecast of the electromagnetic load to be created by the cellular communications equipment on the given territory or from the forecast of the traffic density of mobile communication systems that are providing wireless information services to the people on the given territory.

■ EMC Lab INNOVATIVE PRODUCTS

– EMC-Analyzer

Special software for analysis of intra system electromagnetic compatibility of complex onboard (i.e. on an airplane, ship, car, etc.) and local ground-based (i.e. at an airport, sea port, communication and control center, etc.) groupings of radioelectronic systems. It is based on the DLA EMC and DNA EMC technologies, is designed as an expert analysis system and can be used at any stage of the life cycle: e.g. during the design of a radio system grouping, or during its exploitation or modernization.

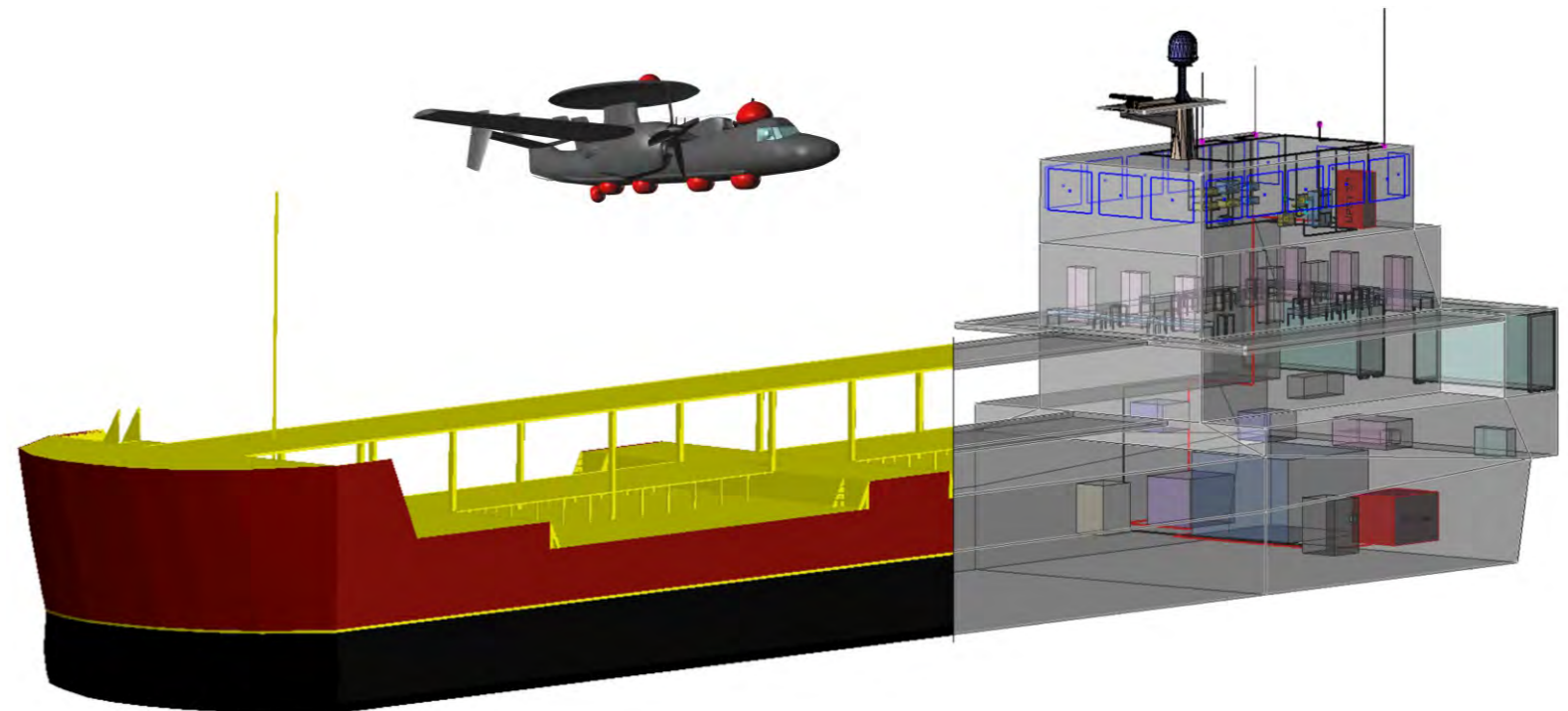
– VTA
Virtual Testing Area (virtual polygon)

The VTA hardware and software complex is designed for electromagnetic compatibility analysis of radio systems of various services (radio communication, radio location, radio navigation, etc.) that are integrated into large territorial (regional) groupings. The VTA complex is based on the DLA EMC, DNA EMC, GIS-RF, ADFTT, and Augmented Reality technologies. It enables conducting a comprehensive multivariate EMC analysis, as well as semi natural simulation and decision-making support on issues related to electromagnetic compatibility of various geographically-distributed radio systems.

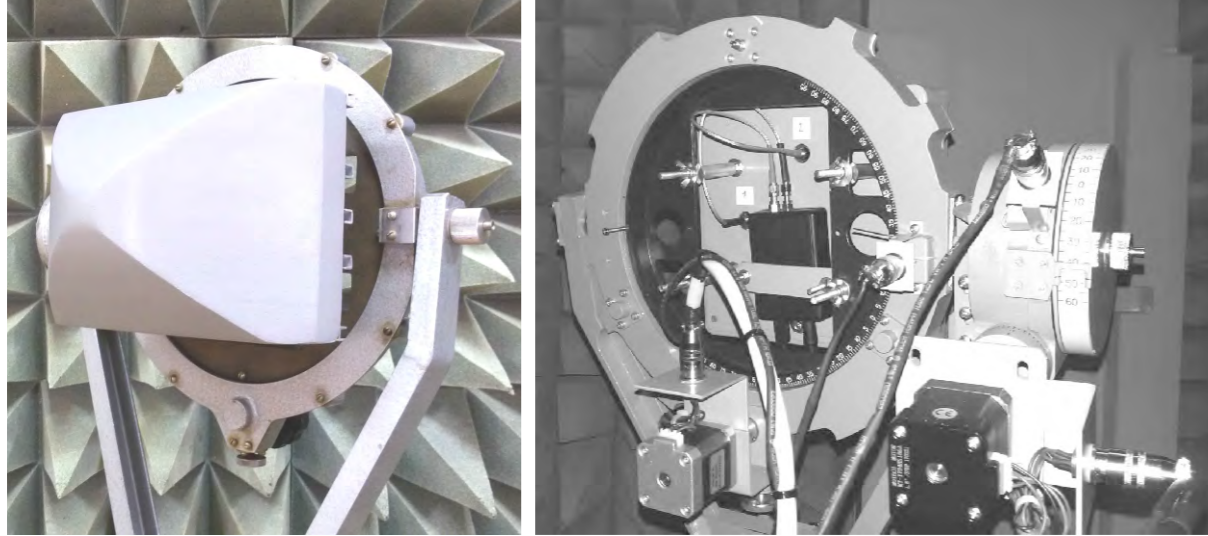
– ADFTS
Automated Double-Frequency Test System

The ADFTS hardware and software complex is designed for experimental analysis and support of selectivity, non-linearity and electromagnetic compatibility of radio receivers and radio frequency components (i.e. radio frequency amplifiers, mixers, etc.). The ADFTS complex is based on the ADFTT technology, and it enables obtaining comprehensive information about the parameters of radio receivers and radio frequency components so as to support the decision-making process in issues related to electromagnetic compatibility.

emc@bsuir.by
 tel.: +375 17 293 84 38
 BSUIR, 6, P. Brovki Str., Minsk
 220013, Republic of Belarus



RFID identification technologies



■ We offer customized development of the following equipment:

- RFID identification systems.
- Functional nodes of antenna-feeder paths for RFID systems in HF, UHF and SHF ranges.
- Metrological system for parameters research and verification of wireless identification and sensor platforms in UHF range in real electromagnetic environment.
- Antenna-feeder paths for unmanned aerial vehicles.

