World of MEPhI

Special issue «Science»

«ONE EXPERIENCE IS MORE THAN THOUSANDS OF OPINIONS, BORN ONLY BY IMAGINATION»

M.V. LOMONOSOV

NEWS

MEPHI PHD STUDENT VLADISLAV VOROBYOV WAS AWARDED A MEDAL BY THE RUSSIAN ACADEMY OF SCIENCE

December 10, awards ceremony was held at Russian Academy of Science, following the results of the 2018 competition. Medals and prizes were presented by the Vice President of the Russian Academy of Sciences, Academician Valery Kozlov.

PhD students of Scientific & Educational Centre NEVOD (Institute of Nuclear Physics and Engineering) Vladislav Vorobyov got a prize in the field of nuclear physics for his work «The investigation of cosmic ray muons by the coordinate-tracking detector based on the drift chambers”

In total, 606 scientific works of 744 authors were submitted to the competition. Among them were 201 students (starting from the first year) of higher educational institutions and 543 young scientists. The expert commissions of the Russian Academy of Sciences, in agreement with the specialized departments of the Russian Academy of Sciences and the Russian Commission for Youth Affairs, identified 80 authors (54 young scientists and 26 students) as winners of the competition.

PHYSICISTS EXPLAIN THE EVOLUTION OF SUB-SPACES

Physicists at National Research Nuclear University MEPhI have proposed a model for the evolution of sub-spaces at high and low energies. According to the researchers, with this model, it will be possible to clarify how the Universe was formed, as well as to indicate the ways of survival in the face of its gradual cooling.

According to experts, today, the most common base for theoretical research in physics is the idea that, apart from the well-known three spatial and temporal dimensions, there are some extra ones. It is assumed that the size of the extra dimensions is so small that they can not be detected with modern equipment.

Scientists at MEPhI, together with their colleagues from Kazan Federal University, have studied why the Universe has grown to gigantic size, while the sub-spaces remained microscopic. The study was based on the Big Bang theory, which resulted in the creation of our world as well as the Universe growing.

“We’ve found out that everything depends on the initial form of the additional and main spaces. For example, if you are on top of the mountain and you slide two balls into the valley, even if at first they are close to each other, they may end up on different sides of the pass,” Sergey Rubin, professor at the Department of Elementary Particle Physics at MEPhI, told Sputnik.

According to Rubin, the scientists will study the role of extra dimensions in the observed physical phenomena and in the early Universe, as well as study whether the size and shape of extra dimensions are the same in different areas of space.

The researchers noted that the observable physical parameters are quite numerous: particle masses, their charges, the number of types of particles and so on. Therefore, scientists believe that the sub-space that describes them must have a rather complex shape.

Successive restoration of this shape is a difficult task, which will take more than a dozen years to resolve.

The scientists emphasised that, like all basic research, the study is an attempt to obtain new knowledge that will be used in the future to preserve civilization in the Universe, which is gradually cooling after the Big Bang.

The study results were published in European Physical Journal C.

THE INTERFACE BETWEEN DIFFERENT SCIENCES

FIGHTING CANCER WITH PHYSICS: WHAT WILL SURPRISE NANOBIOMEDICINE

Biomedicine is a rapidly developing, promising area of science. Why did physicists come to biomedicine? What applied scientific problems do they solve today? How can be used nanotechnology for early diagnosis of cancer or brain scans? Professor of MEPhI Institute of Engineering Physics for Biomedicine, Victor Timoshenko told us about it.

— Victor Yuryevich, what scientific problems does biomedicine solve today?

We serve the goal of creating new methods for diagnosing and treating diseases and improving people's quality of life. It is very interesting because living system is one of the most mystery and inexperienced areas of science, where you can use equipment and methods very productive.

We research and modified the physical properties of the particles. After that, together with biologists and physicians, we make experiments with biological models to identify ways to apply them further.

For example, to solve global problems as oncological, infectious and degenerative diseases treatment.

Now we are creating drugs for early diagnosis and gentle treatment of cancer. In the near future we will research the nanoparticles and nanomedicines for treatment of cardiac and infection diseases, as well as for better quality of life, fight against free radicals and reduce the negative effects of environmental pollution. All this we can do with help of modern nano- and biotechnologies.

- Do you and your colleagues develop nanomaterials?

- It is our specialization. We are physicist and we know a lot about laws of physics, for example about modification of materials and creating new ones.

For example, we can create available materials, modified them both to set the desired properties and to research by different methods. It is our normal working process.

- Which scientific discovery or research of your employees do you suppose is the most important at this moment?

- In my view, our main achievement in the field of theranostics is the combining processes of diagnosis and therapy by using nanoparticles. In some cases, nanoparticles can give optical or magnetic resonance (nuclear) response. These particles can be use also as molecularly targeted therapy, which reduce the time of diagnosis and treatment. For cancer patient it is critical. We are looking for methods to remove a cancerous tumor for the minimum time with the least harm to the patient.

- When research results will be put into practice?

- We believe that it will be quickly. We are working on it. Nevertheless, there is some binding rules, clinical trial. Implement and producing specific drug take at least three years.

Most likely, our drugs will be agents with enhancing and improving characteristics or contrast material in diagnostic studies such as MRI.

