BeppoSAX Observations of 1 Jy BL Lacertae Objects

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1. Observations and Preliminary Results

We present preliminary results on *BeppoSAX* observations of seven BL Lacertae objects selected from the 1 Jy sample. These observations are part of a Core Program we are currently conducting which includes all 1 Jy BL Lacs with estimated $0.1 - 10$ keV flux larger than 2×10^{-12} erg cm^{-2} s^{-1}.

The X-ray astronomy satellite *BeppoSAX* is a project of the Italian Space Agency (ASI) with a participation of the Netherlands Agency for Aerospace Programs (NIVR). The scientific payload comprises four Narrow Field Instruments (NFI): the Low Energy Concentrator Spectrometer (LECS), the Medium Energy Concentrator Spectrometer (MECS), the High Pressure Gas Scintillation Proportional Counter (HPGSPC), and the Phoswich Detector System (PDS), all pointing in the same direction, and two Wide Field Cameras (WFC), pointing in opposite directions perpendicular to the NFI common axis. A detailed description of the entire *BeppoSAX* mission can be found in Boella et al. (1997).

Our main scientific objectives are to: 1. study inverse Compton emission, thought to be the dominant X-ray component in this BL Lac subclass, which is

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characterized by a peak in the multifrequency spectra in the IR/Optical band; 2. compare the *BeppoSAX* spectra with the far- to near-infrared ($1-200\mu$) spectra for the objects observed by ISO as part of a GO program (P.I. P. Padovani); 3. check for any differences between the X-ray spectra of BL Lacs with the peak of the emission in the IR/Optical band (LBL) and in the UV/X-ray band (HBL; Padovani & Giommi 1995). Differences exist in the *ROSAT* band (e.g., Padovani & Giommi 1996). A parallel *BeppoSAX* Core Program, in fact, deals with HBL (Wolter et al. 1998).

Details on the observations, data analysis and reduction can be found in Padovani et al. (1998), who presented results for three of the seven sources described here. Spectral fits for all sources with LECS ($0.1-10$ keV) data show that the fitted $N_{\rm H}$ values are consistent with Galactic absorption, which was then assumed in all composite (LECS and MECS) fits.

The preliminary results of the combined LECS and MECS fits are as follows. The mean value of the energy index $\alpha_{\rm x}$ is ~ 1, but the 6 LBL in the sample (BL Lacs with the peak of the emission in the IR/Optical band) have a mean value $\langle\alpha_{\rm x}\rangle = 0.92 \pm 0.07$, while the only HBL in the sample (PKS 2005−489) has the steepest X-ray index ($\alpha_{\rm x} = 1.32 \pm 0.04$). Inclusion of the 10 HBL studied by Wolter et al. (1988) gives a mean HBL value in the $0.1-10$ keV range of $\langle\alpha_{\rm x}\rangle = 1.31 \pm 0.05$, clearly steeper than the 1 Jy LBL mean. PKS 1144−379 is the only object which shows a significant departure from a single power law (although the verdict on PKS 1519−273 is still open given its low signal to noise ratio), i.e., a flattening above 2 keV. Detection at high energies by the PDS (E $>$ 10 keV) is certain for BL Lac and possible for OJ 287.

A comparison with *ROSAT* results (Urry et al. 1996) shows that some objects exhibit spectral and flux variability. In particular, both OJ 287, in a *lower* state as compared to the *ROSAT* observations (taken in November 1991), and PKS 2005−489, which was in a *higher* state, have a *harder BeppoSAX* spectrum. Although *BeppoSAX* spectra cover a wider energy range than the *ROSAT* ones, this trend agrees with the observed different behaviors of X-ray variability of LBL and HBL, interpreted by Padovani & Giommi (1996) as an effect of the change of the position of the peak of the emission (which moves into the X-ray band from lower energies and out of the X-ray band to higher energies for LBL and HBL respectively).

Overall, the different *BeppoSAX* spectra for LBL and HBL are consistent with a dominance of synchrotron emission in HBL and an inverse Compton contribution in LBL. More specific conclusions on the hard X-ray properties of the 1 Jy sample will have to wait completion of the *BeppoSAX* observations.

References

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