The Germanium detector array for P̄ANDA *

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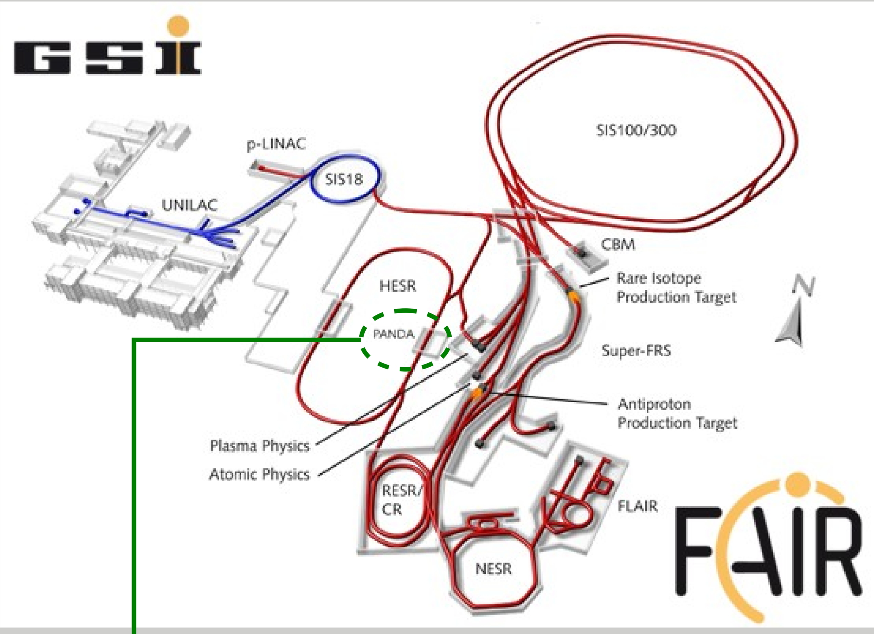
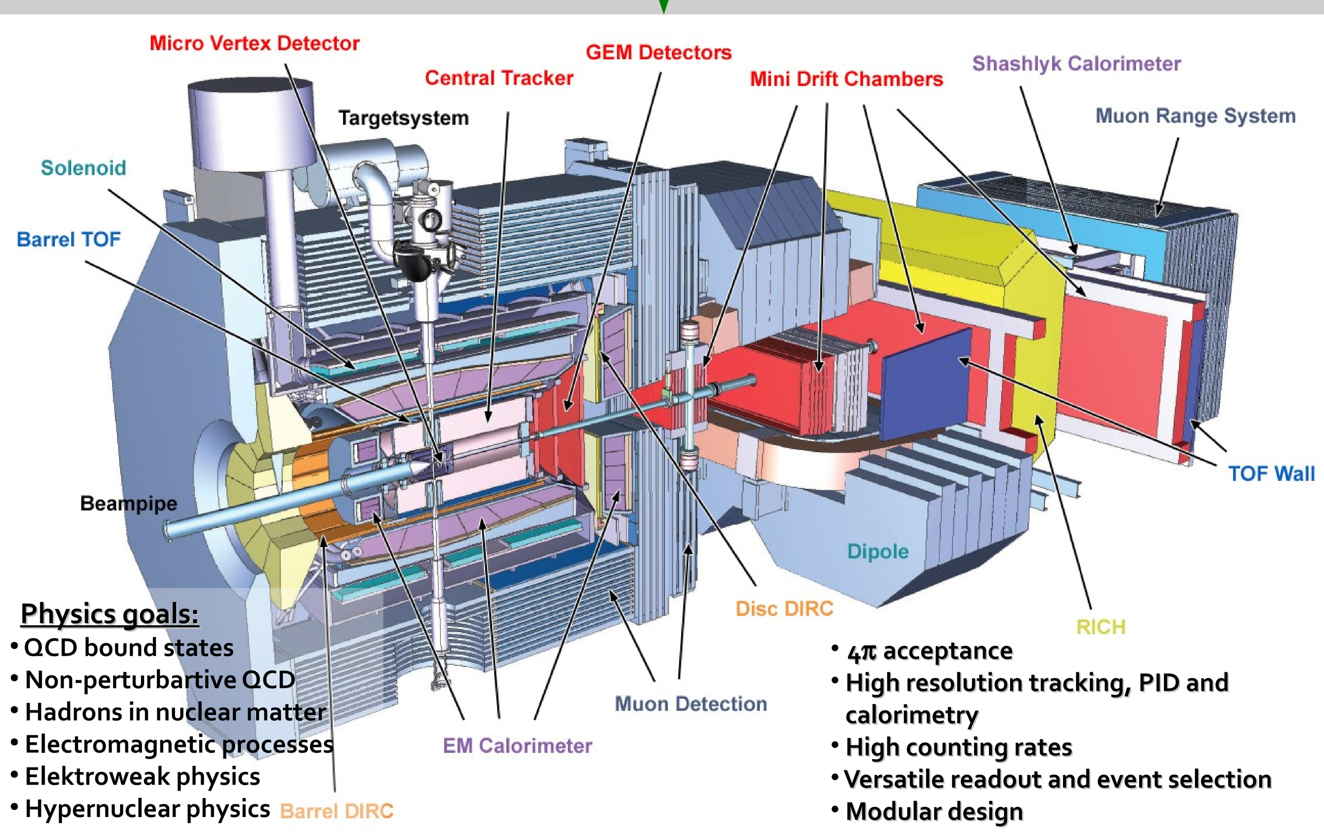
HadronPhysics2 Study of Strongly Interacting Matter