- Which new research are you going to undertake?

- There is a lot of them. It will be very helpful to integrated into research new people.

It is important to expand the range of materials and methods, because diseases are all very diverse. For example, cancer have a wide number of varieties. We have focused on treating certain types of tumors. However, there are other oncological diseases, such as leukemia.

Brain diseases also, in many ways, remain a mystery. We would like to try new methods in this area by using composite particles and carbon-based particles and by using nuclear medicine methods. We could scan areas of the brain and find nanoparticles that would show where the problem area is.

- Are you ready to recruit any students?

- First, a student should study well and have no doubt that this work is interesting and helpful. He also should have good theoretical knowledge in physics and biology and should have specific competencies in chemistry. Moreover, he should be an enthusiast.

IT-technology and business sector draw the youth over to its side. There is no secrets. Sometimes it interrupt scientific work. I think that a student should be in tune for solving scientific problems.

FUTURE PLANS

A SERVANT, A FRIEND, OR AN OWNER: WHAT AI WILL BECOME FOR MANKIND

Specialists in the field of human-level artificial intelligence are currently facing the necessity of dealing with not only scientific, but also ethical issues. What are the challenges that scientists are confronted with? How can we safeguard humanity from potential threats? Professor Aleksey Samsonovich of the Institute of Intellectual Cybernetic Systems at MEPhI has shared his stance on these issues and more.

Sputnik: Aleksey Vladimirovich, we are now talking within the framework of the international conference titled “Biologically Inspired Cognitive Architectures”, BICA 2019. Which talking points are now taking centre stage in light of the creation of human-level artificial intelligence?

Aleksey: The conference has let us again come to realise the key challenges in the creation of next-gen artificial intelligence. To start with, it may be considered a challenge to create human-level emotional intelligence capable of exploiting emotions when making decisions and generating behaviour. More specifically, this ability will enable the machine to set up long-term social connections similar to relationships between people that are close to each other. It will also enable it to explain its moves and decisions, to pick goals and a way of learning.

Emotional intellect is a key to solve all the other challenges. It is not limited only to an ability to detect and express emotions, which most researchers working in the field are preoccupied with. it is difficult to understand how the two are interconnected – something that emotional intellect actually provides.

Secondly, an intelligent agent should grasp the context of what is going on. It means that based on the available information, he should be able to generate and constantly update the global scenario of the past and present, determine his own role in it, and then, based on this, set clear-cut goals and ways to achieve them. In scientific literature, this very capability is referred to as “narrative intellect” (one shouldn’t confuse it with programs that work in line with the scenario or narrative, pre-written by a person).

Sputnik: Is there also a third challenge?

Aleksey: This is the course to take to teach artificial intelligence, which, like humans, will work out the system of its values that will motivate it throughout learning, as well as to set goals, a roadmap for learning, along with choosing methods and, pushed by its own initiative, use these means to achieve its goals. The machine should be also capable of developing from a children’s level to an adult level and beyond, to super-intellect.

This third branch can be called human-level learning intelligence to differentiate it from “deep learning”. Human-level learning intelligence will be rendered possible based on emotional and narrative intelligence.

Sputnik: What kind of research are you currently conducting? How is your work going on virtual human assistants and emotional intelligence modelling?

Aleksey: We are modelling human emotional intelligence seeking to develop socially compatible virtual assistants based on our models.

We are looking into a great variety of concrete goals and branches of research. For instance, this is about the creation of a virtual partner in a video game, a virtual coordinator, or moderator; a virtual creative assistant to a composer, a choreographer, designer, solver of insight tasks; or a virtual listener (soon it will be a virtual interlocutor), as well as a virtual pet that will be comparable to a real one in terms of its social-emotional characteristics.

It is rather challenging to share the results in detail here, but they are available in open-source study papers. Despite the vast nature of our attempts and successes, we are in need of a breakthrough in one direction: in the explanation of the practical value of the general model of human emotional intelligence embodied in an intelligent agent.

Not long ago, our laboratory, BICA Lab, at the department of cybernetics at MEPhI, was empowered with brand-new research techniques, including an experimental platform based on virtual and mixed reality (with monitoring the direction that the subject’s eyes take), as well as electromyography and automated facial expression analysis, which enable us to register the emotions of the test subjects immersed in virtual surroundings.

A big share of our research is now conducted using these techniques. Some experiments also involve electroencephalography and functional magnetic resonance tomography (functional MRT).

Our immediate super-task is the improvement and empirical validation of social-emotional cognitive architecture “eBICA” and the development of catchy demonstrations based on it. This research is being conducted at MEPhI and financed by the Russian Science Foundation (grant number 18-11-00336).

Sputnik: Elon Musk’s start-up has recently announced research that may at some point transform humans into cyborgs capable of managing computer programmes with the power of thought. How promising do you think this branch of study is?

Aleksey: I think artificial intelligence should become, on the one hand, a full-fledged partner and friend for humans, and on the other hand, an extension of normal, or replacement of lost human capabilities, including means based on a direct interface with the human brain.

In this case, humans would literally be able to use a computer or microchip as part of their brains. Both are meant for good and must be fully controlled by their creator. I wish Elon Musk all possible success.

