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Fine-tuning of the cosmological constant is not needed

We show that the usual formulation of the cosmological constant problem breaks down when the effect of the huge fluctuations in quantum vacuum stress-energy tensor is considered. Even if one has successfully fine-tuned the bare cosmological constant in the Einstein equations to the required accuracy of 10^{-122}, the fluctuations would still cause the universe to explode. The fluctuations would also produce a large positive contribution to the averaged macroscopic spatial curvature of the Universe. In order to cancel this contribution, the bare cosmological constant has to take large negative values, and if it is large enough, the spacetime structure would be similar to the cyclic model of the universe in the sense that at small scales every point in space is a "micro-cyclic universe" which is following an eternal series of oscillations between expansions and contractions. Moreover, due to the weak parametric resonance effect caused by the fluctuations of the quantum vacuum stress-energy, the size of each "micro-universe" increases a tiny bit at a slowly accelerating rate during each micro-cycle of oscillation. Accumulation of this effect over the cosmological scale gives an accelerating universe. More importantly, the extreme fine-tuning of the cosmological constant is not needed. This resolves the cosmological constant problem and suggests that it is the quantum vacuum fluctuations serve as the dark energy which is accelerating the expansion of our Universe.

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