Diles, Saulo M.; **Mamani, Luis A. H.**; **Miranda, Alex S.**; **Zanchin, Vilson T.**

Third-order relativistic hydrodynamics: dispersion relations and transport coefficients of a dual plasma. (English) Zbl 1437.83023

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Summary: Hydrodynamics is nowadays understood as an effective field theory that describes the dynamics of the long-wavelength and slow-time fluctuations of an underlying microscopic theory. In this work we extend the relativistic hydrodynamics to third order in the gradient expansion for neutral fluids in a general curved spacetime of d dimensions. We find 58 new transport coefficients, 19 due to third-order scalar corrections and 39 due to tensorial corrections. In the particular case of a conformal fluid, the number of new transport coefficients is reduced to 19, all of them due to third-order tensorial corrections. The dispersion relations of linear fluctuations in the third-order relativistic hydrodynamics is obtained, both in the rest frame of the fluid and in a general moving frame. As an application we obtain some of the transport coefficients of a relativistic conformal fluid in three dimensions by using the AdS/CFT correspondence. These transport coefficients are extracted from the dispersion relations of the linear fluctuations. The gravity dual of the fluctuations in this conformal fluid is described by the gravitational perturbations of four-dimensional anti-de Sitter black branes, which are solutions of the Einstein equations with a negative cosmological constant. To find the hydrodynamic quasinormal modes (QNMs) of the scalar sector we use the SUSY quantum mechanics of the gravitational perturbations of four-dimensional black branes. Such a symmetry allows us to find the wavefunction of the scalar (or sound) sector in the hydrodynamic limit directly from the wavefunction of the vector (or shear) sector, which is usually easier to be found because the perturbation wave equations for the vector sector are much simpler than the ones for the scalar sector.

MSC:

83C15	Exact solutions to problems in general relativity and gravitational theory	Cited in **2** Documents
83E05	Geometrodynamics and the holographic principle	
83C57	Black holes	
81V05	Strong interaction, including quantum chromodynamics	
81T40	Two-dimensional field theories, conformal field theories, etc. in quantum mechanics	
76Y05	Quantum hydrodynamics and relativistic hydrodynamics	

Keywords:

AdS-CFT correspondence; black holes; classical theories of gravity; holography and quark-gluon plasmas

Full Text: DOI arXiv

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