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Optical photometry of X-ray selected BL Lacertae objects

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Abstract. We present optical R band photometry of nine X-ray selected BL Lac objects: 1ES 0229+200, 1ES 0323+022, 1ES 0502+675, 1ES 0647+250, 1ES 0806+524, 1ES 0927+500, 1ES 1028+511, 1ES 1959+650, 1ES 2344+514. Variability on long time scales within one magnitude in R band was found for all of the observed objects, except 1ES 0229+200 and 1ES0927+500. Largest variation was detected for 1ES 0502+675 and equals to $1^{m}.07$.

Key words. Active Galactic Neclei – BL Lacertae – Photometry

1. Observations, Results and Conclusion

Blazar Monitoring Program at Abastumani Observatory was started in the May 1997 and is carried out with ST-6 CCD Camera attached to the Newtonian focus of the 70-cm meniscus telescope (1/3, 14.9x10.7 sq. arcmin). All observations are performed using combined filters of glasses that match the standard B, V (Johnson) and Rc, Ic (Cousins) bands well (Kurtanidze et al. 1999). Reference sequences in the blazar fields are calibrated using the equatorial standard stars (Landolt 1992). The frames were reduced using DaophotII. List of target objects was compiled from Einshtein Slew Survey Sample of BL Lacertae objects (Perlman et al. 1996). During more than 200 nights about 1400 ccd frames were obtained in R band to study long-term and intraday variability of selected objects. Most frequently observed object, as on long-term as well as on intraday scales, is 1ES 1959+650.

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1.1. 1ES 0323+022 and 1ES 0502+675

1ES 0323+022 is the most frequently studied object. Brightest state R=$15^{m}.62$ was detected in Dec 1982 (Feigelson et al. 1986). Largest amplitude $0^{m}.67$ in R band was detected during three years (23.10.1996-23.01.1999) of observation by Torino group with a maximum R = $16^{m}.60$ (Villata et al. 2000).

Our observations include the period from 04 Oct 1997 to 04 Feb 2002. There were two dramatic changes of brighthness:first, up to $0^{m}.43$

from 31 Aug 1998 to 23 Nov 1998 and second one from 12 Sept 1999 to 23 July 2000 about $0^{m}.26$, while the maximum amplitude was $0^{m}.45$.

Early observations of 1ES 0502+675 (31.10.1996-22.02.1997) show that maximum amplitude in R band equals to $0^{m}.58$ (Raiteri et al. 1998).

Our observations include the period from 09 Nov 1997 to 12 Feb 2000. Dramatic chages R=$15^{m}.67$-$16^{m}.74$ was detected before 23 Nov 1998 with an amplitude $1^{m}.07$. After the minimum it rapidly insreases again and reach a mean state characterised by R=$16^{m}.40$ and ΔR=$0^{m}.36$.

1.2. 1ES 0647+250, 1ES 0806+524 and 1ES 1028+511

The previous observation of 1ES 1028+511 during Dec 3,1996 - May 8, 1997 revealed variation ΔR=$0^{m}.18$ and maximum brightness R= $16^{m}.53$ (Villata et al. 2000).

Our observations of these objects include the period from 25 Nov 1997 to 25 Jan 2002. All three objects show significant light variations that are equal to $0^{m}.37$ (25 Nov 1997-13 Dec 1998), $0^{m}.88$ (28 Dec 1997-06 June 2000) and $0^{m}.60$ (28 Jan 1998-25 Jan 2002), respectively.

1.3. 1ES 1959+650 and 1ES 2344+514

Observations of 1ES 1959+650 from February 29,1996 to May 30, 1997 shows that the light curve in the R band is characterized by rapid flickering, a decrease of $0^{m}.28$ mag in 4 days (Villata et al. 2000).

Both objects during our observations show light variations bellow $0^{m}.4$ in R band. Largest one is observed for 1ES 1959+650 (Kurtanidze et al. 2001). 1ES 2344+514 show obvious long-term variability trend over the observing period at ΔR=$0^{m}.1$ level (see also Fan et al. 2001). Consequently, the intraday variability is very week bellow $0^{m}.05$ and may only be detected in exceptional cases of high photometric accuracy. More higher level activity of 1ES 1959+650 in comparison with 1ES 2344+514 may be attributed to its higher radio luminosity (Raiteri et al. 1998).

1.4. Conclusion

Seven of X-Ray BL Lacertae object show variability on long-term scale. Three of them show variation over $0^{m}.5$ (1ES 0502+675, 1ES 0806+524 and 1ES 1028+511), while other four bellow $0^{m}.5$ (1ES 0323+022, 1ES 0647+250, 1ES 1959+650 and 1ES 2344+514). Long-term variability was not detected for two BL Lacertae 1ES 0229+200 and 1ES 0927+500. Intraday variability of 1ES 1959+650 and 1ES 2344+514 is bellow $0^{m}.05$. In general, X-ray selected blazars show week optical variability in comparison with radio selected blazars.

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