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RXTE observation of the millisecond pulsar PSR B1821-24

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Abstract. We performed 82 ksec observation of the millisecond pulsar PSR B1821-24, the brightest in the X-ray band among the species. It shows a double peaked pulse profile, with peak widths of 80 and 170 μsec in FWHM, respectively. The sharper peak coincides approximately with one of the two radio peaks as reported before. The shape of the pulse profile does not depend on energy in 2 to 20 keV band and shows no variation during the observation. The energy spectra of the both peaks are represented by a hard power-law with photon index of 1.1 and no apparent difference in the spectra is found.

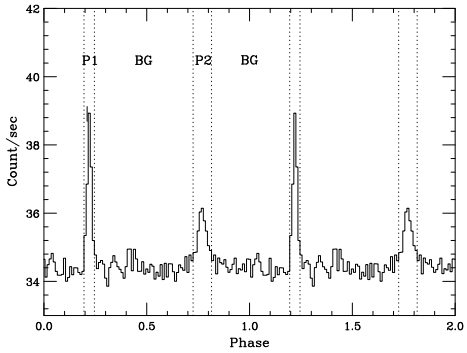
1. Introduction

We now know at least three millisecond pulsars emit pulsed hard X-rays. Study on their emission allows us to explore a new parameter space of rotation-powered pulsars, since their rotation parameters and magnetic field strength are markedly different from ordinary pulsars. So far their observations were limited by photon numbers and timing accuracy of the detectors. Large photon collecting area and high time resolution of RXTE enable us to study the brightest pulsar PSR B1821$-$24 among the species for the first time.

2. Observation and analysis

The *RXTE* observation of PSR B1821$-$24 was performed from February 10 to 13 in 1997. After standard data screening, the total exposure time was 81.7 ksec. The PCA data configuration was *GoodXenon*, which records all good events with the highest timing resolution of 1 μsec. Since the source is too faint to be detected by HEXTE and detected as a steady source by PCA, we concentrated in the analysis of pulsed component observed by PCA.

Using the program faseBin developed by one of us (R.A.), we converted the arrival times of events to those at barycenter, using an ephemeris being valid for



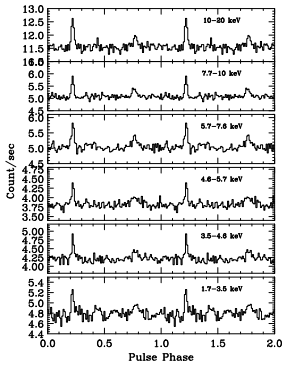


Figure 1. Pulse profiles of PSR 1821−24.

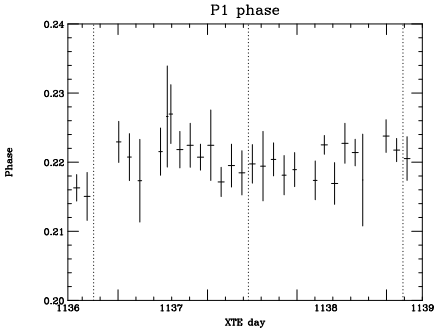


Figure 2. Phase variation.

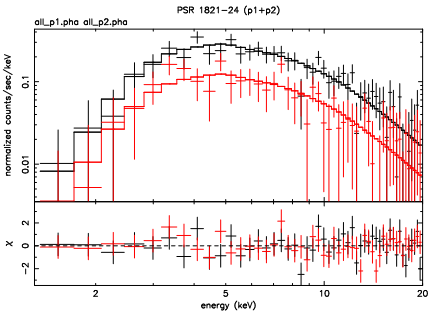


Figure 3. Energy spectra.

the observation. Each event was filled in a two-dimensional histogram of energy channel versus pulse phase. Starting from the histogram, we projected toward the energy axis to obtain phase resolved energy spectra and the phase axis to energy resolved pulse shapes.

It shows double peaked sharp pulse profile as suggested by previous observations as shown in Fig. 1 (Saito *et al.* 1997). If fit with two Gausians, their peak widths are 80 and 170 μsec in FWHM, respectively, and the phase separation is 1670 μsec. The phase of the sharper peak almost coincides with one of the two radio peak as reported before (Rots *et al.* 1998). We studied how the profile depends on energy as shown in Fig 1. from 1.6 to 20 keV, no apparent variation is found. We also studied time variation of the pulse profile within the observation to find no variation (Fig. 2).

We extract the pulsed components (P1 & P2 in Fig.1) by subtracting the steady emission (BG in Fig.1) and made energy spectra as shown in Fig. 3. Both spectra were represented with power-lows with the same photon indices of 1.1, with flux of 3.7×10^{-12} and 1.6×10^{-12} erg·s^{-1}·cm^{-2}, respectively.

References

Saito, Y. et al. 1997, ApJ*Lett., 477, L37*
Rots, A. H. et al. 1998, ApJ, *501, 749*