Test of prototype crystals of the γ-ray detector CATANA

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The γ-ray detector CATANA (**CA**esium iodide array for γ-ray **T**ransitions in **A**tomic **N**uclei at high isospin **A**symmetry) has been developed to measure γ ray associated with highly excited states like the pygmy dipole resonance and/or giant dipole resonance. CATANA will be used with SAMURAI at RIBF.[1)] The excitation energy will be reconstructed by combining the invariant mass of the reaction products measured by SAMURAI and γ-ray energies from CATANA.

The CATANA array consists of CsI(Na) crystals and has between 10 and 15 cm thickness. The crystals are housed in 0.5-mm-thick aluminum boxes. The photosensors for the scintillation light from the crystals are the photo multiplier tubes (PMTs) R580 and R11265 from Hamamatsu Photonics. A detailed description of CATANA can be found in ref.[2)].

The position dependence of light collection efficiency can be significant for the crystals of CATANA, because the crystals have relatively large volumes. We have tested the position dependence of the light collection efficiency of the prototype CsI(Na) crystals by using γ rays from ^{137}Cs, ^{22}Na, and ^{60}Co sources. The geometry of the tested crystals is shown in Fig. 1. To evaluate the position dependence, the collimated γ rays irradiated the crystals from a direction perpendicular to the $x-z$ plane defined in Fig. 1. The collimator was a 10 cm thick lead with a 1-cm-diameter hole. The test was performed for two crystals from different companies. The two crystals have almost identical geometry. We tentatively name the two crystals as A and B in this report. Figure 2 shows the typical response of the crystals A and B to the uncollimated 511 and 1275 keV γ rays from ^{22}Na. Crystal A has a better energy resolution than crystal B. The position dependence of the light collection efficiency along crystal length z of the crystals A and B to the γ rays from ^{22}Na is shown in Fig. 3. The light output of the crystal B is larger at larger z. This tendency is due to the optical focusing caused by the reflection of lights at the polished surface of crystal B[3)]. To obtain a better position dependence and energy resolution, changes in the reflectivity of the crystal A surfaces were realized by roughening the crystal surfaces.

The fabrication of the CsI(Na) crystals for CATANA will start in spring 2015, and finish in late 2015.

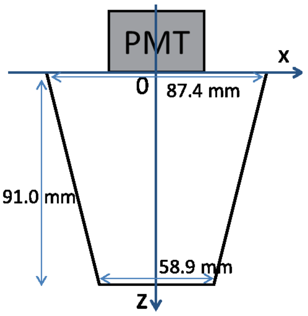

Fig. 1. Geometry of the tested prototype crystals. The definition of the axis in the test is also shown. PMT was attached to the top of the crystals.

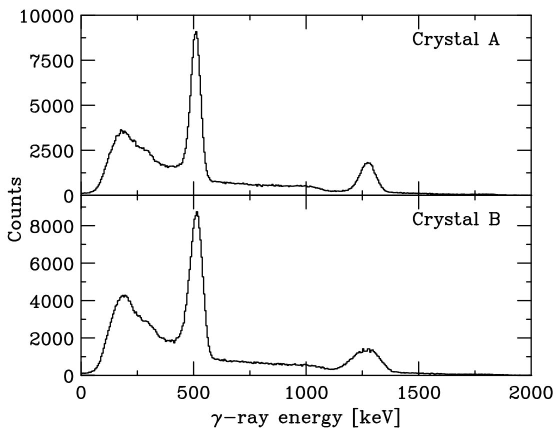

Fig. 2. Typical response of the crystals to the ^{22}Na source.

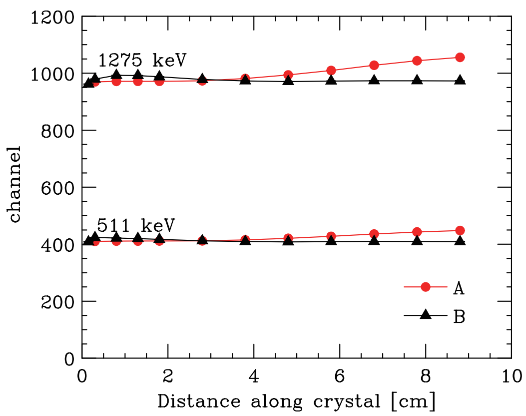

Fig. 3. Position dependence of the light collection efficiency for the crystals A (red) and B (black) along the crystal length z. Crystal B shows larger position dependence of the light collection efficiency.

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References

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