

Performance of hard X-ray polarimeter for off-axis injection

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Introduction

The Gamma Ray Burst (GRB) is one of the most important topics in the fields of astrophysics and is the most energetic phenomenon in the universe. However, the radiation mechanism is still unknown in spite of many studies for about 50 years. Recently, it has been reported that the key to the clarification is in the polarization observation for the hard X-rays from GRBs[1]. However, there is no polarimeter sensitive to GRBs. So we are developing hard X-ray polarimeter with wide field of view in use of two kinds of scintillator. Since the hard X rays often enter to the polarimeter from off-axis, the response of the polarimeter for the off-axis must be investigated in detail. So we constructed prototype polarimeter and then injected hard X rays at 80 keV to the prototype polarimeter at BL14A in Photon Factory of KEK. We will report the experimental results and those of computer simulation.

Design of Polarimeter

The Figure.1 shows the schematic view of the polarimeter for GRBs. It consists of four identical counters which operate as polarimeters individually. One module in the right figure is made of segmented plastic scintillator as a scatterer for the incident hard X ray surrounded by segmented CsI(Tl) scintillator as an absorber for the scattered hard X ray. The signal from these scintillator can be read out by appropriate optical device such as MAPMT and then the scattering direction can be measured. Because the scattering direction depends on the direction of the polarization for the incident hard X ray, the information on the polarization can be obtained. On the injection experiment at BL14A, we constructed the prototype polarimeter which consists of 36 pieces of the plastic scintillator and 28 pieces of CsI(Tl) scintillator mounted on one MAPMT with 64 channels.

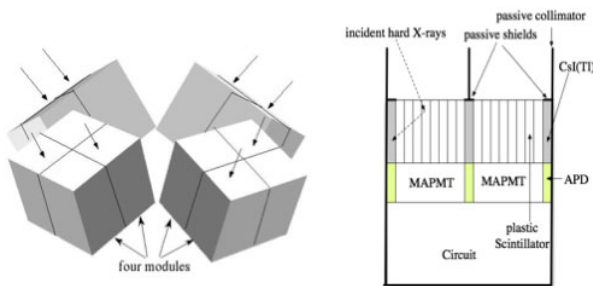


Figure.1: The schematic view of the hard X-ray polarimeter for GRBs.

Experimental Setup

The Figure.2 is the schematic view of the experimental setup. The prototype polarimeter was irradiated with polarized hard X rays at 80 keV from off-axis direction.

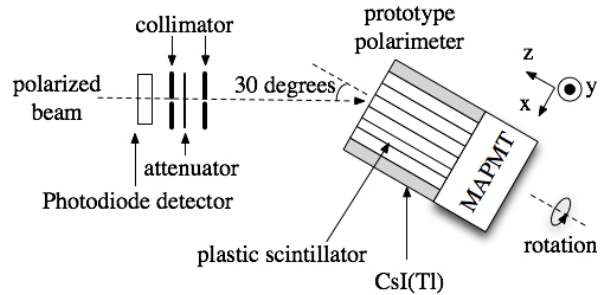
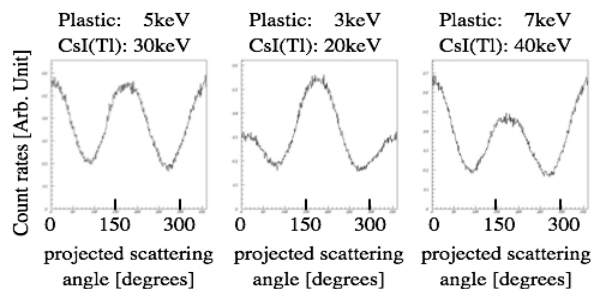


Figure2: The polarized hard X rays were injected to the prototype polarimeter at the slant of 30 degrees. The polarimeter rotates along the axis shown in this figure and the scattering angle was measured for each scattering event. The direction of the polarization is parallel to the y axis in this figure.

Results

The three figures in Figure.3 show the distribution of the scattering angle to xy coordinates in the Figure.2. In these figures, the x and y axes correspond to the scattering angle and the count rates in arbitrary unit, respectively. The 0 degree of the scattering angle is defined as the direction of the x axis in the Figure.2. On each figure, the energy thresholds on offline analysis for the plastic scintillators and the CsI(Tl) scintillators are written down. The modulation curve can be corrected by selecting appropriate energy threshold even in the case of slant injection.



References

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