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Linearly resumed hydrodynamics from gravity

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Using fluid/gravity correspondence, we study all-order resumed hydrodynamics in a weakly curved spacetime. The underlying microscopic theory is a finite temperature $\mathcal{N} = 4$ super-Yang-Mills theory at strong coupling. To linear order in the amplitude of hydrodynamic variables and metric perturbations, the fluid's stress-energy tensor is computed with derivatives of both the fluid velocity and background metric resumed to all orders. In addition to two viscosity functions, we find four curvature induced structures coupled to the fluid via new transport coefficient functions, which were referred to as gravitational susceptibilities of the fluid (GSF). We analytically compute these coefficients in the hydrodynamic limit, and then numerically up to large values of momenta. We extensively discuss the meaning of all order hydrodynamics by expressing it in terms of the memory function formalism, which is also suitable for practical simulations. We also consider Gauss-Bonnet correction in the dual gravity, which is equivalent to some $1/\mathcal{N}$ corrections in the dual CFT. To leading order in the Gauss-Bonnet coupling, we find that the memory function is still vanishing.

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