

INTRADAY VARIABILITY STATISTICS IN RADIO-SELECTED AND X-RAY SELECTED BL LAC OBJECTS

Implications for Unified schemes

J. HEIDT

Landessternwarte, Königstuhl, 69117 Heidelberg, Germany

1. Introduction

BL Lac objects, characterized by their high variability across the electromagnetic spectrum, strong and variable polarization in the radio and optical domain and a (nearly) featureless continuum can in general be divided into the radio-selected (RBL) and X-ray selected BL Lac objects (XBL) according to their $\alpha_{ro} - \alpha_{ox}$ spectral indices (Stocke et al., 1985). Attempts to unify both classes within a single model have been suggested e.g. by Ghisellini et al. (1993) or Giommi et al. (1994).

In an attempt to characterize the variability behaviour of the BL Lac class as a whole or to search, whether there are differences between both classes a systematic study of several well defined samples of BL Lac objects have been carried out. The intraday variability characteristics have been examined in the optical, since short-term variability is most likely intrinsic in nature in that frequency regime. The aim of this study was to measure the duty cycle in RBL and XBL, to investigate their variability characteristics and to compare the observations with the prediction of the models.

2. The samples and the observations

The 1 Jy sample of RBL (Stickel et al., 1991) and XBL samples taken from the EXOSAT HGLS (Giommi et al., 1991) and EMSS (Morris et al., 1991) have been observed. The samples consist of 34, 11 and 22 BL Lac objects, respectively. Each object has been observed typically for one week several times per night using telescopes at the Landessternwarte Heidelberg, Calar Alto, Spain, ESO, Chile and Cananea, Mexico. A CCD camera with a R filter was attached to the telescopes in order to perform relative photometry.

3. Results

A χ^2 test has been applied to the lightcurves. This gave the fraction of the variable objects. After subtracting a linear slope, the χ^2 test has been applied to the residuals. This gave the fraction of objects displaying intraday variability. The results are summarized in table 1. The RBLs have a very high duty cycle (at least 0.8), whereas the duty cycle in XBLs is low (≈ 0.4).

TABLE 1. Variability statistics of the samples

The sample	non-variable [%]	variable [%]	intraday variable [%]
1 Jy sample	18	82	82
EXOSAT sample	45	55	36
EMSS sample	73	27	23

By means of structure function and autocorrelation analysis, the typical time-scales, amplitudes and an activity parameter \dot{I} have been investigated. The amplitudes during one week are 28% for the RBL and 10% for the XBL, the time-scales 0.5-3 days in RBL, in a few XBL a time-scales could also be measured lying in the same range. The activity parameter \dot{I} (in %/day) is between 3 and 27 %/day in RBL. Here a trend for higher \dot{I} with increasing absolute magnitude was found. In this sources relativistic beaming may be important. In the XBL \dot{I} was always below 3 %/day.

The different duty cycle is not expected from model, where both classes of BL Lac objects differ mainly by their average inclination angle between jet axis and observer (Ghisellini et al. 1993), but challenges also the suggestions by Giommi et al. (1991), where both classes differ mainly by their high-energy cutoff in their energy distribution in different frequencies. In this model relativistic beaming may be present in both classes.

Acknowledgments This work was supported by the DFG (Sonderforschungsbereich 328).

References

- Ghisellini, G. et al.: 1993, *ApJ* **407**, 65
 Giommi, P. & Padovani, P.: 1994, *MNRAS* **268**, L51
 Giommi P., et al.: 1991, *ApJ* **378**, 77
 Morris, S.L., et al.: 1991, *ApJ* **380**, 49
 Stickel, M., et al.: 1991 *ApJ* **374**, 431
 Stocke, J.T. et al.: 1985, *ApJ* **298**, 619