Abstract

The presentation is devoted to description of a complex of underground laboratories of the Baksan Neutrino Observatory of Institute of Nuclear Research RAS (BNO INR RAS) which is situated at an elevation of 1700 m above sea level, in the valley of the Baksan River. The underground work is done in Mount Andyrchi, which is part of the Lateral Spur of the Main Caucasus Ridge. The site of the Observatory was chosen because of the steep slopes of Mount Andyrchi and its relatively high elevation above the base (2300 m). These favorable characteristics of the mountain make it possible to set up deep-foundation chambers (cavities) with a relatively short (4000 m) horizontal adit (gallery). The minimal thickness of rock above these cavities is ~ 2000 m of rocky soil.

First the presentation presents a short review of the entire complex of the underground laboratories which can be divided into two groups: the first group consists of moderately deep laboratories with the largest of these being the Scintillation Telescope Laboratory, the second group of very deep laboratories including the solar neutrino radiochemical detector of SAGE detector (**S**oviet-**A**merican **G**allium **E**xperiment) whose construction was finished in 1987.

Main goal of the presentation is detailed description of a design and construction of a deep underground low background laboratory for SAGE experiment. The main chamber of the laboratory is 60 m long, 10 m wide and 12 m high (V ~ 7000 m3). It is located 3.5 km from the entrance of the tunnel, and has an overhead shielding of 4715 m water equivalent (mwe). In order to reduce neutron and gamma backgrounds from the rock, the laboratory is lined with 60 cm of low-radioactivity concrete. This low-radioactive concrete is a key and unique feature of this underground lab: it serves as radiation shielding and structural reinforcement of rocks (at such a depth it is a prerequisite). Because SAGE

detector is radiochemical detector ones cannot control the right moment of expected event but just collect radioactive Ge-71 atoms produced by solar neutrino (71Ga(nu,e-)71Ge*) and by some background as well. The only way to be sure that these Ge-71 atoms are produced by solar neutrinos is to substantially decrease and well-controlled any possible channels of background events. Actually, the goal is to dramatically decrease fast neutrons flux from surrounded shale rock. Very low background components of the concrete (crushed stone, sand, and cement) with ultra-low content of U, Th and Ra have been specially chosen and then delivered to BNO from different areas of Soviet Union during construction works.

All time during concrete placement a group of physicists regularly controlled the gamma-activity of the main component of the concrete - dunite. Total volume of low background concrete is 2200 m3, the thickness is 70 cm, total weight of frameworks with steel siding is 370 tons.

To keep Rn content into the air of the laboratory at low level, we pump fresh air from the valley through steel tube with the diameter of 1220 mm. This air is cooled down into conditioner and purified from dust and aerosols (including the products of Th and U decay) with the filters. Rate of fresh air is 60000 m3/hour. The air exchange multiplicity is 7 hour-1.

Presentation gives a review of characterization of physical parameters of the lab: measurement of muon flux, fast neutron flux and gamma-radiation.

Ultra-low muons flux has been measured with a 1 m2 plastic telescope with a thick lead absorber between plastic layers. The measurements have been done at three sites: above-ground, at moderate depth near Scintillation Telescope with well-known muon flux and in the GGNT lab. Global muons flux is (3,03+/-0,10)*10-9 muons/cm2/sec.

Fast neutron flux (En > 3 MeV) has been measured using the radiochemical detector (187 kg of CaC_2O_4 compund) which works based on $^{40}Ca(n,alpha)^{37}Ar$ reaction. Decays of extracted radioactive atoms of Ar-37 have been registered with miniature proportional counter whose cathode was made on zone melting iron or ultra-pure aluminum. Fast neutron flux is $(6,28 \pm 2,20) \cdot 10^{-8}$ neutron/cm2/sec.

Attenuation of gamma-flux at the laboratory k ~ 15 times compare with that into an un-shielding cavity.