Contribution ID: **21** Type: **not specified**

Dark matter capture in Celestial objects: Effect of multi-scattering and light mediators

Friday, May 5, 2023 4:45 PM (10 minutes)

We revisit dark matter (DM) capture in celestial objects, including the impact of multiple scattering, and obtain updated constraints on the DM-proton cross-section using observations of white dwarfs. Considering a general form for the energy loss distribution in each scattering, we derive an exact formula for the capture probability through multiple scatterings. We employ these results to compute a "dark"luminosity (LDM), arising solely from the thermalized annihilation products of the captured dark matter. Demanding that LDM does not exceed the luminosity of the white dwarfs in the M4 globular cluster, we set a bound on the DM-proton cross-section, almost independent of the dark matter mass between 100 GeV and 1 PeV and mildly weakening beyond. This is a stronger constraint than those obtained by direct detection experiments in both large masses (M>5 TeV) and small mass (M<10 GeV) regimes. For dark matter lighter than 350 MeV, which is beyond the sensitivity of the present direct detection experiments, this is the strongest available constraint. Moving further, we also generalize the formalism for DM capture in celestial bodies to account for arbitrary mediator mass, and update the existing and projected astrophysical constraints on DM-nucleon scattering cross-section from observations of neutron stars. We show that the astrophysical constraints on the DM-nucleon interaction strength, which were thought to be the most stringent, drastically weaken for light mediators and can be completely voided.

Authors: GUPTA, ARITRA (IFIC); RAY, Anupam; Prof. DASGUPTA, Basudeb (TIFR Mumbai)

Presenter: GUPTA, ARITRA (IFIC)