



World of MEPHI

BALL in MEPHI



"... And again girls in the rustling of dresses and gentlemen in a tuxedo are the hall. Smiles, sparkling glances, and... A dance is declared, and HE is going to you. Breathing seizes, you have not enough time to think, and he's already inclined in a respectful bow. You answer with a slight nod and give not your hand – but the whole you for a

few moments. Prelude sounds – the first chords are quite, then louder and louder! And you're already flying around the room in a waltz, almost not touching the floor... And it is not clear at this moment: if it your partner who leads so skillfully or it's the music itself. And this is not just a dance. This is a real mystery... It is a ball in MEPHI."

CHECK YOUR HEALTH WITH WATCH

UNIQUE BRACELET FOR HEALTH CONDITION MONITORING WORKED OUT IN MEPHI

Most people strive to follow themselves such health indicators as blood pressure, heart rate, monitoring of physical activity and others. Foreign companies as STBL Medical Research AG, Bredem, Beurer, OMRON, and GARMIN come to help them. They provide the market with bracelets, made in the form of a wristwatch. However, the functionality of the proposed solutions is insufficient for an exhaustive control over the user's health. For example, some devices can control only pulse, the other – measure blood pressure, and others can only calculate the number of steps.

An engineer of the General Physics Department Vitaliy Florentsev together with Innovative Small Enterprise "Kadetek" has offered to expand opportunities of multifunctional bracelets market using them for medical purposes. Pulsometer, tonometer, passometer, Holter monitoring, skin temperature- and moisture-measuring system, environmental temperature and air pressure sensor, data about running, cycling, swimming and GPS

are a list of functions to be incorporated into one device – a multifunctional bracelet Hgazer. The name comprised of «health» and «gazer» reflects the main idea of intense scrutiny of clients' state of health.

The system can automatically identify heart disorders comparing the received data with programmed limits and calculate statistical characteristics.

The bracelet conveniently fits the arm. An active optical sensor which allows controlling the pulse and measuring the oxygen level in blood by the intensity of reflection of radiation with different wave-length from blood cells is incorporated into the device case. The bracelet has sensors of temperature, skin moisture, environmental air pressure, positional checking. Information about subject's state can be shown at the main screen of the device as well as reading devices connected to PC.

The main advantage is the absence of numerous wires for ECG monitoring and application of modern specification detector PQRST-area



PS25251 EPIC UHI ECG Sensor. The developers have renounced electric motor-air pump into an air bag-cuff as well as the bag itself which make carpal tonometers inconvenient in everyday wear and consuming too much battery charge.

An alternative has been offered – a compact "breathing" silicone cuff

with channels full of liquid where pressure is made by piezoelectric ceramic pushers. The device is compact, energy efficient and noiseless.

The system is different from existing analogues because of the elements described above and it belongs to 2 classes: wearable electronics and medical equipment.

MEPHI CREATING HIGH-TENACITY SIALON CERAMICS

Interdepartmental laboratory of advanced technologies for creation of new materials is working on getting composite ceramics on the basis of sialons by spark-plasma sintering and research of their structure and characteristics.

Sialon is a promising material which can function in extreme conditions and is free-cutting by traditional instruments. Possessing high strength, chemical stability and thermal resistance, sialon-based materials are used at high-speed mechanical load, heat pulse, impact of aggressive chemical agents and abrasion particles. Depending on the additive, sialon-based materials are widely used not only as high-temperature construction ceramics (cutting tools) but also as functional materials (phosphor in white light-emitting diodes).

Production of solid composite sialon-

based ceramics uses a wide range of powder material consolidation methods. Nowadays the quickest and the most effective method of thickening of ceramics and other solid materials is the method of spark-plasma sintering. This technology allows getting materials with density close to theoretical value and the size of grains close to the size of the starting powder.

The method is the combined action of average mechanical pressure and electric current. Heating of current-conducting mould up to sintering temperature is made through pulse advancing of direct current. Usage of large currents and short impulses of 10-3 duration allows heating at high speed (up to 500°C/min) shortening the duration of sintering process and limiting the growth of powder particles.



Creators of the "Miotest-Symmetry", Department №7

SCOLIOSIS? STRAIGHTEN YOUR BACK! UNIVERSITY CREATES UNIQUE COMPLEX FOR STATIC SCOLIOSIS DIAGNOSTICS AND TREATMENT

Nowadays up to 92 % of children and nearly 70-90 % of adults suffer from static scoliosis. Spinal disorders provoke many internal organs diseases such as encephalopathy, cardialgia, gastritis, gastric ulcer etc. The disadvantage of the metrological method used now in medicine is its error of 6 mm or more.