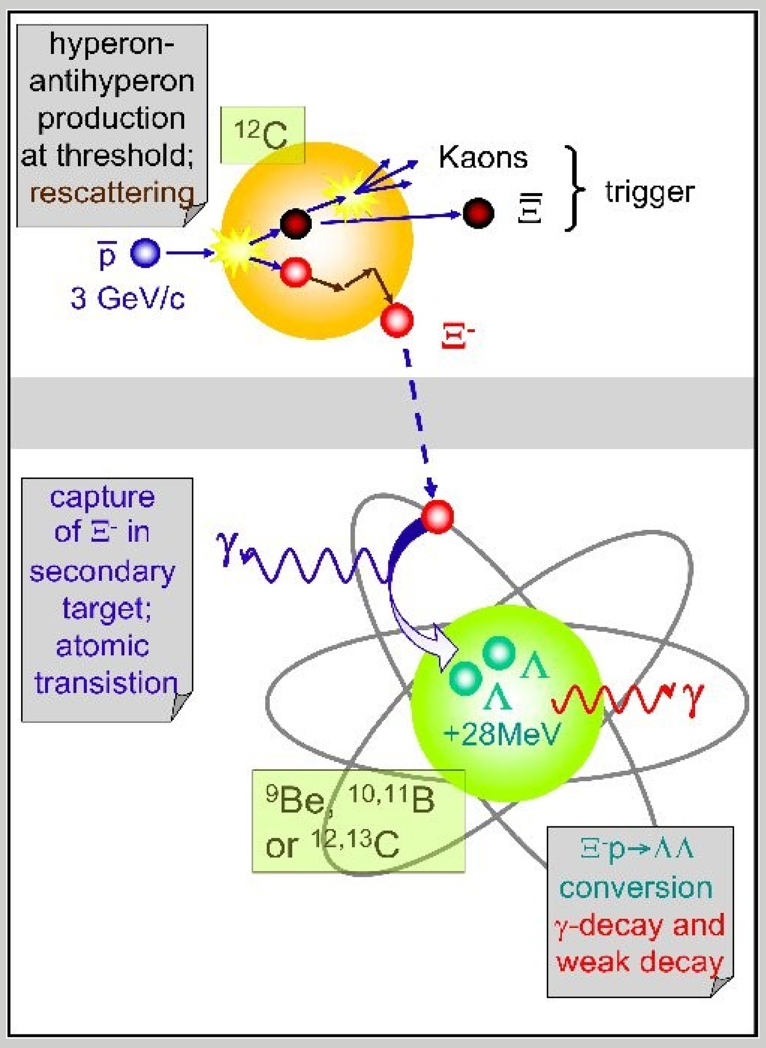
Production and detection of double Λ hypernuclei with the P̄ANDA experiment@FAIR

