GERDA – Germanium Detector Array

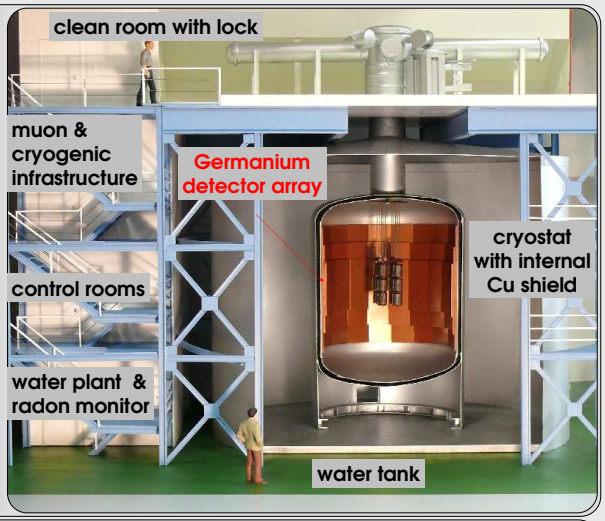
searching for the

Neutrinoless Double Beta Decay

Construction of the GERDA experiment

The GERDA experiment has been designed for the clean handling and the stable long-term operation of the Germanium Detector Array in a shield of liquified gas, copper and water that suppresses the environmental radioactivity by a factor of ~1/100 000 000.

The Ge detectors are lowered from the lock in the clean room into the centre of a double-walled vacuum-isolated cryostat (Ø 4.2m, H=9m) which is filled with 65 000 litres of liquid argon (T = -175 ºC). The cryostat is manufactured from 30 tons of selected stainless steel of low radioactivity; its vertical walls are covered with 16 tons of ultrapure copper. The shield is completed by a tank (Ø10m, H=9m) filled with ultrapure water. It suppresses not only the external gamma radiation but also moderates and absorbs neutrons very efficiently. The water serves also as radiator for a Cherenkov detector which allows to identify and veto the few muons, ~60 per hour, which penetrate through the Gran Sasso massif into the GERDA setup.



The operation of a large volume cryostat in a water tank is unique, so far. The setup accounts for all recommendations of a detailed risk analysis including earth quake tolerance up to 0.6g. The cryostat adheres to the principle of leak before break, has no penetration below the fill level and is certified for 1.5 bar overpressure being actually operated at 0.2 barg. The water tank can be completely drained within less than 2 hours.

Fotos (left) Insertion of the cryostat's inner vessel (Ø 4.0m) into the outer shell (Ø 4.2m). The inner vessel is covered with „superinsulation" to keep the thermal losses of the cryostat below 300W.

(right) The water tank has been built around the cryostat from top to bottom: roof and topmost cylindrical ring have been built first and have then been lifted by the hall crane for the assembly of the next ring underneath (see inset and left).

(below right) All vertical surfaces within the water tank including those of the cryostat have been covered with a reflective and wave-length shifting foil for improved detection of the Cherenkov light. The purple layer on the cryostat's wall consists of 6mm thick extruded poly-styrene foam serving as a thermal impedance which limits the evaporation in case of a leak in the inner container. A similar barrier is mounted on the inner wall.

A short history of GERDA construction

2005 Mar: GERDA proposal approved by LNGS, hall A assigned, start of safety study for copper cryostat

2006 May: contract for water tank Jul: decision for stainless steel cryostat, selection & order of 23 tons of low-radioactive stainless steel sheet material, safety reviews continued, Aug: hall A ready for installation Nov: cryostat ordered Dec: safety review available

2007 Jun: GERDA setup approved by LNGS, delivery of last (repaired) vessel head Aug: bottom plate of water tank in place

2008 Mar: delivery of cryostat, internal Cu shield installed, acceptance tests passed, Jun: water tank construction completed, Jul: decision for commissioning lock Oct: GERDA building erected

2009 Apr06 mag 6.3 earthquake at L'Aquila, May: works resumed, clean room ready, final cleaning of cryostat, Aug: active cooling system, Radon shroud and muon veto system installed, Nov: transfer of clean bench into clean room, Dec: cryostat filled with 90 tons of LAr

2010 Jan: active cooling effective, Mar: c-lock installed