Contribution ID: **293** Type: **Oral**

A Unified Framework for Dwarf Galaxy Cores and Cluster Substructure Cusps via Self-Interacting Dark Matter with Mass Segregation

Tuesday 26 August 2025 14:20 (20 minutes)

Self-interacting dark matter (SIDM) provides a promising solution to small-scale structure anomalies, yet a unified explanation across mass scales remains challenging. Recent dwarf galaxy surveys favor a relatively small cross section of $\sim 0.3\mathrm{cm}^2/\mathrm{g}$—insufficient to induce core collapse—while strong lensing signals in galaxy clusters require dense inner subhalos typically associated with much larger cross sections. We demonstrate that this tension can be resolved in two-component SIDM models, where even modest inter-component interactions lead to efficient mass segregation in massive halos. This enhancement occurs without requiring large self-interaction rates, as the strength of SIDM effects scales with the scale density ρ_s and radius r_s as $\sigma_{\rm eff}/m\ r_s\rho_s^{3/2}$. Consequently, the impact is amplified in cluster subhalos, where both ρ_s and r_s are large, while remaining insignificant in dwarf galaxies. Using a set of cosmological zoom-in simulations of clusters and high-resolution controlled simulations of dwarf halos, we show that this framework can simultaneously reproduce cored dwarfs and cuspy cluster substructures. Our results highlight two-component SIDM with mass segregation as a unified and testable framework for explaining structural features of dark matter halos that are otherwise puzzling.

Collaboration you are representing

Author: YANG, Daneng (Purple Mountain Observatory, Chinese Academy of Sciences, Nanjing 210023, China)

Co-authors: Prof. TSAI, Yue-Lin Sming (Purple Mountain Observatory CAS, and University of California, Riverside); Prof. FAN, Yizhong (Purple Mountain Observatory CAS, and University of California, Riverside)

Presenter: YANG, Daneng (Purple Mountain Observatory, Chinese Academy of Sciences, Nanjing 210023, China)

Session Classification: Dark Matter and Its Detection

Track Classification: Dark Matter and Its Detection