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Exploring the impact of Non-Standard Interactions on Sterile Neutrino dark matter production: Part 1

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Mixing between active and sterile neutrinos represents a fundamental mechanism for sterile neutrino dark matter production in the early Universe. However, the standard Dodelson-Widrow (DW) mechanism is in tension with astrophysical bounds, particularly those arising from structure formation and X-ray observations. To address these challenges, and building on previous works, we introduce non-standard interactions (NSIs) in both the active and sterile sectors, including active neutrino self-interactions, sterile neutrino self-interactions, and active-sterile secret interactions. These interactions are mediated by a generic $U(1)$ scalar mediator, and we explore their effects in different regimes of mediator mass. We find that depending on the mediator mass, sterile neutrino production rate can be enhanced by resonance or through number changing reactions, potentially offering a resolution to the constraints that limit the standard DW mechanism.

Authors: DEV, Bhupal (Washington University in St. Louis); Prof. DUTTA, Bhaskar; GOSWAMI, Srubabati (physical research laboratory); TANG, Jianrong; UR, Aaroodd

Presenter: UR, Aaroodd

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