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Neutrino emission from hadronic X-ray Blazar Flares

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Blazars are a subclass of active galaxies with jets closely aligned to the observer's line of sight. In addition, they are the most powerful persistent sources across the electromagnetic spectrum in the universe. The detection of a high-energy neutrino from the flaring blazar TXS 0506+056 and the subsequent discovery of a neutrino excess from the same direction have naturally strengthened the hypothesis that blazars are cosmic neutrino sources. The lack, however, of gamma-ray flaring activity during the latter period challenges the standard scenario of correlated gamma-ray and high-energy neutrino emission in blazars. Motivated by a novel theoretical scenario where neutrinos are produced by energetic protons interacting with their own X-ray synchrotron photons, we make neutrino predictions for X-ray flaring blazars. Our sample consists of all blazars observed with the X-ray Telescope (XRT) on board Swift more than 50 times from November 2004 to November 2020. To statistically identify an X-ray flaring state we apply the Bayesian Block algorithm to the 1 keV XRT light curves of frequently observed blazars. Using X-ray spectral information during the flaring states, we compute for each flare the 1-10 keV energy fluence, which is a good proxy for the all-flavor neutrino fluence in the adopted theoretical scenario. We present the expected number of muon neutrino events above 100 TeV expected with IceCube for each source as well as the stacked signal from all X-ray flares of the selected sample. We discuss the implications of our results for IceCube and IceCube Gen-2.

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