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The Correlation between the Gamma-Ray Luminosity and the Core-Dominance Parameters for a Fermi Blazar Sample

J. H. Fan[1,2], J. H., Yang[3,1], D. X. Wu[1,2], S. H. Li[1,2], Y. Liu[1,2], and Z. Y. Ji[4]

[1]CfA, Guangzhou University, Guangzhou 510006, China email: fjh@gzhu.edu.cn

[2]Astron. Sci. & Tech. Res. Lab. of Dept of Edu. of Guangdong Province, China

[3] Dept. of Phys. & Electron. Sci., Hunan Uni. of Arts and Sci., Changde 415000, China

[4] School of Astronomy and Space science, Nanjing University, Nanjing, China

Abstract. In this work, we investigated the correlation between the γ-ray luminosity, $\log L_\gamma$ and the core-dominance parameter, $\log(1+R)$, for a sample of 124 Fermi blazars with available core and extended radio emissions. Our analysis shows that there is no correlation between the γ-ray luminosity, $\log L_\gamma$ and the core-dominance parameter, $\log(1+R)$. However, there is a closely linear correlation between $\log L_\gamma - \log L_{\rm Ext}$ and $\log(1+R)$, $\log L_\gamma - \log L_{\rm Ext} = (0.95 \pm 0.08)\log(1+R) + (2.72 \pm 0.11)$, for the whole sample. The result suggests that the γ-ray emissions are composed of two components, one is beamed, the other is unbeamed.

Keywords. galaxies:active-galaxies:BL Lacertae objects-galaxies:quasars-galaxies:jets

1. Introduction

Blazars are a very extreme subclass of active galactic nuclei(AGNs) showing rapid and high amplitude variability, high and variable polarization, strong and variable γ-ray emissions, and even superluminal motions etc. (Abdo *et al.* 2009, 2010; Ackermann *et al.* 2011; Bastieri 2012; Fan *et al.* 2011; Ghisellini *et al.* 2010; Gupta *et al.* 2011; Giroletti *et al.* 2010, 2012; Ivezić & MacLeod, 2013; Marscher *et al.* 2011; Massaro, *et al.* 2013a,b; Nolan *et al.* 2012; Sarajedini, 2013; Sol, 2013; Wills *et al.* 1992; Urry, 2011). In a two component relativistic beaming model(Urry & Shafer 1984), the observed total emission, $S^{\rm ob}$, is the sum of the beamed core emission, $S^{\rm ob}_{\rm Core}$ and the unbeamed extended emission, $S_{\rm Ext}$. The ratio, R, of the two parts is defined as the core-dominance parameter, $R = L_{\rm Core}/L_{\rm Ext}$. It is, to some extend, an indicator of the beaming effect. Since the launch of a new generation of γ-ray detector, Fermi/LAT, a lot of blazars have been detected. The relativistic beaming effect was discussed in the papers (see Kovalev *et al.* 2009; Arshakian *et al.* 2010; Savolainen *et al.* 2010; Pushkarev *et al.* 2010; Fan *et al.* 2013a,b; Giovannini, 2013). From the blazar catalogue (Massaro *et al.* 2011), the Fermi catalogues, and the sample of radio sources with available core-dominance parameters (Fan *et al.* 2011), we obtained a sample of 124 Fermi blazars with available core-dominance parameter, and investigate the correlation between the γ-ray luminosity and the core-dominance parameter.

2. Results and Conclusion

Based on the available luminosity and the core-dominance parameter for the sample, we can get that there is almost no correlations for $\log L_\gamma$ and $\log R$, and for $\log L_\gamma$ and $\log(1+R)$. $\log L_\gamma = -(0.19 \pm 0.11)\log R + (46.59 \pm 0.14)$ with a correlation coefficient

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$r = -0.156$ and a chance probability of $p = 8.4\%$, and $\log L_\gamma = -(0.20 \pm 0.12)\log(1 + R) + (46.63 \pm 0.16)$ with a correlation coefficient $r = -0.149$ and a chance probability of $p = 9.9\%$.

