Contribution ID: **65** Type: **not specified**

Leptophilic Scalar Dark Matter: Evading direct detection and prospective neutron star heating

Sunday, 19 April 2026 16:30 (25 minutes)

Leptophilic dark matter offers a well-motivated framework in which conventional nuclear-recoil limits can be strongly suppressed, while viable parameter space remains testable through astrophysical observations. In this talk, I will present a study of scalar leptophilic dark matter in a gauged $\mathrm{U}(1)_{L_\mu - L_\tau}$ extension of the Standard Model, including secluded and pseudo-Nambu–Goldstone boson benchmark realizations. After imposing relic-density, direct- and indirect-detection, and neutrino-trident constraints, viable sub-TeV to TeV parameter regions remain. I will emphasize that neutron star heating provides a powerful complementary probe of these models: even when terrestrial direct-detection signals are suppressed, dark matter capture in neutron stars can still yield observable heating signatures. This complementarity makes old neutron stars a promising probe of thermal dark matter scenarios that evade strong constraints from conventional direct-detection searches.

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Session Classification: Parallel Cosmology & Astrophysics: Cosmic Signals (Room 302, Chair Zhao-Feng Kang)