

EMERGENT SPACETIME IN THE BOSE-EINSTEIN CONDENSATES AND THE REMOVAL OF NAKED SINGULARITIES

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ABSTRACT

In recent years, it has been demonstrated that the propagation of acoustic-like perturbations within a flowing fluid can be described by an effectively curved space-time, which in many senses, resembles a black hole space-time. Such correspondence helps to study analogies of the black hole horizon-related phenomena in terrestrial laboratory setups. We study the Bose-Einstein Condensate as a quantum analogue system, and demonstrate that the shock-wave-induced acoustic naked singularity, which is evident to develop in a frictionless fluid for a non-dispersive shock wave, is prohibited to form in such a system. The reason behind this is the microscopic structure of the underlying ether and the resulting effective trans-Planckian dispersion. Approaching the instant of shock, rapid spatial oscillations of density and velocity develop around the shock location, which begins to emerge already slightly before the instant of shock, due to the quantum pressure in the condensate. These oscillations render the acoustic spacetime structure completely regular and therefore lead to the removal (censoring) of the spacetime singularity. Thus, distinct from the cosmic censorship hypothesis of Penrose formulated within Einsteinian gravity, the quantum pressure in Bose-Einstein condensates censors (prohibits) the formation of a naked shock-wave singularity, instead of hiding it behind a horizon.



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