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Lepto-hadronic modeling of the emission processes in blazar jets

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The observation of a very-high-energy neutrino by IceCube (IceCube-170922A) and its association with the flaring blazar TXS 0506+056 provided the first multimessenger observations of a blazar jet, demonstrating the important role of protons in their dynamics and emission. In this paper, we present SOPRANO, a new conservative implicit kinetic code which follows the time evolution of the isotropic distribution functions of protons, neutrons and the secondaries produced in photopion and photopair interactions, alongside with the evolution of photon and electron/positron distribution functions. SOPRANO is designed to study leptonic and hadronic processes in relativistic sources such as blazars and gamma-ray bursts. Here, we use SOPRANO to model the broadband spectrum of TXS 0506+056 and 3HSP J095507.9+355101, which are associated with neutrino events, and of the extreme flaring blazar 3C 279. Each SEDs is interpreted within the guise of both a hadronic and a hybrid model. We discuss the implications of our assumptions in terms of jet power and neutrino flux.

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