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Bounds on Long-lived Dark Matter Mediators from Neutron Stars

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Neutron stars close to the Galactic center are expected to swim in a dense background of dark matter. For models in which the dark matter has efficient interactions with neutrons, they are expected to accumulate their own local cloud of dark matter, making them appealing targets for observations seeking signs of dark matter annihilation. For theories with very light mediators, the dark matter may annihilate into pairs of mediators which are sufficiently long-lived to escape the star and decay outside it into neutrinos. We examine the bounds on the parameter space of heavy (\sim TeV to \sim PeV) dark matter theories with long-lived mediators decaying into neutrinos based on observations of high energy neutrino observatories, and make projections for the future. We find that these observations provide information that is complementary to terrestrial searches, and probe otherwise inaccessible regimes of dark matter parameter space.

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