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Superheavy Supersymmetric Dark Matter for the origin of KM3NeT Ultra-High Energy signal

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We propose an explanation for the recently reported ultra-high-energy neutrino signal at KM3NeT, which lacks an identifiable astrophysical source. While decaying dark matter in the Galactic Center is a natural candidate, the observed arrival direction strongly suggests an extragalactic origin. We introduce a multi-component dark matter scenario in which the components are part of a supermultiplet, with supersymmetry ensuring a nearly degenerate mass spectrum among the fields. This setup allows a heavy component to decay into a lighter one, producing a boosted neutrino spectrum with energy $E_\nu \sim 100$ PeV, determined by the mass difference. The heavy-to-light decay occurs at a cosmological redshift of $z \sim$ a few or higher, leading to an isotropic directional distribution of the signal.

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