OPTICAL MONITORING OF BLAZARS WITH THE PERUGIA AIT

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ABSTRACT. Here we present the optical monitoring program of blazars which is ongoing at the Perugia University Observatory. The observations are carried out in a fully automatic way with the help of an Automatic Imaging Telescope (AIT). Further we discuss the differences in the behaviour of the flaring activity between objects belonging to the subset of the X-selected and Radio-selected BL Lac samples included in our monitoring program.

1. Introduction

Blazars are powerful compact radio sources showing jets, superluminal motions and variability at all wavelengths from radio through TeV gamma-rays. It is now clear that to understand the emission mechanisms which are at the origin of the complex phenomena we observe in blazars, we must observe these objects simultaneously all over the electromagnetic spectrum. In the recent years, there has been a big chance to do this thanks to the presence in orbit of space satellites such as IUE, ROSAT, ASCA, CGRO and the more recently launched ISO, RXTE, SAX which allow to investigate the part of the spectral energy distribution of blazars that is not accessible from the ground. Nevertheless it is worthy to note that during most of the satellite pointings of blazars there have not been collected sufficient data in the optical. As a consequence many of the outbursts observed in the X and γ bands are not well covered at optical frequencies, with the lost of important information needed to constrain the theoretical models.

This paper point out how the heavy and repetitive work of monitoring can be optimized with the help of dedicated automatic systems such as that operating at the Perugia University Observatory.

2. The Perugia AIT

Considering that many relatively bright blazars may be observed efficiently by small telescopes, at the Perugia University Observatory we developed an Automatic Imaging Telescope (AIT) able to observe, in an unattended mode, pre–defined lists of objects. In this way only weather conditions can hinder the observations.

The AIT, which is fully described in Tosti, Pascolini & Fiorucci (1996), is based on an equatorially mounted 0.4 m Newtonian reflector ($f/5$), having a 0.15-m refractor ($f/15$) solidly joined to it. A CCD camera and Johnson–Cousins BVR_cI_c filters are

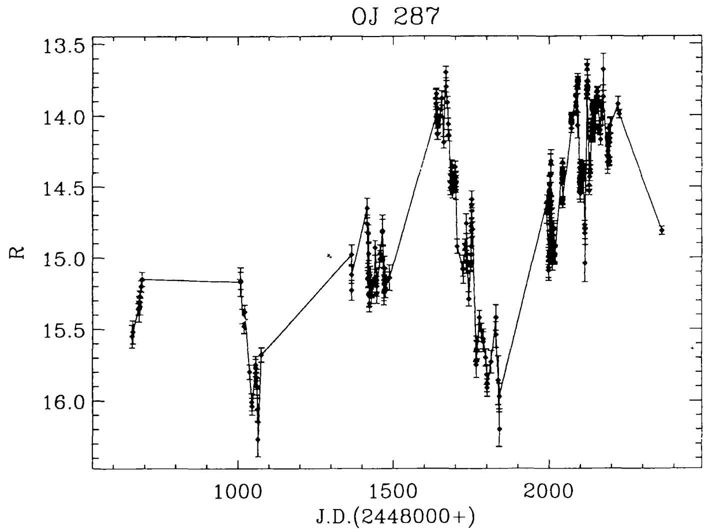

Fig. 1. R–band light curve of OJ 287 from February 1992 to October 4th, 1996.

utilized for photometry. Our system is equipped with an autoguider (based on a CCD camera) that is mounted at the focus of the refractor.

The control of the observatory during the night is now completely automated with the computers deciding the opening or the closing of the dome shutter, selecting the object from the observing list, setting and centering the telescope on the field, taking the desired CCD exposures, and reducing the data after the end of the night. Moreover, a menu–driven user interface allows interactive control of the system which is convenient when the AIT is used for teaching purposes.

The system began full operation in October 1994 and it is able to take 60–120 exposures per night. However, there are limits to the number of objects that can be monitored during a single night. In our monitoring of blazars, each object is observed through the VR_cI_c filters (the filter B is utilized solely for the brightest objects). Taking into account the average object integration time of 5 minutes, the time necessary to acquire dark frames, and time devoted to standard stars, the number of blazars that can be observed each night varies from 12 to 18 depending on the length of the night.

