RESEARCH TRAINING GROUP
Models of Gravity

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On Quantum Spacetime and the horizon problem

Journals' Club - Paper by

Sergio Doplicher, Gerardo Morsella, Nicola Pinamonti
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Abstract

In the special case of a spherically symmetric solution of Einstein equations coupled to a scalar massless field, we examine the consequences on the exact solution imposed by a semiclassical treatment of gravitational interaction when the scalar field is quantized. In agreement with Doplicher *et al.* (1995) [2], imposing the principle of gravitational stability against localization of events, we find that the region where an event is localized, or where initial conditions can be assigned, has a minimal extension, of the order of the Planck length. This conclusion, though limited to the case of spherical symmetry, is more general than that of [2] since it does not require the use of the notion of energy through the Heisenberg Principle, nor of any approximation as the linearized Einstein equations.

We shall then describe the influence of this minimal length scale in a cosmological model, namely a simple universe filled with radiation, which is effectively described by a conformally coupled scalar field in a conformal KMS state. Solving the backreaction, a power law inflation scenario appears close to the initial singularity. Furthermore, the initial singularity becomes light like and thus the standard horizon problem is avoided in this simple model. This indication goes in the same direction as those drawn at a heuristic level from a full use of the principle of gravitational stability against localization of events, which point to a background dependence of the effective Planck length, through which a-causal effects may be transmitted.