Experimental Nuclear Physics and Cosmophysics Department with the participation of Kabardino-Balkarian State University has worked out a unique computer system "Miotest-Symmetry" for fundamental research, diagnostics and correction of movement stereotype disfunction (static scoliosis) at the early stage among children and adults.

The system is aimed at the introduction of new technology of com-

plex diagnostics and treatment of static scoliosis into diagnostic and treatment and educational processes of therapeutic and prophylactic, sanatorium-and-resort, sports and other specialized agencies. The realization of the project should reduce the prevalence of the disease at least 2 times.

The diagnostics system has been registered. It is planned to create a stabilometrical platform of foot pressure. The date is processed through a computer and a model of medical insole is worked out. Then a 3D-printer "prints" the insole, whose production cost will be about 300-500 roubles per unit.

The total amount of funds requested is 1.2-1.7 mln roubles. The expenditure will pay off within 2 or 3 years.



Developer of sialon ceramics, engineer of the Interdepartmental laboratory of advanced technologies for creation of new materials Evgeniya Nefedova.

TAMERS OF PARTICLES

MEPHI POST-GRADUATES HELP TO MANAGE RESULTS OF LHC EXPERIMENTS

At the moment several postgraduate students of MPhI Department №40 are undertaking internship in CERN, where they take an active part in research work related to conducted at LHC experiments. A postgraduate Daniil Ponomarenko talks about working in the lab to collect data from the TRT detector:

"A special system of control and data collection has been launched for successful analysis of data, received in proton-proton collisions at CERN. Since 1954 any detector cannot function without these systems.

The Transition Radiation Tracker (TRT) in the heart of the ATLAS experiment allows to measure tracks of charged particles and to separate the electrons from the pions. Members of the MPhI Department №40 have become a key contributor in the development of TRT and now together with colleagues from other institutions provide its support.

TRT Data acquisition system (DAQ) is a complex consisting of several levels of signals' digitization, formatting and data compression. The system operates in streaming mode and controls the internal time of the detector.

The collisions frequency at the LHC reaches record values of 100kHz and all systems, including the DAQ, should work successfully with such loads. This is a serious challenge for developers of DAQ architectural solutions and software.

TRT DAQ system is as follows: signals from each proportional counter in TRT are digitized by the analog chip and is sent to a special board (DTMROC), where several such signals build packets for a series of proportional counters. Then received packets go via patch-panels in the Read Out Drivers (or ROD). There signals are again combined into larger packets and after compression by special

algorithms are sent to a main system of the ATLAS experiment, which make the decision whether to record this event or not depending on the command from the trigger system of the experiment.

Software for DAQ control system was developed by the University of Pennsylvania in cooperation with Siemens. Now, in a short break of LHC work during the winter vacation, it has become possible to make the necessary up-

dates in the subsystems. TRT has replaced the computing power of DAQ from 32 to 64 bit systems that is associated with big changes in hardware and software systems. The group of MPhI takes an active part in these works".



The postgraduate student of the MPhI Department №40 Daniil Ponomarenko (left) with a colleague from the Manchester University is taking a course in radiation safety prior to the work with the TRT DAQ system

MEPHI LEARNES TO MEASURE NANO-HARDNESS OF ALLOYS

Hardness measurements on nanometer scale in linear dimensions are extremely important in the study of thin films and coatings, as well as in the study of properties of the individual phase and structural components of various alloys. Hardness measured at small depths of the probe (indenter) digging into the material is often called nano-hardness. The value of material hardness in the nano-volume is determined by pressing a sharp diamond tip with simultaneous registration of load applied to the indenter and displacement of the indenter under this load.

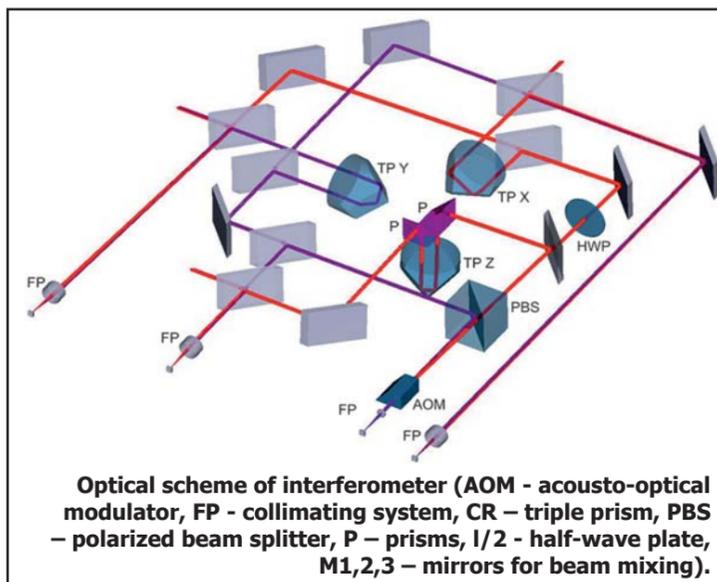
During the work of all nano-hardness testing machine there is a problem about determination of the indent tip's shape. It is known that dealing with solid surfaces, the geometry of the tip changes (blunting of the tip, grinding of edges, etc.). All these parameters affect the surface area of the probe's tip and, as a consequence, material characterization. Thus, reliable measurement of nano-hardness requires assurance of metrological control the indenter tip's shape with sub-nanometre accuracy.

