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Progress in optical monitoring of a sample of FR II-type QSOs

S. Zola[1,2], G. Bhatta[1], A. Kuzmicz[3], M. Jamrozy[1], W. Ogloza[2], M. Drozdz[2], M. Siwak[2], G. Stachowski[2], D.E. Reichart[4] and D.B. Caton[5]

[1] *Astronomical Observatory, Jagiellonian University, ul. Orla 171, 30-244 Krakow, Poland (E-mail: szola@oa.uj.edu.pl)*

[2] *Mt. Suhora Observatory, Pedagogical University, ul. Podchorazych 2, 30-084 Krakow, Poland*

[3] *Center for Theoretical Physics, Polish Academy of Sciences, Al. Lotnikow 32/46, 02-668 Warsaw, Poland*

[4] *University of North Carolina at Chapel Hill, Chapel Hill, North Carolina NC 27599, USA*

[5] *Dark Sky Observatory, Department of Physics and Astronomy, Appalachian State University, Boone, NC 28608, USA*

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Abstract. We present results derived from a monitoring program of a sample of FR-II type radio quasars. The variabilities detected in their densely covered light curves, which have being gathered over a period of more than 9 years, are analyzed with statistical methods (LSP and WWZ). We found no statistically significant, strictly coherent periodicities in our data.

Key words: galaxies: photometry – galaxies: nuclei, – quasars:individual: J0713+3656, J0952+2353, J1007+1248, HB1156+631, HB1525+267, J1504+6856, HB1721+343, J2042+7508

1. Introduction

The variability of quasars over the entire electromagnetic spectrum became known soon after their discovery. Radio observations of optically selected samples of quasars showed that 10-40% of objects are powerful radio sources. The orientation of the radio jet axis toward us can have dramatic effects on the observed source structure, apparent jet speed, and other characteristics. At a large inclination angle the observed core-jet emission is largely depressed and generally weaker than the extended steep-spectrum radio lobe emission, and as such a lobe-dominated radio quasar is observed. Several studies suggested that the flux changes may be correlated with the mass of the central supermassive black hole (e.g. Wilhite et al., 2007). Many observational projects were undertaken to study the quasars' variability with two approaches: the analysis of data from large surveys which provide data on numerous objects, or based on specific samples of a smaller number of targets. In this project we follow the latter approach to investigate a small sample of carefully chosen radio-loud quasars. The selected quasars possess an extended (angular size $\lesssim 20"$) classical FRII (Fanaroff & Riley, 1974) radio morphology, i.e. core and two lobes that are ended with prominent hotspots. Since our sample of targets is seen at intermediate or high angles, the optical observations most likely represent the accretion disk emission (see Bhatta et al., 2018, for a discussion).

2. Optical observations

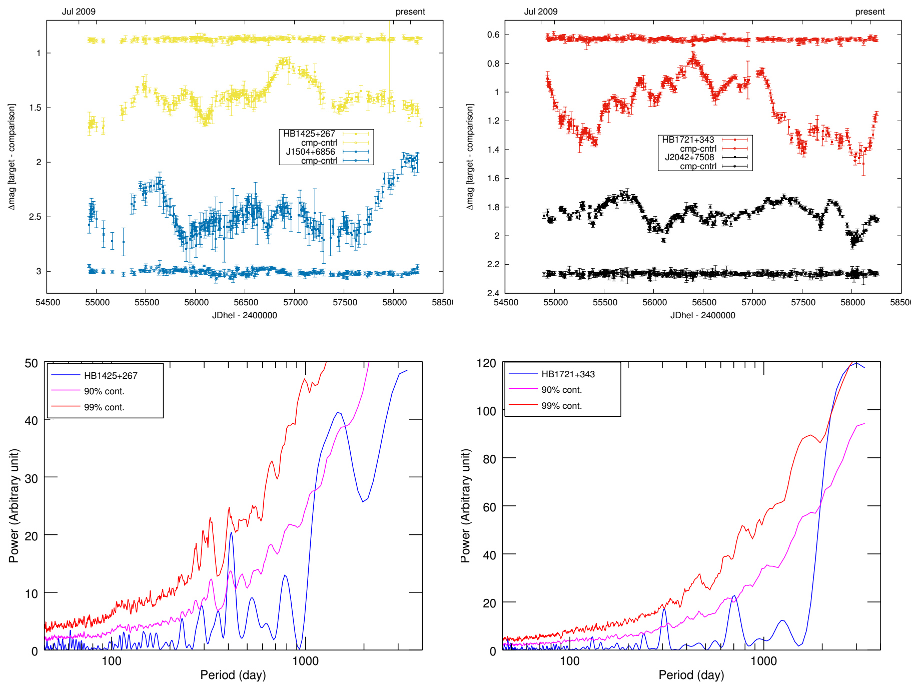

Figure 1. The light curves of four monitored radio-quasars in the R-filter(top panels). Lomb-Scargle periodograms of two sources are shown in the bottom panels.

We started an observing program aimed at long-term monitoring of a sample of 8 radio-quasars in 2009. The motivation for undertaking these observations have been given in detail in Zola et al. (2012). The chosen sample consists of objects located in the northern hemisphere, bright enough to allow photometric measurements with small telescopes with an accuracy better than a few hundredths of a magnitude. Observations in the R-filter are being taken primarily with two telescopes located in Poland: the 60 cm reflector at the Mt. Suhora Observatory of the Pedagogical University and the 50 cm Cassegrain telescope of the Astronomical Observatory of the Jagiellonian University in Krakow. To avoid large gaps in the case of cloudy weather at the Polish sites, we gather data with two telescopes operated by the SKYNET Robotic Telescope Network: DSO-17 (40 cm) and/or RRRT (60 cm). The light curves of four targets, spanning more than 9 years, are shown in Fig. 1 (top panels).

3. Preliminary results from statistical analysis of light curves

Two standard tools were applied to reveal possible coherent periods in the runs: the Lomb-Scargle periodogram (Lomb, 1976; Scargle, 1982) and Weighted Wavelet Z-transform (WWZ; Foster, 1996) The statistical significance of the spectral features observed in the LSP were estimated using the Monte Carlo simulations method described by Timmer & Koenig (1995). A large number of light curves were simulated using the power spectral slope of 1.4 (see Bhatta et al., 2018) and subsequently sampled similarly to real observations. The 90% and 99% confidence contours for two our targets are shown in the bottom panels of Fig. 1 by the magenta and red lines, respectively. Our preliminary analysis indicates that the lower frequency spectral features primarily show the underlying red noise and none of the peaks exceed the 99% confidence level.

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