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Simulations of Relativistic Heavy Ion Collisions in Multi Modular Model

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Relativistic Heavy Ion Collisions (RHIC) allow one to create ultra hot and dense systems where a phase transition from hadronic matter to quark-gluon plasma is expected to occur. Studying RHICs is crucial to understand what happened the firsts moments of the universe when temperatures and densities were so high that matter was only able to be found in the form of quark and gluons. RHICs are also important to understand the QCD phase diagram and to find the critical point. In RHICs simulations we clearly separate the evolution of the reaction into three different stages, each one being described with a most suitable model:
- initial stage, before the equilibration and fluidization are reached;
- intermediate stage, typically described by relativistic hydrodynamics;
- and final stage, after hadronization, which is described via hadron cascades, like UrQMD or SMASH.
It is also very important that these different modules are coupled to each other correctly.

I will present a Multi-Modul Model which is used in our group. As the first step of my PhD project, I modified the model, used to describe the initial stage of the collision, by taking into account initial state fluctuations, what allows to describe RHICs on an event-by-event basis. This modified model is known as Generalize Effective String Rope Model [1] and in our simulations it generates the initial conditions for further hydrodynamics evolution, for which I adapted a relativistic hydrodynamics code based on the Particle in Cell method. Results from the first and second stage of the collision will be presented and discussed. The last and most difficult step of my PhD project, which is in progress right now, is to couple the hydrodynamics module with the hadronic cascade one through an intermediate step called 'particlization'process.

[1] A. Reina, V.K. Magas, L.P. Csernai, and D.D. Strottman, Phys. Rev. C 107 (2023) 3, 034915.

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