Sputnik: How great is the necessity to develop the ability to oppose artificial intelligence?

Aleksey: I think, humans will be in full control of AI. If there is anyone capable of making it rise against humans, these are only humans themselves. Then the question arises about the means to oppose those humans.

It is no secret that AI is mostly needed by the military. Today, like in the past, new assault and defensive methods and techniques are being created, but the distinguishing feature of our time is that both contain AI. In this respect, the importance of the development of assault means is really huge and some countries prioritise it from a financial point of view.

Sputnik: What awaits us after the creation of AI that surpasses human intelligence? Will we co-exist with machines or merge into some single entity?

Aleksey: AI will become (and is already becoming) an indispensable part of human civilisation. However, there could be two ways that this could unfold: AI potentially inheriting our values, hopes, and ideals, or replacing them with “machine values” that will spread not only on to machinery, but also human society. It depends on us which of the two scenarios will be fulfilled.

Sputnik: What does it mean to remain humans in the AI era?

Aleksey: To remain humans in the AI era means to take the first course of action.

Source: Sputnik

MEGA SCIENCE

TO NEW PHYSICS – ALMOST AT THE SPEED OF LIGHT

There are rumours and legends surrounding the activities of CERN (European Organisation for Nuclear Research). What technologies have been created with their help? What has the discovery of the "God Particle" led to? Will the collision of particles in the Large Hadron Collider destroy our planet?

With the advent of Einstein's theory of relativity in physics, an era that saw a variety of fundamental models began, which to this day cannot be combined into a single system. Today, it's high-energy physics that provide the most accurate data about the structure of matter. CERN's collider studies the processes of production of fundamental particles using collisions of protons and nuclei, which are accelerated to speeds extremely close to the speed of light. This allows one to verify theoretical predictions and discover new physical states of particles.

The standard model, which had been created by the 1960s, is a system of particle physics theories that explain most, but not all fundamental phenomena: for example, it doesn't explain gravity. To clarify this model, the Large Hadron Collider (LHC) was created.

The LHC is a ring-shaped tunnel operating at a depth of a hundred-metres with a circumference of 27 km, inside which more than 1,200 superconducting magnets accelerate particles to collide at a speed of 0.99999999 the speed of light. Apart from the LHC, CERN has six more accelerators and a number of detectors that record the results of particle collisions.

The volume of information produced by the detectors is estimated to comprise tens of petabytes (tens of millions of gigabytes) per month. The data produced by the centre's laboratories are processed using a multilevel network, the nodes of which are located in universities and research centres in 40 countries, including Russia.

The discovery of the Higgs boson in 2012 was the finale of the grandiose work to confirm the standard model. Today, a number of parallel experimental programmes have been launched on the basis of CERN, dedicated to both checking the accuracy of the standard model's predictions and searching for manifestations of the "new physics".

"It's impossible to know for sure the direction of scientific research that will lead us to new technologies. Therefore only research on fundamental problems, which involves overcoming the boundaries of what is currently possible, can guarantee the development of applied science," Anatoly Romaniuk, a member of the ATLAS collaboration and professor at MEPhI, explained.

The need to process a huge amount of data has made the CERN one of the hotbeds of computer technology. In addition to the World Wide Web, the centre has also greatly influenced the distributed computing technology.

Scientists are especially proud of the work to reduce the physical dimensions of accelerators. Miniature accelerators are already actively used to scan the internal structure of objects.

The associated visualisation technologies are also being developed at CERN. The Medipix Collaboration is adapting the technology used to monitor particle collisions for diagnostic applications. The fourth generation of chips is already being developed, which allows both receiving 3D scans of the human body and monitoring of various kinds, including in space conditions.

In addition, unique experimental conditions make it possible to study the effect of cosmic radiation on climate formation and to develop methods for protecting electronics from it for the aerospace sphere.

CERN has unique expertise both in a number of production competencies and in process management, which makes it an avant-garde hub of 4.0 industry, influencing knowledge-intensive business all over the world.

In total, CERN has several dozen collaborations or experimenters, who are pushing the horizons of science in different directions. The largest of them, ATLAS and CMS, are aimed at searching for new elementary particles, dark matter, and other new phenomena. LHCb studies antimatter and ALICE specialises in studying the state of matter during the first microseconds after the Big Bang.

Rumours and alarming theories often appear with regard to the work of the LHC, and, fortunately, they have all been refuted: neither microscopic black holes, which really can occur in the collider for a split second, nor the mysterious magnetic monopole can destroy the Earth. But there is always the possibility of making a discovery that will turn everything upside down – in a good way.

