Feeding Compact Objects: Accretion on All Scales
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The radio jet of ultra-high-energy peaked BL Lac objects(UHBLs)

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Abstract. By using our one-epoch EVN+Merlin data and some archived VLBA data, we present the radio properties of 9 ultra-high-energy synchrotron peak BL Lacs (UHBLs) selected as all BL Lacs with log $(\nu_{\rm peak}/{\rm Hz}) > 20$ from Nieppola *et al.*. Our results support that UHBLs might be the less Doppler beamed versions of HBLs with similar jet power.

Keywords. BL Lac objects – galaxies: active – quasars: general

1. Introduction

BL Lac objects are a type of radio loud active galactic nuclei (AGNs) with no emission lines or less of them . They can be classified as different subclasses based on their spectral energy distribution (SED), namely, low frequency peaked BL Lac objects (LBL), intermediate objects (IBL) and high frequency peaked BL Lac objects (HBL) (Padovani & Giommi 1995). Ghisellini *et al.* (1999) suggested that there is a class of BL Lacs with the synchrotron peak at higher frequencies than that of conventional HBLs, i.e. log $(\nu_{peak}/{\rm Hz}) > 19$, and these sources can be called ultra-high-energy syn- chrotron peak BL Lacs (UHBLs) (Giommi *et al.* 2001). UHBLs are at the extreme end of ν_{peak} distribution. As Wu *et al.* (2007) suggested, UHBLs: smaller Doppler factor, larger viewing angle, and lower radio luminosity. However, as far as we know, the VLBI observations are only presented for a few UHBLs, and the radio compact structures of UHBLs are largely unknown. In this paper, we discuss the radio structure of UHBLs based on our EVN and MERLIN observation and VLBI archive data.

2. Observations

Nieppola *et al.* (2006) have constructed the SEDs for a large, heterogeneous sample of BL Lacs. In the sample, 22 BL Lacs with $\nu_{\rm peak} > 10^{19}$ Hz were classified as UHBLs candidates. From these sources, we selected all nine sources with log $(\nu_{\rm peak}/{\rm Hz}) > 20$, which represent the extreme population of UHBLs. In order to explore their radio structure, the VLBI simultaneous observations with EVN and MERLIN, were carried out at 5 GHz for these sources in February 2009 with a total observing time of 24 hours.

Besides our observations, we also collected the available VLBA archive data. The data reduction were performed using the NRAO Astronomical Image Processing System (AIPS). The imaging and model fitting were carried out with DIFMAP package (Shepherd, Pearson & Taylor 1994).

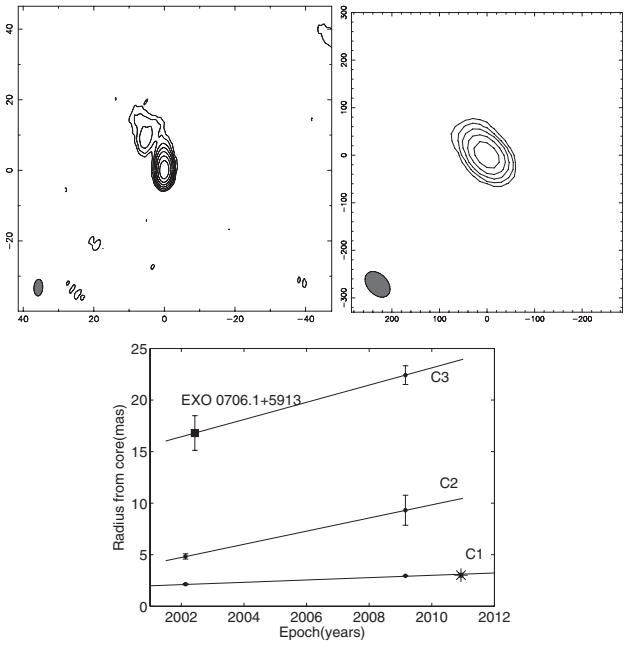

Figure 1. The EVN (top left) and Merlin (top right) structure of RXS J1012.7+4229, Bottom figure is the jet proper motion of EXO 0706.1+5913: the solid lines are linear fits for components C1, C2 and C3. The solid cycle and asterisks are data at 5 GHz and 8 GHz respectively), while the square is 1.6 GHz data component from Giroletti *et al.* (2006).

3. Results and discussions

1 The core-jet structure is detected in five sources, one example can be seen in fig 1, while four sources only have compact core on pc scale.

2 There is no significant variations in two sources (2E 0414+0057 and EXO 0706.1 +5913). No evident proper motion is found in 2E 0414+0057, while the superluminal motion is likely detected in EXO 0706.1+5913(see fig 1), about 0.93c, 5.24c and 6.87c for components C1, C2, C3 respectively.

we also found that our sources show high brightness temperature and less compact than the typical HBLs which can be seen in wu *et al.* 2012. Combining all our results, we propose that the beaming effect might be present in the jets of UHBLs, however, it is likely weaker than that of typical HBLs.

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