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Deep Underground laboratories in Russia

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ABSTRACT

The Baksan Neutrino Observatory (BNO) of the Institute for Nuclear Research RAS is the oldest underground facility in the world built specially for scientific research in the fields of neutrino astrophysics, solar neutrino and cosmic ray physics. It is located in Baksan Valley in Northern Caucasus, Elbrus region, and has an advantageous geographic location: remoteness from industrial nuclear reactors and deep underground disposition. A number of halls with facilities are situated along two 4 km tunnels excavated in the side of Mt.Andyrchi which are accessible by electrical train.

- The hall for Baksan Underground Scintillation Telescope (BUST) is situated 500 m from entrance to tunnel at an effective depth of 850 m.w.e. volume (24x24x16) m^3.
- The hall for the Gallium-Germanium Neutrino Telescope (GGNT) is located 3500 m from entrance to tunnel at an effective depth of 4700 m.w.e.; volume (60x10x12) m^3, area on the floor 720 m^2. The entire surface of the hall has been covered with low background concrete with thickness 60 cm. The global intensity of muon is $(3.03 \pm 0.19) \times 10^{-9}$ (cm^2/s). Average energy of muon 381 GeV. Fast neutron flux (> 3 MeV) is $(6.28\pm2.20)\times10^{-8}(cm^2s)^{-1}$. Rn activity in the air ~40 Bq/m^3.
- A number of halls with volume 100m^3 to 300 m^3 at a depth of 660, 1000 and 5000 m.w.e. for low background measurements are situated at different distances from the entrance.
- The largest deep underground hall with volume about 60000 m^3 was started with construction 4000 m from the entrance in 1990 at an effective depth of ~ 5000 m.w.e to locate next generation projects and the works were stopped in 1992, when the Soviet Union collapsed.

The current scientific program of the Baksan Neutrino Observatory includes: (1) studies of the internal structure and evolution of the Sun, other stars, Galaxy nuclei and other objects of the Universe by detecting their neutrino emission; (2) search for new particles and super-rare processes predicted by up- to-date elementary particle theories; (3) research of high energy cosmic rays, gamma astronomy.
The scientific program for the next decade is as following: (1) BUST (upgrade with new electronics and added target to increase its sensitivity to SN); (2) SAGE (further running; upgrade of the Gallium Germanium Neutrino Telescope to search for oscillation transitions of electron neutrino to sterile states with use of very intense artificial neutrino source); (3) development and construction of a new large scale detector filled with liquid scintillator to carry out basic research in the field of neutrino physics and neutrino astrophysics: geo and SN neutrinos (with energies 1-50 MeV), solar and SN neutrinos (with energies 0.5-20 MeV), proton decay and atmospheric neutrinos (with energy > 0.5 GeV), as well as neutrino background from all gravitational collapses in the history of the Universe. The design of the proposed detector should allow to significantly decrease the background level and to link this facility to the international network of such type detectors.

Baksan Neutrino Observatory takes part in International collaborations (GERDA, EMMA) and has plan to increase the participation in International efforts in the astroparticle field.