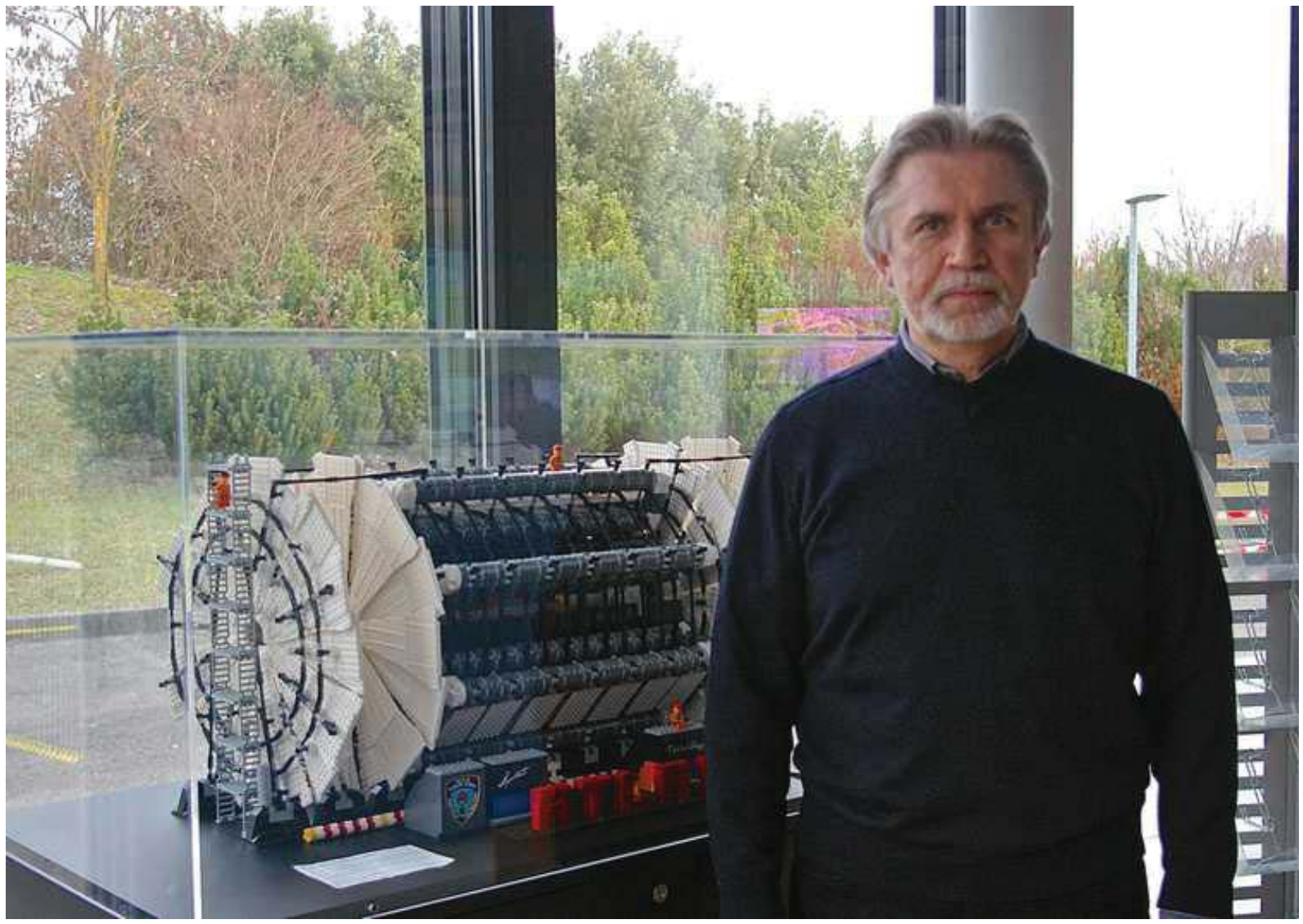
To improve the efficiency of observations at the LHC, a modernization project is being implemented, which will turn it into a "high luminosity" collider (HL-LHC). It's believed that the upgrade will busy scientists with data until about 2035.

As scientists plan, the LHC will be replaced by either the Future Circular Collider, with the circumference of about 100 km, or the Linear Collider, an accelerator of a completely different type. These projects are aimed at a detailed study of the Higgs boson.

"The brightest minds working in various fields of physics and technology from around the world gather at CERN. There is no such level of professional communication, such an exchange of experience anywhere else," Anatoly Romaniuk told Sputnik.

Today, about 2,600 scientists and engineers work at CERN. More than 12,000 physicists from 85 countries take part in the centre's experiments, including more than a thousand Russians. Over the years the centre has expanded from 11 to 23 member states.

The material is based of the lecture "The Large Hadron Collider: The History and Future of CERN Research," held at the MIA "Rossiya Segodnya," and was prepared with the assistance of scientists from MEPhI.



PROSPECTS

DIGITAL HOLOGRAPHY: SCI-FI BORDERING ON REALITY

Digital holography refers to the acquisition and processing of 3D information using digital cameras. It already has a wide practical application and in the future, as scientists claim, it will be indispensable in many areas, ranging from medicine to astronomy.

Physical Principles of Holography

Holography is a method of recording information about an object and restoring its image on a three-dimensional surface by measuring not only the amplitude of light (as in photography), but also its phase.

Recording holograms is done by registering the total amplitude of two light beams: a signal beam (reflected from the object or passed through it) and a reference beam. If the beams are coherent, a picture is formed in the plane of their superimposition, which is recorded by photodetectors.

"The extensive development of digital holography has recently begun with the advent of high-quality digital cameras, but several impressive results have already been obtained", an associate professor at the National Research Nuclear University MEPhI, Pavel Cheryomkhin, explained.

