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Does the cosmological constant really indicate the existence of a dark dimension?

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When the Higgs effective potential $V_{eff}(\phi)$ and/or the vacuum energy ρ are derived from higher dimensional theories with compact extra dimensions and non-trivial boundary conditions (as in the case of the Scherk-Schwarz SUSY breaking mechanism), the usual calculations lead to the conclusion that these quantities are UV-insensitive. Based on the finite result for ρ and on the measured value of the cosmological constant, it has been recently proposed that we might live in a universe with a single compact extra dimension (dark dimension), whose mesoscopic size is of order μm. Since this proposal has been advanced, a lot of work has been dedicated to studying several phenomenological consequences related to the existence of this fifth (compact) dimension. We show that a source of strong UV-sensitivity for ρ, intimately connected to the non-trivial topology of the spacetime, is missed by the usual calculation and renders the dark dimension proposal untenable, at least the way it has been originally formulated.

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