CURRENT STATUS OF THE DEMONSTRATOR MODULE FOR SuperNEMO EXPERIMENT*

M. Macko

on behalf of the SuperNEMO Collaboration

Faculty of Mathematics, Physics and Informatics, Comenius University
Mlynská dolina F1, 842 48 Bratislava, Slovakia
and
Institute of Experimental and Applied Physics
Czech Technical University in Prague
12800 Prague, Czech Republic
and
Université de Bordeaux
351 cours de la Libération, 33405 Talence Cedex, France

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The possible existence of neutrinoless double beta decay ($0\nu\beta\beta$) gives us an opportunity to study unknown properties of neutrinos. Among other $0\nu\beta\beta$ experiments, SuperNEMO is unique for its tracking technique and the measurement of all kinematic parameters. First demonstrator module has entered its latest stage of construction. In this paper, we briefly present current status of the construction works of the integral units of this experiment.

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1. Introduction

SuperNEMO represents new generation of $0\nu\beta\beta$ experiment which could answer fundamental questions of neutrino physics [1]. It profits from the success and experience of its predecessor NEMO-3 [2]. The aim is to study the $0\nu\beta\beta$ of ^{82}Se. Roughly 100 kg of this isotope will be split into 20 planar modules equipped with tracking detectors and scintillating detectors (calorimeters). Now, the first module (the demonstrator) is being built. In the following, the progress and current status of construction of certain crucial parts of SuperNEMO demonstrator module is presented.

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2. Calorimetry, tracker and source foil status

The construction of the calorimeter walls takes place in CENBG near Bordeaux. The basic units of the calorimeter wall are the polystyrene optical modules with addition of 1.5% of para-terphenyl (pTP) and 0.05% of 1,4-bis(5-phenyloxazol-2-yl) benzene (POPOP) fluorescent additives. The right composition of pTP and POPOP with respect to the energy resolution was tested and achieved in the study done by [3]. The whole geometry in the form of two planar walls is consisting of 520 optical modules. The objective for the calorimeter optical modules was to reach an energy resolution of 7% FWHM for 1 MeV electrons (equivalent to the 4% FWHM at 3 MeV). In the production process, all modules were tested by 1 MeV electron beam in CENBG [4]. The first wall was already finished in February 2016. The construction of the second one is now in the late stage and it is expected to be finished by the end of July 2016.

The SuperNEMO tracker will serve for identification of the electrons reducing drastically the background. It will be composed of 2034 cells operating in Geiger mode. These will be surrounded by optical modules on the top (to tag gamma rays) and on the side. The whole tracker will be encapsulated in a radon-tight chamber. The cells are assembled at the Manchester University and sent to Mullard Space Science Laboratory (MSSL) of the University College London (UCL), where assembly of the whole tracker takes place in a large clean tent. Tracker will be composed of four sections (C0, C1, C2, C3). First quarter C0 is already assembled in Laboratoire Souterrain de Modane (LSM). The C1 will arrive in June 2016, while C2 is now being tested in MSSL. After the C3 is produced, they will be shipped with C2 to Modane in September 2016 and integrated.

As the decay source there was chosen ^{82}Se because of its natural abundance and high value of $Q_{\beta\beta}$. The demonstrator will contain 7 kg of enriched ^{82}Se in the form of foil strips of thickness on the level of 40–55 mg/cm^2. The responsibility for preparation of the foil is given to ITEP in Moscow and LAPP in Annecy. Selenium purification process will end in July 2016. Total number of 36 foils is planned to be installed in LSM during the winter 2016.

3. Conclusion

With exposure of 20 kg yr during a 2.5 years long run, SuperNEMO demonstrator is expected to achieve the $0\nu\beta\beta$ half-life sensitivity of 6×10^{24} yr which corresponds to the sensitivity on the effective neutrino mass of 0.16–0.40 eV. This is highly competitive level for the neutrino mass measurement. Demonstrator is expected to be finished at the end of year 2016 and start to take first data in year 2017.

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