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Neutrino nonradiative decay and the diffuse supernova neutrino background

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When a massive star dies and, its core collapses, most of its gravitational binding energy is released as neutrinos. These neutrinos are messengers that can provide information on the supernova's dynamics and properties of neutrinos. However, core-collapses are rare in our galaxy. The Diffuse Supernova Neutrino Background (DSNB) provides an alternative opportunity to detect these supernova neutrinos. The DSNB is the constant flux of neutrinos and antineutrinos emitted by all past CCSNe in the observable Universe.

In this talk, I will present the potential to extract information on the neutrino lifetime from the observation of the DSNB flux [1]. The DSNB flux has a unique sensitivity to neutrino non-radiative decay for $\tau/m \in [10^9, 10^{11}]$ s/eV. Firstly, I will introduce the description of the DSNB flux used in our work and the effect neutrino decay has on it. Our description integrates, together for the first time, astrophysical uncertainties, the contribution from failed supernovae and a three-neutrino description of neutrino non-radiative decay. Furthermore, I will show our predictions for future detection at the running Super-Kamiokande + Gd, and the upcoming Hyper-Kamiokande, JUNO, and DUNE experiments. Finally, I will stress the importance of identifying the neutrino mass ordering to restrict the possible decay scenarios for the impact of non-radiative neutrino decay on the DSNB.

[1] P. Iváñez-Ballesteros and M. C. Volpe, Phys. Rev. D, 107 023017, arXiv:2209.12465

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No

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