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Relativistic hydrodynamics on graphics processing units

Hydrodynamics calculations have been successfully used in studies of the bulk properties of the Quark-Gluon Plasma, particularly of elliptic flow and shear viscosity.
However, there are areas (for instance event-by-event simulations for flow fluctuations and higher-order flow harmonics studies) where further advancement is hampered by lack of efficient and precise 3D+1 program.
This problem can be solved by using Graphics Processing Unit (GPU) computing, which offers unprecedented increase of the computing power compared to standard CPU simulations.

In this poster, we present an implementation of 3D+1 ideal hydrodynamics simulations on the Graphics Processing Unit using Nvidia CUDA framework.
MUSTA-FORCE (multi stage, first order central, slope limited) scheme is employed in the simulations, delivering second order accuracy in both space and time.
Our implementation improves the performance by about 2 orders of magnitude compared to a single threaded program.
The algorithm tests of 3D+1 simulation with ellipsoidal and Hubble-like expansion are also presented.

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