

Results from the Gamma-Ray Bursts polarimeter POLAR and future prospects with the POLAR-2 mission

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Since the discovery of Gamma-Ray Bursts (GRBs), these violent transient events in the Universe are among the hottest astronomy topics, followed by many outstanding observations and theoretical interpretations. However, many open questions remain or are even newly raised about their nature, especially the physical mechanisms during their prompt emission phase, although more than half a century has past. The polarization properties have long been thought to be a powerful probe for investigating the radiation mechanisms of the prompt emission, as well as the geometrical structure and magnetic field configurations of the radiation region. Fortunately, newly developed polarimeters in recent years have overcome the space technical difficulties on polarization measurements, which opens a new window for space hard X-ray/Gamma-ray polarimetry.

The Gamma-Ray Burst polarimeter POLAR, which has been launched onboard the China's space lab "Tiangong-2" in September 2016, is a space mission dedicated for the GRB prompt emission polarization measurements in the 50-500 keV energy range, under the collaboration between Chinese and European scientists. During about 6 months of space observation, POLAR detected 55 confirmed GRBs jointly with other missions and some potential individual GRBs by itself. A polarization catalog of 14 GRBs in total has been published from POLAR in-orbit data, which is the best GRB polarization measurement results so far thanks to the high sensitivity and large field of view of the instrument, as well as the precisely calibrated systematic errors for polarization measurements. The results show that the detected GRBs are at most modestly polarized. Another new finding of the evolution of the intrapulse polarization angle provides us with a new insight into the GRB physics. POLAR results raised large interests as well as several critical scientific questions regarding GRB physics. Furthermore, the scientific potentials of POLAR have been extended during the flight which enabled the instrument to detect the Crab pulsar for navigation test studies, phase-resolved spectrometry and even polarization measurements. Currently, the POLAR data analysis is still ongoing for several research interests. The POLAR-2 mission, which is the successor of POLAR, has been accepted to be installed onboard the China Space Station experimental module dedicated to answering the questions raised by POLAR results under an enlarged China-Europe collaboration. With an improved instrument design, POLAR-2 will be able to provide a much larger sample of GRB polarization measurements with high quality and detailed polarization measurements specified as time-resolved and energy-resolved polarization analysis, thanks to the large and efficient polarimeters, and also the spectrometers which are planned to be equipped. Besides, several pulsars are expected to be seen by POLAR-2 and more stringent constraints are foreseen on the Crab pulsar polarization measurements. Currently, the POLAR-2 instruments are under development with the aim of launching date around 2025.

In this talk we will mainly present an overview of the POLAR results and the prospects and progress of the POLAR-2 mission.

Topic

探测设备与技术

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