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ORIGINAL ARTICLE

Broad line and multi-wave luminosity relations in Fermi FSRQs

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Abstract We study broad line and multi-wave luminosity relations for 80 flat-spectrum radio quasars (FSRQs) detected by Fermi LAT. Our results are as follows: for FSRQs, the correlations between $\log L_\gamma$ and $\log L_{\rm BLR}$, between $\log L_{\rm X}$ and $\log L_{\rm BLR}$, between $\log L_{\rm O}$ and $\log L_{\rm BLR}$, between $\log L_{\rm R}$ and $\log L_{\rm BLR}$ are significant; the correlation between $\log L_{\rm IR}$ and $\log L_{\rm BLR}$ ($P = 0.08$) is not significant, but might be refereed as a "trend" of significant correlation. These results support a close link between jet formation and accretion disk, and the L_γ-$L_{\rm BLR}$ correlation suggests that the radiation mechanism of the γ-ray emission in FSRQs is likely to be inverse Compton scattering of seed photons from BLR or outflowing BLR.

Keywords Galaxies: active · Galaxies: accretion disks · Galaxies: jets · Quasars: emission lines

1 Introduction

Jet formation is one of the most fundamental and unsolved problem in astrophysics (e.g., Meier et al. 2001; Wang et al. 2004). The relation between jets and accretion disk is a crucial ingredient in understanding of jet formation (e.g., Cao and Jiang 1999). Many models have been proposed to explain the origin of jets. In these models, the power of jet is generated via accretion and extraction of rotational energy of disc/black hole (Blandford and Znajek 1977; Blandford and Payne 1982). It is expected that there is a connection between the relative jet and the accretion disk, and the jet-disk connection has been extensively explored by many authors in different ways (Wang et al. 2004). An effective approach to study jet-disk connection is to explore the relationship between different emission-line luminosity and jet kinetic power at different scales (e.g., Rawlings and Saunders 1991; Celotti et al. 1997; Cao and Jiang 1999). The jet kinetic power can be estimated by radio luminosity (Celotti and Fabian 1993; Cao and Jiang 1999; Wang et al. 2004;), γ-ray luminosity (Ghisellini et al. 2010, 2011; Sbarrato et al. 2012), and the standard synchrotron self-Compton theory (Celotti and Fabian 1993).

Cao and Jiang (1999) found that there is a correlation between radio and broad-line emission for a sample of radio loud quasars that supports a close link between accretion processes and relativistic jet. Ghisellini et al. (2010) found that the jet power is proportional to the accretion rate $\dot{M}$ and there is a very close link between jets and disks by studying a correlation between the luminosity of the broad lines and the γ-ray luminosity. Using good-quality broad X-ray data, Maraschi and Tavecchio (2003) also found a significant correlation between the luminosity of relativistic jets and the nuclear luminosity of accretion. Yi and Xie (2008) studied the correlations of the flux of broad-line emission with the X-ray emission flux, optical emission flux at 5500 Å and radio emission flux at 5 GHz, respectively, and their results supported a close link between relativistic jets and accretion onto the central Kerr black hole.

Since the launch of the Fermi satellite, we have entered in a new era of blazars research (Abdo et al. 2009, 2010a). Up to now, the Large Area Telescope (LAC) has detected hundreds of blazars because it has about 20 fold better sensitivity than its predecessor EGRET in the 0.1–100 GeV energy rang. In addition, other wave-band information come from the WISE, UVOT, XRT and BAT telescopes onboard

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