Contribution ID: **86** Type: **Poster presentation**

Development of ultra-sensitive radon detector for SuperNEMO experiment

Monday 4 July 2011 17:45 (1 minute)

Neutrinoless double beta decay (0nuBetaBeta) is a problem of great interest in particle physics (e.g.[1], [2]). It is the best process to study the nature of the neutrino (Dirac or Majorana particle) and could clarify its mass scale. This year the NEMO collaboration [3] has finished main R&D of the SuperNEMO detector design to improve the sensitivity to T1/2(0nu) to the level of ˜10ˆ26 years [4]. The construction of the first SuperNEMO detector module (demonstrator with 5-7 kg of enriched 82Se isotope) has already started. One of the most important source of radioactivity is the radon gas and its daughter products.The radon activity in the tracking volume of its predecessor NEMO-3 detector has been reduced significantly (to 6.5 mBq/m3) after installation of an antiradon facility (providing a continuous flow of air 150 m3/hour with a radon level ˜1 mBq/m3). For measurement of the radon activity at the output of the antiradon facility the 70-litre detector [5] developed for the SuperKamiokande experiment is used. Its sensitivity (1 mBq/m3 corresponds to 1 detected event per day) is not sufficient for purposes of the SuperNEMO detector. To be able to measure lower radon activities (below 1mBq/m3) in reasonable time of measurement the development of new ultra-sensitive radon detector is currently carried out.

Our R&D towards such sensitive radon detector started in 2010. The detection is based on electrostatic collection of radon progenies (214Po, 218Po) on Si PIN diode. The same approach was selected for 718-litre radon detector [6], which provides the detection limit for air as 0.7 mBq/m3 for one-day measurement. The detector is made of stainless steel using 6 kV high voltage. During last year our R&D was devoted to the improvement of collection efficiency by testing of different geometrical shapes of the detector volume (cylindrical, spherical, cubical), location of the Si PIN diode, different HV (up to 30 kV) and material of the detection vessel (stainless steel, wire net). The tests show that the optimal detector vessel should be hemisphere with smaller volume of 50 l using HV as high as possible (e.g. 25 kV, because no saturation was observed). The results of R&D (comparison of obtained efficiencies for different geometrical shapes as well as HV) will be presented.

Based on our tests two prototypes of high sensitivity radon detector with volumes of 50 l and 200 l were constructed as first steps towards 1m3 detector which will be divided into smaller subdetectors providing high efficiency of detection. The first prototype has hemispherical shape and is made of stainless steel. The second prototype is stainless steel box (200 l volume). Its volume is divided into 4 independent submodules (made of wire net) with hemispherical shape using high voltage (25 kV) for electrostatic collection of radon progenies at Si PIN diodes (also 4 pieces). At present, the long term measurement of the background is performed. As next step we plan to measure the efficiency of the apparatus using stable Rn source with known activity. Both prototypes and the results of testing (efficiencies, background level) will be presented.

References:

1. H.V. Klapdor-Kleingrothaus et al., Phys. Rev. D 63 (2001) 073005.
2. S.M. Bilenki et al., Phys. Rev. D 64 (2001) 053010.
3. R. Arnold et al., Nucl. Instr. Meth. A536, 79 (2005).
4. E. Chauveau, AIP Conference Proceedings 1180, (2009) 26.
5. Y. Takeuchi, et al., Nucl. Instr. And Meth. A 421 (1999) 334.
6. C. Mitsuda et al., Nucl. Instr. And Meth. A 497 (2003) 414.

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Session Classification: Poster Mini Talks III

Track Classification: Detector Systems