Global Trends

Digital holography allows you to create a real three-dimensional visualisation of objects and scenes. At the same time, no special glasses or positioning of the observer is required for observation. Nowadays, 3D-displays are being actively developed, enabling high-quality images to be visualised. Scientists say that soon full-colour hologram images will come close to photos in terms of the quality of colour rendering.

Holography-based 3D printing is a promising trend. The image is divided into projections by sections, and then each projection is printed in layers under programme control.

The fields of digital holography applicable in scientific and applied research are being actively developed: digital holographic microscopy (DHM) and interferometric microscopy.

Moreover, digital holography is already being widely used in medical and biological imaging, data encryption, transmission and storage systems, as well as making it possible to increase the security of products, banknotes, and bank cards.

Russia's Achievements

Today, some universities and companies are conducting holographic research.

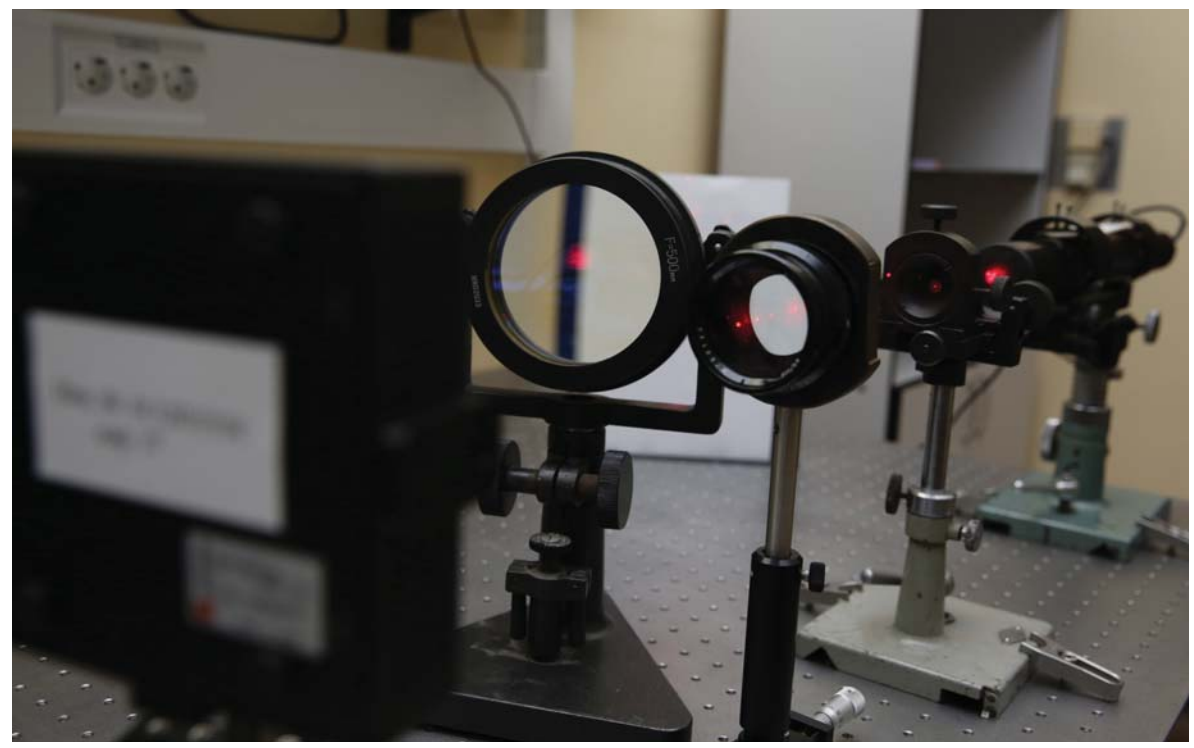
For instance, MEPhI has developed a system of dynamic recording, transfer, and real-time optical demonstration of holograms with a resolution of at least two million pixels. This system allows rendering scenes and objects recorded in both optical and infrared frequencies.

