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XTE J1858+034: Timing Study of transient X-ray Pulsar during Outburst of 2010

[1]Dr. Yogita Shrimali,

[1] Department of Physics

[1]Janardhan Rai Nagar Rajasthan Vidyapeeth University, Udaipur, Rajasthan, India

Abstract: In this paper we present result of systematic study of timing properties of transient X-ray Pulsar XTE J1858+034 using RXTE observations during outburst of 2010. We detect the QPO of frequency 0.1636.

Index Terms **- RXTE, Pulse Period, Pulsar**

1. INTRODUCTION:

X-ray pulsars which also known as accretion-powered pulsars, sources displaying strict periodic variations in X-ray intensity, consisting of a magnetized neutron star in orbit with a normal stellar companion. In these binary systems, the X-ray emission is powered by the release of gravitational potential energy as material is accreted from a massive companion. X-ray pulsars are among the most luminous objects in the X-ray sky. Accreting X-ray pulsars (XRPs) are binary systems consisting of a neutron star (NS) that accretes matter originating from a donor companion star via stellar wind or Roche-lobe overflow. The XRP XTE J1858+034 was discovered with the Rossi X-ray Timing Explorer in 1998 by Remillard et al. (1998) and Takeshima et al. (1998). Those observations also detected X-ray pulsations with a period of 221 s. The X-ray emission from this source has been detected only in a few short outbursts (Nakajima et al. 2019 and references therein), thus preventing the obtaining of an orbital solution or in-depth characterization of the system. A cyclotron resonant scattering feature (CRSF) also has not been observed from this source so far.
XTE J1858+034 were first discovered in 1998 as a hard X-ray transient by the Rossi X-ray Timing Explorer (RXTE). Observations of this source have found that it is an X-ray pulsar with spin period of approximately 220.4 seconds and also detected that it experiences QPOs. Such oscillations are believed to occur when X-rays are emitted near the inner edge of an accretion disk in which gas swirls onto a compact object like a neutron star or a black hole.

2. DATA REDUCTION AND TIMING ANALYSIS:

RXTE was launched on 31 December 1995. The main objective of launching of RXTE is to study the timing properties of celestial objects. RXTE has three sets of instruments.

a) ASM (all sky monitor)
b) PCA (Proportional Counter Array)
c) HEXTE (High Timing Experiment)

ASM was sensitive in energy range 1.5-12keV.PCA was sensitive in energy range 2-60 Kev. It consist five Xenon filled detectors (Jodha et al, 1996). HEXTE was operating in energy range 15-250 Kev.
In this paper we analyze data of XTE J1858+034during outburst of 2010 data. We analyze 20 observations. In present analysis standard 1 mode data with time resolution of 0.125 second was used. PDS power density spectrum was generated by using the FTOOLs. The pulse period of this pulsar shown in figure 1.

