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A Spectrograph for Prompt Observations of Gamma-Ray Bursts with a 1-m Telescope

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Abstract. We are developing a new slit-less spectrograph for gamma-ray bursts (GRBs) at Bisei Astronomical Observatory. We can quickly point the 1-m telescope to the GRB coordinates provided by HETE-2 via the GRB Coordinates Network. The pointing is readjusted when the position is refined to 5" accuracy by the small optical telescope RIBOTS using the optical image of the GRB, and we then take an exposure immediately with the slit-less spectrograph.

1. Introduction

GRBs were discovered more than thirty years ago. They generally have durations between 0.1 s and 100 s and appear at random times from unpredictable positions on the sky. Recent observations of GRB afterglows support that the bursts originate in other galaxies at cosmological distances (e.g. Metzger et al. 1997). The physical mechanism which produces these brief flashes of high-energy radiation has remained a mystery. In order to investigate the physical processes of GRBs we need the spectra in early phase. The networking between satellites and ground-based telescopes permits small telescopes to observe the GRB spectra before they decline. We are therefore developing a new slit-less spectrograph and control system for prompt observations of GRBs at Bisei Astronomical Observatory (BAO).

2. Spectrograph and Telescope Control

The Bisei Imaging Spectrograph (BIS) is attached to the cassegrain focus of the BAO 1-m telescope and is always standing by for prompt observations. BIS is a very low-resolution spectrograph, consisting of a removable slit, the optical elements and the CCD camera ST6. Figure 1 shows the observed sample image

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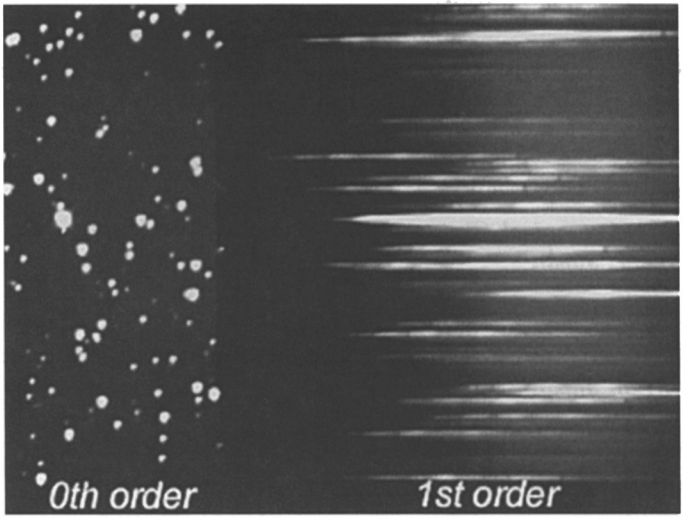

Figure 1. An observed BIS image of the open cluster M37 is shown. The left and right side is 0th and 1st order image, respectively.

of M37. Both the 0th and 1st order spectra in the field of 6' x 2'.5 are taken simultaneously. The resolution is 7nm with a seeing size of 3" and the wavelength range is from 400nm to 800nm. The limiting magnitude is 14 with 5 minutes of exposure time. After an observation the slit is inserted into the focal plane and adjusted to the position of the GRB counterpart in order to take the flat fields and the comparison frames for wavelength calibration.

HETE-2 (Kawai et al. 2001) detects GRBs and gives their positions to the GRB Coordinates Network (GCN) whoose accuracy is around 10'. The small optical telescope RIBOTS (Urata et al. 2001) and the 1-m telescope move quickly to the GRB coordinates provided by HETE-2 via GCN. RIBOTS takes the optical images for refining the accurate position to within 5" and sends it to the 1-m telescope. The pointing of the 1-m telescope is then readjusted and BIS immediately takes an exposure.

3. Discussion

HETE-2 shall localize around 50 GRB events per year. The opportunity for spectroscopic observations is a few times per year because of geographic and weather conditions.

References

Metzger, M. R., et al. 1997, Nature, 387, 878
Kawai et al. 2001, thess proceedings
Urata et al. 2001, thess proceedings

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