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Polarization measurements of the Crab Pulsar with POLAR

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POLAR is a dedicated Gamma-Ray Burst polarimeter making use of Compton-scattering which took data from the second Chinese spacelab, the Tiangong-2 from September 2016 to April 2017. It has a wide Field of View of $\sim$ 6 steradians and an effective area of $\sim$ 400 cm^2 at 300 keV. These features make it one of the most sensitive instruments in its energy range (15-500 keV), and therefore capable almost continuously monitoring persistent sources such as pulsars. Significant folded pulsation from both PSR B0531+21 (the Crab Pulsar) and PSR B1509-58 has been observed. Observations of the Crab Pulsar with POLAR have previously been used for: 1). pulsar navigation test to predict orbit information of Tiangong-2; 2). phase-resolved spectroscopy of the Crab Pulsar to calibrate the instrumental responses of POLAR. In this work, we investigate a polarimetric joint-fitting method for observations of the Crab Pulsar with POLAR. Unlike a GRB observation with POLAR, the observations of the Crab Pulsar are complicated by multiple observational datasets during which the polarization plane rotates as well. So before fitting, we have to correct the modulation curves under different datasets, with taking into account the rotations of the Crab Pulsar's relative position in the detctor's local coordinate, and the changes of detector response in different datasets. Despite these difficulties and the low signal to background for such sources constraining, polarization measurements were possible with the POLAR data. We will present the developed methodology, which could be applied to any wide FoV polarimeter, and polarization results of the Crab pulsar with POLAR. Finally, the inferred ability of pulsar detection with POLAR-2 (the successor of POLAR) will also be discussed.

Keywords

POLAR; gamma-ray; neutron star; pulsars; PSR B0531+21 (Crab pulsar); polarimetry

Collaboration

other (fill field below)

other Collaboration

POLAR

Subcategory

Experimental Methods & Instrumentation

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