Two active states of GB6 B1310+4844

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The Flat Spectrum Radio Quasar (FSRQ) GB6 B1310+4844, also known as GB1 1310+487 (13:12:43.354 +48:28:30.94, J2000; $z = 0.501$), drew the attention of observers after exhibiting a prominent GeV γ-ray flare in November 2009 which was detected by *Fermi*/LAT and AGILE/GRID. The peak photon flux at $E > 100$ MeV has reached $1.2 \pm 0.2 \times 10^{-6}$ photons cm^{-2} s^{-1} on November 26, more than 40 times above the average level during the first 11 months of the Fermi mission. The γ-ray flare has triggered follow-up X-ray, UV, optical, IR and radio observations with *Swift*, Kanata, 2.1 m Guillermo Haro (OAGH) and the Effelsberg 100 m telescopes. The second high γ-ray state of the source was observed by *Fermi*/LAT in June 2010. It was considerably longer than the previous flare and was characterized by a lower peak γ-ray flux. Additional observations with *Swift*, Nordic Optical Telescope (NOT), OAGH and Effelsberg were obtained. MOJAVE 15 GHz VLBA observations in 2009–2010 reveal a compact core with no visible extended jet. Here, we investigate multi-wavelength properties of the two active states of GB6 B1310+4844.

Radio to γ-ray lightcurves

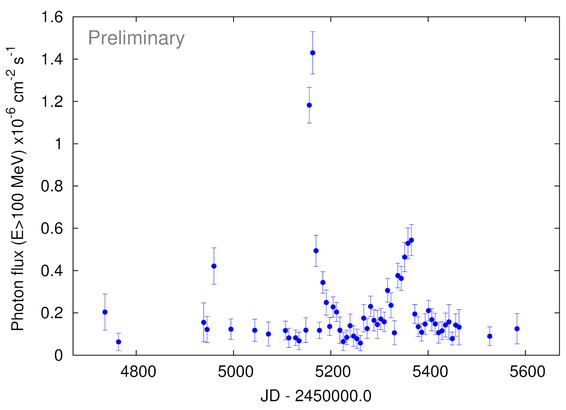

Figure 1: *γ-ray lightcurve obtained during the 30 moths of Fermi/LAT observations, 7d binning.*

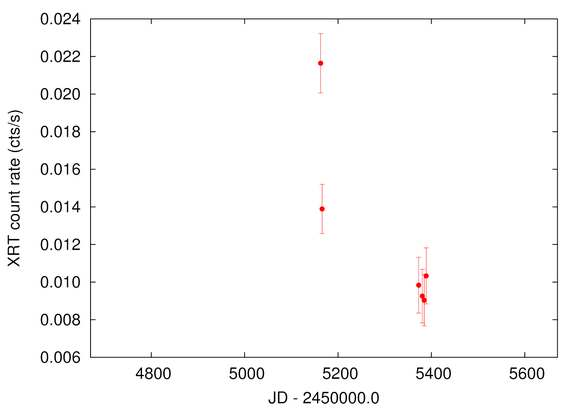

Figure 2: *X-ray (0.3–10 keV) lightcurve by Swift/XRT.*

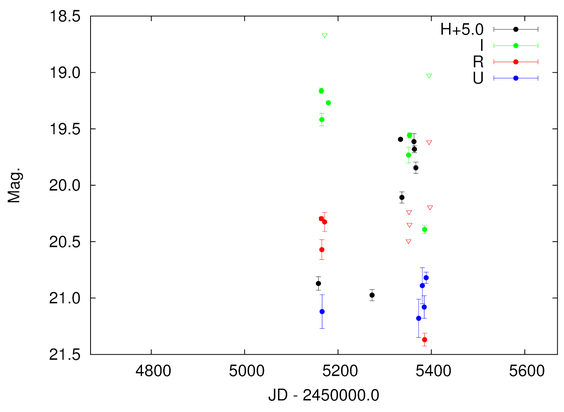

Figure 3: *Optical and near-infrared observations by the Kanata telescope, Swift/UVOT, NOT and OAGH. Open triangles indicate 2σ upper limits.*

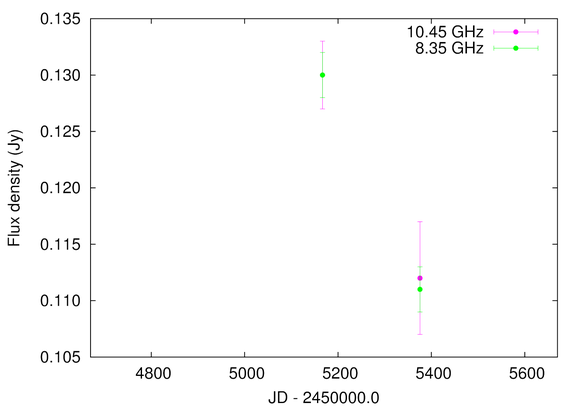

Figure 4: *Radio observations with the Effelsberg 100 m telescope (F-GAMMA program).*

