

VISH ν : a unified solution to five SM shortcomings with a protected electroweak scale

A.H. Sopov and R.R. Volkas

ARC Centre of Excellence for Dark Matter Particle Physics, School of Physics, The University of Melbourne, Victoria 3010, Australia

We propose a Standard Model extension, coined VISH ν (Variant-axIon Seesaw Higgs ν -trino), that is a variation of its predecessor, the ν DFSZ model. In accounting for the origin of neutrino masses, dark matter and the baryon asymmetry of the universe, VISH ν inherits the explanatory power of ν DFSZ while, of course, resolving the strong CP problem. In both models, the electroweak scale is naturally protected in the presence of a high seesaw scale that is identified with the Peccei-Quinn (PQ) spontaneous symmetry breaking scale. Importantly, VISH ν extends the cosmological reach of ν DFSZ to include a viable period of inflation and, through a variant flavour coupling structure, evades a cosmological domain wall problem. The focus of this paper is thus on the inflationary dynamics of VISH ν and their naturalness in the sense of radiative stability. In particular, we find that non-minimal gravitational couplings of the VISH ν scalar fields naturally give rise to a selection of viable inflatons. An axion mass window [$40\mu\text{eV}, \sim 2\text{meV}$], which is accessible to forthcoming searches, results for the case that PQ symmetry is restored during the (p)reheating phase.