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Walls, Bubbles and Doom – the Cosmology of HEFT

Abstract

As experiment charts new territory at the electroweak scale, the enterprise to characterize all possible theories becomes all the more necessary. In the absence of new particles, this ambitious enterprise is attainable and has led to Higgs Effective Field Theory (HEFT) as the most general framework, containing the Standard Model Effective Field Theory (SMEFT) as a subspace. The characterization of this theory space led to the dichotomy SMEFT vs. HEFT/SMEFT as the two possible realizations of symmetry breaking. The criterion to distinguish these two possibilities is non-local in field space, and phenomena which explores field space beyond the neighborhood of the vacuum manifold is in a singular position to tell them apart. Cosmology allows for such phenomena, and this works focuses on HEFT/SMEFT, the less explored of the two options, to find that first order phase transitions with detectable gravitational wave remnants, domain wall formation and vacuum decay in the far, far distant future can take place and single out HEFT/SMEFT. Results in cosmology are put against LHC constraints, and the potential of future ground- and space-based experiments to cover parameter space is discussed.