Changes in the γ-ray spectrum

Period	Time interval	Flux	Γ
30 months	2008-08-04 – 2011-02-04	$1.126 \times 10^{-7} \pm 3.9 \times 10^{-9}$	2.177 ± 0.023
Pre-flare	2008-08-04 – 2009-11-16	$3.436 \times 10^{-8} \pm 4.9 \times 10^{-9}$	2.409 ± 0.094
Flare 1	2009-11-16 – 2009-12-21	$6.940 \times 10^{-7} \pm 3.2 \times 10^{-8}$	1.973 ± 0.032
Inter-Flare	2009-12-21 – 2010-04-26	$1.370 \times 10^{-7} \pm 1.1 \times 10^{-8}$	2.145 ± 0.055
Flare 2	2010-04-26 – 2010-07-26	$2.825 \times 10^{-7} \pm 1.6 \times 10^{-8}$	2.139 ± 0.041
After-flare	2010-07-26 – 2011-02-04	$5.938 \times 10^{-8} \pm 8.3 \times 10^{-9}$	2.348 ± 0.096

Column designation: Col. 1 – γ-ray activity state, Col. 2 – time interval used for spectral analysis, Col. 3 – $E > 100$ MeV flux in the units of photons cm^{-2} s^{-1}, Col. 4 – photon index.

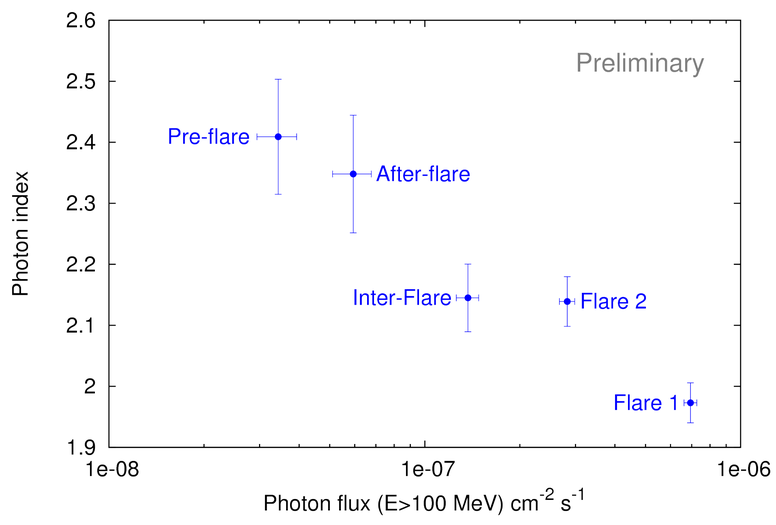

Figure 5: *Photon index as a function of flux.*

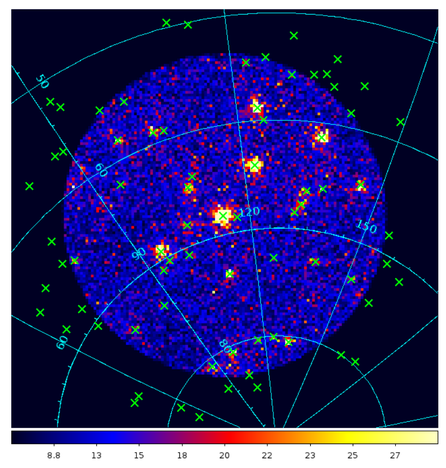

Figure 6: *Fermi/LAT 30-months count map centered on GB6 B1310+4844. The Galactic coordinate grid is shown. Green crosses mark point sources included in the analysis.*

Results

- Multi-wavelength observations confirm the identification of the flaring γ-ray source with the FSRQ GB6 B1310+4844 (Fig. 1–4, 6, and 7).
- Large Compton dominance in the SED (Fig. 7) suggest external Compton mechanism of γ-ray production in this source as opposed to the synchrotron self-Compton scenario.
- Significant evolution of the γ-ray spectrum is observed (Fig 5).
- Unusual flaring behavior: extreme infrared flare does not correspond to the brightest observed γ-ray state. The optical, X-ray, and radio fluxes are lower when the γ-ray flux is lower.

Quasi-simultaneous SED

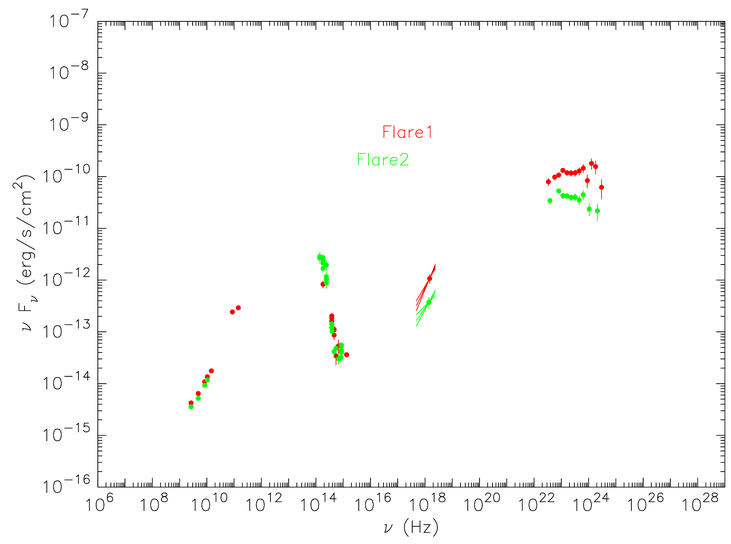

Figure 7: *Spectral Energy Distribution (SED) of GB6 B1310+4844 during the two flaring periods in November–December 2009 (marked as "Flare1", red) and May–July 2010 ("Flare2", green).*

Acknowledgements

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