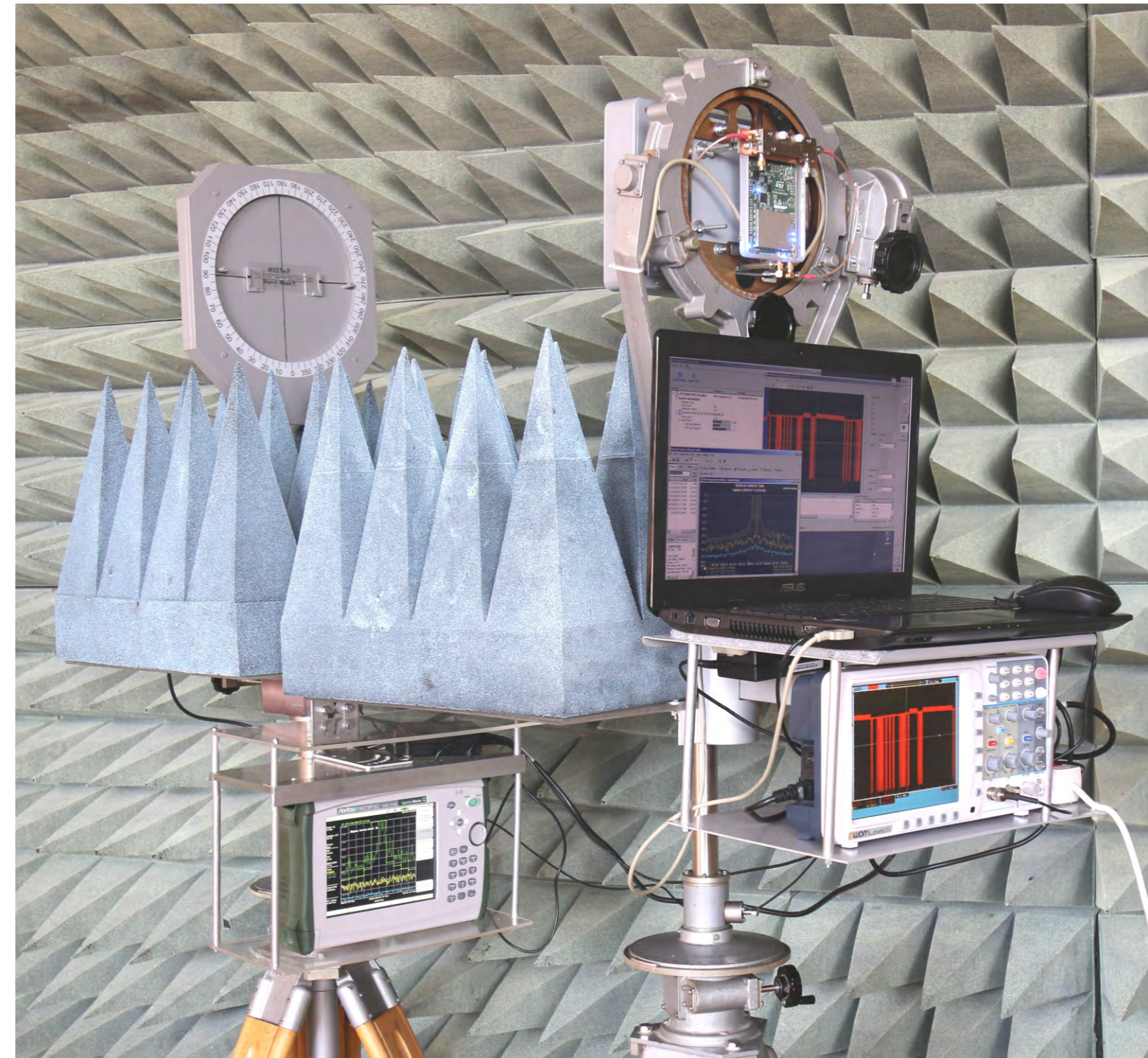
kirylichuk@bsuir.by
tel.: +375 29 643 70 04
+375 29 624 85 70
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus

■ Research areas:

- Design of advanced RFID systems in HF, UHF and SHF ranges based on spatial polarization signal processing method.
- Design and modelling of functional nodes of advanced RFID systems in HF, UHF and SHF ranges.
- Research and verification of system and component parameters for RFID technologies in HF, UHF and SHF ranges.
- Antenna-feeder paths for unmanned aerial vehicles.

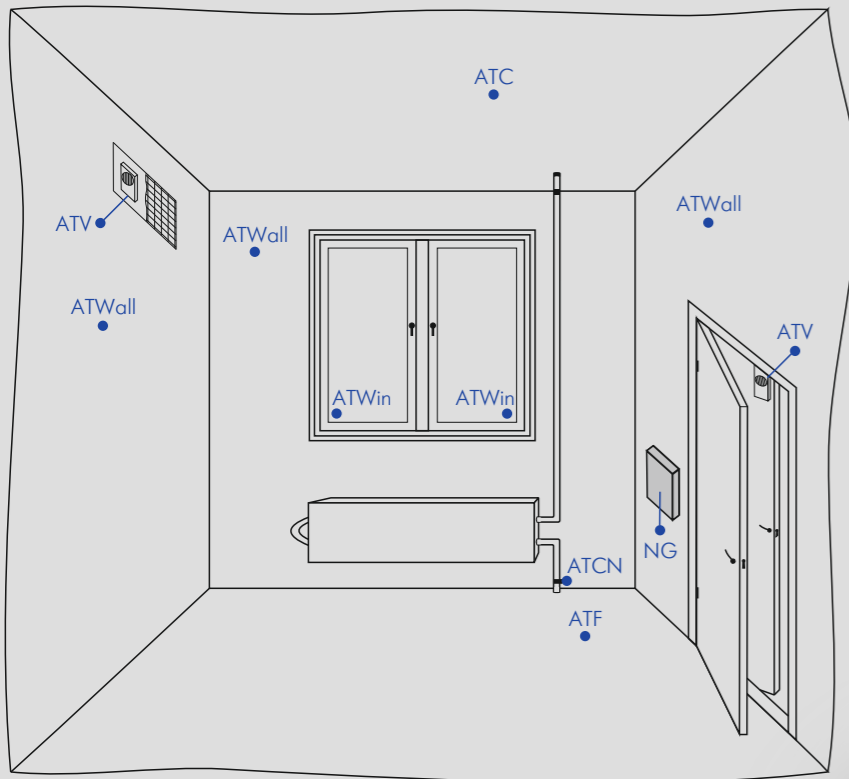
■ We offer the following services:

- Staff training on measurement techniques based on the developed metrological systems.



