Status and results of GERDA

Experiment aimed for the $0\nu\beta\beta$ decay search

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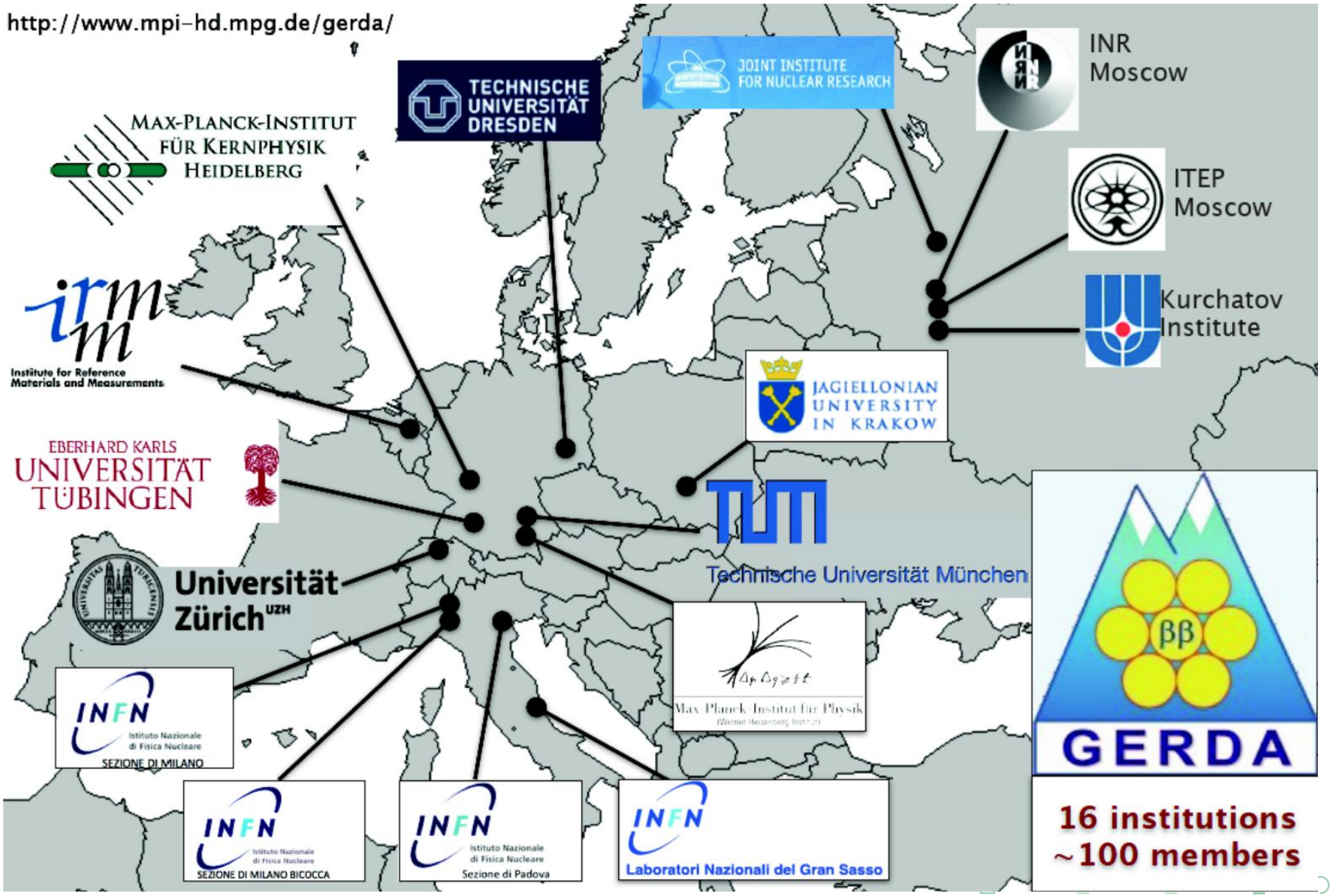
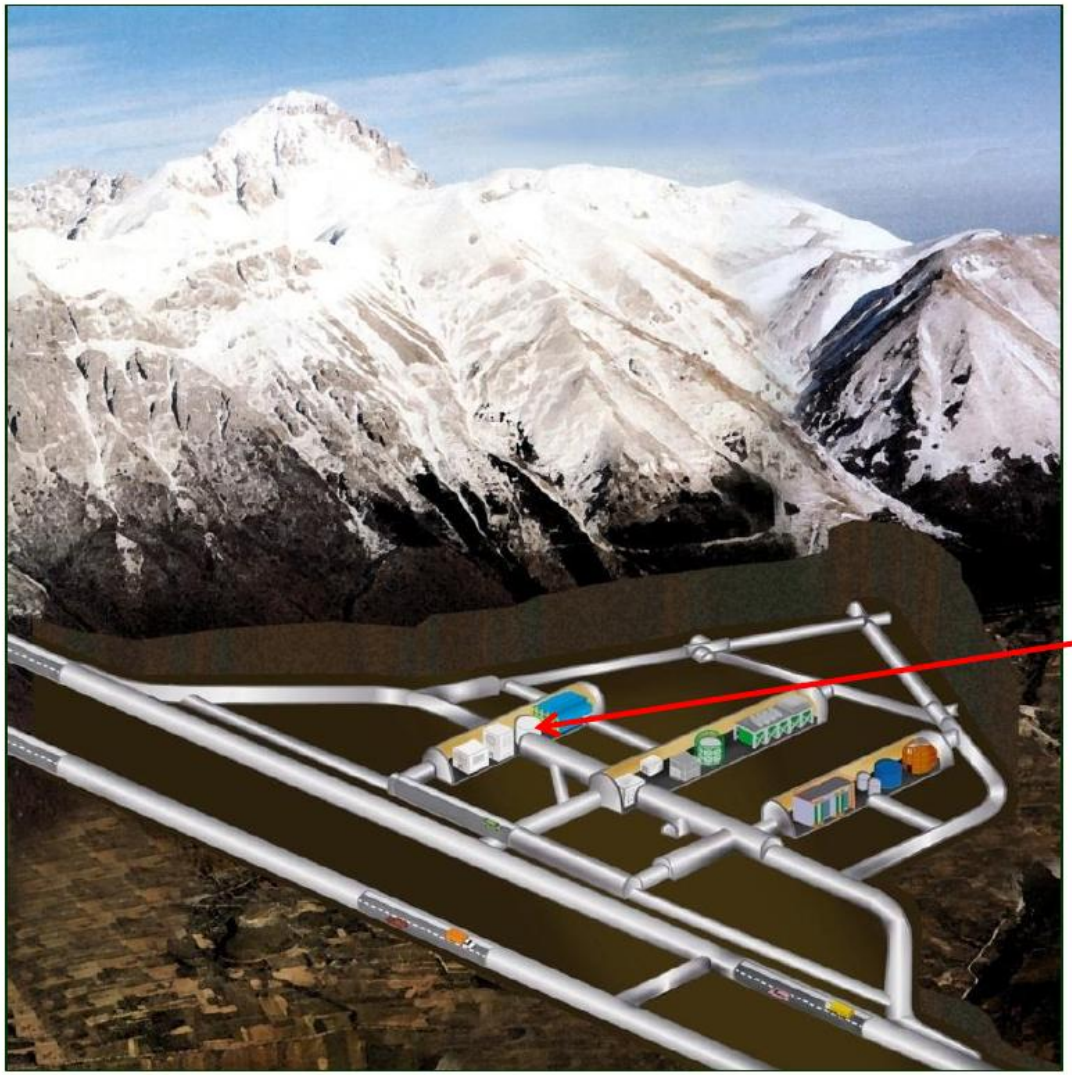
GERDA collaboration



