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Light Curve Periodic Variability of Cyg X-1 using Jurkevich Method

Ai-Jun Dong[1,2,*], Yan-Ke Tang[3] & Ning Gai[3]
[1]*School of Physics, Huazhong University of Science and Technology, Wuhan 430074, China.*
[2]*Mechanical and Electronic Engineering Department, Chuzhou University, Chuzhou 239000, China.*
[3]*Physics Department, Dezhou University, Dezhou 253000, China.*
[*]*e-mail: aijdong@163.com*

Abstract. The Jurkevich method is a useful method to explore periodicity in the unevenly sampled observational data. In this work, we adopted the method to the light curve of Cyg X-1 from 1996 to 2012, and found that there is an interesting period of 370 days, which appears in both low/hard and high/soft states. That period may be correlated with black hole physics and accretion disk geometry.

Key words. Black hole physics: star: binary—X-rays: individuals: Cyg X-1.

1. Introduction

Since the identification of the black hole X-ray binary Cyg X-1, X-ray observations have been made to investigate the spectral and temporal properties of the black hole binary (Bowyer *et al.* 1965). Several spectral states have been identified during an outburst (McClintock & Remillard 2006). At both the beginning and the end of a burst, Cyg X-1 normally stays in a low/hard (LH) state, in the state its emissions are dominated by a power-law spectrum with a photon index of $1.5 < \Gamma < 2.0$. However, when it stays in a high/soft (HS) state, the emissions can be expressed by a power law with a photon index of $\Gamma > 2.0$. As a persistent source, Cyg X-1 normally exhibits periodic temporal properties and some periodical signs have been found. The periods may be connected with black hole physics and/or accreted geometry (e.g. Benlloch *et al*. 2004; Dong 2012). In this work, we mainly use the Jurkevich method (Jurkevich 1971) to explore the periods in the light curve of Cyg X-1, and use Kidger criterion to check the obtained results (Kidger *et al.* 1992).

2. Results and conclusion

2.1 *Data analysis*

In this work, the data are from the ASM data observed by RXTE between MJD = 50087−55841. Firstly, we divide the data by the hardness ratios (HR(3−12 keV))

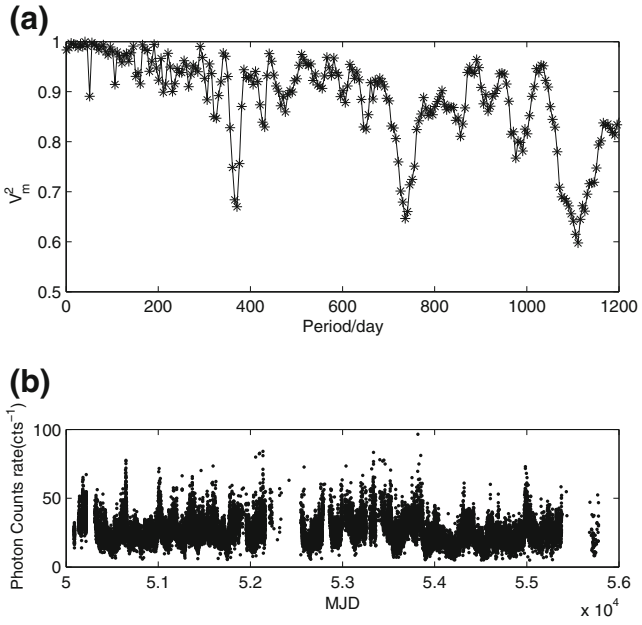

Figure 1(a, b). The light curve periodicity of Cyg X-1 in low/hard states.

into the HS state with HR $= 0.5 \pm 0.3$ and the LH state with HR $= 1.5 \pm 0.3$. Then, we adopted the Jurkevich method to light curves of the two states. The analysis results are shown in Figures 1 and 2, which shows clearly $T \sim 370$-day

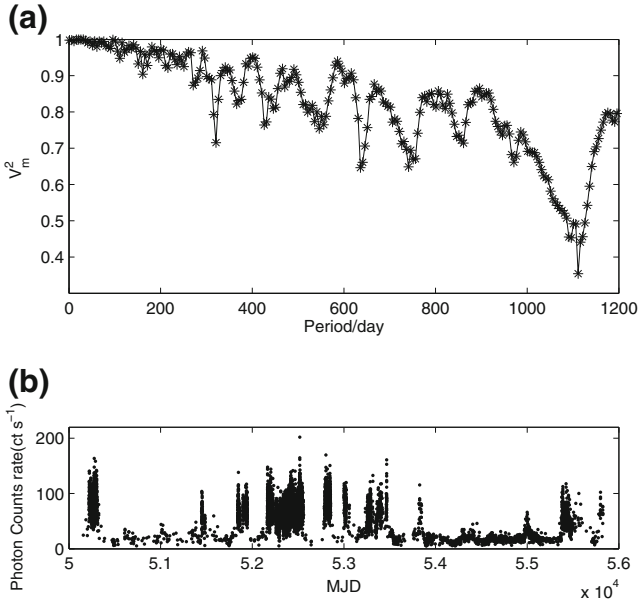

Figure 2(a, b). The light curve periodicity of Cyg X-1 in high/soft states.

periodicity in both LH and HS states, which might be correlated with state transition and/or accretion geometry (Benlloch *et al.* 2004).

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