

Naturally Light Scalar Particles: A Mechanism Involving Dangerously Irrelevant Discrete Anisotropies

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The hierarchy problem in the Standard Model is usually understood as both a technical problem of stability of the calculation of the quantum corrections to the masses of the Higgs sector and of the unnatural difference between the Planck and gauge breaking scales. Leaving aside the gauge sector, we implement on a purely scalar toy model a mechanism for generating naturally light scalar particles where both of these issues are solved. In this model, the scalar particle is a pseudo-Goldstone whose mass comes from a highly non-renormalizable term that explicitly breaks the continuous symmetry down to a discrete one. Being discrete, the spontaneous breaking of the symmetry does not generate vanishing masses. However, the non-renormalizable character of the term of explicit breaking drives through quantum corrections the mass of the would-be Goldstone to a very small value without fine-tuning.

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