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Inverse Reynolds-dominance approach to transient fluid dynamics

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In the original DNMR derivation [1], irreducible moments are used to derive the evolution equations of second order hydrodynamics for the dissipative quantities (bulk viscous pressure, diffusion current and shear tensor) from kinetic theory. In general, this procedure gives rise to terms of order Knˆ2 (second order in gradients), which are parabolic in nature and thus acausal. In this contribution, we rigorously eliminate all parabolic terms by systematically expressing the Knˆ2 terms as terms of order Reˆ{-1} Kn (proportional to the first order gradient of the dissipative quantities). We therefore refer to this scheme as the Inverse Reynolds Dominance (IReD) approach [2]. This procedure fixes the relaxation times of the dissipative quantities in terms of the inverse of the collision matrix and thermodynamic integrals. In particular, we find that the relaxation times corresponding to higher order moments grow as their order increases, thereby contradicting the separation of scales paradigm. The formal (up to second order) equivalence with the standard DNMR approach is proven and the connection between the IReD transport coefficients and the usual DNMR ones is established.

[1] G. S. Denicol, H. Niemi, E. Molnar, D. H. Rischke, Phys. Rev. D 85 (2012) 114047. DOI: 10.1103/PhysRevD.85.114047.
[2] D. Wagner, A. Palermo, V. E. Ambrus, arXiv:2203.12608 [nucl-th].

Primary authors: PALERMO, Andrea; WAGNER, David (Goethe University Frankfurt); AMBRUS, Victor Eugen (West University of Timisoara (RO))

Presenters: AMBRUS, Victor E.; AMBRUS, Victor Eugen (West University of Timisoara (RO))

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