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A simple solution to the fine tuning problem of the cosmological constant

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We show that the fine tuning problem of the cosmological constant can be solved in a conformal model, with explicit conformal symmetry breaking. We argue that the model has two different terms which essentially contribute to the cosmological constant. A local conformal transformation leads to a cancellation of these two terms among one another. Hence these produce no physical consequence for cosmic evolution. The model generates a small cosmological constant without requiring any fine tuning.

Summary

We have presented a simple mechanism which solves the fine tuning problem of the cosmological constant. It is based on local conformal invariance but also requires terms which break this symmetry. We show that by a suitable conformal transformation we can cancel the cosmological constant in the symmetry breaking sector with a quadratic scalar field term in the symmetry preserving sector. This leaves behind a small term which effectively leads to the physical cosmological constant. Its small value is maintained by choosing very small parameters in the symmetry breaking sector. These do not require fine tuning since they do not get any contribution from the symmetry preserving sector at loop orders. The model is very economical since it only introduces one additional real scalar, χ, and the Weyl meson. The model uses the GR-SI prescription for renormalization. The perturbation theory in this case is more complicated. However if we ignore the contributions due to χ and the Weyl meson, it reduces to the standard perturbation theory. The contributions due to χ break renormalizability of the model. However such terms are suppressed by Planck mass and comparable to contributions due to quantum gravity. Hence this problem is only as serious as the problem of non-renormalizability of gravity. Our proposal solves the fine tuning problem of the cosmological constant due to potentially large contributions arising from the matter fields.

Author: Prof. JAIN, PANKAJ (IIT KANPUR)

Co-author: Mr KASHYAP, GOPAL (IIT KANPUR)

Presenter: Mr KASHYAP, GOPAL (IIT KANPUR)

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