Contributed Talk

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Title: Thermodynamics of shearing massless scalar field spacetimes is inconsistent with the Weyl curvature hypothesis

Abstract: In my talk, I will critically examine the Penrose conjecture according to which the gravitational entropy should be quantified via the Weyl curvature, with the Clifton-Ellis-Tavakol entropy being one specific realization of this proposal. In fact, I will show that in some exact inhomogeneous and anisotropic cosmological models which arise in general relativity with either closed and open topologies, the Clifton-Ellis-Tavakol gravitational entropy is increasing in time despite the decrease of the magnitude of the Weyl curvature: this is possible thanks to the growth of the spacetime shearing effects. The matter content driving the dynamics of this model comes in the form of a chameleon massless scalar field. The values of the free parameters entering the metric tensor we choose are those consistent with the holographic principle and the second law of thermodynamics. Finally, I will mention the possible formation of some primordial structures, like the Large Quasar Groups, in this class of models as suggested by the growth of gravitational entropy, and whose existence cannot be accounted for by standard perturbation techniques over a Friedman background. My talk is based on Phys. Rev. D 102, 023539 (2020).