

SMASH-ing Vacuum Metastability

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Five fundamental problems - neutrino oscillations, baryogenesis, dark matter, inflation, strong CP problem - are solved at one stroke in a model, dubbed as “SM-A-S-H” (Standard Model-Axion-Seesaw-Higgs portal inflation) by Andreas Ringwald et. al. The Standard Model (SM) particle content is extended by three right-handed SM-singlet neutrinos N_i , a vector-like color triplet quark Q , a complex SM-singlet scalar field σ that stabilises the Higgs potential, all of them being charged under a global lepton number (hyper-charge) and Peccei-Quinn (PQ) U(1) symmetry, the vacuum expectation value $v_\sigma \sim 10^{11}$ GeV breaks the lepton number and the Peccei-Quinn symmetry simultaneously. We found that numerically SMASH model not only solves five fundamental problems but also the sixth problem “Vacuum Metastability” through the extended scalar sector.

Summary

SMASH unifies axions, seesaw and extended Higgs sector on one energy scale, $\mu \sim 10^{10} - 10^{11}$ GeV, solving several problems badgering the Standard Model in one go. SM vacuum is metastable, since λ_H turns negative around $\mu \simeq 10^{12}$ GeV, SMASH can fix this vacuum metastability problem with $\lambda_{H\sigma} \approx$ between -10^{-6} & -0.1 .

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