

Test of Self-interacting dark matter and its thermal transport in the Sun

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The halo dark matter (DM) can be gravitationally captured by the Sun. For self-interacting DM (SIDM), we show that the number of DM trapped inside the Sun remains unsuppressed even if the DM-nucleon cross section is negligible. We consider a SIDM model where $U(1)$ gauge symmetry is introduced to account for the DM self-interaction. Such a model naturally leads to isospin violation for DM-nucleon interaction, although isospin symmetry is still allowed as a special case. We show that the indirect detection of DM-induced neutrinos from the Sun can probe those SIDM parameter ranges not reachable by direct detections. Those parameter ranges are either the region with a very small m or the region opened up due to isospin violations. The energy flows in and out of the system include the gravitational capture via DM-nucleon and DM-DM scatterings, the energy dissipation via DM annihilation, and the heat exchange between DM and solar nucleus are studied. The DM temperature can be higher than the core temperature of the Sun. We further explore its impact on the DM indirect search signal.

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