



Timing offset calibration of CZTI instrument aboard ASTROSAT

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Both the radio and the high-energy emission mechanism in pulsars is not yet properly understood. A multi-wavelength study is likely to help better understand of such processes. ASTROSAT, the first Indian space-based observatory, has five instruments aboard that cover the electromagnetic spectrum from infra-red (1300 Å) to hard X-ray (380 keV). The instrument relevant to our study is the Cadmium Zinc Telluride Imager (CZTI). CZTI is a hard X-ray telescope functional over an energy range of 20– 380 keV. We aim to estimate the timing offset introduced in the data acquisition pipeline of the instrument, which will help in time alignment of high energy time-series with those from two other ground based observatories, viz. the Giant Meterwave Radio Telescope (GMRT) and the Ooty Radio Telescope (ORT).

Crab pulsar (PSR B0531+21) is a well studied bright pulsar with closely aligned radio and hard X-ray pulse profiles. We used simultaneous observations of this pulsar with the ASTROSAT, the ORT, and the GMRT. As the pulsar resides in a very turbulent environment and shows significant timing noise, it was specially observed using the ORT with almost daily cadence to obtain good timing solutions. We also supplemented the ORT data with archival FERMI-LAT data for estimation of timing noise. We obtained the phase connected timing solution of the pulsar by estimating its dispersion measure variations and the timing noise. The timing offset of ASTROSAT instruments was estimated from fits to pulse arrival time data at the ASTROSAT and the radio observatories.

We estimate the relative offset of ASTROSAT-CZTI with respect to GMRT to be -4716 ± 50 μ s. The corresponding offset with the ORT was -29639 ± 50 μ s and Fermi-LAT was -5368 ± 56 μ s respectively.