

Theoretical Physics Symposium

Foundations of Conformal Cyclic Cosmology

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Conformal Cyclic Cosmology

- Conformal Cyclic Cosmology (CCC) is an alternative to the inflation era of current cosmology. CCC replaces inflation by cosmological (Λ) constant driven exponential growth of a pre Big Bang universe.
- The whole universe history is a sequence of aeons, each beginning with Big Bang and ending with a Λ driven exponential expansion. Future conformal infinity of each aeons and conformally stretched Big Bang hypersurfaces are spacelike, then one can smoothly joined them.
- Conformal invariance plays important role in CCC model. Theory of massless particles is conformally invariant.

Big Bang epoch

- Just after the Big Bang universe was extremely hot
- A mass of particles was irrelevant and effectively they were massless
- Conformal stretching provides reduction of temperature

Remote future

- Exponential expansion driven by Λ epoch is essentially dominated by photons coming from red-shifted light of stars, CMB and Hawking radiation.
- Conformal squashing of cold future universe increase temperature

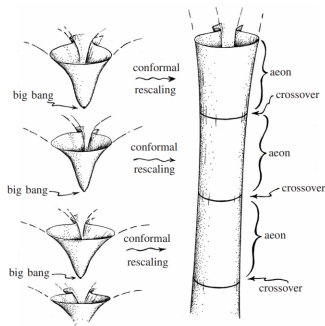


Figure: CCC model. (Penrose, R. (2011). Cycles of time: An extraordinary new view of the universe. New York: Alfred A. Knopf.)

Main problems

1. Fate of black holes in deSitter space
2. Weyl Hypothesis
3. Massive particles problem

- If massive particles somehow survive up to exponential expansion era, then one cannot use conformal transformations. Mass breaks conformal invariance.
- Λ driven mass fade-out: masses of all particles go asymptotically to zero in a remote future
- Standard way of looking for the mass is irreducible unitary representations of Poincare group, which is symmetry of Minkowski space
- In Λ domination era the fundamental group is DeSitter group, and the mass is not the Casimir operator of DeSitter group.

- Locally, there are two Poincare Casimir operators, which one of them is mass, but after some time, because of Λ , one can expect different Casimir operator corresponding to different mass
- We explore how irreducible representations of DeSitter group can be decompose into irreducible representations of Poincare group.