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Unifying Seesaw and Radiative Neutrino Mass Mechanisms with A_4 Symmetry: A Pathway to Dark Matter Stability

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To address the smallness of neutrino masses and the observed large neutrino mixing, we propose a hybrid framework that synergistically combines the canonical seesaw mechanism with radiative mass generation. This model is embedded in the A_4 non-Abelian discrete flavor symmetry, whose spontaneous breaking generates correct neutrino mixing patterns and stabilizes dark matter through a conserved residual symmetry. We investigate the phenomenological consequences of this "discrete dark matter" paradigm, analyzing both Dirac and Majorana neutrino mass scenarios. The interplay between the seesaw and radiative mechanisms is shown to yield testable predictions for neutrinos (e.g., mixing angles, mass-squared differences) and dark matter (relic density, direct detection signatures). This work bridges high-scale symmetry-based models with low-energy observables, offering a unified approach to neutrino mass and dark matter stability.

Primary author: KARMAKAR, Biswajit (University of Silesia in Katowice)

Presenter: KARMAKAR, Biswajit (University of Silesia in Katowice)

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