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From quantum regime to cosmology via forcing and 4-smoothness

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Recently we proposed a cosmological model based on smooth 4-manifolds admitting non-standard smoothness structures. The manifolds are so-called exotic versions of $\mathbb{R}^4$ (R^4) and $S^3 \times \mathbb{R}$. This model has been developed further and we have shown how to derive some realistic cosmological parameters from these exotic smoothings in a new way. Besides, we indicated the quantum origin of the smoothings. In more detail: the cosmological constant is identified with the constant curvature of the embedding $R^4 \to \mathbb{R}^4$. The calculations are in good agreement with the observed small value of the dark energy density. Furthermore, the handle-body structure of R^4 implies an exponential potential rather than a polynomial potential for the inflaton field again in agreement with the Planck sattelite results. The important problem about a physical origin of the presence of exotic smoothness in the cosmological models is also settled. In particular, we found that the algebraic structure of the quantum mechanical lattice of projections enforces the exotic smoothness on $\mathbb{R}^4$. If the lattice were distributive and the corresponding observables were commutative, the resulting smoothness structure would be the standard $\mathbb{R}^4$. Additionally, the set-theoretical forcing, derived from the QM lattice and from exotic $\mathbb{R}^4$, explains the vanishing of the QFT contributions to cosmological constant.

Summary

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