PROCEEDINGS OF SCIENCE

Optical microvariability in type 2 quasars

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The AGN unified scenario suggests that the type 2 quasars are the obscured counterparts of type 1 quasars where the difference is caused only by the orientation of the object. Optical microvariability is supposed to arise from the regions which are closer to the supermassive black hole at the center of the AGN. The search for microvariability is an important test for the AGN unified scenario. We present first results from the microvariability campaign carried out at San Pedro Martit observatory. We have targeted three brightest ($Vmag < 17$) type 2 quasars from SDSS. Using analysis of variance (ANOVA), we have detected significant microvariability events in two out of three type 2 quasars we have observed.

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1. Introduction

According to the unified scenario, active galactic nuclei (AGN hereafter) differ only due to the orientation of the objects. This scenario suggest that the only difference between type 1 and type 2 quasars is presence of the obscuring torus, which is in case of type 2 quasars, blocking the view onto the central engine. Variation on different timescales is a well established property of type 1 quasar. Optical microvariability (changes in the magnitude on timescales of hours) is supposed to arise from the regions which are closer to the supermassive black hole at the centre of the AGN. The general variability of type 2 (obscured) quasars is much more scarce than in the case of type 1 objects. This is due to the fact that our view onto the central black hole is blocked by the obscuring torus of gas and dust. We challenge the unified scenario by observing a sample of type 2 quasars, aiming at the detection of microvariability also in this type of objects.

2. Sample and Observation

The objects were chosen to be bright, $Vmag < 17$, due to the telescope limitations. The whole sample of type 2 quasars from SDSS according to [1] contains only 4 objects $g < 17$ (roughly comparable with V filter). Out of this sample, three object were observed (fourth object was not observed due to the pointing problems). The observations were carried out at San Pedro Martir observatory in Mexico with the 1.5 m telescope during four nights in March 2011. Each object was observed in Johnson BVR filters, where the majority of the observations was carried out in V filter, B and R images were taken as a references for the color information. Exposure times were set to 60 seconds, targets were observed on average during four hours per night. Light curves were obtained using differential photometry, which proved to be rather efficient for studying microvariability, i.e. [5]. It is also time saving, since the field are big enough to provide constant stars and hence we eliminate the need for standard stars observations.

3. Analysis

Images were bias subtracted and flat-fielded using standard procedures in IRAF, cosmic rays removal was done with LAcos [2]. Photometry was carried out with SExtractor [3]. We used aperture photometry, taking into account the fact, that our targets are nearby and host galaxy contribution cannot be neglected. On the other hand, host galaxy contribution is believed to be constant, so for the targets, aperture needed to be bigger in order to include whole host galaxy. Traditional C-statistic doesn't seem to be suitable tool for microvariability study, hence analysis of variability was done using one way analysis of variance (ANOVA) which proved to be a robust method for analyzing microvariability [4]. The data were divided into groups of five datapoints. Then for each group, variance was computed as well as mean. The ratio between the groups variances is then computed and multiplied by the number of datapoints per group. According to this, we can decide if the light curve exhibits any variability or not, compared to the differential light curve of the constant star.

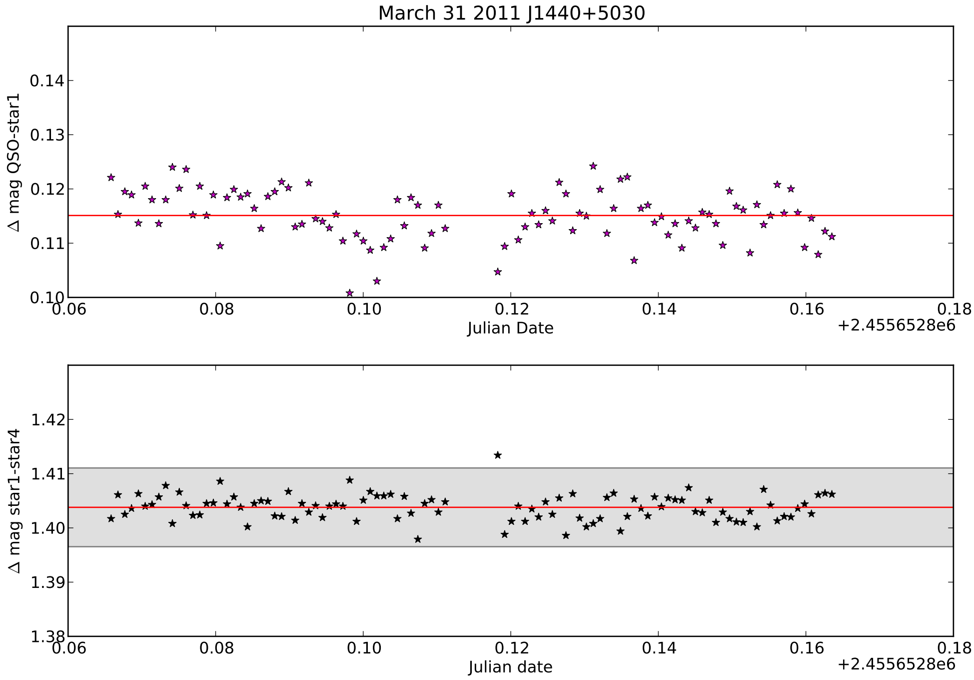

Figure 1: Intra-night light curve of one of the targets. Grey area marks 3σ constraint for constant stars. Datapoints outside of this range were not used for the ANOVA analysis.

4. Results

The undergoing analysis of the light curves in V filter (figure 1) shows prima facie evidence of microvariability in J1440+5030 and J0759+5050. In the case of J1440+5030 (Mrk 477), microvariability is detected during both nights when the object was observed. In J0759+5050, microvariability event was observed only during one out of three observing nights. The upcoming analysis will be complete with color information (from the B and R filter observations taken during the same night.)

References

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