



Improved installation prototype for measurement of low argon-37 activity

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On-site Inspection (OSI) is a key element of verification of State Parties' compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT). An on-site inspection is launched to establish whether or not a nuclear explosion has been carried out. One of the most significant evidence of a nuclear underground nuclear explosion (UNE) is detection above background concentrations of argon-37 in near surface air.

Argon-37 is formed in large amounts at interaction of neutrons of UNE with the potassium which is a part of the majority of rocks. Its estimated contents for the 100th days after explosion with a energy of 1000 t of TNT near a surface can vary from 1 to 1000 mBq/m³. The background concentrations of argon-37 in subsurface air vary from 1 to 100 mBq/m³.

Traditionally, for argon-37 activity measurement the gas-proportional counters are used. But at Khlopin Radium institute the developments of the new type of highly sensitive and low-background installation capable to provide the required range of measurements of the argon-37 concentration are conducted. The liquid scintillation method of the registration of the low-energetic argon-37 electrons is the basic installation principle and as scintillator, the itself condensed air argon sample is used.

Registration of scintillations of liquid argon is made by means of system from 3 PMT which cathodes are cooled near to the temperature of liquid nitrogen together with the measuring chamber in which placed the quartz glass ampule, containing the measured sample of the liquefied argon. For conversion of the short wavelength photons ($\lambda = 127$ nm) of liquid argon scintillations to more long-wave, corresponding to the range of PMT sensitivity, the polymer film with tetra-phenyl-butadiene (TPB) is provided.

Even the insignificant impurities of nitrogen, oxygen and others gaseous in the liquid argon samples can cause the quenching of scintillation, especially their slow components. To account this effect and its influence on change of registration efficiency is possible to imply the TDCR method, similar with the classical liquid scintillation measurements method, based on the triple to double coincidence ratios correction.

The prototype of installation is constructed and being evaluated now. Preliminary estimated value of minimum measured argon-37 activity in the sample of the liquid argon of 20 cm³ volume is about 0.1 Bq for a 5-hour exposure. For the volume of processed air about 2 m³ it corresponds to 50 mBq/m³ subsurface argon-37 measurements sensitivity.