MPhI Laboratory of Laser Diagnostics has worked out a three-coordinated heterodyne laser interferometer with polarization multiplexing of beams in a sampling and a reference arm. The author of the project is a student of 1st year doing Master's degree in MPhI Mariia Ponarina whose supervisor is Professor of the MPhI Department №37 "Laser physics", head of the Laboratory of Laser Diagnostics A.P. Kuznetsov.

Laser interferometry has been chosen as the basis for creating a system capable of characterization of sur-

face shape of nanohardness indentors which shows high accuracy and metrological precision of measuring. This optical scheme allows to incorporate interferometer into serially manufactured nanohardness testers. The range of measuring in three axes is 100x100x10 microns, measuring resolution is 0,01 nm.

Method offered by MPhI employees has higher accuracy and resolution and provides a possibility to trace measuring to meter standard through the wave length of frequency-stable He-Ne.



Optical scheme of interferometer (AOM - acousto-optical modulator, FP - collimating system, CR – triple prism, PBS – polarized beam splitter, P – prisms, I/2 - half-wave plate, M1,2,3 – mirrors for beam mixing).

CERN TO EXPAND PROGRAM OF NA61/SHINE EXPERIMENT UPON MEPHI'S INITIATIVE



A new program offered by MPhI scientists on beam momentum scan with Pb+Pb collisions at NA61/SHINE has been endorsed at the 120th meeting of SPS and PS experiments Committee (SPSC) which was held in CERN this January.

The program was presented by Associate Professor of the Department №67 Ilya Selyuzhenkov at the 119th Meeting of the SPSC Committee in CERN. He is the MPhI head of the research of collective flows in heavy-ion collisions in NA61/SHINE experiment responsible for preparation of this part of the program.

The analysis of data of the test of Pb nuclei beams with the energy of 30 gigaelectron-volt carried out in CERN in November, 2015, has played a key role in new program endorsement. This analysis has shown possibility to use a front hadron calorimeter for measuring of collective flows. The front

hadron calorimeter measures energy distribution of projectile nuclei fragments (PSD). It's notable that a new central module for PSD was used in the test which had been created last year in MPhI under the supervision of Department №67 Associate Professor, PhD Arkadiy Taranenko together with a group from INR RAS supervised by leading research worker Fedor Guber.

The first physical data of NA61/SHINE for Pb nuclei is expected in the end of 2016. Despite the fact that there is less than a year since MPhI has joined international collaboration NA61/SHINE, the University was able to quickly take a leading position in this international experiment, and even to determine its scientific program over the next several years.

Students and post-graduates take part in the NA61/SHINE experiment. Alexander Zaitsev and Svetlana Vdovkina were among the first MPhI students to participate in test in November, 2015.

Training of specialists who have experience of work in large international experiments is very important for future tests like hard-ion collision tests at NICA accelerator complex in Dubna.

BALL in MEPhI



Our University has held the 4th MEPhI ball dedicated to the Day of Defender of the Fatherland. The ball was organized by the school of historical dance "Chamomile waltz". In addition to students and employees of MEPhI it was traditionally attended by members of the Youth club of Peter and Fevronia.

The premier of the dance "Scarlet sails" opened the event. The soloists of the "Chamomile waltz" gracefully embodied a dream of the charming prince in their dance. After that a violin virtuoso Aleksey Alekseev inflamed the audience with energetic rhythms of the "Moldova" and music from "Pirates of the Caribbean".

It was followed by the main part of the ball – dancing under the direction of the dancing-master Alexander Anoshkin: Moscow quadrille, Russian lyrical and graceful pas de grace, cheerful polka and catchy French polka. Also there were complicated dances such as Russian quadrille and the waltz.

The ball was also attended by great knights (Roman Ryzhkin and Alexander Gordienko) in the armour of the Club of historical reconstruction "Bulat". It reconstructs everyday life, costume, military traditions of Russia of IX-XVI centuries.

And then again and again participants of the Spring MEPhI ball were dancing and playing fun games.