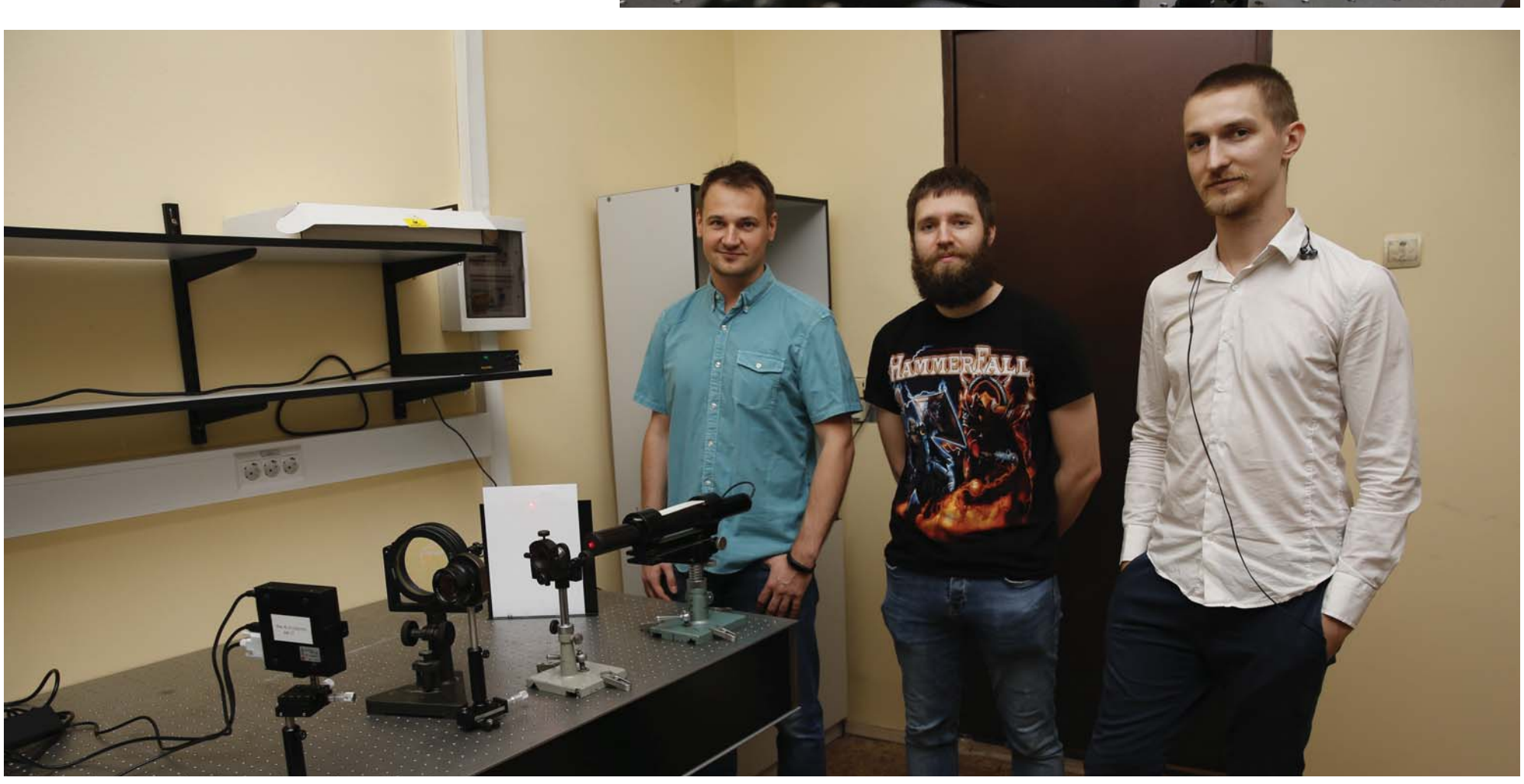
Today's holographic video transmission requires a channel with a bandwidth of at least one gigabit per second, which is why digital holographic conversion and compression technologies are of great importance. MEPhI is actively working in this direction as well. In May 2019, scientists at MEPhI presented a method for compressing the holographic information by hundreds of times.

Another important field is improving the quality of the optical display of 3D scenes from recorded holograms. MEPhI Institute of Laser and Plasma Technologies (LaPlas MEPhI) is developing methods to improve computer and real optical display of holograms using multi-gradation liquid crystal and high-speed binary spatial light modulators.

Holography is applicable not only for storage, but also for information protection. MEPhI scientists are currently developing data coding systems that use the image recorded on the hologram as an encoding key.

Another important area of research is object recognition. Today, recognition devices usually use only spatial features. MEPhI has recently proposed a method of simultaneous recognition by shape and spectral characteristics, which can be used, for example, in orientation systems in space or for identification of species.





IN TOUCH

RUSSIAN ASTROPHYSICISTS CLOSE TO UNRAVELING ORIGIN OF THE UNIVERSE

Russian astrophysicist Gennady Bisnovatyi-Kogan, Chief Researcher at Space Research Institute of RAS, has achieved significant progress in the possibility of testing the “Zeldovich pancakes” model, which describes the formation of the Universe.

According to the scientist, this could be a major breakthrough in fundamental physics and cosmology. The research data were published in Astronomy Reports magazine.

The birth of the Universe as we observe it is the most important scientific problem. Although the Universe is now heterogeneous, at birth, according to scientists, it consisted of completely homogeneous plasma. The Big Bang launched an expansion of the gradually cooling plasma, which instabilities led to the formation of the observed structure – galaxies and their clusters, stars and planets.

