

Direction-Sensitive Dark Matter Search Using Tungstate Scintillator

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One of the candidates for the Dark Matters are weakly interacting massive particles (WIMPs), and we expect that the Earth should experience a “wind” (named “WIMP wind”) against the direction of the rotation, where is direction to Cygnus.

In this study, we propose a new type Dark matter detector using single crystals in order to have higher detection efficiency than gaseous ones. Some team reported that ZnWO_4 can detect the direction of incident particles due to anisotropic. However, the mechanism has been not revealed. A Mg-admix ZnWO_4 crystal is expected to have different lattice constant from normal ZnWO_4 , and anisotropic properties can be changed. Thus, we compare scintillation and anisotropic properties for ZnWO_4 and Mg-admix ZnWO_4 in this paper.

We grew ZnWO_4 and $(\text{Zn, Mg})\text{WO}_4$ single crystals with diameters of ~0.5 inch grown by the Czochralski process. We checked the crystal phase and structure using the powder X-ray diffraction.

Light outputs of the crystals irradiated with 5.5 MeV alpha rays and 59.5 keV X-rays were estimated for each surface (orientation) for ZnWO_4 and $(\text{Zn, Mg})\text{WO}_4$ using a photo multiplier and an ^{241}Am source, and the light output ratios (α/β ratio), defined as peak channel of 5.5-MeV alpha-ray absorption peak over that of 59.5-keV X-ray, were evaluated. The results show we find anisotropic for both samples, while anisotropic effect for Mg-admix made smaller than Mg-free one.

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