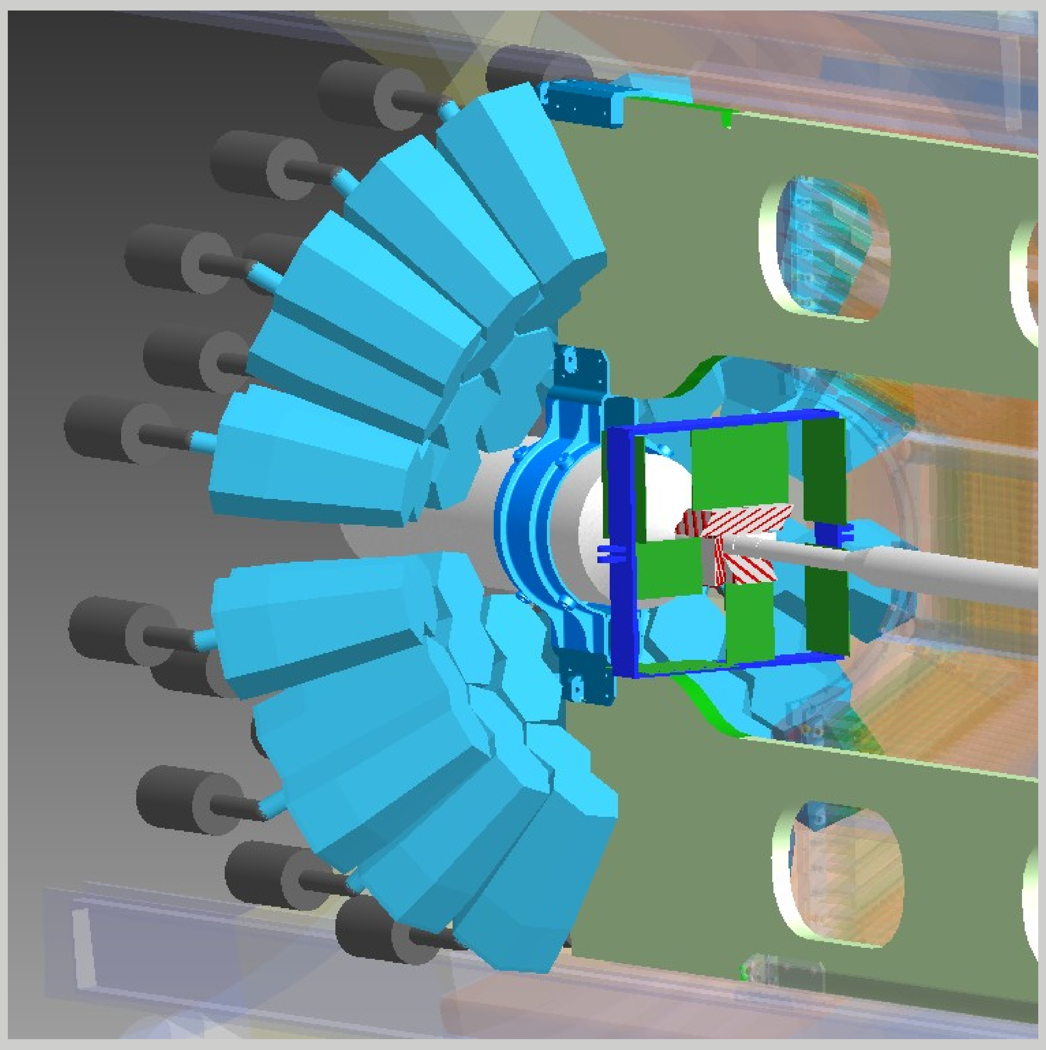


The building of the new accelarator facility **FAIR** has just begun. It is built beside the research center **GSI** (Darmstadt, Germany) and will make use of the existing accelarators.
The **P̄ANDA** Spectrometer will be situated inside the antiproton storage ring HESR. The HESR can store up to 10^{10} antiprotons in a momentum range of 1.5 GeV/c to 15 GeV/c.



