Contribution ID: **172** Type: **not specified**

Probing long-range dark matter-baryon interactions in compact stellar systems

Monday 7 July 2025 17:00 (20 minutes)

We investigate the astrophysical consequences of an attractive long-range interaction between dark matter and baryonic matter. Our study highlights the role of this interaction in inducing dynamical friction between dark matter and stars, which can significantly influence the evolution of compact stellar systems. Using the star cluster in Eridanus II as a case study, we derive a new stringent upper bound on the interaction strength < 314.5 for the interaction range $= 1$ pc. This constraint is independent of the dark matter mass and can improve the existing model-independent limits by a few orders of magnitude. Furthermore, we observe that the constraint is insensitive to the mass of the stellar system and the dark matter density in the stellar system as long as the system is dark matter dominated. This new approach can be applied to many other stellar systems, and we obtain comparable constraints from compact stellar halos observed in ultrafaint dwarf galaxies.

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Session Classification: Parallel 1