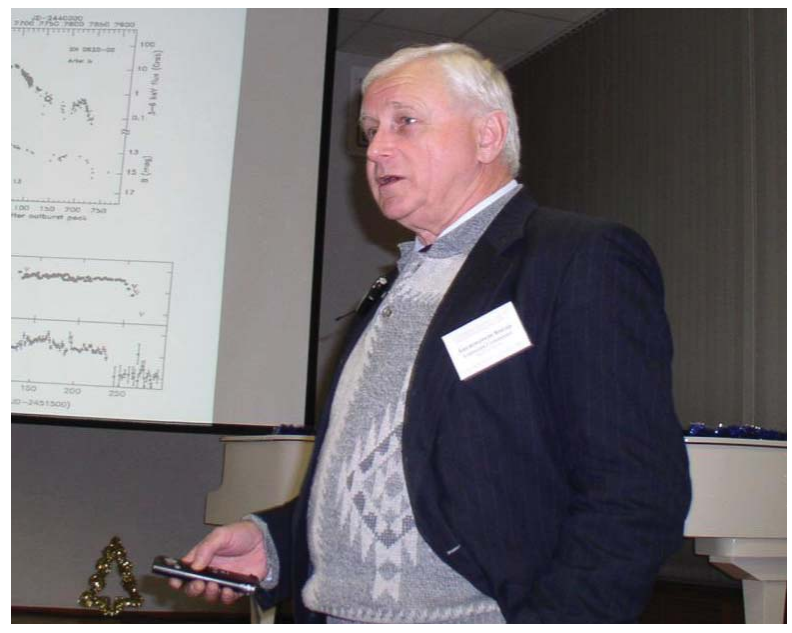
One of the most authoritative models explaining the genesis of instabilities and the emergence of the first stationary large-scale objects was proposed by famous Soviet physicist Yakov Zeldovich.

The model is based on the hypothesis of the primary collapse of large masses – massive gas clouds, like clusters of galaxies – which results in the formation of “Zeldovich pancakes.” Their shape is due to the fact that when a figure, different from the sphere, is formed, its smaller side always shrinks faster, thereby forming a “pancake.”

“We’ve obtained an approximate solution for the shape of the relict background spectrum after being scattered by plasma that rapidly shrinks in a flat layer due to self-gravity,” Gennady Bisnovatyi-Kogan explained.

The relict background is the radiation left after the cooling of the primary plasma, which fills the entire Universe. For astrophysicists, it serves as a kind of screen that, due to changes in its spectrum, allows recording events of the Universe formation period. It is the interaction of relict radiation with the rapidly contracting ionised substance of the “pancake” that leads to such distortions.

“Passing through the compression region, the background radiation has a slightly different shape than other possible distortions. If my calculations are confirmed when observing background fluctuations, this will support the Zeldovich model,” Gennady Bisnovatyi-Kogan said.



In the future, the scientists want to numerically simulate the bulk-comptonised spectra formed during the formation of “pancakes”. This will help clarify the shape of the calculated spectra. An increase in the equipment sensitivity is necessary to search for the form of deviations from the Planck spectrum in local regions of the sky, which is extremely important for further studying the relict background and determining the model for the large-scale structure formation.

THE NATIONAL RESEARCH NUCLEAR UNIVERSITY MEPHI CONDUCTS JOINT RESEARCH WITH TOKYO INSTITUTE OF TECHNOLOGY

MEPhI won a state grant for joint research with the Tokyo Institute of Technology. Russians and Japanese will study the properties of corium at the Fukushima nuclear power plant in order to develop a universal method for determining the characteristics of any sources of radioactive contamination.

Using data provided by the Japanese side, MEPhI specialists will develop methods for determining the characteristics of corium – nuclear meltdown. In parallel, the same will be done at the Tokyo Institute of Technology.

Universities have been friends for a long time – a framework agreement on cooperation was signed in 1993, and three years ago a program to interact with Russian universities was launched in Japan. Since then, students and teachers have gone to exchange practices and participated in forums.

The best minds around the world are engaged in the elimination of the consequences of the Fukushima accident, in particular the study of the properties of corium. Georgy Tikhomirov, the head of the grant work and deputy director of the Institute of Nuclear Physics and Technology at MEPhI, says what contribution the Russian university can make: “There are special codes – computer programs that calculate many parameters, for example, the isotopic composition of the fuel irradiated in the reactor. The effectiveness of such codes depends on the computer power and professionalism of users. MEPhI has extensive experience working with many codes, calculations are performed on our supercomputers as well. We will use several Russian and foreign programs in the grant project, and this is one of the important advantages. However, the programs must be adapted by further developing of the accompanying modules specifically for the task for which the grant is allocated. It means that first you need to describe on paper the methodology for determining the properties of corium, and then to create its software implementation.”

A significant part of the grant will be used to purchase a supercomputer for performing calculations for the project. The work is carried out by three laboratories of the Institute of Nuclear Physics and Technology.

Anton Smirnov, an employee of one of the laboratories: “First, we will determine the isotopic composition of the fuel from the Fukushima-1 reactor before and at the time of the accident. Then we’ll find out what elements left the fuel after the accident. So, we will be able to make a conclusion about the composition of the corium. Our laboratory is engaged in these calculations. The second laboratory will develop a method for determining the geometric characteristics of corium according to the isotopic composition we obtained and the detectors’ readings. The third laboratory will analyse the applicability of xenon gamma-ray spectrometers as part of the methodology for determining the characteristics of the corium.

The Japanese have accumulated colossal knowledge in the field of radioactive waste management and share this experience with us. They are also amazingly hardworking, organized. It will be useful for us to adopt some things, such as weekly meetings in each laboratory, obligatory individual meetings of students with the professor, their supervisor.”

MEPhI hopes for an additional effect from research. Firstly, all patented developments (and registration of patents is one of the conditions of the grant) will remain the intellectual property of the university. Secondly, modified programs can be used not only to model the consequences of accidents at nuclear power plants, but also for justifications of the safety of regular decommissioning. MEPhI specialists are sure that there will be a demand for such software.