The P̄ANDA spectrometer in standard configuration



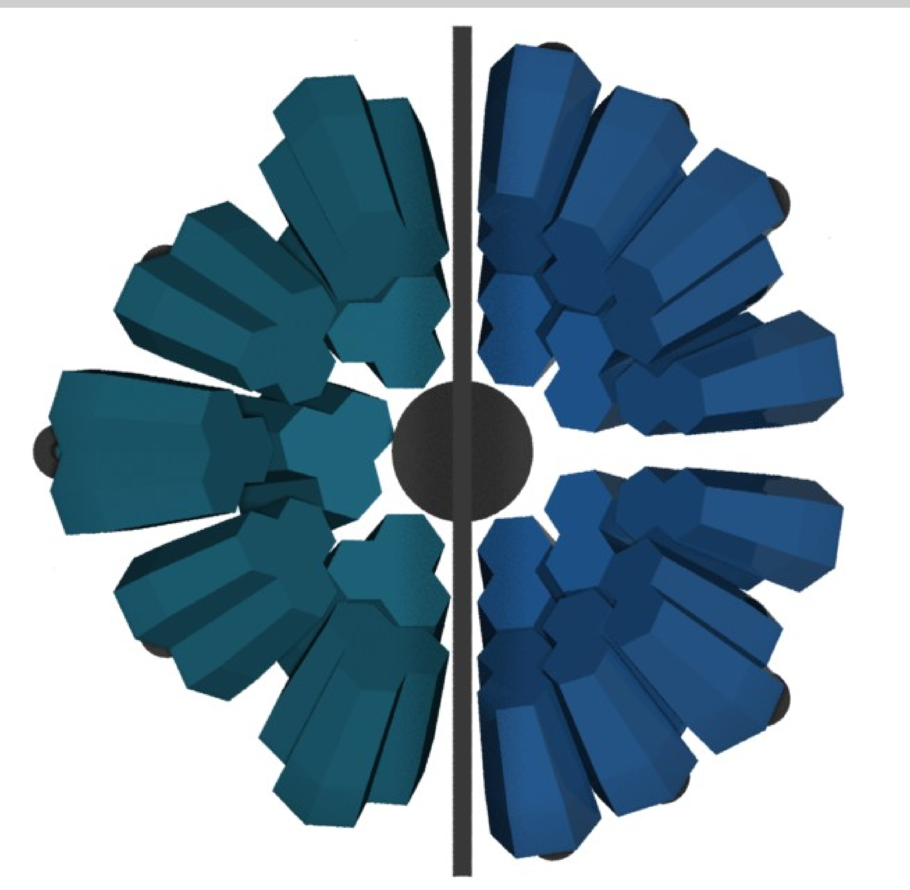


The production of double Λ hypernuclei with P̄ANDA is a **two step process**:

