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Low rank structure in forward and inverse kinetic theory

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Multi-scale kinetic equations can be compressed: In certain regimes, the Boltzmann equation is asymptotically equivalent to the Euler equations, and the radiative transfer equation is asymptotically equivalent to the diffusion equation. Detailed information is lost when a system passes to the fluid limit. In linear algebra, it is equivalent to a system being of low rank. I will discuss such transition and how it affects the computation. Mainly, in the forward regime, inserting low-rank structure could greatly speed up the computation [1, 2], while in the inverse regime, the system being of low rank typically makes the problems significantly more ill-posed [3, 4]. This is a review of a collection work with Ke Chen (UT-Austin), Kathrin Hellmuth (Würzburg), Christian Klingenberg (Würzburg), Ru-Yu Lai (UMN), Jian-feng Lu (Duke), Gunther Uhlmann (UW-Seattle), and Stephen J. Wright (UW-Madison).

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