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The core dominance parameter for gamma-ray loud blazars

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Abstract. In this work, we compiled 604 blazars with available core-dominance parameter, out of which 149 blazars are known to have γ-ray emissions. We compared the logR between the 149 Fermi-detected blazars (FDB) and the rest non-Fermi-detected blazars (non-FDB), and found that the average values are $< log\, R >= 1.12 \pm 0.88$ for FDBs and $< log\, R >= 0.05 \pm 0.94$ for non-FDBs. A K-S test shows that the probability for the distributions of FDB and non-FDB to come from the same parent distribution is $P = 2.38 \times 10^{-7}$. We also investigated the correlation between the core-dominance parameters and the γ-ray emission variability index (VI) for 125 FDBs (45 BLs and 79 FSRQs), and found that there is a tendency for VI to increase with the core-dominance parameter for 79 FSRQs, but there is no such tendency for 46 BLs.

1. Introduction

Active galactic nuclei (AGNs) consist of quasars, Seyfert galaxies, radio galaxies, BL Lac objects, optically violent variable (OVVs), and LINER. Blazars are a extreme subclass of AGNs, which can be divided two sub-classes, BL Lac Objects (BLs) and flat spectrum radio quasars (FSRQs). Blazars are also the most active galaxies in the Universe, and show some extreme properties: radio loud, rapid variability in all the emission wavebands, superluminal motion, non-thermal continuum spectrum, high and variable polarization, strong emission line or non-emission line at all (see Fan 2005, Fan 2011, Li *et al.* 2014. We also regarded γ-ray emission as one of properties of blazars (Fan *et al.* 2013). Observations show that high energy γ-rays may be strongly beamed (Fan *et al.* 2014). In radio bands, emissions are assumed to consist of two components, namely the core and the extended emissions. The ratio of the core to the extended emission is called the core-dominance parameter, $log\, R = S_{core}/S_{ext}$. We compiled 1223 radio sources with log R (Fan 2011). From a paper by Pei *et al.* (2014, in preparation) and a paper by Fan 2011, we got a sample of 604 blazars with available $log\, R$, and used this value to compare the FDBs and non-FDBs. In section 2, we will present the results and discussions and conclusion in section 3.

2. Sample and result

After the launch of Fermi/LAT, many blazars have been detected to show γ-ray emissions (see Abdo *et al.* 2010; Ackermann *et al.* 2011; Nolan *et al.* 2012; Lott 2014), it has provided good chance to study γ-ray emission mechanism of γ-rays and beaming effect. We compiled 604 blazars with available core-dominance parameter, $log\, R$, out of which

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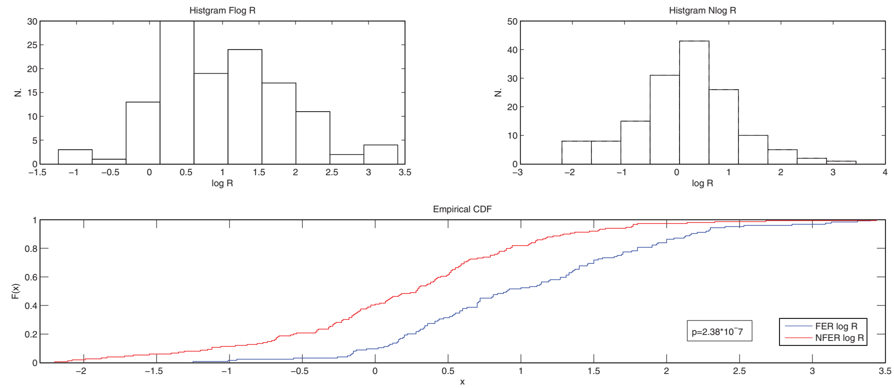

Figure 1. Histogram of logR and the cumulative distribution for Fermi-detected blazars and non-Fermi-detected blazars.

149 are Fermi-detected blazars (FDB) and 463 are non-Fermi-detected blazar (non-FDB) (Pei *et al.* 2014 in preparation). We use those data to investigate the beaming effect as follows.

Comparison of $log\, R$ between FDBs and non-FDBs: From the 604 sources, we can get that the averaged values are $< log\, R >= 1.12 \pm 0.88$ for FDBs and $< log\, R >= 0.05 \pm 0.94$ for non-FDBs. A K-S test shows that the probability for the distributions of FDB and non-FDB to come from the same parent distribution is $P = 2.38 \times 10^{-7}$). The results are shown in Fig. 1.

Correlation between the core-dominance parameter and variability index in γ-ray band: For the 149 FDBs, we can get variability indexes for 125 sources (46 BLs and 79 FSRQs). When we investigate the correlation between the variability index and logR, we found that there is a positive correlation: $log\, VI = -0.04 logR + 1.85$ for BLs and $log\, VI = 0.11 logR + 1.91$ for FSRQs.

3. Discussion and Conclusion

In this work we used 149 FDBs and found that their averaged $log\, R$ is higher than those of non-FDBs supporting our previous result (Li *et al.* 2014). Namely, there may be strong beaming effect in γ-ray emissions. For the variability index, $log\, VI$ and $log\, R$, FSRQs and BLs show different correlation. However, if we take the subclasses of BLs (LBL, IBL, and HBLs) separately, we found that both LBLs and HBLs show positive tendency for the variability index to increase with log R. The investigation of the correlation between $log\, VI$ and $log\, R$ for FSRQs, LBLs and HBLs also support the beaming effect in γ-ray emissions. But the sample used here is not complete, a complete sample will be useful for the investigation.

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