

Relativistic (a)causality in hydrodynamics and its effect on Bayesian analyses

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Relativistic fluid dynamics remains the backbone of modern simulations, which affects both bulk properties and rare probes such as jets. However, there have long been questions about whether it is being used outside its regime of validity in modern simulations. An important new tool for answering this question is a causality analysis – if the evolution equations do not respect relativistic causality, they are not a faithful representation of the underlying theory (i.e., QCD). Using this non-linear criterion, it has been shown that hydrodynamics is indeed being used outside its regime of validity, at least sometimes.

In this talk I will explore some phenomenological implications of this, and in particular the quantitative effects of demanding limits on acausality in a modern Bayesian parameter estimation. I will also make a few comments about the relationship to jets traversing the medium – just like at early times when the system finds itself far from equilibrium and must thermalize sufficiently for hydrodynamics to be valid, energy deposited by jets can locally bring the system out of equilibrium, and a similar hydrodynamization process could apply.

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