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On the smallness of the dark energy density in SUGRA models with Planck scale SUSY breaking and degenerate vacua

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In $N = 1$ supergravity (SUGRA) supersymmetric (SUSY) and non-supersymmetric Minkowski vacua originating in the hidden sector can be degenerate. This allows for consistent implementation of the multiple point principle (MPP) assumption. We present no–scale inspired SUGRA model where the MPP assumption is realised at the tree–level without extra fine-tuning. In the supersymmetric phase in flat Minkowski space SUSY may be broken dynamically inducing tiny vacuum energy density which can be assigned, by virtue of MPP, to all other phases including the one in which we live.We argue that the measured value of the cosmological constant, as well as the small values of quartic Higgs self–coupling and the corresponding beta function at the Planck scale, which can be obtained by extrapolating the Standard Model (SM) couplings to high energies, can originate from supergravity (SUGRA) models with degenerate vacua. This scenario is realised if there are at least three exactly degenerate vacua. In the first vacuum, associated with the physical one, local supersymmetry (SUSY) is broken near the Planck scale while the breakdown of the $SU(2)_W \times U(1)_Y$ symmetry takes place at the electroweak (EW) scale. In the second vacuum local SUSY breaking is induced by gaugino condensation at a scale which is just slightly lower than Λ_{QCD} in the physical vacuum. Finally, in the third vacuum local SUSY and EW symmetry are broken near the Planck scale.

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