Centre d'Etudes Nucléaires de Bordeaux-Gradignan

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Report on GERDA (LEGEND) PROJECT: SEARCHING FOR NEUTRINOLESS DOUBLE BETA DECAY OF GE-76.

The LEGEND experiment is looking for neutrinoless double beta decay using Germanium detectors. It is a long-term project started more than 25 years with the success of Heidelberg-Moscow and GERDA experiments. GERDA has already obtained excellent results with xx kg of germanium experiment demonstrating the capability of the collaboration to improve the low radioactive conditions and the background. The experiment is one of the global leading experiment. The GERDA experiment reached the best limit in term of half-live limit for the neutrinoless double beta decay with $T_{1/2} > 1.8\ 10^{26}$ years.

The LEGEND project, continuation of GERDA project, is a large international collaboration with 240 members from 47 institutions allowing to federate a part of the global efforts on the domain of double beta decay studies. The aim of LEGEND is to reach a final sensitivity of on the half-live T1/2 > 10^{28} years using 1 ton of germanium enriched in ^{76}Ge. The first phase of LEGEND-200 will measure 200 kg of enriched ^{76}Ge. The final sensitivity of the experiment relies on the background improvements and it is expected to improve the background by a factor 5 for the LEGEND-200 phase when it will be needed to improve it by an additional factor 10 the final background for for the ton-scale experiment. If the background requirements are reached, LEGEND-200 will have a sensitivity of $T_{1/2} > 10^{27}$ years for an exposure of 5 years. The experiment will be installed in the GERDA cryostat at the Gran Sasso Underground laboratory in Italy.

A major milestone is to reach the background requirements and the collaboration has developed a strategy to mitigate the risks. It has also shown its capabilities in this domain with the success of GERDA experiment. However, it is not clear in the proposal if the materials can be qualified at the required levels before the installation of the detector or if the final qualification will come from the detector itself. The schedule of the project is not very detailed, in particular the expected time to reach the final sensitivity of LEGEND-200 requiring at 5 years of data with the full setup.

The JINR has key contribution in LEGEND-200 with the procurement of 15 kg of enriched germanium. Presently, the collaboration has about half of the detectors (100 kg), a part coming from GERDA and Majorana experiments. The raw material to produce additional 100 kg of detectors has been purchased or funded.

The contributions of JINR are important in this collaboration with key responsibilities. However more details on these contributions, in particular associated FTE could be useful to have a full picture. JINR contributes to the procurement of enriched ^{76}Ge. Already, 15 kg have been provided and this contribution

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will increase in the future. The JINR has a key role in the design and production of the new liquid argon veto in collaboration with TUM laboratory. The veto is essential to reduce background from external radiations. It took also in charge the design of the glove box used to install and operate the germanium detectors. It is an essential tool to ensure the access to the detector keeping low radioactive conditions. Another important contribution is the design and production of the mini-shrouds surrounding the detectors to avoid deposit of ^{42}Ar radio-isotope on their surface.

The JINR team will be also strongly involved in operation of the detector and the data analysis. The contributions in term of FTE and a more detailed schedule on the main milestones could have been described with more accuracy.

The LEGEND-200 project will be a world leading experiment in the future in the search of neutrinoless double beta decay. The JINR has important and visible responsibilities inside this collaboration. The involved team has a long experience in low background technique and Germanium detector R&D and operation. The required budget is at the level of the ambition of its participation to the budget.

In conclusion, I strongly recommend to support the extension of the GERDA (LEGEND) PROJECT: SEARCHING FOR NEUTRINOLESS DOUBLE BETA DECAY OF GE-76.

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