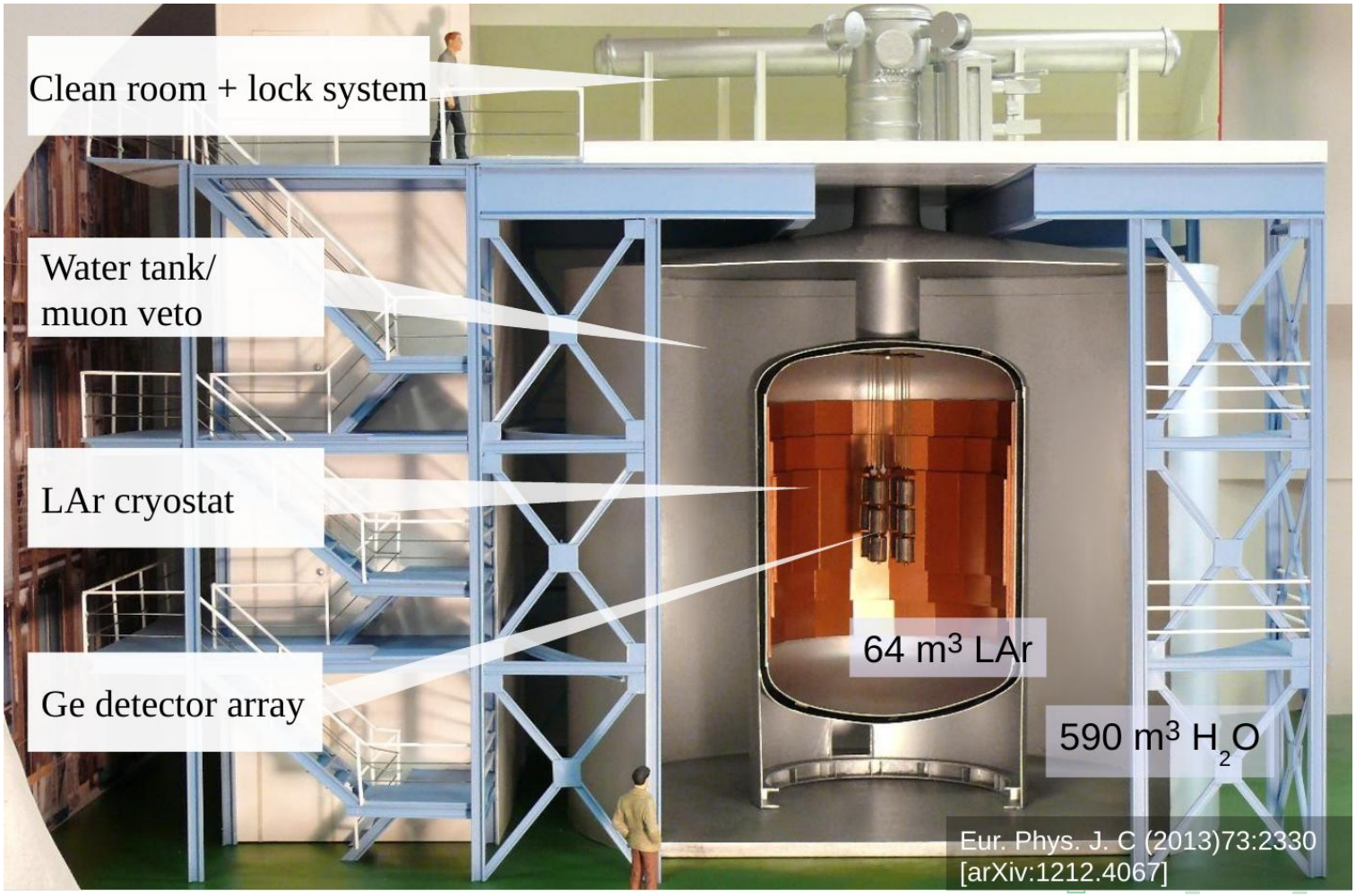
GERDA experiment

GERmanium Detector Array Experiment aimed fot the search of $0\nu\beta\beta$ decay of ^{76}Ge, located in Hall A of LNGS, the rock overburden is equivalent to 3500 m.w.e (1 muon/m^2·h)



GERDA experiment

Bare HPGe detectors enriched by ^{76}Ge (86%), submerged in high-purity liquid argon (LAr), are used both as detectors and source



GERDA phase I

Goal

- verify the $0\nu\beta\beta$ claim by Klapdor [Phys.Lett. B586 198, 2004], increasing the sensitivity of the Heidelberg-Moscow experiment
  - background index of $BI \sim 10^{-2}$ cts/(kg keV yr)
  - exposure of ~ 20 kg yr

