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Optical variability of PHL 1811 and 3C 273

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Abstract. In this work, we reported the optical photometry monitoring results for two brightest nearby quasars, PHL 1811 and 3C 273 using the ST-6 camera at Abastumani Observatory, Georgia. For PHL 1811, we found 3 microvariability events with time scale of $\Delta T = 6.0$ min. For 3C273, we found that the largest variations are $\Delta V = 0.369 \pm 0.028$ mag, $\Delta R = 0.495 \pm 0.076$ mag, and $\Delta I = 0.355 \pm 0.009$ mag. When periodicity analysis methods are adopted to the available data, a period of $p = 5.80 \pm 1.12$ years is obtained for PHL 1811, and $p = 21.10 \pm 0.14$, 10.00±0.14, 7.30±0.09, 13.20±0.09, 2.10±0.06, and 0.68±0.05 years are obtained for 3C 273.

Keywords. quasars: individual (PHL 1811, 3C273): photometry

1. Introduction

Blazars are a special subclass of active galactic nuclei (AGN). Variability is one of the most extreme observation characteristics of blazars, which show variabilities at almost the whole electromagnetic wavebands (see Fan *et al.* 2009, Fan *et al.* 2014, and Wang 2014). The variations have been found to be over a time scale from less than one hour to as long as years (Fan 2005), who divided the time scales into three classes: microvariability (intra-day variability, or IDV), short-term variation, and long-term variation. Generally the short-term variations are non-periodic while the long-term variation in some cases is claimed to be periodic and can be called quasi-periodic.

PHL 1811, located at z = 0.192 (M_V = -25.9), is classified as a high-luminosity narrow-line Seyfert 1 quasar (Leighly *et al.* 2001). PHL 1811 shows significant variations over a day or two in the V band and reached a low V-brightness at around JD 2452895 (Gaskell *et al.* 2006).

3C 273, located at z = 0.158, is a well studied blazar since its discovery in 1963. Manchanda (2002) analyzed its long-term X-ray spectral variability, and untangled the jet and accretion disk emission in the object. Periodicity analysis was also performed by Ryabov *et al.* (2012) and references therein.

2. Observations and results

Abastumani Observatory is located at the top of Mt. Kanobili in the South-Western part of Georgia. Observations are made using a 70 cm meniscus telescope (f/3), to which a Peltier cooled ST-6 CCD imaging camera was attached to the Newtonian focus from March 1997 to Sept 2006. All our observations are made using the filters combined of glasses. Those filters matched with the standard B, V (Johnson), R_C and I_C (Cousins) passbands (Kurtanidze *et al.* 2009).

The magnitude determinations of targets, the variability parameter, V_C by Romero *et al.* (1999), and the periodicity analysis results are included in our very recent paper (Fan *et al.* 2014).

Variations: For PHL 1811, we found 3 microvariability events with $V_C \geqslant 3.0$ on JD 2453565 ($V_C = 17.5$ with an amplitude of $\Delta R = 2.09\%$ over $\Delta T = 6.0$ min), JD 2455410 ($V_C = 3.5$ with $\Delta R = 1.45\%$ over $\Delta T = 6.0$ min), and JD 2455495 ($V_C = 3.0$ with $\Delta R = 2.20\%$ over $\Delta T = 6.0$ min). For 3C 273, we found $\Delta m_{\rm B} = 47.3\%$ with V_C(B) = 3.07 between JD 2451170 and 2451602, corresponding to an interval of 372 days. In that period, $\Delta m_{\rm V} = 32.1\%$ with V_C(V) = 3.37, and $\Delta m_{\rm R} = 24.1\%$ with V_C(R) $\sim$ 3.0. The detected largest variations, $\Delta V = 0.369 \pm 0.028$ mag, $\Delta R = 0.495 \pm 0.076$ mag and $\Delta I = 0.355 \pm 0.009$ mag.

Period Analysis: When the periodicity analysis methods are adopted to the available R data of the two quasars, we found that a period of $p = 5.80 \pm 1.12$ years is obtained for PHL 1811, and $p = 21.10 \pm 0.14$, 10.00±0.14, 7.30±0.09, 13.20±0.09, 2.10±0.06, and 0.68±0.05 years are obtained for 3C 273. For 3C 273, our results are consistent with those by others (Smith & Hoffleit 1963, Babadzhanyants & Belokon 1993, and Vol'vach *et al.* 2013).

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