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Massive neutrino self-interactions and inflation

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Certain inflationary models like Natural inflation (NI) and Coleman-Weinberg inflation (CWI) are disfavoured by cosmological data in the standard ΛCDM+r model (where r is the scalar-to-tensor ratio), as these inflationary models predict the regions in the n_s–r parameter space that are excluded by the cosmological data at more than 2σ (here n_s is the scalar spectral index). The same is true for single-field inflationary models with an inflection point that can account for all or majority of dark matter in the form of PBHs (primordial black holes). Cosmological models incorporating strongly self-interacting neutrinos (with a heavy mediator) are, however, known to prefer lower n_s values compared to the ΛCDM model. Considering such neutrino self-interactions can, thus, open up the parameter space to accommodate the above inflationary models. In this work, we implement the massive neutrino self-interactions with a heavy mediator in two different ways: flavour-universal (among all three neutrinos), and flavour-specific (involving only one neutrino species). We implement the new interaction in both scalar and tensor perturbation equations of neutrinos. Interestingly, we find that the current cosmological data can support the aforementioned inflationary models at 2σ in the presence of such neutrino self-interactions.

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