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Jae Hyeok Chang (Stonybrook): Supernova 1987A Constraints on Low-Mass Dark Sectors

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Supernova 1987A provides strong constraints on dark-sector particles with masses below ˜100 MeV. If such particles are produced in sufficient quantity, they reduce the cooling time of the supernova, in conflict with observations. We consider the resulting constraints on dark photons, milli-charged particles, axions and sub-GeV dark matter coupled to dark photons. For the first time, we include the effects of finite temperature and density on the kinetic-mixing parameter, ε, in this environment. Furthermore, we estimate the systematic uncertainties on the cooling bounds by deriving constraints assuming one analytic and four different simulated temperature and density profiles of the proto-neutron star. Our constraints exclude novel parameter spaces for sub-GeV dark matter, and for dark photons and axions differs significantly from previous work in the literature.

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