GERDA phase I

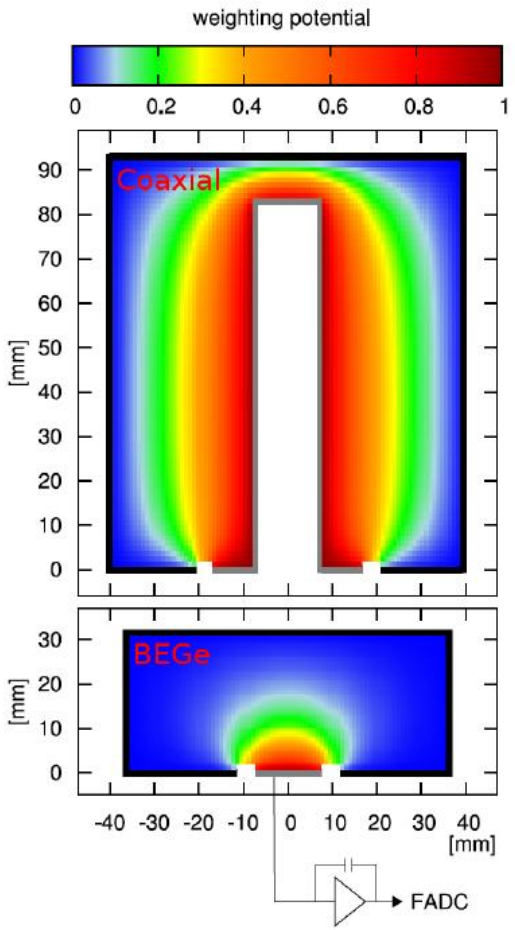
Germanium detectors

Coaxial

- from HdM and IGEX experiment ($2.4^{0}/_{00}$ FWHM @ $Q_{\beta\beta}$)
- total mass: 17.7 kg (14.6 kg used in the analysis)

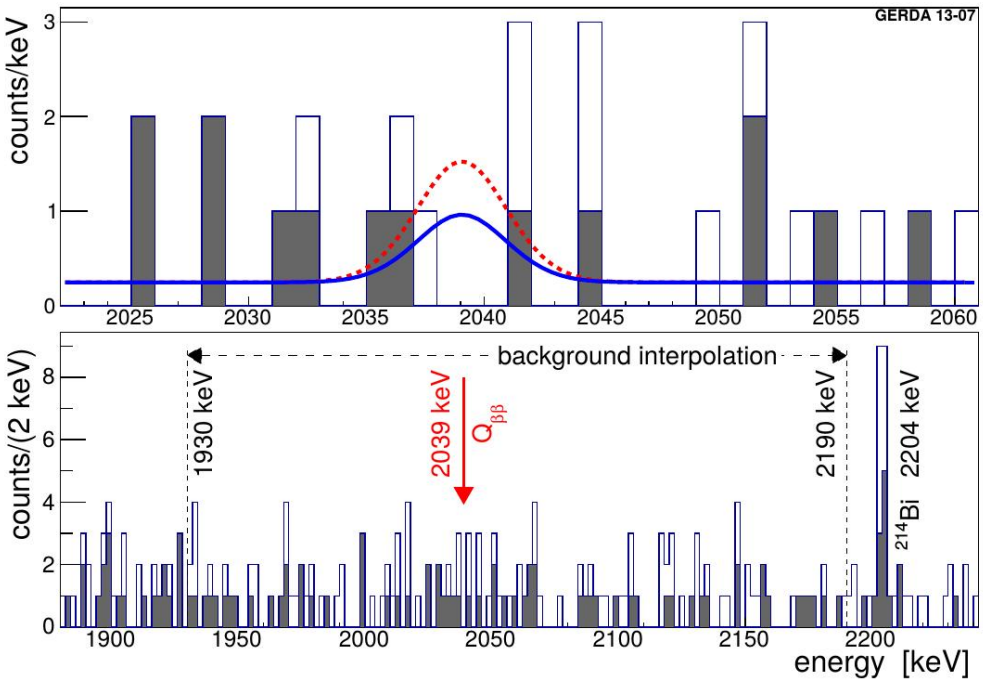
BEGe detectors (designed for phase II)
BEGe = Broad Energy Germanium
($1.6^{0}/_{00}$ FWHM a $Q_{\beta\beta}$)

- $\sim$ 20 kg of BEGes produced and tested in 2012
- 5 BEGes introduced in GERDA in July 2012 (added to coaxial det.)

