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Causality as a bound to fluid dynamics

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Dissipative relativistic fluid dynamics is not always causal. We discuss the causality structure of high energy nuclear collisions. When the fluid evolution equations are hyperbolic, one can bring them to a characteristic form describing the radial expansion of the fireball. This dynamics is causal if the characteristic velocities are smaller than the speed of light such that the domain of dependence of a space-time point is within its past light cone. Within the second order theory of Denicol, Niemi, Molnar and Rischke, we obtain a concrete inequality from this constraint and discuss how it can be violated for certain initial conditions sometimes used in phenomenological studies. We argue that causality poses an important bound to the applicability of relativistic fluid dynamics in particular at very early times.

Content type

Theory

Collaboration

Centralised submission by Collaboration

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