Software and hardware system for research and verification of RFID systems of HF and UHF bands

Information protection



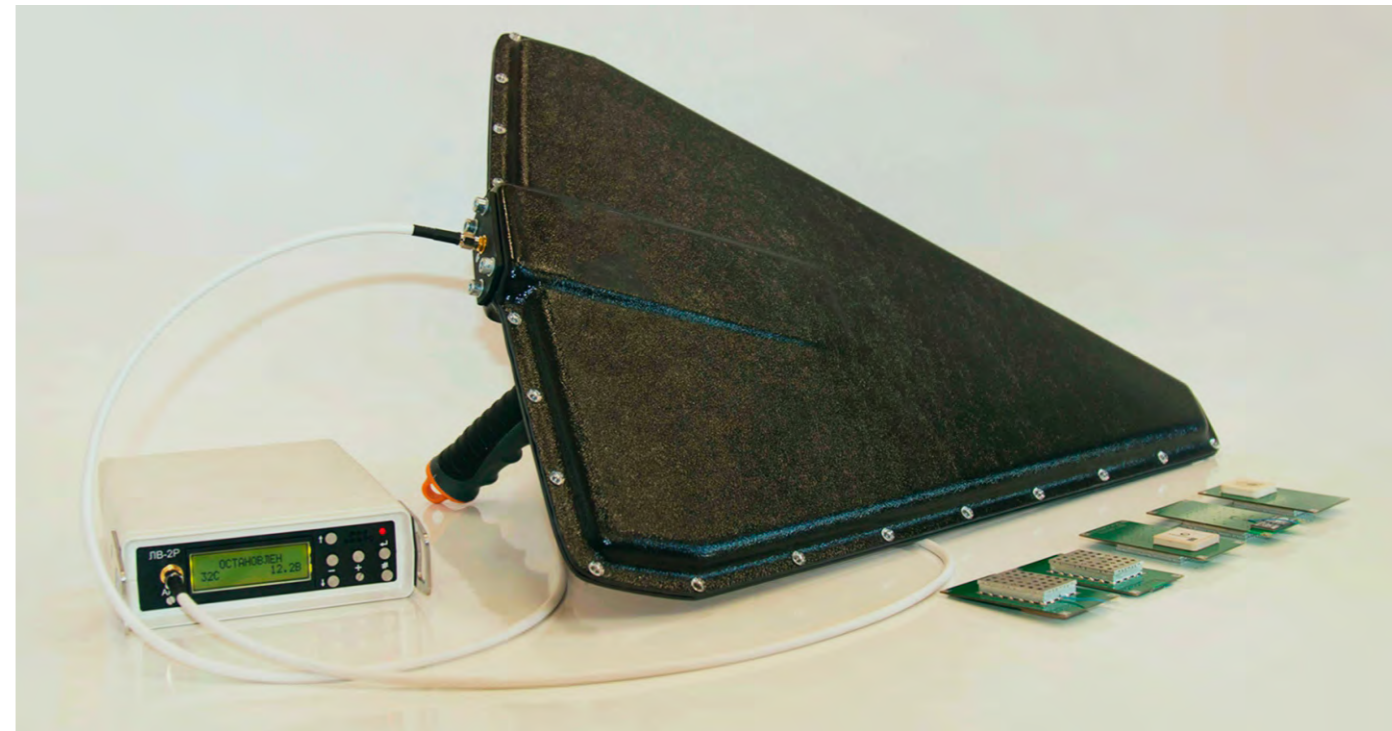
Standard layout of the noise generator (NG) and acoustic transducers to be mounted in the room walls (ATWall), windows (ATWin), ceiling / floor (ATC \ ATF), ventilation channels (ATV), communication networks (ATCN)

– PRIBOI voice information leakage via acoustic and vibration channels from the room beyond the protection zone protection equipment

Operation principle:
Creation of masking signals ("white noise", "speech-like signals", "white noise" + "speech-like signals") in a voice information leakage channels (windows, walls, ceilings, floors, vents, door vestibules, communication networks) corresponding to the formal properties of speech. The signals can be tailored to address a specific person.

The kit supplied includes: acoustic (at least 10 pcs.) and vibro-acoustic (at least 30 pcs.) converters (weight not exceeding 0.15 kg).

Size: 280x60x200 mm, weight is not more than 3 kg.



– LOCATOR to detect devices of unauthorized information collection

Locator can be used to localize radiocontrol devices or other operating units which have a radio control channel.

The operational principle is similar to the principal of a non-linear locator.

The main difference lies in the necessity to consider the possibility of missing the "target" due to the discrepancy in the polarization of the locator antenna and antenna of radio control devices.

– DETECTOR hardware and software complex to test computing equipment for the presence of devices of unauthorised opportunities

The detector includes:
– a tract of provoking electromagnetic and acoustic signals;
– a measuring tract;
– a control computer.



■ We offer the following services:

- Manufacturing and supply of the device with subsequent maintenance.
- Staff training on information protection.

- We are interested in joint research projects in the development of the technology to generate speech-like signals in foreign languages.

nil53@bsuir.edu.by
tel.: +375 17 293 89 39
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus

■ **We develop and produce the following equipment on customer request:**

- Cavitometers including high-temperature ones.
- Ultrasonic low-frequency cavitation systems.
- Contactless digital vibrometers.
- Ultrasonic dispersers.
- Ultrasonic high-frequency generators.
- Ultrasonic baths.
- Sonoluminescence setups.

Equipment delivery time is min. three months, collaboration on a contract basis.

These devices are in demand in the Netherlands, Italy, France, Russia, Ukraine, the USA, Poland, the UK, and Denmark.

dnv@bsuir.by
tel.: +375 17 293 86 35
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus

■ **Research areas:**

- Fundamental research on the physics of high-power ultrasound including but not limited to cavitation, ultrasonic capillary effect, and sound luminescence including in the suspensions of nanoparticles and during the formation of nanostructures.

- We develop special-purpose ultrasonic technologies and equipment, such as to process and format suspensions of nanoparticles, or to apply high-power ultrasound, dispersing and emulsifying techniques in medicine.

- We provide on demand services on the optimization of operation procedures in ultrasonic equipment.

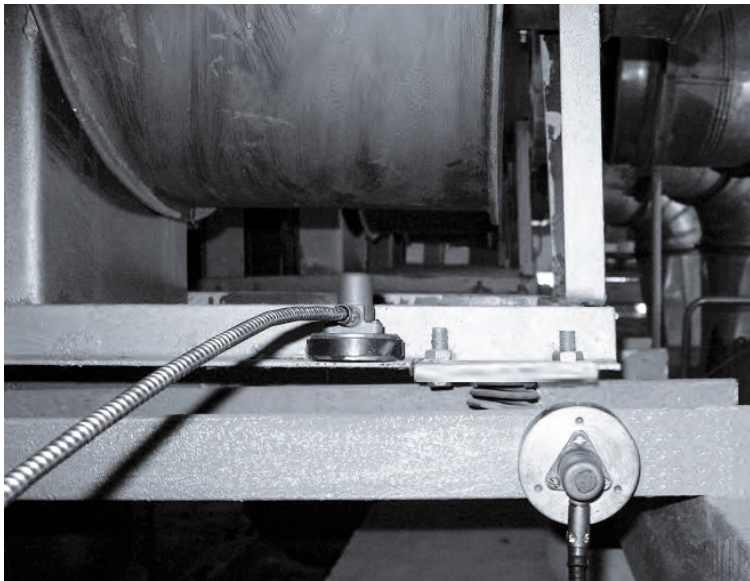
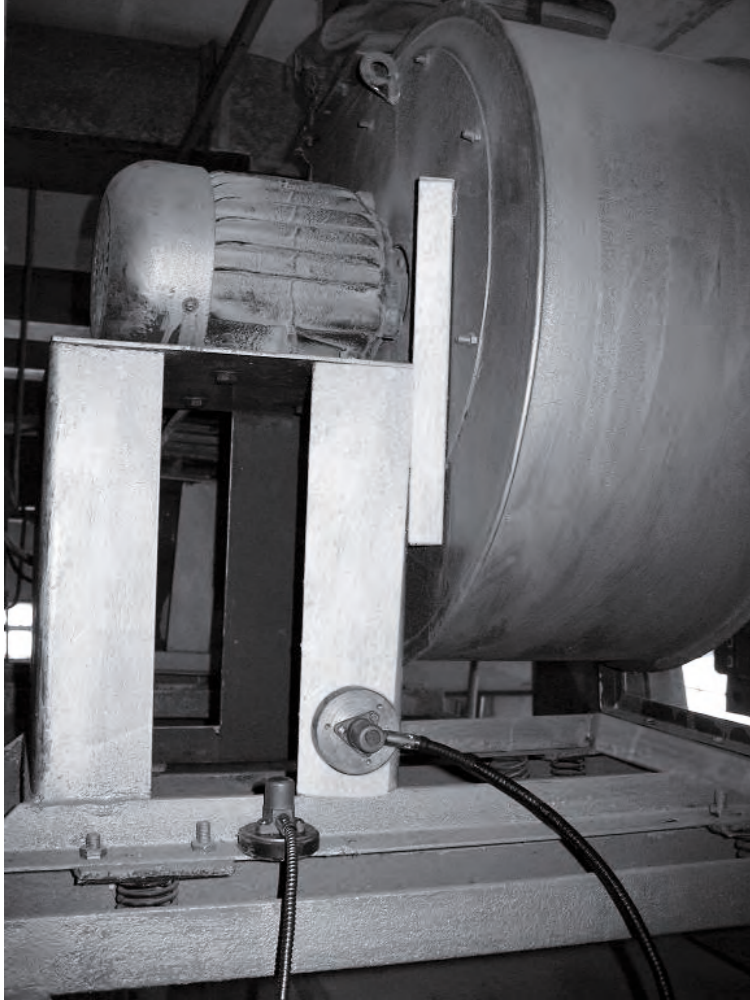
- We are open for joint collaboration under research and development projects.