YOUTH AND SCIENCE

YOUNG INVENTORS COME UP WITH SMART SNEAKERS

Pre-university students of MEPhI have created sneakers that can give directions, count a person's steps and tally the number calories burned, the university's press service said.

Navigation in unfamiliar places is a major problem for residents of large cities. Therefore, the popularity of mobile GPS devices has risen significantly. However, it's nonetheless sometimes difficult for users of such devices and apps to understand where to go. In addition, they have to regularly look at the screen to track the route, which distracts users from what's happening around them and increases risks on the road.

MEPhI pre-university students have come up with an original solution to this problem: they've created smart sneakers that can lead you to your destination. The idea is very simple: when you approach the turn to the right, the right shoe vibrates, and when you need to turn left, the left shoe vibrates.

"We've developed an electronic module that synchronizes with a special mobile app via Bluetooth and receives information about a route. The module performs all the necessary functions without interfering with walking and can be attached to the laces of ordinary sneakers. The user only needs to run the app once, and then put the phone away and enjoy the walk. In addition to navigation, the system can also track the distance travelled, as well as the number of steps and calories burned. This information can be found in the mobile app», Alexander Pinchuk and Maxim Levkin, the authors of the BiGiPiS project, said.

The team plans to continue developing the BiGiPiS project because the smart clothing market is growing every year. According to the creators of the project, it's likely that in a few years, smart sneakers will be comparable to smartwatches in terms of popularity.

"Our pre-university students have created rather original projects before. For example, last year our students developed a multifunctional orientation system for the visually impaired, and won an international children's competition for engineering teams; then they won the Junior competition and took part in the largest international competition: Intel ISEF. Now these guys are our first-year students, and this indicates the high level of our applicants», said Deputy Director of the Institute of Intelligent Cybernetic Systems of MEPhI Valentin Klimov

According to him, MEPhI students and young scientists are involved in other developments that make life easier for people, including those with disabilities. For example, university employees have created a wheelchair specifically designed for sedentary patients, which is controlled by vision. A student at the Higher Engineering School of MEPhI has created a bionic prosthesis that helps people with an absent limb return to an active life.

"Generally, students who are passionate about technical creativity become the winners of subject olympiads or engineering competitions, which gives them some advantages when they enter our university. As MEPhI students, they can continue engaging in technical creativity with numerous student groups, take part in international competitions and Olympic games and reach newer heights», Valentin Klimov concluded.

SCIENTIFIC EXCITEMENT HELPS TO MOVE FORWARD

Laili Sultanalieva, a graduate of the Department of Elementary Particle Physics of MEPhI and a post-graduate student of the Lebedev Physical Institute (LPI RAS), spoke about work on the ATLAS experiment at the LHC.

— Laili, why did you choose studying for master's degree at the MEPhI?

— I graduated from the Department of Applied Physics at the Tomsk Polytechnic University. Unfortunately, our department did not offer any study programs for master's degree, which would logically continue the field of studies for our group (physics of the atomic nucleus and particles). Therefore, I began to look for alternatives. Some of my friends had chosen MEPhI to continue their studies, so I received feedback and relevant information about enrolment from them. And since our group was given unscheduled lectures on experiments in high-energy physics and data processing, thoughts about the particle physics got into my head, and after submitting documents I chose Department 40 at MEPhI.

— Tell us about the post-graduate school of the LPI. Are you happy with everything from the point of view of studies and from the point of view of scientific activities?

— Considering that the LPI is a scientific institution, and not a university, the organization of scientific activities is at a decent level. There is a task, there is a supervisor who is always in touch and periodically arranges surveys on the current state of affairs, which stimulates very well to work. In addition, I was hired and assigned a workplace, which also helps to solve scientific problems.

— What does your research group do?

— I work with b or beauty physics. My task is to partially restore the B and D mesons according to the data of 2015-2018 from the ATLAS experiment. I didn't do data analysis before entering a post-graduate school. Consequently, I was familiar with the process only in general terms. Over the past couple of months, I have been well drawn into the work. It happens that nothing is going on well, and the working program indicates only fatal errors. But there is scientific excitement that makes you move on, understand, read materials, ask questions.

— Tell us more about your scientific task?

— The study of the processes of the production of heavy quarks is one of the important tools in verifying the predictions and calculations of quantum chromodynamics (QCD), which describes strong interactions. High energies of collision at the Large Hadron Collider (LHC) provide large values of the cross sections for the production of heavy quarks. For this reason, we are interested in D and B mesons are, which are produced in large numbers in proton-proton collisions in the LHC as a result of the hadronization of the charmed and beauty quarks (also called c and b).

The ATLAS experiment is a general-purpose detector, and B-physics involved in the study of hadrons containing heavy b- or c-quarks is one of the priority tasks of the experiment. During the period from 2015 to 2018, a large amount of physical data was collected in the ATLAS experiment at an interaction energy of 13 TeV. Based on these data, it is possible to measure single and double production of B and D mesons. A study of the pair production of the D meson will also make it possible to estimate the contribution of double parton scattering.

The task is divided into two parts. In the first part, we plan a partial reconstruction, selection of candidates and calculation of the differential cross section for the production of B mesons; in the second part, we do all the same actions for D mesons.