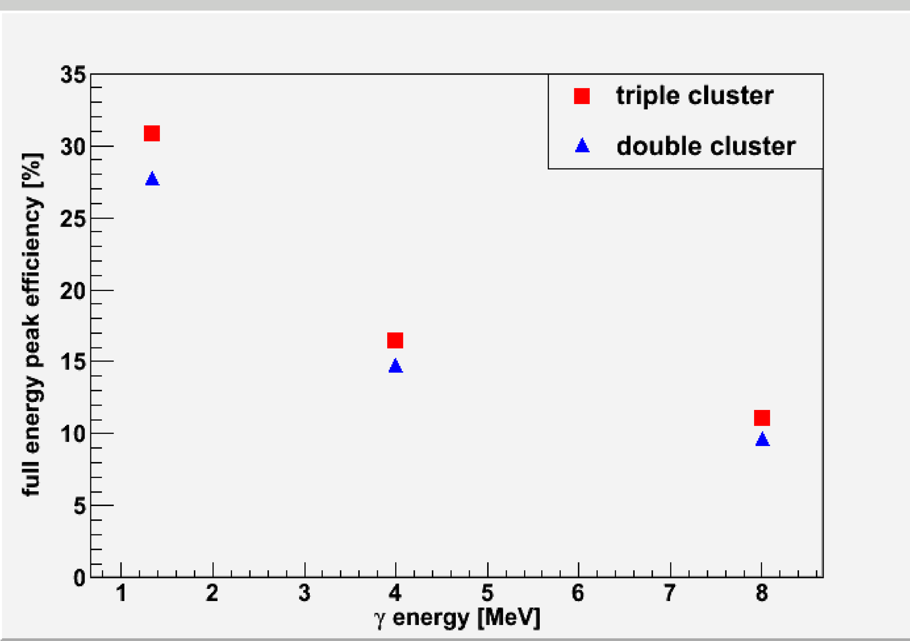
1) $\bar{p}p \rightarrow \bar{\Xi}^{+}\Xi^{-}$.
2) $\Xi^{-}p \rightarrow \Lambda\Lambda + 28$ MeV

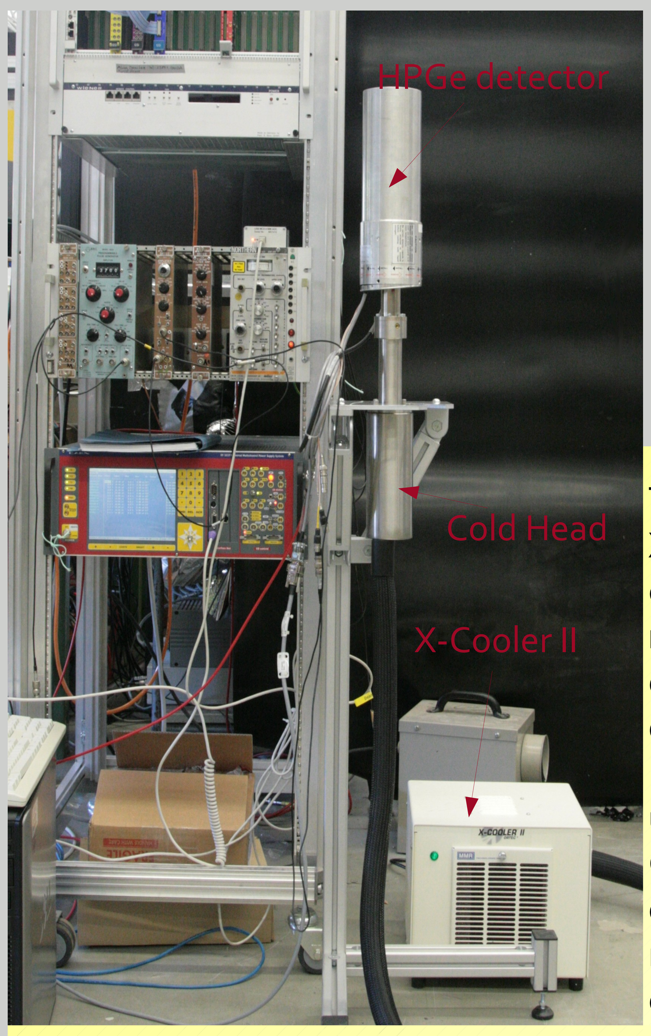
A) Inside the **primary, internal target**, the first step takes place. To keep the luminosity of the beam constant a steerable ^{12}C micro-wire is foreseen.
B) The second step is done in the **secondary, active target**. This target has to slow down the Ξ^{-} so that they can be caught inside a nucleus. Additionally the acitve part of the secondary target will be used to track the incoming Ξ^{-} as well as the charged decay products of the double Λ hypernuclei.
C) The **germanium detector array** is used for γ-spectroscopy of the deexciting double Λ hypernuclei.