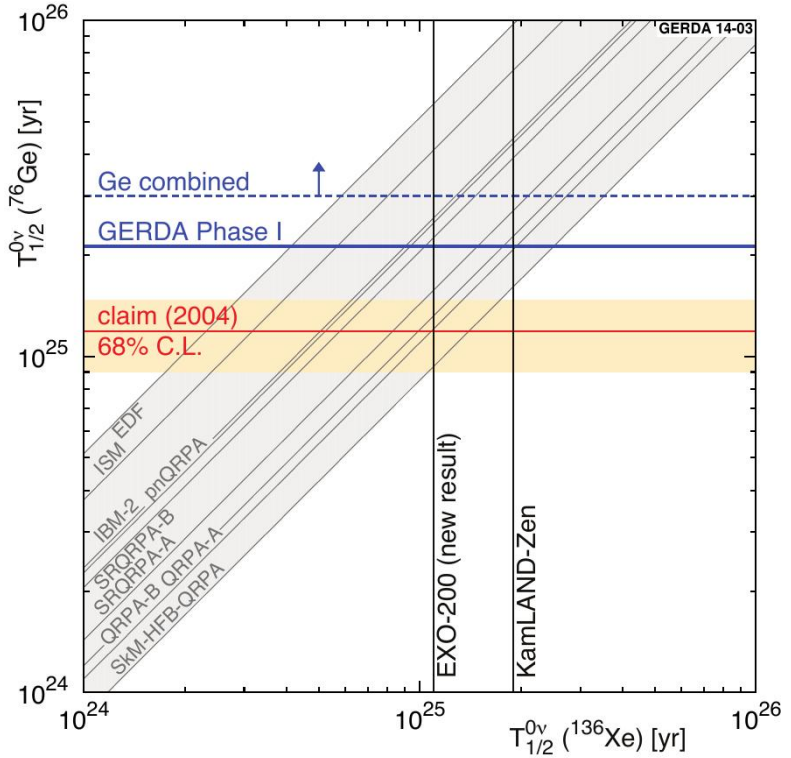


GERDA phase I - Final Results [Phys. Rev. Lett. 111 (2013) 122503]

- exposure 21.6 kg yr
- $BI = (11 \pm 2) \cdot 10^{-3}$ cts/(keV kg yr)
- **7 events observed** vs **5.1 ± 0.5** expected
- after PSD **3 events** vs **3.3** expected



$$T_{1/2}^{0\nu} > 2.1 \cdot 10^{25}\ yr\ 90\%C.L.$$



The Klapdor claim is rejected with 99 % probability

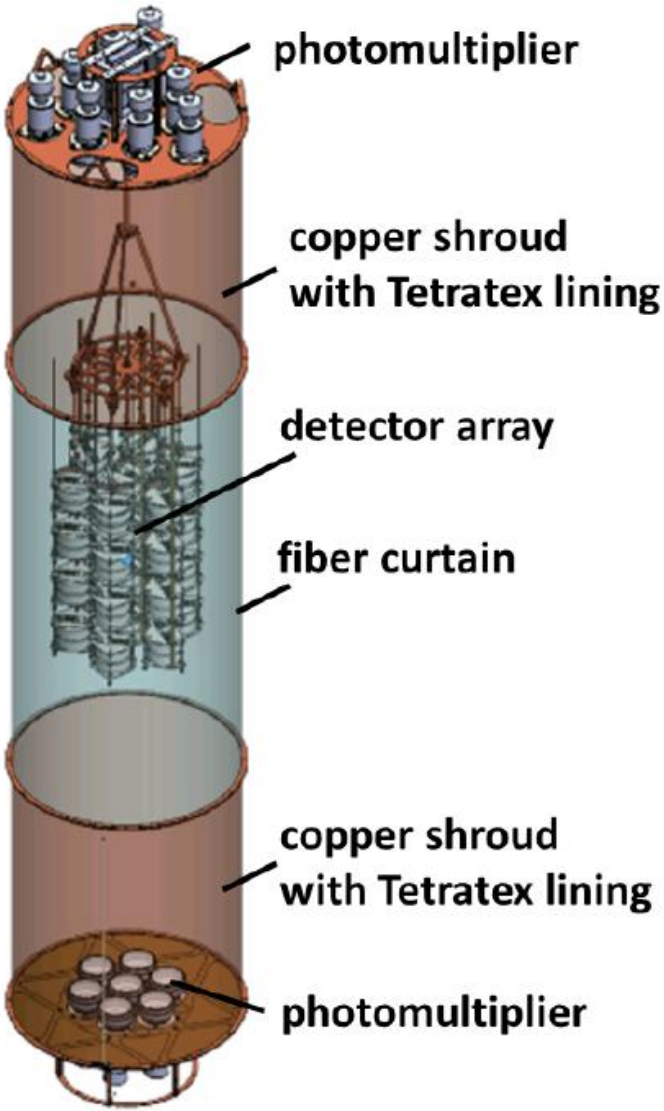
GERDA phase II

- **energy resolution** FWHM < 3 keV @ $Q_{\beta\beta}$
  - detectors BEGe
  - new shaping techniques of signals
- **exposure** ~ 100 kg·yr
  - increase the active mass (~ 40 BEGe detectors)
  - ~ 3 years of data acquisition
- **background reduction** $BI \sim 10^{-3}/(\text{keV}\cdot\text{kg}\cdot\text{yr})$
  - new detector holders and new electronics
  - active background suppression (PSD and LAr veto)