- We develop methods to make measurements in high-power ultrasonic fields, as well as methods to control the modes of ultrasonic technological processes in liquids.

- We develop software to control the operating modes of ultrasonic equipment.



Vibration diagnostics technologies and equipment



Vibration measuring transducers for the vibration control of a motor mounting platform

- **Vibration monitoring, comprehensive assessment of the technical condition and malfunctions diagnostics of various equipment and mechanisms.**
- **Development of multifunctional systems and portable devices for measuring and controlling of vibrations.**
 - Single-channel vibration meter with vibration shutdown function.
 - Distributed systems for collecting and centralized processing of vibration data.
 - Alarm and safety shutdown systems for turbo generators.
 - System of vibration control and protection of the "Lukoml" series.
 - Program-controlled vibration test systems.
- **Development of multifunctional safety systems based on vibration monitoring of rotary mechanisms during their operation.**
 - Multi-level monitoring system of the vibration condition of rotating mechanisms.
- **Development of vibration diagnostics systems for buildings and constructions.**
 - Mobile measuring and computing complex "Tembr".
- **Design and modernization of vibration diagnostics complexes according to customer's requirements and production conditions.**



Mobile measuring and computing complex "Tembr"



Single-channel vibration meter with vibration shutdown function

victor@bsuir.by
 tel.: +375 17 293 84 63
 +375 17 293 88 65
 BSUIR, 6, P. Brovki Str., Minsk
 220013, Republic of Belarus



Moving man-made objects remote monitoring systems

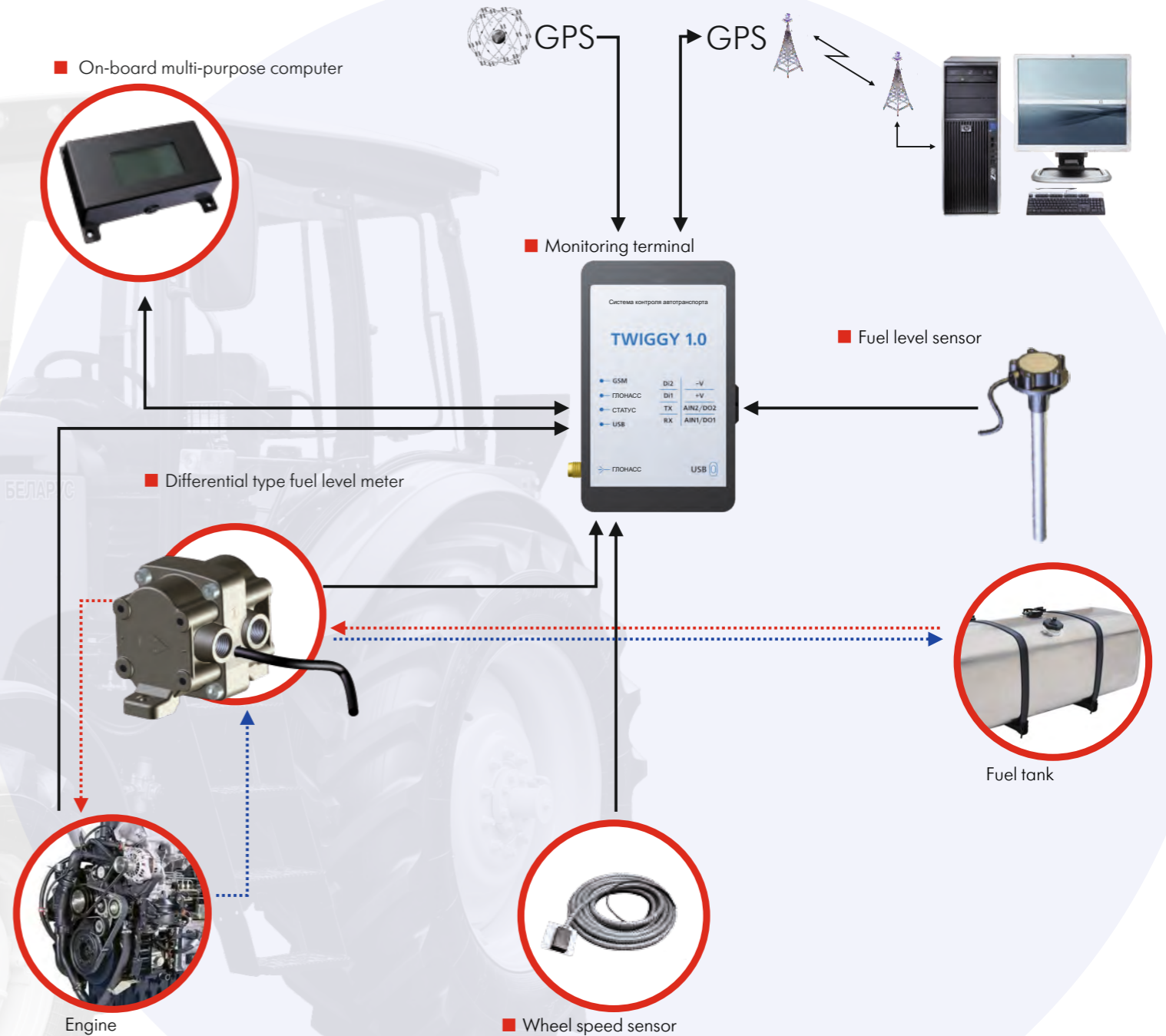
Tractors. Road-building and self-propelled agricultural machines

Vehicles monitoring system

Auxiliary equipment and sensors: multifunctional transport monitoring terminal TWIGGY; on-board computer; radio identifier; camcorder; fuel level sensor; fuel level meter; temperature, pressure, rotation, operation time, angle, axle load, tilting sensors.

- Remote monitoring of the moving object parameters in real time: record and normalization of fuel consumption over a certain period of time and for a separate type of work, calculation of the fuel weight, etc.
- Efficiency evaluation of man-made object usage.
- Automatic detection of emergency situations.
- Fast response to the problem, emergency situations prevention.

