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## Constraints on Neutrino Secret Interactions from Multi-messenger neutrinos scattering on CvB

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We present new constraints on neutrino secret interactions (vSI) using high-energy and ultra high-energy astrophysical neutrinos as probes of new physics beyond the Standard Model. By studying neutrinos from established sources, such as SN1987A, NGC 1068, TXS 0506+056, PKS 0735+178, and the extreme-energy KM3-230213A event, we explore the potential interactions of Dirac neutrinos with a massive spin-one boson during their propagation through the Cosmic Neutrino Background (CvB). Notably, the KM3-230213A event allows us to probe an entirely new scale of interaction strength and reveals sensitivity to heavier mediator masses previously beyond reach.

Our analysis covers both ultra-relativistic and non-relativistic regimes, deriving exclusion limits on the vSI coupling constant across the full mediator mass range. We examine flavor-universal and flavor-non-universal coupling scenarios, the latter are often addressed in discussions about cosmological tensions such as  $H_0$  and  $S_8$  discrepancies. This work contributes to the ongoing development of the theoretical framework for vSI and illustrates the potential of multi-messenger neutrino observations to probe fundamental aspects of neutrino interactions.

### Collaboration(s)

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