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ORIGINAL ARTICLE

Correlation between X-ray and γ-ray for Fermi blazars

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Abstract Using γ-ray band data detected by Fermi Large Area Telescope (LAT) and X-ray band data for 78 blazars, we find a medium correlation between X-ray flux and γ-ray flux in all states. A medium correlation is also found between X-ray (1 keV) mean spectral index α_x and γ-ray mean spectral index α_γ for BL Lacertae objects (BL Lacs), and there is no correlation for Flat Spectrum Radio Quasars (FSRQs). From these results, we suggest that the most likely radiation mechanism for the high energy gamma-rays would be synchrotron self-Compton (SSC), and that the gamma-ray emission mechanism may be somewhat different for BL Lacs and FSRQs.

Keywords Blazars · General: γ-ray · Nonthermal

1 Introduction

A relativistic jet is a clear taxonomical characteristic of extragalactic sources detected in γ-rays. Sources with jets pointing close to our line of sight are called blazars and are the brightest and most dominant population of active galactic nuclei (AGN) in the γ-ray sky (Fichtel 1994; Abdo et al. 2010a). Generally, a large γ-ray luminosity emitted in a compact volume is attenuated by strong photon-photon absorption (Dondi and Ghisellini 1995). Many models have been proposed to explain the origin of the blazar γ-ray emission, including synchrotron self-Compton (Maraschi et al. 1992), inverse Compton scattering on photons produced by the accretion disk (Dermer et al. 1992; Zhang and Cheng 1997), scattered by ambient material, or reprocessed by the broad-line clouds (e.g., Blandford 1993; Sikora et al. 1994; Blandford and Levinson 1995; Xie et al. 1997), synchrotron emission by ultrarelativistic electrons and positrons (Ghisellini et al. 1993; Cheng et al. 1993), and electromagnetic cascade by collision of ultrarelativistic nucleons (e.g., Mannheim and Biermann 1992; Mannheim 1993; Cheng and Ding 1994). However, there is no consensus yet on the dominant emission process. These emission models may imply various correlations in different wavelengths that can be used to distinguish among them observationally.

Until recently, making use of EGRET data, the correlation between X-ray and gamma-ray emission has been studied by Dondi and Ghisellini (1995) and Xie et al. (1997). With the launch of the Fermi Gamma-ray Space Telescope in 2008, hundreds of blazars have been found. The primary instrument of Fermi is the Large Area Telescope, LAT. It is an imaging, wide field-of-view telescope covering the energies between 20 MeV and 300 GeV. Fermi works in survey mode, scanning the full sky in only three hours. It also has unprecedented sensitivity, the detection limit being $F(E > 100\ \text{MeV}) \approx 7.5 \times 10^{-9}\ \text{ph cm}^{-2}\,\text{s}^{-1}$ for high galactic latitude and photon index $\Gamma = 2.2$, after 11 months of operation (Lott 2010). Fermi finally offers the flux and time sensitivity needed to shed more light on the correlation between the frequency bands. In addition, the relation between X-ray and gamma-ray fluxes is believed to be key to understand the origin of gamma-ray emission in Blazars. And the relation supports that the origin of gamma-ray can be synchrotron self-Compton (SSC). So it is important to explore the relation between X-ray and gamma-ray emission.

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