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Development of a cosmic ray calibration method for GAGG(Ce) scintillation detector

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In nuclei, protons and neutrons are not uniformly distributed, but rather form sub-structures called nuclear clusters within the nucleus. This has been known since the discovery of the nucleus by Rutherford, but it has not been explicitly taken into account in the standard picture of nuclei in current nuclear physics. For example, it is not known how the magic number that appears in nuclei is related to the formation of nuclear clusters. On the other hand, without a picture of nuclear clusters, it is difficult to explain even the fundamental decay process, alpha decay.

We have started the ONOKORO project to elucidate the formation mechanism of clusters inside nuclei using the cluster knockout reactions. We are currently developing the TOGAXSI telescope, a detector designed specifically for cluster knockout measurement.
TOGAXSI consists of a GAGG(Ce) scintillation detector as an energy calorimeter and a Si strip detector as a position detector.

In this study, we developed a calibration method for the GAGG scintillator using cosmic rays and evaluated the accuracy of the relative light output and energy calibration among different crystals. The evaluation using the beam showed that a kinetic energy resolution of 0.2% was achieved. This is better than the 1% kinetic energy resolution required to realize the target cluster separation energy resolution of 2 MeV.
On the other hand, the absolute calibration of kinetic energy using cosmic rays could only be determined with an accuracy of about 11%.

This can be due to the difference in the response of the GAGG scintillator to cluster particles and cosmic rays. In future work, we plan to quantitatively evaluate the effects of quenching and the position dependence of the light output.

Presentation type

Oral presentation

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