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Recent theoretical developments in hydrodynamics[1]

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In this talk we focus on two recents developments in relativistic hydrodynamics which is an important tool in understanding the physics of heavy ion collisions. i) We review the theory of fluctuations in relativistic hydrodynamics and its implementation in numerical simulations. In particular we present a general systematic formalism describing dynamics of fluctuations in an arbitrary relativistic hydrodynamic flow. We derive a deterministic evolution equation for the fluctuation modes which nontrivially matches the kinetic equation for phonons propagating on an arbitrary background, including relativistic inertial and Coriolis forces due to acceleration and vorticity of the flow. We also describe the procedure of renormalization of short-distance singularities which eliminates cutoff dependence, allowing efficient numerical implementation of these equations. ii) We briefly discuss the asymptotic nature of the derivative expansion and show that the way the expansion diverges is related to the existence of certain non-hydrodynamic modes and show how quantitative information about these modes can be extracted from the late terms in the derivative expansion.

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