- **Monitoring systems development and supply for specific customer's requirements (hardware and software package).**
- **Technical support. Service maintenance.**
- **Personnel training: equipment assembling, operators training.**



info@mwmlab.com
 tel.: +375 17 293 84 96
 +375 17 293 84 42
 BSUIR, 6, P. Brovki Str., Minsk
 220013, Republic of Belarus

Remote monitoring components

- Fuel level, temperature, pressure and density sensors
- Differential type fuel consumption sensors
- Fuel level sensors couplers
- Fuel level sensors adders
- Two-channel vibration switches
- Data indication blocks



Fuel level sensor linking device

System components (fuel level sensors) are mounted on commercially manufactured products by the following enterprises of the Republic of Belarus: RUE "Minsk Tractor Works", OJSC "Beltransgaz", RUE "Gomelenergo" RUE "Gomselmash", RUE "Production Association" Belorusnef".

info@mwmmlab.com

tel.: +375 17 293 84 96
+375 17 293 84 42

BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus



Differential type fuel consumption sensor



Fuel level sensor

Online remote control system for pipes insulated with PU-foam



- **Parameters monitoring: prediction of emergency situation by the dynamics of variations in the pipe insulation resistance and its early detection.**
- **Minimal emergency response.**
- **Reliability and resistance to external influences.**
- **Remote equipment maintenance: configuration, diagnostics, software updates, and parameters monitoring.**

The pipeline damage controller shows the results of resistance measurements conducted in place.

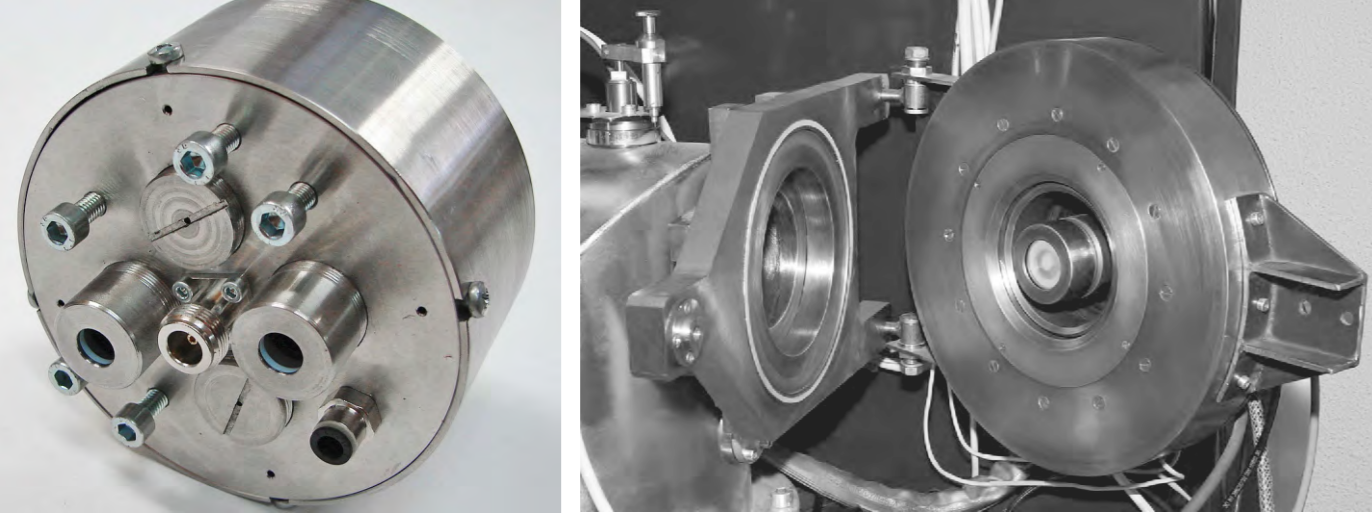
The data transmission channel: GSM or Ethernet/RS485. Number of pipes connected: 2, 4. Each channel controller is galvanically isolated.

Detectable defects:

- insulation wetting;
- signal wires breakage;
- short-circuit effects between signal wire and metallic pipe.

- **We provide a full range of services related to the installation of a monitoring system: from design to ready-to-operate solutions, from a simplified version to monitor parameters and manage certain processes to a scaled-up control complex (SCADA-system).**

Ion and plasma processing. Equipment



■ Research areas:

- Sputtering ion sources, double-beam ion sources, sources for ion-beam assisted deposition (IBAD).
- Magnetron sputtering systems, unbalanced magnetron sputtering systems, magnetron sputtering at low pressures.
- Processes of reactive ion-beam and magnetron sputtering.
- Processes of unbalanced magnetron sputtering.
- Ion beam neutralization methods.
- Ion and plasma deposition of multilayer optical structures with high resistant parameters.
- Deposition and composition of high-k and low-k dielectrics.
- Deposition and composition of magnetoresistive thin films.
- Ion-beam polishing of optical units.

■ We offer customized development of the following equipment:

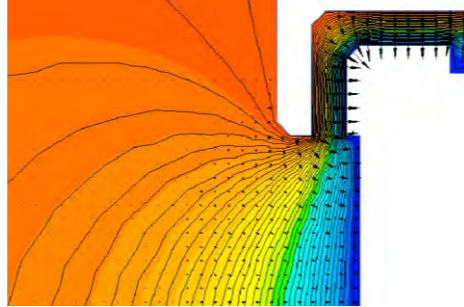
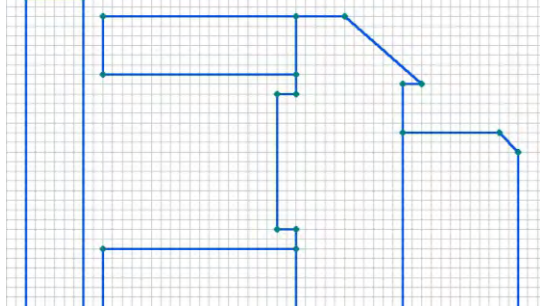
- Magnetron sputtering systems with targets sized from 2.5 cm (1") to 17.0 cm (7") as well as extended magnetron sputtering systems with targets sized up to 100 cm (40").
- Sputtering ion sources for thin films deposition based on accelerator with anodic layer or on end-Hall accelerator: i.e. sputtering ion sources, double-beam ion sources, sources for ion-beam assisted deposition.
- Systems for operational parameters control of charged particle fluxes (e.g. ion energy, ion current density) and of neutral atoms (deposition rate).

Equipment is developed using state-of-the-art computer simulation methods and unique software.

