

Early polarization observations of the optical emission of gamma-ray bursts: GRB 150301B and GRB 150413A

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ABSTRACT

We report early optical linear polarization observations of two gamma-ray bursts made with the MASTER robotic telescope network. We found the minimum polarization for GRB 150301B to be 8 per cent at the beginning of the initial stage, whereas we detected no polarization for GRB 150413A either at the rising branch or after the burst reached the power-law afterglow stage. This is the earliest measurement of the polarization (in cosmological rest frame) of gamma-ray bursts. The primary intent of the paper is to discover optical emission and publish extremely rare (unique) high-quality light curves of the prompt optical emission of gamma-ray bursts during the non-monotonic stage of their evolution. We report that our team has discovered the optical counterpart of one of the bursts, GRB 150413A.

Key words: telescopes – gamma-ray burst: general – gamma-ray burst: individual: GRB 150301B – gamma-ray burst: individual: GRB 150413A.

1 INTRODUCTION

Gamma-ray bursts are among the most distant and powerful explosions in the Universe. The idea that gamma-ray burst emission originates in a narrow magnetized jet with an opening angle of 1° now appears to be a generally accepted hypothesis, though so far unsupported by direct experimental evidence. One of the consequences of the presence of jets and ordered magnetic fields in these jets could be observation of the polarization of the prompt emission

of the burst. Prompt optical emission of gamma-ray bursts is the emission that originates at the time when the central engine of the burst still continues to operate, i.e. when the gamma-ray emission has not yet faded.

Scarce and always unique (one burst, one telescope) observations of early optical emission, which is sometimes synchronous with gamma-ray emission, show that bursts may exhibit one of the two behaviour patterns (Vestrand et al. 2005):

(i) optical emission appears simultaneous with gamma-ray emission (or sometimes even before it) and appears correlated with the gamma-ray light curve; and

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