THE RESULTS OF LONG-TERM MONITORING OF BLAZARS AT ABASTUMANI OBSERVATORY

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ABSTRACT

We give a brief summary of the ongoing Abastumani Active Galactic Nuclei Monitoring Program started in the May of 1997. More than 110 000 frames are obtained during more than 1300 nights of observation for about 50 target objects, among them γ-ray, X-ray and optical blazars. All observations were done in the BVRI bands using ST-6 CCD based Photometer attached to the Newtonian focus of 70-cm meniscus telescope.

Key words: Blazars; CCD Photometry; Variability.

1. INTRODUCTION

Among active galactic nuclei (AGNs), blazars are objects most dominated by non thermal continuum emission, which extends from radio to γ-rays, and whose properties are best explained by emitting plasma in relativistic motion towards the observer, closely aligned with the line of sight (Urry, 1995). One of the distinguishing characteristics of the blazars which includes BL Lacertae type objects, high polarization quasars (HPQ) and optical violently variable (OVV) quasars is that their flux densities are highly variable at all wavelength from radio to γ-rays. Therefore the optical multiband monitoring along with other ones gives unique clues into the size and structure of the radiating region. Variability time scales have been derived for many blazars from monitoring programs which attain a time resolution of days and to years (Wagner, 1995). Unfortunately, existing multiwavelength data are not adequate yet to permit definite conclusions to be drawn about the nature of blazars due to the optical coverage in the previous campaigns has been much too sparse. We started systematic multiband optical monitoring of blazars at Abastumani Observatory in the May of 1997. In the late of October 1997 we joined the Whole Earth Blazar Telescope (WEBT, http://www.to.astro.it/blazars/webt). The aim of the programme is to study short-term and long-term variability of blazars and their correlations with that in radio, X-ray and γ-ray bands.

2. OBSERVATION AND DATA REDUCTION

Abastumani Observatory is located in the South-Western part of Georgia at a latitude of $41^{\circ}\!.8$ and a longitude of $42^{\circ}\!.8$ on the top of the Mt. Kanobili at 1700 m above mean sea level. The weather and seeing are very good in Abastumani (150 nights per year, 1/3 with seeing <1 arcsec). The mean values of the night sky brightness are B=$22^{m}\!.0$, V=$21^{m}\!.2$, R=$20^{m}\!.6$ and I=$19^{m}\!.8$. Blazar Monitoring Program at Abastumani Observatory was started in the May 1997 and is carried out with Peltier cooled ST-6 CCD Imaging Camera attached to the Newtonian focus of the 70-cm meniscus telescope (1/3). The pointing accuracy of the meniscus telescope is one-two arcminutes and it is good enough to locate target object inside of the full frame field of view 14.9x10.7 sq. arcminute. The ST-6 Imaging Camera uses the TC241 chip (375x242, 23x27 sq.micron) with a maximum quantum efficiency 0.7 at 675 nm. All observations are performed using combined filters of glasses which match the standard B, V (Johnson) and Rc, Ic (Cousins) bands well. Reference sequences in the blazar fields are calibrated using the Landolt's equatorial standard stars (Landolt, 1992). In photometric nights at least one equatorial field is observed with different exposures. Because of the scale of CCD and resolution of the meniscus telescope are equal to 2.3x2.7 sq. arcsec per pixel and 1.5 arcsec respectively, the images are undersampled, therefore to improve sampling it is needed to defocus frames slightly. Unfortunately, the high dark current limits the exposure time to 900 sec. The images are reduced using Daophot-II (Stetson, 1987). The highest differential photometric accuracy reached in R band is $0^{m}\!.005$ (rms) magnitude at m_r=$14^{m}\!.00$ during 180 sec.

RA (2000)	DEC (2000)	Name	Nights	Observations				
				N_B	N_V	N_R	N_I	$N_{IDV,Nights}$
01 12 05.7	22 44 38	S2 0109+22	88	107	87	198	83	602, 11
02 19 42.8	02 19 42	3C 66A	137	129	111	284	85	1443, 17
02 38 38.8	16 36 59	AO 0235+164	147	71	81	683	52	1102, 15
07 21 53.4	71 20 36	S5 0716+714	440	390	323	1300	600	15470, 360
08 54 48.9	20 06 31	OJ 287	135	111	103	196	92	647, 18
09 58 47.2	65 33 55	S4 0954+658	89	65	79	132	88	249, 14
11 04 27.3	38 12 32	MKR421	156	192	180	647	163	3906, 79
11 59 32.1	29 14 42	4C 29.45	91	85	85	218	112	380, 12
12 21 31.7	28 13 58	ON 231, W Com	142	135	193	495	160	
12 56 11.2	-05 47 22	3C 279	96	120	98	196	85	332, 9
16 42 58.8	39 48 37	3C 345	96	87	95	178	106	600, 19
16 53 52.1	39 45 36	MRK 501	93	143	105	185	91	373, 12
17 28 18.5	50 13 11	I ZW 187	83	76	85	179	96	
18 00 45.7	78 28 04	S5 1803+784	147	78	74	500	57	
18 06 50.7	69 49 28	3C 371	120	137	99	164	118	
19 59 59.9	65 08 55	1ES1959+650	160	142	175	275	194	1790, 38
22 02 43.2	42 16 40	BL Lacertae	600	583	1189	1700	453	28227, 439
22 57 17.3	07 43 12	S2 2254+074	110	65	68	193	74	
23 47 04.8	51 42 18	1ES2344+514	147	124	156	242	95	467, 12

3. RESULTS AND CONCLUSIONS

List of target objects was compiled using two Catalogues of AGNs (Padovani (1996), Perlman (1996)). In the period from May 1997 to September 2005, during about 1300 observing nights, more than 110 000 frames were obtained. In the Table the list of the target objects along with the number of nights observed and frames obtained in every of the BVRI bands in excess of one hundred fifty in R band are given. Last column shows the number of frames obtained to study the intraday and intrahour variability. Among most frequently observed objects are BL Lacertae, S5 0716+714, AO 0235+164 and Mkr 421. So far we took part in many international multiwavelength campaigns conducted during outburst and post-outburst era of BL Lacertae, S5 0716+71, 3C 279, Mrk 241, AO 0235+164, 4C 29.45, OJ 287, S4 0954+65 and ON 231. The main part of the results are already published (Hartmann (2001), Raiteri (2003), Massaro (2003), Osterman (2003), Villata (2004), Krawczynski (2004), Jorstad (2004), Raiteri (2005), Bottcher (2005)). Most objects under study show light variations over one magnitude in the optical band. Largest one was observed for AO 0235+164 and equals to $4^{m}.0$ in R band. A few faint variable stars (B$\sim16^{m}.5$) with amplitude $0^{m}.3$-$0^{m}.4$ and periods 3-5 hours were also identified.

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