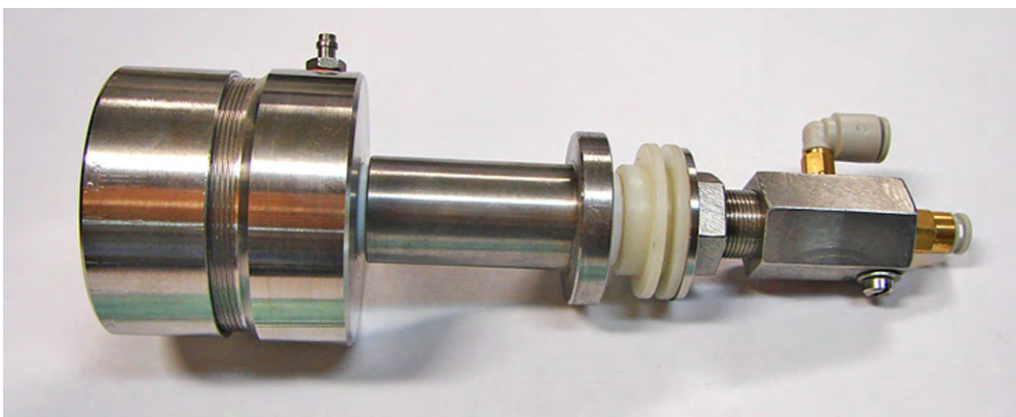
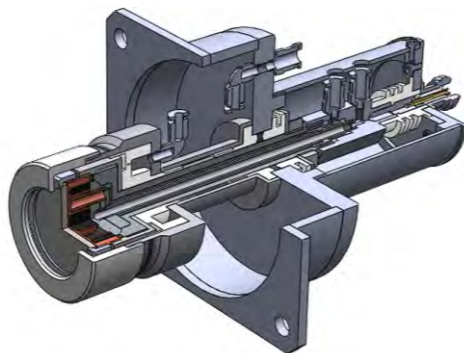
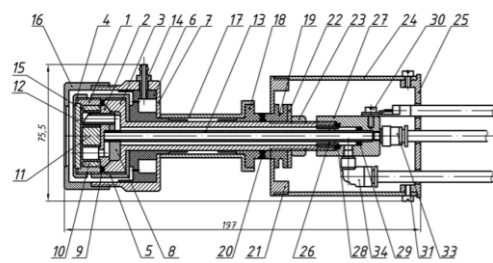
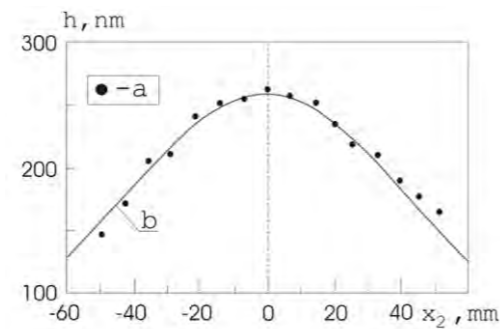
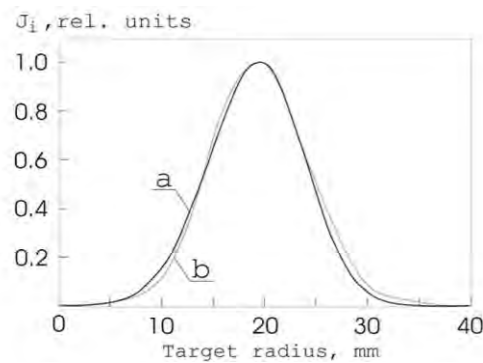
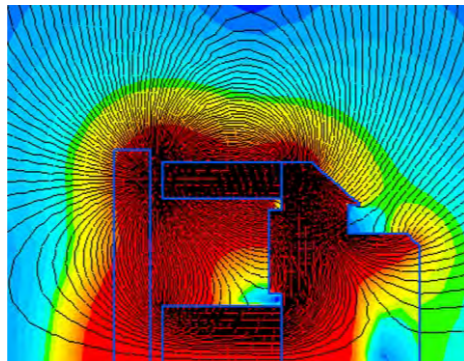
These devices are in demand in [Russia](#), [South Korea](#), and [China](#).

szavad@bsuir.by
tel.: +375 17 293 80 79
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus





R, mm	Z, mm
18	0,053 0,037 0,027 0,021
17	0,040 0,027
16	
15	
14	0,039 0,027
13	0,060 0,043 0,032 0,024
12	0,074 0,056 0,043 0,033 0,025
11	0,083 0,065 0,051 0,040 0,031 0,024
10	0,089 0,072 0,057 0,045 0,035 0,028 0,021
09	0,095 0,078 0,062 0,049 0,039 0,030 0,024
08	0,102 0,082 0,065 0,052 0,041 0,032 0,025
07	0,107 0,085 0,067 0,053 0,041 0,032 0,025
06	0,111 0,086 0,067 0,052 0,040 0,031 0,024
05	0,109 0,083 0,063 0,049 0,037 0,029 0,022
04	0,099 0,074 0,056 0,043 0,033 0,025
03	0,081 0,061 0,045 0,034 0,026 0,020
02	0,057 0,043 0,032 0,024
01	0,029 0,022
00	



The following software modules were developed and implemented to simulate ion and plasma equipment and processes:

- Simulation of electric and magnetic fields aimed at optimizing magnetic systems of ion and plasma equipment.
- Calculation of solenoids (electromagnetic units).
- Modeling of magnetron target erosion.
- Calculation of the distribution profiles of the deposition rate for extended and axial magnetrons, magnetrons with several spraying areas taking into consideration various camera geometry and methods of the substrate movement.
- Calculation of the component composition of the deposited films upon sputtering of mosaic targets.
- Process simulation of reactive magnetron sputtering.
- Calculation of magnetron sputtering systems including the unbalanced ones (i.e. level of unbalance, distribution of ion current density, etc.).

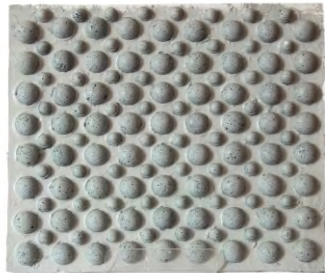
We offer the following services:

- Development of ion and plasma equipment of varying complexity, and deposition of thin films by ion-beam sputtering or reactive ion-beam sputtering.
- Design and production of multifunctional modular vacuum facilities.
- Diagnostics of electrophysical, optical, mechanical, and tribological properties of thin films.
- Modernization of vacuum equipment.
- Research and development of technological processes for thin films deposition.

szavad@bsuir.by
 tel.: +375 17 293 80 79
 BSUIR, 6, P. Brovki Str., Minsk
 220013, Republic of Belarus

Broadband absorbers of electromagnetic radiation

- We develop broadband and frequency-selective absorbers of electromagnetic radiation in the microwave range based on electrically conductive fibrous and powdery materials.



- We are interested in conducting joint research and development projects.
- We train specialists to participate in joint research, development, and production projects.

DEVELOPED AND MANUFACTURED:

- Materials for the construction of shielded buildings, premises, engineering structures.
- Construction materials that reduce the energy of electromagnetic radiation and are designed to be applied to walls, floors and ceilings of premises.
- Materials that reduce the level of radar visibility of military equipment, and protect radio-electronic equipment from electromagnetic weapons.
- Products that protect humans from the effects of electromagnetic radiation from stationary and portable personal computers, tablets, mobile phones, and medical equipment.
- Individual covering equipment to protect people from the effects of microwave range electromagnetic radiation.
- Devices for protecting information entered in biometric passports from unauthorized access.
- Flexible and solid-state modules for lining walls, floors, and ceilings of anechoic chambers.

nil53@bsuir.edu.by
smu@bsuir.by
tel.: +375 17 293 89 39
BSUIR, 6 P. Brovki str., Minsk,
220013, Republic of Belarus

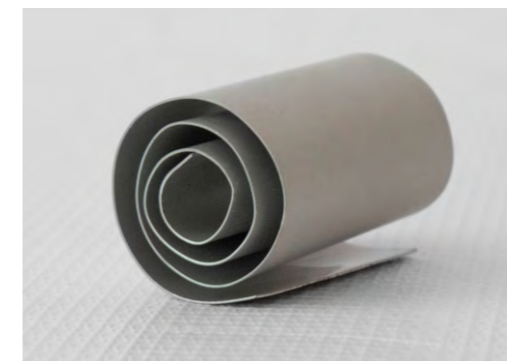
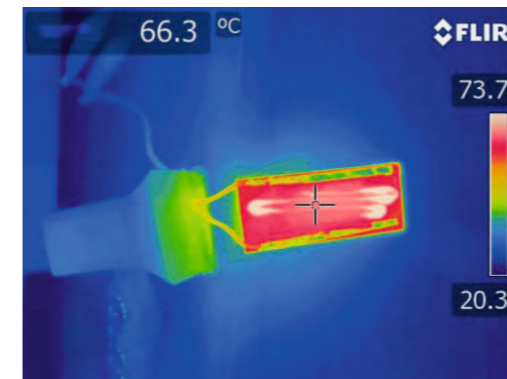
New functional materials

Developed technologies for the production of:

- Flat aluminum heating elements.
- Selective light-absorbing composite coatings.
- Screen films designed to maintain the confidentiality of information demonstrated on a display.
- A belt-type desiccant based on aluminum oxide nanofibers.
- Thermally conductive circuit boards based on anodized aluminum with copper metallization.

