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Hydrodynamics of simply spinning black holes & hydrodynamics for spinning quantum fluids. (English) Zbl 1457.83033

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Summary: We find hydrodynamic behavior in large simply spinning five-dimensional Anti-de Sitter black holes. These are dual to spinning quantum fluids through the AdS/CFT correspondence constructed from string theory. Due to the spatial anisotropy introduced by the angular momentum, hydrodynamic transport coefficients are split into groups longitudinal or transverse to the angular momentum, and aligned or anti-aligned with it. Analytic expressions are provided for the two shear viscosities, the longitudinal momentum diffusion coefficient, two speeds of sound, and two sound attenuation coefficients. Known relations between these coefficients are generalized to include dependence on angular momentum. The shear viscosity to entropy density ratio varies between zero and $1/(4\pi)$ depending on the direction of the shear. These results can be applied to heavy ion collisions, in which the most vortical fluid was reported recently. In passing, we show that large simply spinning five-dimensional Myers-Perry black holes are perturbatively stable for all angular momenta below extremality.

MSC:

83C57 Black holes

83C47 Methods of quantum field theory in general relativity and gravitational theory

76Y05 Quantum hydrodynamics and relativistic hydrodynamics

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AdS-CFT correspondence; holography and condensed matter physics (AdS/CMT); holography and quark-gluon plasmas; quark-gluon plasma

Software:

QNMspectral

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