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A Numerical Causal Viscous Hydrodynamics with a Riemann Solver

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Hydrodynamic model is now commonly applied to the description of space-time evolution of quark-gluon matter in relativistic heavy-ion collisions. Information on initial structure as well as transport properties of the fireball are expected to be imprinted in the anisotropies of the final hadron spectra. To gain accurate information on these, it is essential to have a numerical scheme with both accuracy and stability. We develop a new algorithm for relativistic ideal fluid in the Godunov scheme using a Riemann solver for quark-gluon plasma. The Riemann solver is derived based on the solution to a Riemann problem in two-shock approximation by Mignone, Plewa, and Bodo. We incorporate this Riemann solver into the numerical scheme of causal viscous hydrodynamics by Takamoto and Inutsuka. In this talk, we will present the structure of our algorithms and show some results of numerical tests. We also propose a method to measure the intrinsic artificial viscosity of each numerical scheme.