- Production and supply of specialized semi-automatic equipment for anodizing processes.
- Organization of a production site for electrochemical processes.
- Conducting R&D, scientific examination, consulting, and training of personnel.

vrublevsky@bsuir.edu.by
tel.: +375 17 293 89 40
BSUIR, 6 P. Brovki str., Minsk,
220013, Republic of Belarus



Micro- и nanotechnology

■ INTEGRATED MICRO- AND NANOSYSTEMS



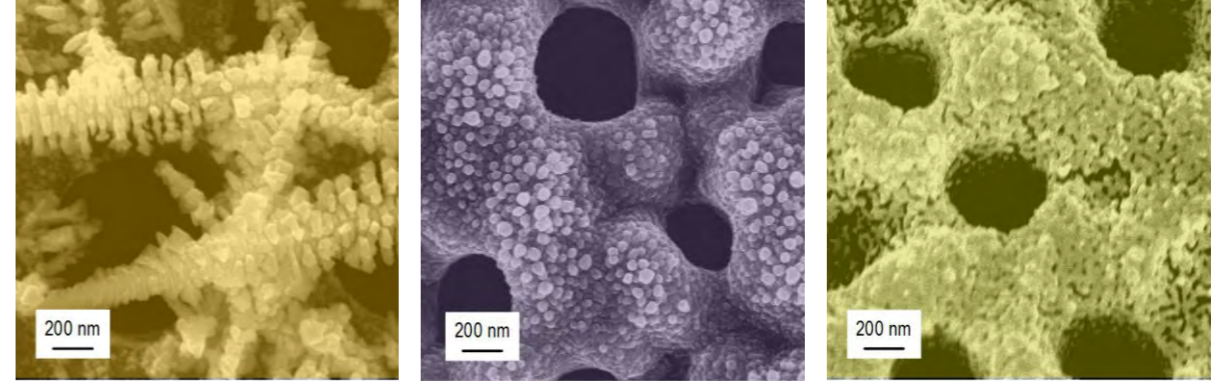
■ We offer the following services:

- Design and production of micro- and nanoelectronic devices.
- Synthesis and study of carbon nanotubes and organic molecular nanocrystals.
- Design and production of micro- and nanoelectronics based on carbon nanotubes and organic molecular nanocrystals.
- High temperature annealing up to 1000 °C of samples and materials in specified gas environments.

■ We offer services on the development and manufacture of vacuum processing equipment for deposition of thin films of organic and inorganic materials on experimental samples.

We provide services on equipment modernization and expansion of the gases used, depending on the customer's requirements and objectives.

labunov@bsuir.by
kashko.ivan81@bsuir.by
tel.: +375 17 293 88 03
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus



■ MATERIALS AND STRUCTURES OF NANOELECTRONICS

■ Developed:

– Electrostatic jet and matrix solid propellant microthrusters for nanosatellites

Created using the MEMS technology. They are used in moving systems for small spacecraft of the CubeSat format with dimensions of 1U – 3U.

– Flexible copper electrodes for electrophoresis

The electrodes are made of nanostructured copper foil incorporated into a soft polymer material, which ensures a tight fit to curved surfaces and resistance to repeated twisting and bending.

– Multi-probe flexible contact devices for measuring electrical parameters of integrated circuits on a wafer

Manufactured using the MEMS technology. The arrangement of contacts is specified for a specific configuration of contact pads on a semiconductor chip. The number of contacts can reach up to 4000 pcs/cm².

– Integrated waveguides based on oxidized porous silicon

Designed for creating optical interconnections between elements of integrated circuits or microassembly crystals, as well as in optical information processing systems. Have optical losses less than 1 dB/cm.

vitaly@bsuir.edu.by
tel.: +375 17 293 88 43
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus

■ We offer the following services:

- Production of porous silicon by electrochemical anodization.
- Obtaining of arrays of silicon nanowires by metal-stimulated chemical etching.
- Galvanic and chemical coating of metal and semiconductor products and substrates with films of metals and alloys.
- Chemical and electrochemical formation of thin-film coatings from semiconductor compounds.
- Modeling of electrophysical and thermal processes.
- Measurement of parameters of semiconductor devices.
- Measurement of optical characteristics of semiconductor and dielectric materials.
- Measurement of electrophysical characteristics of photodetectors, photocatalytic coatings, electrodes of energy storage devices.

■ NANO-ELECTRONICS AND ADVANCED MATERIALS

■ Research areas:

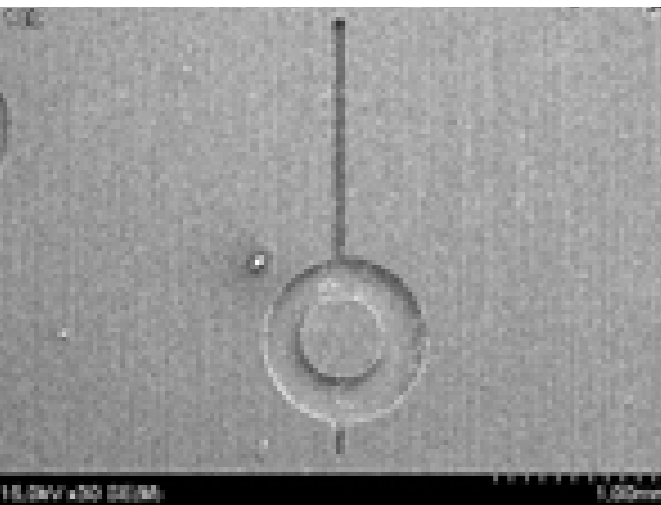
- Silicon and germanium nanostructures and their application.
- Nanostructured oxides of valve metals and their application for photocatalysis.
- Spintronics and quantum calculations.
- Semiconductor compounds for optoelectronics and photovoltaics.
- SPM-based studies and nanotechnologies.

■ We have developed:

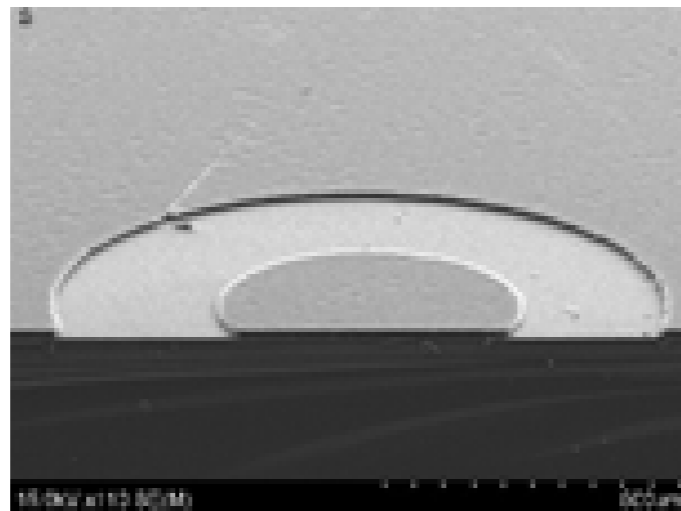
- **Design technology for spintronic elements of integrated circuits.**
- **Technology and materials for photocatalytic purification of water from organic contaminants in a flow-type reactor.**

Geography of cooperation: [Belarus](#), [France](#), [Belgium](#), and [Sweden](#).

andrew@nano.bsuir.edu.by
tel.: +375 17 293 88 69
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus



Imaging on aluminum



Imaging on aluminum

■ NANOPHOTONICS

■ Research areas:

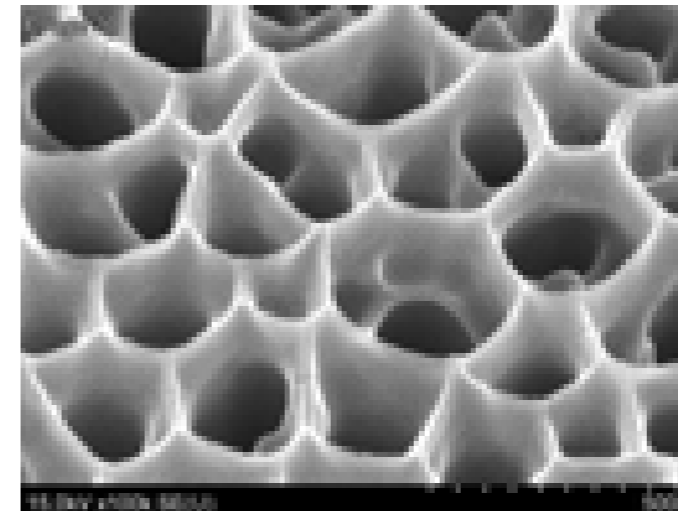
- Sol-gel film structures.
- Luminescent structures with optical anisotropy and two-colour images based on porous anodic aluminum oxide.
- Film structures containing quantum points of silicon and germanium.
- Power-independent memory condenser structures and elements, including quantum points and magnetic ferroelectrics.
- Film devices converting X-ray radiation into visible light.
- Photocatalytically-active films for water purification systems.
- Nanostructured silicon powders with high-melting-point metals for combustion and photocatalysis.

