Contribution ID: **22** Type: **Contributed Talk**

Multi-wavelength Study of Extreme High-energy Peaked BL Lac (EHBL) Source 1ES 0229+200 Using multi-waveband Observations

Friday 4 October 2024 09:30 (15 minutes)

We present a comprehensive analysis of the broadband spectral energy distribution (SED) of the extreme high-energy peaked BL Lac (EHBL) source, 1ES 0229+200. Our study utilizes near-simultaneous data collected at various epochs between September 2017 and August 2021 (MJD: 58119–59365) from different instruments, including AstroSat–UVIT, SXT, LAXPC, Swift–UVOT, Fermi-LAT, and MAGIC. We investigate the one-zone synchrotron and synchrotron self-Compton (SSC) model, employing diverse particle distributions such as the log parabola, broken power law, power law with a maximum electron energy □, energy-dependent diffusion (EDD), and energy-dependent acceleration (EDA) models to fit the broadband SED of the source. Our findings indicate that both peaks in the SED are well described by the one-zone SSC model across all particle distribution models. We estimate the jet power for different particle distributions. The estimated jet power for broken power law particle distributions is found to be on the order of 1047 (1044) erg s−1 for a minimum electron energy □□□□ ~10 (104). However, for intrinsically curved particle energy distributions (e.g., log parabola, EDD, and EDA models), the estimated jet power is ~1044 erg s−1. The SED fitting at five epochs enables us to explore the correlation between the derived spectral parameters of various particle distribution models. Notably, the observed correlations are inconsistent with the predictions in the power-law with a maximum □ model, although the EDD and EDA models yield the correlations as expected. Moreover, the estimated physical parameter values are consistent with the model assumptions.

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Session Classification: AGN III

Track Classification: Active Galactic Nuclei