3. The monitoring program

The list of blazars (about 40) monitored by the AIT and the journal of the observations are available on World Wide Web (*http://wwwospg.pg.infn.it/*). Up to now we collected about 7000 photometric points and for each blazar our data constitute a large contribution to the optical database. High luminosity states of some objects have promptly been announced on IAU Circulars (e.g., Fiorucci & Tosti 1992, 1994a,b), and the light curves of ten blazars can be found in Fiorucci & Tosti (1996). Collaboration with other

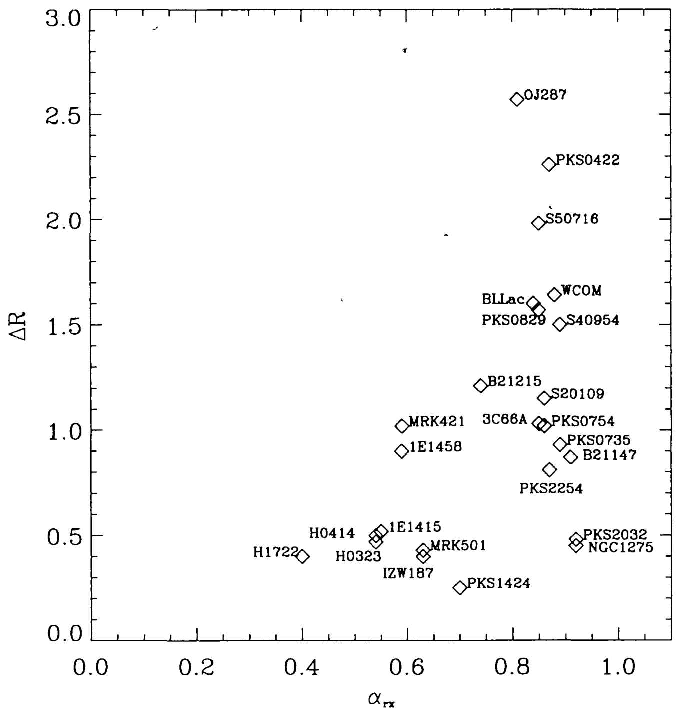

Fig. 2. Amplitude of variability in the R-band vs Radio–X spectral slope α_{RX}. On the average, The RBLs ($\alpha_{RX} > 0.75$) are more variables than XBLs ($\alpha_{RX} < 0.75$)

institutes were started on OJ 287 (Fig.1) and 3C 66A for which we joined the OJ–94 Project (e.g. Sillanpää et al. 1996, Tosti & Fiorucci 1996). For other six sources a collaboration with the Roma and Torino groups was set up (Massaro et al. 1996, Ghisellini et al. 1996, Tosti et al. 1996, Nesci et al. these proceedings).

Most of the blazars in our list were identified as BL Lacertae objects in both radio (RBLs) and $X - ray$ surveys (XBLs). The light curves obtained during the last three years for the 25 BL Lacs included in our sample show the presence of high levels of activity only among the RBLs (see Fig.2). This result confirm that XBLs are less variable than RBLs (Jannuzzi Smith & Elston, 1994). The interpretation of the apparent differences between the two subgroups are still being debated and there are two possible interpretations. It has been suggested that the less optical variability observed in XBLs could be due to orientation effects (see Urry & Padovani, 1995), or, alternatively, the origin of the differences between XBLs and RBLs could be intrinsically related to their different spectral energy distribution (Padovani & Giommi, 1995). Further light on this topic could only come from a better understanding of the physics of the jet which could be deduced from simultaneous multiwavelength campaigns of a large sample of objects.

4. Conclusions

Although several large multiwavelength monitoring have been carried out in recent years, they have lasted short periods and have seen involved only a few objects. Then the available data are still too scarce to develop realistic model of the emission mechanisms of blazars. This is a consequence of the difficulty of arranging multiwavelength monitoring observations, coordinated among several satellites and many ground-based telescopes. One of these difficulties is represented by the impossibility of having access to optical telescopes for large amount of time. For this reason we must increase the number of small facilities dedicated to the monitoring in the optical bands. This is even more important if we consider that the loss of IUE could be partially compensated by the optical data.

In our opinion the only possible way to do this is through a more extensive use of small automatic systems, such as the Perugia AIT, so that, in a near future, the intensive optical monitoring of blazars could be performed by a dedicated **World–Wide network of AITs**

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