

Microvariability Detection of Mrk 421

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Abstract. 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 was observed extensively 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 frames of Mrk 421 were obtained using the 1.0-m Cassegrain telescope at Weihai Observatory of Shandong University equipped with a PIXIS 2048B CCD camera. The scale of CCD was $0.35''$, and the field-of-view was about $12' \times 12'$. The observation usually ranges from $1.5''$ to $2.5''$. All data were processed using an Interactive Data Language (IDL) procedure developed from 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 check star. After data reduction, 2352 data points remained.

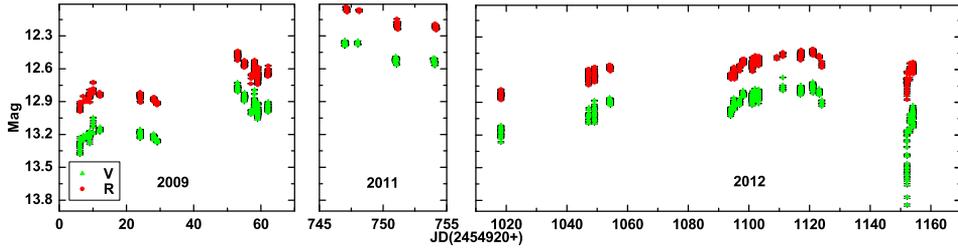


Figure 1. Light curves of Mrk 421 between 2009 April and 2012 May.

3. Results and conclusions

Microvariability of Mrk 421 was investigated by a 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 deviations of the source and the check star, respectively. An F test, which is regarded as a proper statistic for photometry (Gaur *et al.* 2012a), was also used to check microvariability. F is defined as $F = S_Q^2/S_C^2$, where S_Q^2 and S_C^2 are the variance of the source and the check star, respectively. We took 1% as the significance level for both C and F tests.

The brightness of Mrk 421 changed 1.50 (13.84–12.34) and 0.96 (12.99–12.03) magnitudes in the V and R bands, respectively. Light curves were shown in Fig. 1. However, no significant microvariability was detected using the C and F tests for 73 light curves on 29 nights, whose data points were > 5 within one night. Our results are in accordance with those by Gaur *et al.* (2012a). Previous works indicated that HBLs showed less variability than low-frequency peaked blazars (Hedit & 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 to explain this phenomenon.

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