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The beaming effect for Fermi FR-I radio galaxies

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Our knowledge of Giga-electron volt (GeV) Active galactic nuclei (AGNs) has been revolutionized by the Fermi-LAT Telescope. Fermi-LAT-detected blazars show stronger beaming effects than non-Fermi-LAT-detected blazars (Pushkarev et al. 2009; Linford et al. 2011 ;Wu et al. 2014). Based on the unifi-cation of blazars and radio galaxies (Urry & Padovani 1995), it is reasonable to consider that Fermi-LAT-detected radio galaxies may be the transition sources that exhibit intermediate Doppler beaming effects or special properties, due to these objects residing on the boundary between blazars and radio galax-ies. In this work, we collected 30 Fermi-detected Fanaroff–Riley Type I radio galaxies (FR-Is) with available γ-ray emission and redshift. From the unification of FR-Is and BL Lacertae objects (BL Lacs), we propose a formula to estimate the Doppler factors and discuss the beaming effect for Fermi LAT-detected FR-Is. Our main conclusions are as follows: (1) The estimated Doppler factors for 30 Fermi-LAT-detected FR-Is are in a range of δI=0.88−7.49. The average Doppler factor (⟨δI⟩=2.56±0.30) of the 30 FR-Is is smaller than that (⟨δBL⟩=10.28±2.03) of the 126 Fermi-LAT-detected BL Lacs, supporting the unification model that FR-Is are regarded as the misaligned BL Lacs with smaller Doppler factors; (2) We propose that the different regions of FR-Is in the plot of theγ-ray luminosity against the photon spectral index (logLγ−aph) may indicate the different beaming effects; (3) The average Doppler factor of the 6 Tera-electron volt (TeV) FR-Is is similar to that of the 24 non-TeV FR-Is, which implies that the difference between the TeV and GeV emissions is not driven by the beaming effect in the Fermi-LAT-detected FR-I samples.

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