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Local Conformal Symmetry and Prediction of Antigravity in the History of the Universe

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Einstein's theory of General Relativity and its couplings to matter in 3+1 dimensions can be slightly enlarged with the requirement of a local scale (conformal) symmetry and the corresponding gauge degrees of freedom. This form of the theory, which is a prediction coming from 2T-gravity in 4+2 dimensions, has no dimensionful constants, not even the gravitational constant, and requires all scalar fields to be conformally coupled to gravity and to the rest of matter. The theory can be gauge fixed to either the usual gravity theory in the Einstein frame (thus generating the gravitational constant), or to other equivalent forms that lead to the complete set of exact analytic solutions of the usual Friedmann equations. These analytic cosmological solutions, which are geodesically complete at singularities, reveal many surprising properties that are not noticeable with approximate cosmological solutions. In particular, it is predicted that the universe is cyclic and furthermore it has a period of antigravity between every big crunch and the following big bang.

Author: BARS, Itzhak (Univ. Southern California)

Presenter: BARS, Itzhak (Univ. Southern California)

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