However, when considered the subtraction, $\log L_\gamma - \log L_{\rm Ext}$, of the γ-ray luminosity, L_γ and the unbeamed radio emission, $L_{\rm Ext}$, a positively linear correlation can be obtained, namely $\log L_\gamma - \log L_{\rm Ext} = (0.95 \pm 0.08)\log(1 + R) + (2.72 \pm 0.11)$, with a correlation coefficient $r = 0.73$ and a chance probability of $p < 10^{-4}$, for the whole sample.

The result suggest that the γ-ray emissions are composed two part, one is beamed, the other is unbeamed. The unbeamed part should be associated with the extended radio emissions. Recently, γ-ray emissions were detected from the lobe of Cen A (Massaro & Ajello, 2011). Further investigation should be interesting.

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References

Abdo, A. A., Ackermann, M., Ajello, M., *et al.*, 2009, *ApJ*, 700, 597
Abdo, A. A., Ackermann, M., Ajello, M., *et al.*, 2010, *ApJS*, 188, 405
Ackermann, M., Ajello, M., Allafort, A., *et al.*, 2011, *ApJ*, 743, 171
Arshakian, T. G., Torrealba, J., Chavushyan, V. H., *et al.*, 2010, *A&A*, 520, A62
Bastieri, D., 2012, "*Variability of Blazars: From Jansky to Fermi*", Dec. 13-16 , 2012, Guangzhou
Fan, J. H. Yang, J. H., Pan, J., & Hua, T. X., 2011, *RAA*, 11, 1413
Fan, J. H., Yang, J. H., Zhang, J. Y., *et al.*, 2013a, *PASJ*, 65, 25
Fan, J. H., Yang, J. H., Liu, Y., & Zhang, J. Y., 2013b, *RAA*, 13, 259
Ghisellini, G., Tavecchio, F., Foschini, L., *et al.*, 2010, *MNRAS*, 402, 497
Giovannini, G., 2013, IAUS 304, *Multiwavelength AGN Surveys and Studies*, this proceedings
Giroletti, M., Reimer,A. Fuhrmann, L., & Pavlidou, V. 2010, *ASPC*, 427, 283
Giroletti, M., Pavlidou, V., Reimer, A., *et al.* 2012, *AdSpR*, 49, 1320
Gupta, A. C., 2011, *JApA*, 32, 155
Ivezić, Ž & MacLeod, C., 2013, IAUS 304, *Multiwavelength AGN Surveys and Studies*, this proceedings
Kovalev, Y. Y., 2009, *ApJ*, 707, 56
Marscher, A., *et al.*, 2011, *JApA*, 32, 233
Massaro, E., Giommi, P., Leto, C., *et al.*, 2011, *Multifrequency Catalogue of Blazars* (3rd Edition), Edited by E. Massaro, P. Giommi, C. Leto, P. Marchegiani, A. Maselli, M. Perri and S. Piranomonte. ARACNE Editrice, Rome, Italy
Massaro, F., Giroletti, M., & Paggi, A., *et al.* 2013a, *ApJS*, 207, 4
Massaro, F., DAbrusco, R. Giroletti, M., *et al.* 2013b, *ApJS*, 208, 15
Massaro, F. & Ajello, M. 2011, *ApJ*, 729, 12
Nolan, P. L., Abdo, A. A., Ackermann, M., *et al.*, 2012, *ApJS*, 199, 31
Pushkarev, A. B., Kovalev, Y. Y., & Lister, M. L., 2010, *ApJ*, 722L, 7
Sarajedini, V., 2013, IAUS 304, *Multiwavelength AGN Surveys and Studies*, this proceedings
Savolainen, T., Homan, D. C., Hovatta, T., *et al.*, 2010, *A&A*, 512A, 24
Sol, H., 2013, IAUS 304, *Multiwavelength AGN Surveys and Studies*, this proceedings
Urry, C. M. & Shafer, R. A., 1984, *ApJ*, 280, 569
Urry, M., 2011, *JApA*, 32, 139
Wills, B. J., Wills, D., Breger, M., *et al.*, 1992 *ApJ*, 398, 454

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