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Sterile Neutrino Dark Matter Production via Active–Sterile Non-Standard Interactions

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Sterile neutrinos are compelling dark matter candidates, but production solely from active-sterile oscillations is excluded by astrophysical observations. Non-standard self-interactions in either active or sterile sector can modify production to some extent. Here we propose a novel solution where scalar-mediated non-standard interactions between active and sterile neutrinos generate new production channels for ν_s, independent of the active-sterile mixing and without the need for any fine-tuned resonance or primordial lepton asymmetry. Focusing on the heavy-mediator regime (m_ϕ
$gtrsim 5\,\mathrm{GeV}$), these interactions efficiently populate the sterile sector even for vanishingly small mixing, while remaining consistent with cosmology and structure-formation bounds. The mechanism broadens the viable parameter space relative to scenarios that rely on mixing and implies potentially observable neutrino-dark matter interactions in astrophysical environments.

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

Presenter: UR, Aaroodd

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