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Simulations of high-energy neutrino emissions from blazars with the LeHa-Paris code

The identification of astrophysical sources responsible for high-energy cosmic neutrinos has long been a challenge. A significant milestone was achieved with the blazar TXS 0506+056, which was found to be in a flaring state of high gamma-ray emission and associated at the 3sigma level with a 290 TeV neutrino detected by IceCube in September 2017. This discovery motivated deeper exploration of the theoretical link between photon and neutrino emissions. In this context, simulations of proton-photon interactions in blazars and radiative processes are conducted using advanced numerical codes to predict neutrino spectra. The LeHa-Paris code, previously applied to TXS 0506+056, enables the computation of both leptonic and hadronic components of blazar Spectral Energy Distributions, facilitating exploration of a broad parameter space. In this work, starting from the case of PKS 2155-304—one of the brightest and most studied High-frequency-peaked BL Lacs (HBLs), known for its extreme variability and the subject of multi-wavelength observational campaigns—a methodology has been developed to extend neutrino flux templates, optimized via LeHa, to the full class of HBLs. Afterwards, neutrino emission models for all the HBLs from the 3HSP Catalogue have been numerically derived.

Collaboration(s)

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