

Memorandum of the Workshop
"Application of Charged Particle Accelerators in Studying Radiation Damage in Systems with a High Level of Organization (Space, Medical, Biological, and Technical Aspects)"
Dubna, 29 – 30 March, 2010

The Workshop was held to discuss the prospects of using basic facilities of the Joint Institute for Nuclear Research (JINR) for modeling the damaging effect of accelerated heavy ions on systems with a high level of organization: biological objects and electronic devices (microchips); and the prospects of therapeutic uses of accelerated carbon ion beams. Investigations in these fields have a common methodological background aimed at studying the radiation effects induced by accelerated heavy ions in objects of living and non-living nature – namely, the specifics of the transfer of energy by heavy charged particles to the matter of irradiated objects. As a result of multi-charged ions passing through micro- and nano-volumes, much energy is deposited there, which leads to damage in genetic structures and disorder in the element base of complicated electronic devices, etc. The high biological effectiveness of accelerated heavy ions along with the possibility of focusing charged particle energy in tumor tissues with high precision increases interest in using multi-charged ions in cancer therapy worldwide.

The Workshop participants listened to reports on JINR's basic facilities, physical characteristics of radiations they generate, and possibilities for their use in resolving the issues considered by the Workshop. The communications, focusing on different aspects of the biological effect of high-energy heavy charged particles, the use of nuclear physics methods in investigations of planets and physical calibration of space instruments, and radiation-caused failures of spacecraft electronics, emphasized the importance of taking advantage of JINR's potential as regards the problems concerned.

The Workshop notes:

- JINR offers broad opportunities for performing applied research in the mentioned fields at JINR's nuclear physics facilities – first of all, the facilities generating beams of heavy ions of low, intermediate, and relativistic energies. They allow modeling the influence of different types of space radiation, of which the most important are heavy nuclei of galactic cosmic rays, on biological objects and electronic devices. The Workshop welcomes the resolution of the 107th Session of the JINR Scientific Council on the construction of a specialized multi-charged ion channel for these purposes with energies up to 600 MeV/nucleon based on the planned booster of the NICA accelerator complex. The availability of this heavy ion channel, which will be unique to JINR Member States, will make it possible to develop a complex program of research in different fields to be performed at JINR and to join the efforts of a number of leading scientific organizations.
- The important fundamental problems of the effect of neutrons on biological objects along with a wide range of applied issues, which make up one of the basic fields of the mentioned complex program, can be managed using neutron sources based on the EG-5 accelerator, the IBR-2 reactor, and the Phasotron neutron chamber.
- The Workshop participants are interested in the further enhancement of JINR's pool of experimental facilities (the construction of a specialized multi-charged ion channel for irradiating samples) for doing fundamental and applied research in general and space radiobiology, using nuclear physics methods in the investigations of planets, and modeling nuclear physics effects in microchips because the further progress of much applied research and the arrangement of many experiments are held back by the absence of this kind of intermediate-energy ion channel.
- The Workshop supports JINR Directorate's initiative to establish an International Joint Scientific Council of the Russian Academy of Sciences (RAS) on the issues of general

and space radiobiology, which would focus on realizing major research projects in this area using charged particle accelerators. Taking into account the experience of many years in the fulfillment of large-scale international research projects, which has been acquired by JINR as an international intergovernmental organization, the Workshop finds it most appropriate to establish the International Council on Radiobiology on the basis of this organization. The Council, in cooperation with the Scientific Council on Radiobiology, RAS, would be able to coordinate carrying out radiobiological research in the area concerned in Russia and JINR Member States as well as joining research performed in other countries. Undoubtedly, it would be conducive to international cooperation in this field.

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