*Beppo*SAX OBSERVATIONS OF ISOLATED PULSARS

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Abstract

The Crab and PSR B0540−69 were observed with the NFIs onboard *Beppo*SAX from September to October 1996 during the Science Verification Phase. Here we present some results from these observations.

1. Introduction

*Beppo*SAX (Boella et al. 1997) observed PSR B0531+21 (Crab pulsar) and PSR B0540−69 during the Science Verification Phase. The Crab pulsar was observed from 1996 August 31 to September 1 and from 1996 September 6 to 7. Events were acquired in the direct telemetry mode, necessary to obtain the finest time resolution (15 μs). The total exposure times were ∼7000 s for the LECS, ∼33,000 s for the MECS and ∼21,000 s for both HPGSPC and PDS. This source was detected with a high statistical significance by all the NFIs onboard the satellite, allowing a detailed study of the pulsed signal over the entire energy range (0.3 - 300 keV).

PSR B0540−69 was observed on 1996 October 25–26: the exposure times were ∼20,000 s for the LECS, ∼47,000 s for the MECS and ∼23,000 s for the PDS. Pulse profiles were obtained with the folding technique (after corrections to the Solar System Barycentre): in the case of Crab we used the Jodrell Bank radio ephemeris (Lyne & Pritchard 1996), while the period of PSR 0540−69 was optimized by a χ^2 maximization starting from the most recent estimates of the period and its first derivative (Boyd et al 1995).

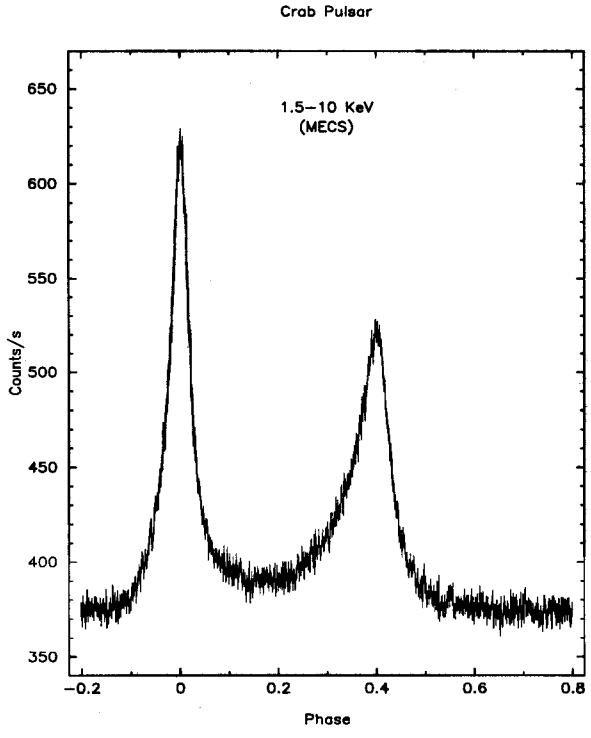

Fig. 1. Crab pulse profile in the whole MECS energy range (1.5 – 10 keV)

2. RESULTS

2.1. Crab Pulsar

A phase histogram in the energy range 1.5 – 10 keV, derived from MECS data, with a very high statistical significance and with the very fine resolution of 0.05 ms (600 bins) is shown in Fig. 1. It is well known that the intensities of the second peak (P2) and of the interpeak region (Ip) with respect to that of the first peak (P1) increase with energy in the X-ray band. We computed the intensity ratios P2/P1 and Ip/P1, after subtraction of a constant off-pulse level, considering the following phase intervals: (−0.05,+0.05) for P1, (+0.27,+0.47) for P2, (+0.05,+0.27) for Ip and (+0.47,+0.77) for the off-pulse. The increasing trends are very well evident from these new measurements and are accurately described by single power laws: the best fit values of the exponents are 0.145 ± 0.032 (for P2/P1) and 0.315 (for Ip/P1).

2.2. PSR B0540−69

The pulse profile of this pulsar in the whole MECS energy range is shown in Fig. 2: it has the usual nearly sinusoidal shape. We do not find evidence for the

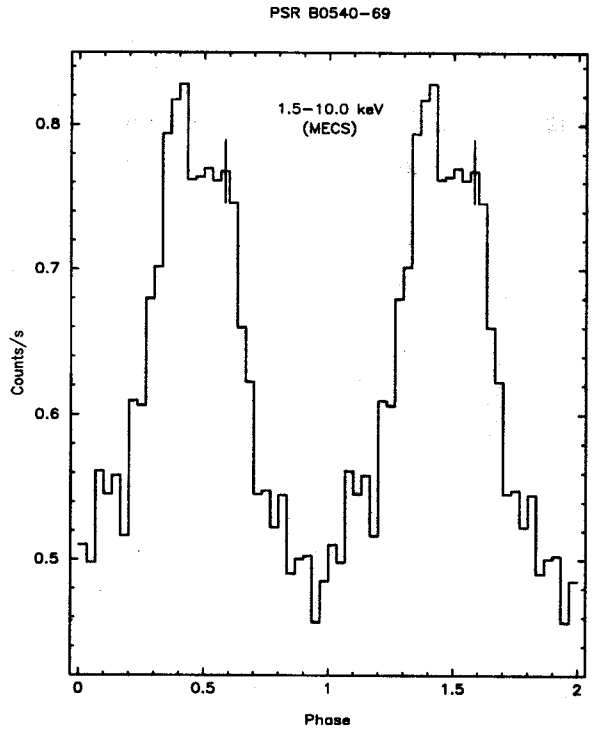

Fig. 2. PSR B0540−69 pulse profile in the whole MECS energy range.

two slight bifurcations at the top of the peak described by Seward et al. (1984). Likely, if a minor structure could be detected, it is a peak just on the left side of the peak top.

PSR B0540−69 is one of the few pulsars for which estimates of the second derivative of the period have been obtained and therefore we used these data for an accurate timing analysis. The high S/N ratio and the overall duration of the observation ($\sim$ 71,000 s) allowed a very precise measure of the barycentric period. In the folding procedure we considered also the period derivative: neglecting this term would produce a period estimate significantly greater than the actual one. Our best evaluation of P is 0.0504650516 $\pm$ (0.0000000006) s at the epoch (JD) 2450381.500. The mean value of $\dot{P}$, measured between our and the ROSAT observations (JD 2448060.286) (Eikenberry et al 1997), is 4.7902 $10^{-13} \pm 3\ 10^{-17}$ s/s.

3. References

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