Referee Report to the 47th N.P. PAC at JINR

concerning 4.1 project GERDA

"searching for neutrinoless double beta decay of Ge-76"

Searches for neutrinoless double beta decays belong to the most fundamental experiments in nuclear and particle physics testing the nature of neutrinos and ultimately also its mass hierarchy. A discovery would establish the Majorana type of neutrinos and signify physics beyond the standard model. Of the possible candidate nuclei, Ge-76 is one of the most promising isotopes, because it can be arranged as active detector with extremely good energy resolution and in massive arrays.

Indeed, the GERDA experiment using a Ge-76 enriched detector array at LNGS (Gran Sasso laboratories), immersed in liquid Argon and surrounded by a large water tank, has improved its sensitivity and background suppression step by step and - now in phase 2 – reached already a 90% C.L. lower limit of T_1/2_0v > 8x10^25 years which is one of the worlds leading results. The experiment is ongoing until 2020 and continuously upgrading sensitivity and background suppression, with the goal to exceed significantly the 10^26 years T_1/2 lower limit. Moreover, these achievements will lay the base for the next generation experiment LEGEND which will use in the first phase 200 kg of enriched Ge-76 and in a second phase 1 ton to reach an ultimate a lower limit of 10^28 years sufficient to answer the question about neutrino mass hierarchy or to discover the neutrinoless beta-decay. Obviously the discovery potential for Majorana neutrinos will be very significant, since sensitivities larger by more than two orders of magnitude can be achieved.

The Dubna group from DLNP for GERDA has played for many years a very significant role in the development, testing, running and analyzing this experiment and reached worldwide a high visibility. The team consists of highly educated specialists in this field and should continue its activities with high devotion, especially in view of the next generation experiment LEGEND (from 2021 on).

Therefore, I strongly recommend that JINR continues the full support of the GERDA experiment and the preparations for the ultimate LEGEND experiment, with highest priority.

Villigen-PSI, Dec-22-2017

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