Comprehensive analysis of the 2021 Flare in BL Lacertae: A Broadband Investigation

Contributed Talk //

Active Galactic Nuclei (AGNs)

Rukaiya Khatoon //
North-West University (NWU)

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BL Lacertae, the prototype of the BL Lacertae (BL Lac) class of blazars, underwent a massive outburst across multi-wavebands during the months of July and August in the year 2021. Specifically, the Fermi Gamma-ray Space Telescope's Large Area Telescope (referred to as Fermi-LAT) recorded a bright γ-ray emission on July 30, 2021, detecting a γ-ray flux ranging from 0.1 to 500 GeV, with a value of approximately 0.9 × 10^−5 photons cm−2 s−1. Simultaneously, the Swift-XRT/UVOT monitored the source's luminosity across X-ray, optical, and UV wavelengths during the γ-ray flare. Remarkably high levels of brightness were discovered, and the corresponding daily average fluxes were recorded as ~ 0.98 × 10^−10 ergs cm−2 s−1, 5.0 × 10^−10 ergs cm−2 s−1, 5.0 × 10^−10 ergs cm−2 s−1, respectively. Through our analysis, we investigated the source's variability by examining its fractional variability amplitude. This analysis revealed a pattern of variability with the highest variability occurring in gamma-ray emissions, succeeded by X-ray emissions, then optical, UV, and radio emissions. To elucidate the observed major activity episodes in July and August 2021, we employed a time-dependent model that incorporates both leptonic diffusive shock acceleration and radiation transfer mechanisms. By employing this model, we were able to recreate the comprehensive spectral energy distributions across various wavelengths and the corresponding light curves. This approach provided valuable insights into the acceleration of particles during these significant periods of heightened activity.

ADDITIONAL AUTHORS

Initials	Surname	Affiliation
M.	Böttcher	NWU

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