Development of the germanium detector array



The germanium detector array shall consist of **48 EUROBALL HPGe crystals**. Since the space available inside the barrel part of P̄ANDA is very limited, no bulky,commonly used LN2 cooling is possible.
Instead of that an **electromechanical cooling** solution (ORTEC X-COOLER II) which can be placed outside the barrel is foreseen. Since the cooling power of these devices is limited, the number of crystals per cluster must be reduced. Therefore simulations for double and triple clusters has been done to compare the full energy efficiency in the expected energy range.

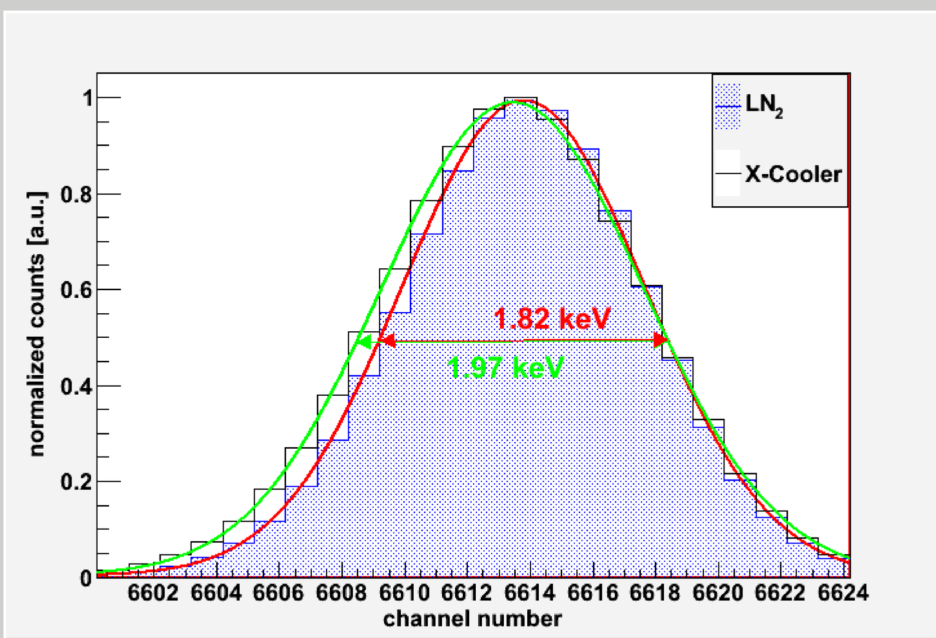


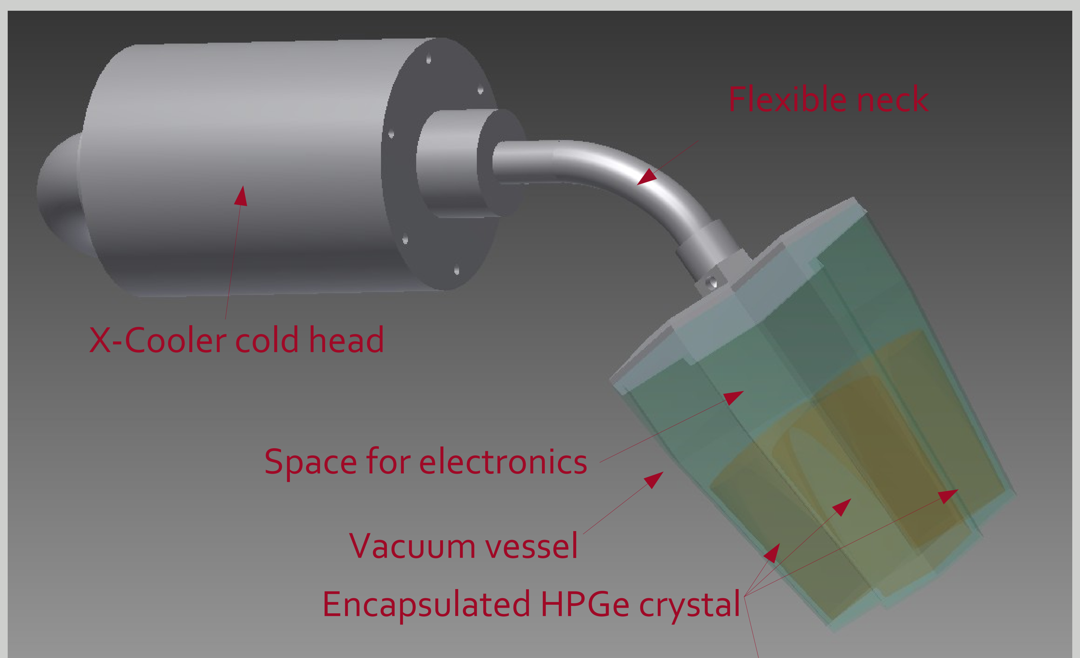


The influence of a X-Cooler II system on the **energy resolution** of germanium detectors has been studied by using an Ortec GEM-75205P device and analog readout electronics.

Energy resolution of 1.332 MeV line of ^{60}Co:
• Reference given by Ortec: at least 2.05 keV
