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Healing the cosmological constant problem through a vacuum energy geometric cancellation

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We explore a geometrical mechanism of cancellation that heals the cosmological constant problem. To do so, during the primordial universe we assume quantum fluctuations to hold and the effective cosmological constant built up in terms of its bare and quantum contributions. We thus notice that if we assume a discontinuity of the Friedmann-Robertson-Walker metric, a corresponding phase of energy release is expected. We motivate such a discontinuity in terms of particle and apparent horizons in an Einstein-deSitter universe dominated by the cosmological constant. We propose this energy release gets rid of particle production. Thus, once quantified the corresponding particle candidate, we model the universe through three phases. The intermediate one is metastable and overcomes the physical issue related to geometric discontinuity, suggesting a phase transition could occur. As a benchmark we there assume an anisotropic universe, computing the corresponding particle production using the Weyl tensor. Finally, we show the corresponding particles are dark matter component, whose mass limits are predicted to guarantee the cosmological constant contribution from vacuum energy is canceled out. The remaining effective constant, namely the bare cosmological one, is therefore interpreted as responsible for the current acceleration, removing de facto the fine-tuning issue.

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