■ We offer the following services:

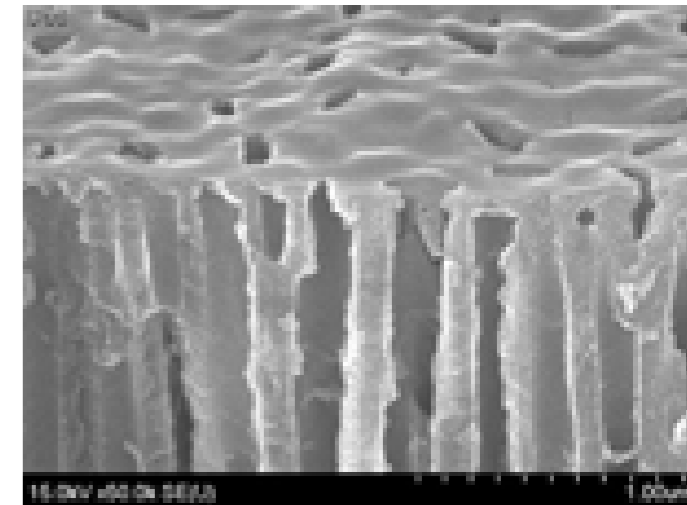
- Staff training in the field of sol-gel technology application in the development of optical converters and radiation filters.

Geography of cooperation:
[Belarus](#), [Russia](#), [Ukraine](#), [Poland](#), [the UK](#), [France](#), [Tunisia](#).

nik@nano.bsuir.edu.by
tel.: +375 17 293 88 69
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus



Matrix film converters of ionizing radiation



Matrix film converters of ionizing radiation

Applied plasmonics

Energy-saving electrodeposition equipment

■ SERS-active substrates have been developed

to improve the sensitivity of Raman spectroscopy. They are used for the detection of single molecules and high-precision molecular analysis of liquid and gaseous media. The original geometry and composition of SERS-active substrates ensure amplification of the Raman signal from molecules in the analyzed media not only due to surface plasmon resonance in the micro- and nanostructures of the metal, but also due to the re-reflection of optical radiation in the cavities between them.

- We develop a protocol for the analysis of target analytes.
- We supply software for processing the results of spectral analysis, including databases of spectra of a number of analytes.
- We supply kits for self-production and testing of SERS-active substrates.
- We provide scientific and technical services (examination, consulting and personnel training).
- We are interested in carrying out joint research and development projects.

■ We offer custom design of the following equipment:

– Energy-saving program-controlled equipment for cathode/anode processing using a direct, impulse and alternating current.

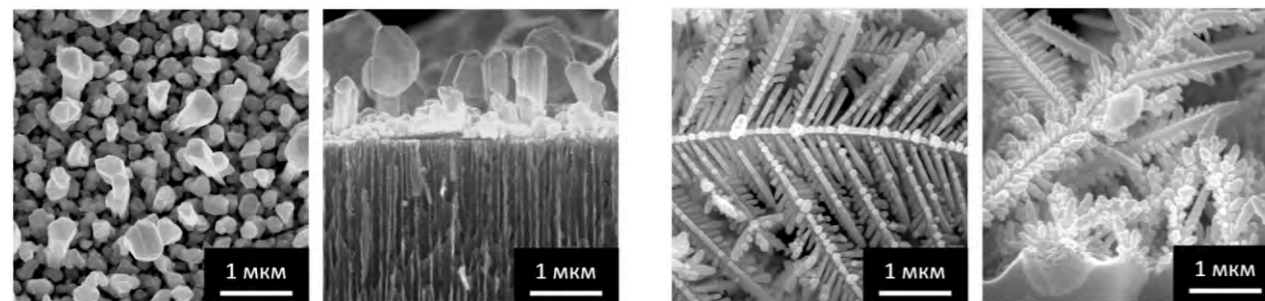
– Generators of current (voltage) pulse sequences of complex shapes for coating in a single technological cycle. The coating process may include up to ten sequentially applied micro- and nanolayers with various composition and physical properties.

■ We provide services on equipment assembly, launching into industrial operation, maintenance and support, as well as personnel training.

■ Alternative processes for the anode or cathode electrodeposition of protective coatings maybe developed on customer request.



A set for teaching the methods of nanostructure synthesis from metals for high precision biosensors as well as for molecular analysis



Examples of micro- and nanostructures in SERS-active substrates based on silver particles on nanostructured silicon

Examples of micro- and nanostructures in SERS-active substrates based on silver dendrites on nanostructured silicon

ghiro@bsuir.by
tel.: +375 17 293 84 52
BSUIR, 6, P. Brovki, Minsk
220013, Republic of Belarus



Computer-aided design of technological processes and device architecture

Design and simulation services

■ Research areas:

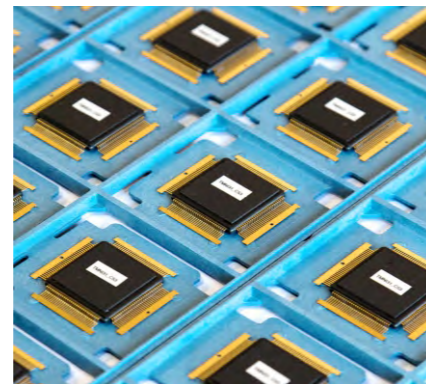
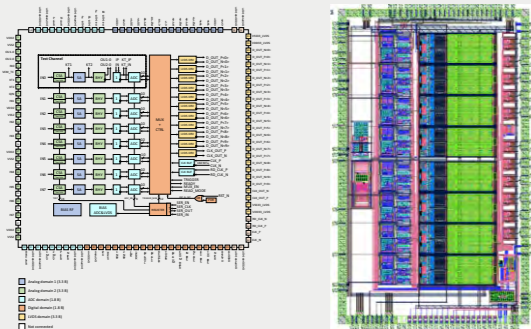
- Computer-aided design of technological processes and device architecture.
- Design and industrial manufacturing of customized (analog, digital and mixed) integral circuits.
- Quantum-mechanical and molecular-dynamic simulation of properties of functional materials and nanostructures.

■ Software available for use:

- Silvaco (for modelling of devices and technologies).
- VASP (for quantum-mechanical and molecular-dynamic simulation).

The R&D Lab possesses an academic licence on Silvaco software as well as is the only official group of VASP users in the Republic of Belarus.

- Systems for real-time monitoring of parameters of charged elements fluxes (ion energy and ion current density) and of neutral atoms (deposition rate).
- Cadence (circuit and system-level engineering).
- Open source software.



lovshenko@bsuir.by
tel.: +375 17 293 84 09
BSUIR, 6, P. Brovki Str., Minsk
220013, Republic of Belarus