• Measured with LN2 cooling: 1.82 keV
→ good resolution of electronics
• Measured with X-Cooler: 1.97 keV
→ worsening of the resolution by 8 %

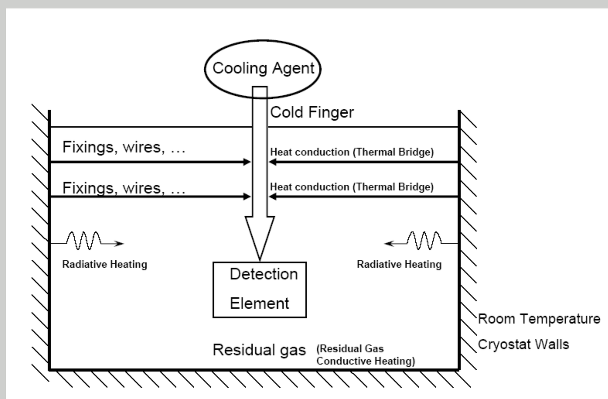
The reason for this degradation is the higher temperature of the crystals (X-Cooler: 110 K, LN2: 77 K) and more thermal noise due to this.

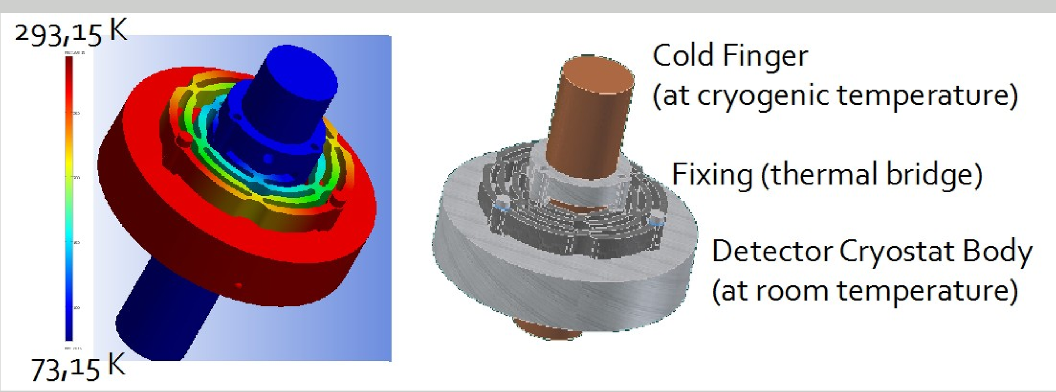




The encapsulated n-type coaxial HPGe crystals (EUROBALL) have a tapered hexagonal shape. The crystals of each triple cluster are arranged in a triangular form. The free space inside the cryostat is foreseen for electronics. The connection from the cryostat to the cold head of the cooler is flexible so that the detector can be adapted to fit into the limited space.

Since the cooling power is limited, lower thermal losses are required. To accomplish that, a new concept for the cryostat is required. Accordingly, thermal simulations of the fixing elements are shown.





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