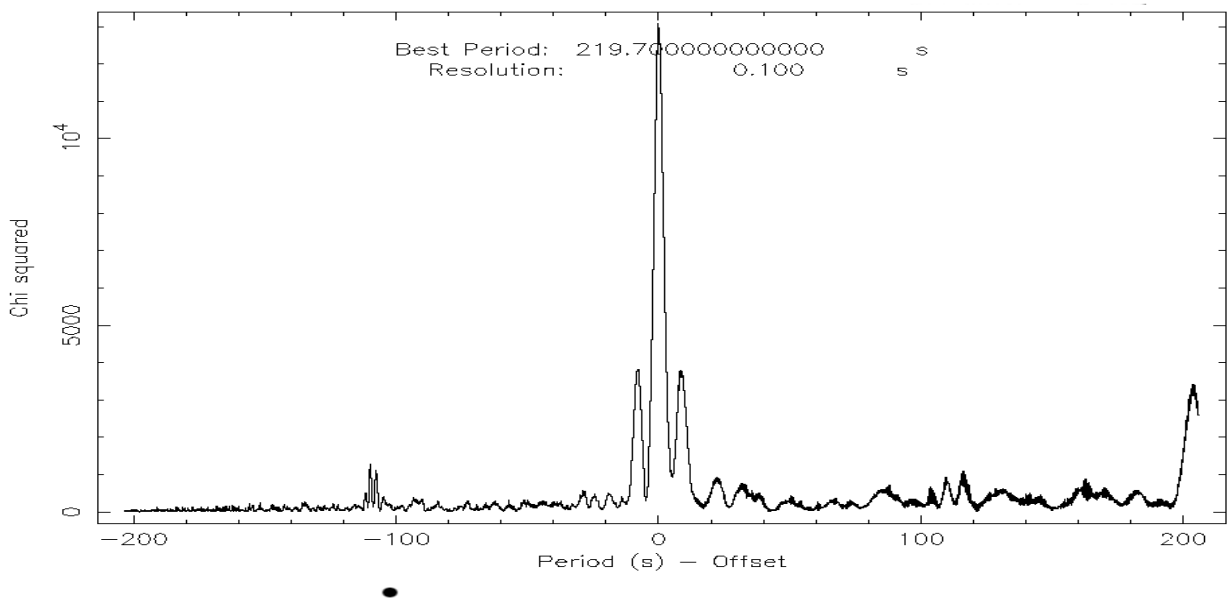

Figure 1: Pulse Period of XTE J1858+034

The power density spectrum for all the observations generated from the 0.125 s binning. In figure the solid lines represent the best fitted model. Here we use Gaussian power law for curve fitting. The figure shows the Gaussian center at 0.1636 Hz which is centroid frequency of the QPO. The light curve in the 3–60 keV energy band was binned to 5 s and used to search for pulsations around the known 221 s periodicity with the epoch folding method (Leahy 1987).

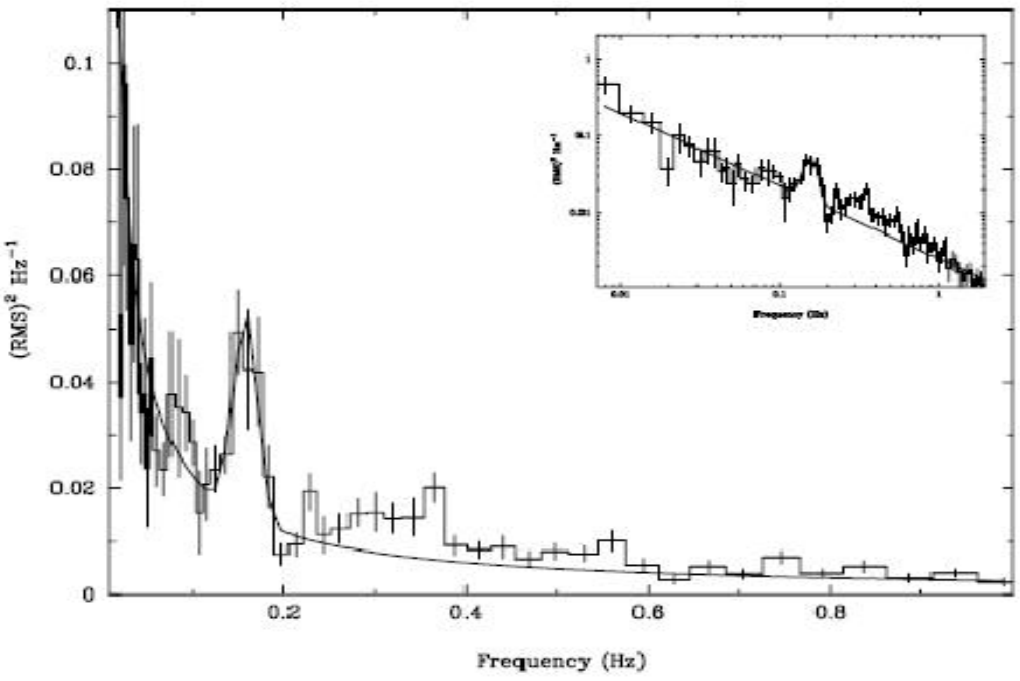

Figure 2: Power density Spectrum

Table: Observations of 2010

Observation ID	Date	MJD
96709-01-02-01	18/01/10	55214
96709-01-02-02	21/01/10	55217
96709-01-03-01	27/01/10	55223
96709-01-04-00	29/01/10	55225
96709-01-04-01	31/01/10	55227
96709-01-04-02	02/02/10	55229
96709-01-04-03	04/02/10	55231
96709-01-05-00	05/02/10	55232
96709-01-05-03	08/02/10	55235
96709-01-05-05	11/02/10	55238
96709-01-06-00	12/02/10	55239
96709-01-06-01	17/02/10	55244
96709-01-07-01	24/02/10	55251
96709-01-08-01	02/03/10	55257
96709-01-08-01	04/03/10	55259
96709-01-09-05	05/03/10	55260
96709-01-10-00	12/03/10	55267
96709-01-10-01	13/03/10	55268
96709-01-10-03	15/03/10	55270
96709-01-10-04	16/03/10	55271

3. CONCLUSION:

In this paper, we performed timing analysis of XTE J1858+034 using the RXTE during the outbursts 2010. Temporal analysis performed with RXTE/PCA observations showed X-ray pulsations. The 220 second pulsations were detected in the light curves. We find the QPO of frequency 0.1636 Hz.

4. ACKNOWLEDGMENT:

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