$\Downarrow$

increase the limit on the half-life of the $0\nu\beta\beta$ decay ($T^{0\nu}_{1/2} \gtrsim 10^{26}$ y) and on effective neutrino mass $m_{\beta\beta} \sim 100$ meV

GERDA phase II - Upgrade

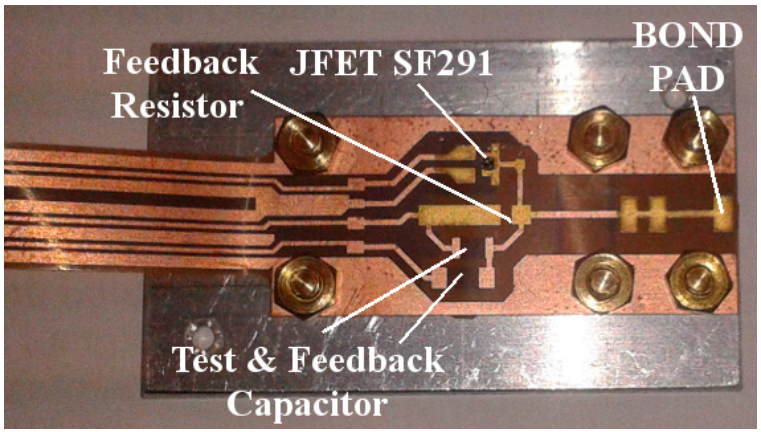


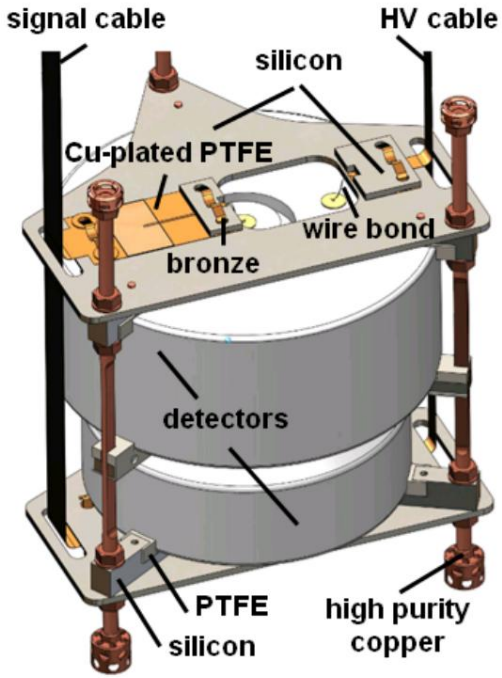
Mounting of new lock in the GERDA cleanroom:

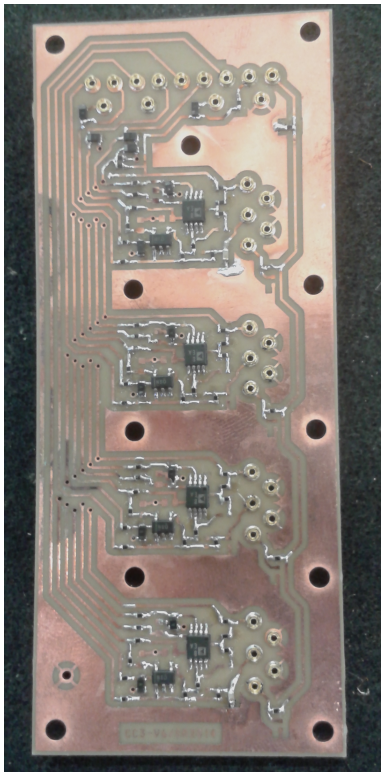
- more space to accomodate 7 arrays of BEGe detectors
- introduction of LAr light instrumentation for active veto

GERDA fase II - Upgrade

- new detector holders of radio-pure silicon, PTFE and copper, to further reduce the background
- new front end electronics divided in 2 sections to improve the energy resolution and minimize the background badget







Conclusions

- GERDA phase I was successfully performed
- new limit on the $0\nu\beta\beta$ of ^{76}Ge is (combining the results from previous experiments):

$$T_{1/2} > 3 \cdot 10^{25}\ yr\ (90\% C.L.)$$

- installation of GERDA phase II is ongoing
- many integration tests with new BEGe detectors and new instrumentation were performed
- the first string with 8 BEGes will be mounted soon in the cryostat