DECAYING COSMOLOGICAL CONSTANT AND THE CHOICE OF A CONFORMAL FRAME

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A solution of the cosomlogical constant problem seems to come from a version of the scalar-tensor theory of gravity, which is characterized by a "nonminimal coupling" $\sqrt{-g}\xi\phi^2 R$ in place of the standard Einstein-Hilbert action, where ϕ is the scalar field while ξ a constant. One then encounters an inherent question never fully answered: How can one single out a right conformal frame?

We specifically focus on J frame and E frame, with and without the nonminimal coupling, respectively, connected to each other by a conformal transformation. By a detailed study of the solutions of the Robertson-Walker cosmological equations with the cosmological constant added, [1] we find reasonable understanding of primordial nucleosynthesis in *neither* of these conformal frames. In E frame, particle masses behave as $t^{-1/2}$ in conflict with the conventional quantum mechanics which one uses in theoretical anayses of nuclear reactions, while masses are constant in J frame, but the universe stays *static* during the radiation-dominated era, desperately in disagreement with the standard scenario.

We then propose to modify one of the premises in the original Brans-Dicke theory, by introducing the ϕ-matter coupling *in the Lagrangian* in J frame with dimensionless coupling constants. At the classical level, ϕ is now "invisible," keeping masses truly constant in E frame. This "success" is lost, however, by a "quantum anomaly effect" due to non-gravitational interactions among matter fields. Consequences are explored showing how reconciliation to the standard cosmology is achieved approximately, also providing a renewed interest in the fifth-force phenomena.

References

1. Y. Fujii, preprint, gr-qc/9708010, August 1997.

K. Sato (ed.), Cosmological Parameters and the Evolution of the Universe, 310.