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Microvariability Detection of Mrk 421

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Abstract. The BL Lac object Mrk 421 was observed in optical bands from 2009 April to 2012 May with the 1.0 m telescope at Weihai Observatory of Shandong University. Microvariability was analysed by C and F tests, but no significant microvariability was detected during our observations.

Key words: AGN-HBL-Mrk 421-microvariability

1. Introduction

The BL Lac object Mrk 421(B2 1101+384) is one of the closest blazars, with a redshift of z=0.031. Mrk 421 was the first BL Lac object detected at γ-Ray energy range(Lin et al., 1992) and was classified as a high frequency peaked blazar (HBL). It has been observed extensively in optical bands and it was believed to be strongly variable in optical bands (Miller, 1975; Liu et al., 1997). Microvariability is regarded as an effective way to investigate properties of Active Galactic Nuclei (AGNs). In this work, we tried to detect microvariability of Mrk 421, but no microvariability was detected during our observations.

2. Observations and Data Reduction

From 2009 April to 2012 May, 2670 observations of Mrk 421 was obtained using the 1.0 m Cassegrain telescope at Weihai Observatory of Shandong University equipped with a PIXIS 2048B CCD camera. The scale of the CCD is 0.35″, and the field of view is about $12' \times 12'$. The seeing usually ranged from 1.5″ to 2.5″. The data were processed using an Interactive Data Language (IDL) procedure developed from the NASA IDL Astronomy Library, including image pre-processing and aperture photometry. V and R magnitudes were derived using differential photometry with an aperture of 6.35″. Stars 1 and 2 or 2 and 3 (Villata et al., 1998) were used as the standard star and the check star. After data filtering, we derived 2352 valid data points.

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3. Results and Conclusions

Microvariability of Mrk 421 was investigated by the commonly used quantity C (de Diego, 2010), which was defined as $C = \frac{\sigma_Q}{\sigma_C}$, where σ_Q and σ_C are the standard deviation of the source and the check star. The F test, which is regarded as a proper statistic for photometry (Gaur et al., 2012a), was also used to detect microvariability. F is defined as $F = \frac{S_Q^2}{S_C^2}$, where S_Q^2 is the variance of the source and S_C^2 is that of the check star. Here we take 1% as the significance level for both C and F tests.

Brightness of Mrk 421 changed 1.50 (13.84 – 12.34) and 0.96 (12.99 – 12.03) magnitudes in V and R band, respectively. Light curves are shown in Figure 1. However, no significant microvariability was detected using C and F tests on 37 nights for 73 light curves, whose data points are more than 5 within one night. Our results are in accordance with results by Gaur et al. (2012a). Previous works indicated that HBLs show less variability than low frequency peaked blazars (Heidt & Wagner, 1996, 1998; Gaur et al., 2012b), which was supported by our results. The scenario of stronger magnetic fields in HBLs (Romero et al., 1999) is reasonable for explaining this phenomenon.

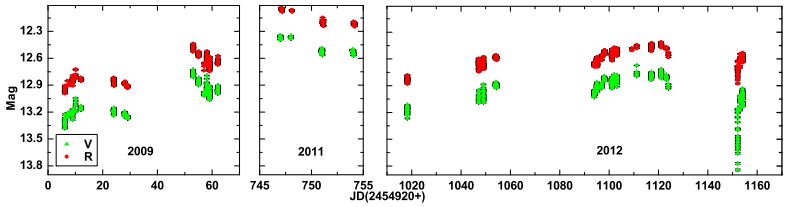

Figure 1. Light curves of Mrk 421 between 2009 April and 2012 May

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