

Dark matter and black holes



Contribution ID: 211

Type: **not specified**

Bosonic dark matter dynamics in neutron stars

Monday 1 December 2025 15:30 (20 minutes)

Excessive dark matter (DM) capture in neutron star (NS) via DM-nucleon scattering, leads to transmutation of NS into solar mass black hole. The formation of such black hole depends on the thermal properties of captured DM particles, particularly if DM particles are bosons. In this work, we study the capture of bosonic particle and subsequent dynamics inside the star, taking the NS temperature evolution into account. In particular, formation of Bose-Einstein condensate (BEC) out of DM particles have been studied along with its consequence on the subsequent black hole formation. We have shown distinct upper bounds on the DM-nucleon cross-section for both BEC and non-BEC scenarios from the existence of old NS. From our dynamical analysis, we find that the DM-nucleon cross-section for DM masses at the electroweak scale is unbounded from NS observations, thereby the direct detection experiments remain important at this regime.

Ref : K. Dutta, D. Ghosh, B. Mukhopadhyaya, JCAP 12 (2024) 053, arxiv: 2408.16091

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Session Classification: Contributed talks