Miami Physics Conference 2025

Date: Dec 12-19, 2025

Location: Lago Mar Resort

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Multi-Field Fuzzy Dark Matter Models and the Radial Acceleration Relation

Abstract

The Radial Acceleration Relation (RAR) of galaxies is a correlation between the observed radial acceleration, and that predicted by the observed distribution of baryonic matter. A phenomenological fit to the RAR implies the existence of a unique acceleration scale for galaxies, which could provide constraints on cold dark matter (CDM) models. Fuzzy Dark Matter (FDM) is an ultra-light scalar particle with de Broglie wavelength ~ 1 kpc. FDM leads to the RAR indicating a quantum-mechanical origin for the observed acceleration scale. Ultra-faint dwarf galaxies (UFDs) are the smallest galaxies, and they are highly dark matter dominated. Due to very high mass-to-light ratios, UFDs are in tension with the RAR. Because FDM suppresses small-scale structure formation, UFDs are in tension with standard FDM as well. We discuss how Multi-Field Fuzzy Dark Matter (MFFDM) can relieve these tensions, and implications for observed acceleration scales in galaxies.