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# Validity of relativistic hydrodynamics beyond local equilibrium

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By constructing a formal solution to the moment equations of the Boltzmann equation within the relaxation time approximation, we identify the key step that allows relativistic hydrodynamics to capture non-gradient corrections: the elevation of anisotropies to independent dynamical fields with their own evolution equations. This highlights a conceptual distinction between the gradient expansion and relativistic hydrodynamics. While the gradient expansion is valid only in the vicinity of local thermal equilibrium, the introduction of dynamical anisotropies inadvertently capture "non-hydrodynamic" corrections, as their evolution equations can closely approximate the exact dynamical equations by rescaling the transport coefficients. Therefore, relativistic hydrodynamics emerges as more than just a near-equilibrium theory.

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