The GERmanium detector array GERDA is a new experiment to search for the neutrinoless double beta decay ($0\nu\beta\beta$) of $^{76}\text{Ge}$. This very rare weakly interacting process is predicted to occur if the neutrino exhibits a mass and is a Majorana particle; i.e. it is its own antiparticle, and thus annihilates during the double beta decay.

Although the $2\nu\beta\beta$ decay has often been found in several nuclei, there is at this moment only a part of the Heidelberg-Moscow Collaboration claiming to have observed the neutrinoless double beta decay.

Their best limit for the half-life is $T_{1/2} > 1.2 \times 10^{25}$ y.

GERDA's 1st phase will measure about 15 kg·y of enriched germanium detectors from the Heidelberg-Moscow and IGEX crystals. In this phase, we will be able to test the Heidelberg-Moscow claim due to reduced background.

In a 2nd phase about 100 kg·y of data will be accumulated, leading to $T_{1/2} > 2 \times 10^{26}$ y.

At the moment the experiment is build up at the LNGS. The cryostat for the germanium crystals is already installed (see right) and tested and now the water tank is constructed on site.

The muon veto will consist of three independent detector systems. A layer of plastic scintillator above the penthouse will detect muons coming straight through the neck, while the water tank will be equipped with 4 times 10 PMTs on the wall and 20 more on the bottom.

It will act as an active Cherenkov veto. Six more PMTs just below the cryostat (pillbox) will complete the GERDA muon veto. The PMTs will be encapsulated in housings of stainless steel with a PET window on the front. To protect the photomultipliers against the water, especially the scaling of the encapsulation was optimized. Several steps beginning with a shrinking hose followed by a block of polyurethane, that protects the voltage divider and finally a layer of silicone shield the contacts of the PMT. (see below)

Long-time tests (One year under water) show that the encapsulation protects very well against water intrusion.

A conservative trigger will be a majority of 6 PMTs in the water tank or 3 PMTs in the pillbox, each with two photoelectrons produced within a time window of 40 ns. Simulations (see far right) show that this gives appropriate efficiencies.

Considering the dark rate of the PMTs, this would also produce only mHz of random coincidences, and therefore be no problem.

To optimize the efficiency of the muon veto, extensive simulations have been performed. In a first step a spectrum of dangerous muons (i.e. 2 MeV energy deposition) was created.

For the final distribution efficiency studies were accomplished, which showed that more than 98% of dangerous muons (muons with energy deposition around the 2 MeV of the neutrinoless double beta decay) will be detected.

According to the latest simulations, most of the Cherenkov photons (around 80%) will be detected within a time window of around 40 ns (see right). This allows to trigger on the photomultiplier signals directly (shown left).