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Boosted Dark Matter and its implications for the features in IceCube HESE data

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We study the implications of the premise that any new, relativistic, highly energetic neutral particle that interacts with quarks and gluons would create cascade-like events in the IceCube (IC) detector which would be observationally indistinguishable from neutral current deep-inelastic (DIS) scattering events due to neutrinos. Consequently, one reason for deviations, breaks or excesses in the expected astrophysical power-law neutrino spectrum could be the flux of such a particle. Motivated by features in the recent 1347-day IceCube high energy starting event (HESE) data, we focus on particular boosted dark matter (χ) related realizations of this premise, where χ is assumed to be much lighter than, and the result of, the slow decay of a massive scalar (ϕ) which constitutes a major fraction of the Universe's dark matter (DM). We show that this hypothesis, coupled with a standard power-law astrophysical neutrino flux is capable of providing very good fits to the present data, along with a possible explanation of other features in the HESE sample: i.e., a) the paucity of events beyond ~ 2 PeV b) a spectral feature resembling a dip in the 400 TeV–1 PeV region and c) an excess in the $50 - 100$ TeV region.

(based on 1612.02834, "Boosted Dark Matter and its implications for the features in IceCube HESE data")

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