Calculation of dissipative phase space corrections

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There is a lot of interest in heavy ion physics in systems that are near local thermal equilibrium. In such systems, particle distributions acquire non-thermal corrections (i.e., they are not Boltzmann). Hydrodynamic simulations of heavy-ion reactions use such corrected distributions to convert the hydrodynamic fields to particles at the end of the calculation. A self-consistent approach to relate dissipative phase space corrections to hydrodynamic fields (namely, the energy momentum tensor and conserved currents) is provided by linearized kinetic theory [1].

Mathematically, the problem boils down to solving a linear integral equation for the phase space corrections as a function of momentum, which is then recast as the maximization of some functional. Numerically, the maximization is done using a finite variational basis of functions. The most time consuming part is the calculation of numerous variational "matrix elements", which involve four-dimensional integrals. I will discuss how the integration is performed using an implementation of adaptive Gauss-Konrod quadrature on GPUs, and present results calculated for a multi-species hadron gas with self-consistent shear viscous and bulk viscous corrections.

References

[1] D. Molnar and Z. Wolff, PRC 95, 024903 (2017)