Development of the Germanium detector array for $\overline{\text{P}}$ANDA*

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The $\overline{\text{P}}$ANDA experiment aims at the high resolution γ-spectroscopy of double Λ hypernuclei. For this purpose a dedicated electro-mechanically cooled Germanium detector array will be placed inside the $\overline{\text{P}}$ANDA barrel spectrometer is needed.

The positioning of the detector at backward polar angles does not avoid the irradiation by still a large particle background. Therefore, in order to evaluate the effect of this irradiation a test experiment at COSY in Jülich was performed. A 5 cm thick carbon target was bombarded by a proton beam with a momentum of 2.78 GeV/c and the generated secondaries were used to irradiate an electro-mechanically cooled single crystal detector prototype located at a polar angle of 120°. The particle spectrum in this angular range is comparable to the expected background seen by the germanium array in $\overline{\text{P}}$ANDA experiment conditions.

The spectrum of a ^{60}Co source was measured during spill pauses to check the influence of the irradiation on the peak shape. Figure 1 shows the broadening of the line shape due to the increasing radiation load of the crystal.

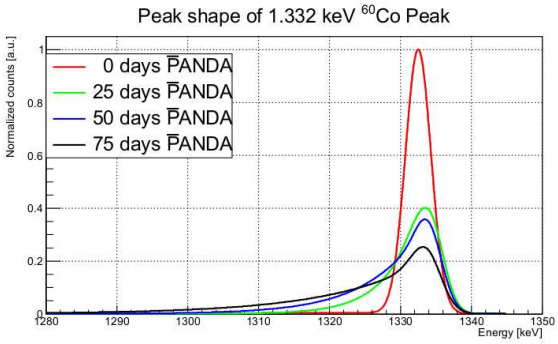

Figure 1: Higher radiation of the germanium detectors results in a broader, non-gaussian peak shape

A detailed analysis of the data shows a non-linear correlation between the calculated risetime and the energy of the signal of γ which depends on the irradiation. This is shown in figure 2 and will allow to correct at least partially the degradation of the peak shape. The analysis of this is ongoing.

Simultaneously, the development of a triple crystal prototype is pursued (figure 3). The cryostat of this detector will be optimized using the latest thermal simulation results[1]. A new Cooler[2] is tested which might offer more cooling power while being small enough to fit inside the $\overline{\text{P}}$ANDA barrel spectrometer.

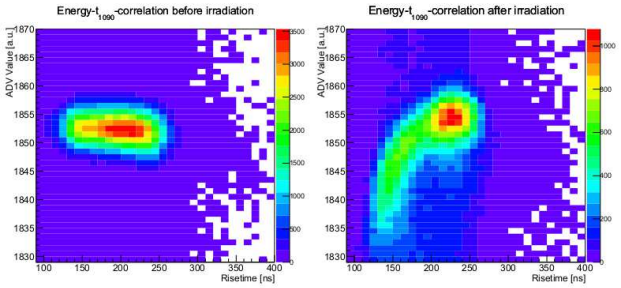

Figure 2: Comparison of the risetime energy correlation before (left) and after (right) the irradiation.

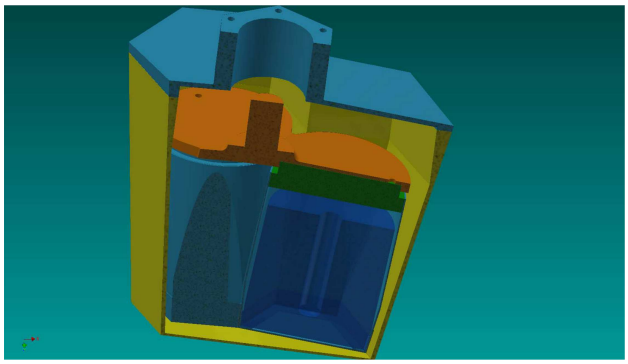

Figure 3: CAD drawing of the triple crystal prototype in development

Additionally the tests in Jülich revealed that an actively resetting preamplifier for the germanium is needed. This will be implemented in future prototypes and the existing prototype will be modified accordingly for further test beams in 2015.

References

[1] J. Kojouharova, "Optimization of electrically cooled complex HPGe Detector" http://www.kph.uni-mainz.de/Dateien/Waermerechnungen_Zwischenbericht2.pdf

[2] SUNPOWER CryoTel CT Datasheet http://sunpowerinc.com/download/cryotel-ct-datasheet-pdf/

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