Long-Term Multiwavelength Studies of High-Redshift Blazar 0836+710

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High-redshift blazar 0836+710 multiwavelength variability exhibits some complex features. The largest variability is seen at gamma-ray wavelengths.

**ABSTRACT:** Following gamma-ray flaring activity of high-redshift ($z=2.218$) blazar 0836+710 in 2011, we have assembled a long-term multiwavelength study of this object. Although this source is monitored regularly by radio telescopes and the Fermi Large Area Telescope, its coverage at other wavelengths is limited. The optical flux appears generally correlated with the gamma-ray flux, while little variability has been seen at X-ray energies. The gamma-ray/radio correlation is complex compared to some other blazars. As for many blazars, the largest variability is seen at gamma-ray wavelengths.

**Gamma-Ray Observations**

During the Compton Observatory era, 0836+710 was detected by COMPTEL (3-10 MeV band, Collmar 2006) and EGRET (Thompson et al. 1993; 3EG J0845+7049, Hartman et al. 1999). This source was not bright enough to be included in the Fermi-LAT Bright Source List (Abdo et al. 2009), however, it was associated with 1FGL J0842.2+7054 in the First LAT Catalog (1FGL, Abdo et al. 2010). Its gamma-ray spectrum is steep, with a photon power-law index of $2.95 \pm 0.07$ in 2FGL.

The Fermi-LAT data (E=100 MeV) considered for this analysis cover the period from 2008 August 4 to 2012 January 31. The data analysis was performed with the standard analysis tool gtlike, along with standard Galactic and isotropic diffuse radiation models, all provided with the Fermi-LAT Science Tools package (v9r23p1). The corresponding P7_V6 Instrument Response Functions (IRF) were used. We restricted the analysis to a region of interest centered on the source and a radius of 10$'$.

**Temporal Behavior**

We divided the observations into two time periods: a quiescent period from 2008 August to 2010 August (matching the 2FGL catalog analysis), and an active period from 2011 March to 2012 January. The weekly light curves in Figure 1 show the integrated flux ($E > 100$ MeV).

**Gamma–Ray Spectra**

The spectral analyses were performed using binned (for the quiescent period) and unbinned (for the active period) maximum-likelihood estimators (gtlike). In the analysis, 0836+710 was detected with a statistical significance of approximately 19$\sigma$ and an integral flux $F(E=100$ MeV$) \approx 6.29 \times 10^{-8}$ cm$^{-2}$ s$^{-1}$ for the quiescent period. During the active state, the fluxes $a$ and $c$ showed $F(E=100$ MeV$)$ in the same units of $2.41 \times 10^{-8}$ cm$^{-2}$ s$^{-1}$ (17$\sigma$), $2.51 \times 10^{-8}$ cm$^{-2}$ s$^{-1}$ (11$\sigma$), and $6.54 \times 10^{-8}$ cm$^{-2}$ s$^{-1}$ (4$\sigma$), respectively. For all time intervals, a power-law fit is well fit by a power law. Flares $c$, spectral curvature is visible (as represented in Figure 3). A detailed spectral analysis during this time interval showed a reduced $\chi^2$ of 2.85 for a power-law fit, while a log-parabola fit produced a reduced $\chi^2$ of 0.89.

Although 0836+710 is monitored regularly by radio telescopes, its coverage at other wavelengths is limited. The optical flux appears generally correlated with the gamma-ray flux, while little variability has been seen at X-ray energies. The gamma-ray/radio correlation is complex compared to some other blazars. As for many blazars, the largest variability is seen at gamma-ray wavelengths.