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Characterizing the initial stages of a heavy-ion collision for determining final state evolution: including conserved charges, momentum, and stress.

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There exist simple and direct relations between the state of the system at early times, and final-state observables. For example, the final elliptic flow is approximately proportional to the initial eccentricity, which represents the leading term in a cumulant expansion of the initial density. This expansion is a systematic method written in terms of length scales that contains the global structure of the initial distribution density.
We describe how to extend this framework to include more information about the early-time system —specifically, conserved currents and additional components of the energy-momentum tensor. These contributions may have particular importance in collisions of small systems and at low energy, respectively, raising the importance of having a complete framework such as this.
We perform hydrodynamic simulations to validate and investigate the proposed extensions. With this information, we can identify what properties of the initial stages are relevant to and accessible by final-state observables, and how they can be constrained by carefully-chosen observables in systems of different size and collision energy.

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