

Probing self-interacting sterile neutrino dark matter with the diffuse supernova neutrino background

Tuesday, 17 September 2024 14:05 (20 minutes)

The neutrinos in the diffuse supernova neutrino background (DSNB) travel over cosmological distances and this provides them with an excellent opportunity to interact with dark relics. We show that a cosmologically-significant relic population of keV-mass sterile neutrinos with strong self-interactions could imprint their presence in the DSNB. The signatures of the self-interactions would be “dips” in the otherwise smooth DSNB spectrum. Upcoming large-scale neutrino detectors, for example Hyper-Kamiokande, have a good chance of detecting the DSNB and these dips. If no dips are detected, this method serves as an independent constraint on the sterile neutrino self-interaction strength and mixing with active neutrinos. We show that relic sterile neutrino parameters that evade X-ray and structure bounds may nevertheless be testable by future detectors like TRISTAN, but may also produce dips in the DSNB which could be detectable. Such a detection would suggest the existence of a cosmologically-significant, strongly self-interacting sterile neutrino background, likely embedded in a richer dark sector.

Working Group

WG 5: Neutrinos Beyond PMNS

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Session Classification: Parallel: WG5

Track Classification: WG5: Neutrino Beyond PMNS