

CERN Yellow Report on Heavy Ion Physics at the HL-LHC

Flow chapter

The QCD fluid

[general introduction, why is it interesting to study the fluid dynamics of QCD, what has been learned so far, what questions remain open]

The macroscopic properties of the QCD fluid

Equation of state [Björn]

[at vanishing or small baryon number density, chemical freeze-out?]

Shear viscosity [Björn]

[typical values, temperature dependence, what are most sensitive observables]

Bulk viscosity [Björn]

[temperature dependence, what are most sensitive observables]

Heat conductivity / Bulk diffusion [Stefan]

[can we constrain it?]

Electric conductivity [Stefan]

[can we constrain it? Relevance for magnetic fields, Chiral magnetic effect]

Second order transport properties, in particular relaxation times [Stefan]

[Important for causality, how can one constrain them?]

Fluctuations in fluid dynamics and at freeze-out

Initial state fluctuations [Björn]

(Thermal) hydro fluctuations during evolution and at freeze-out [Björn]

[Rapidity dependence, various interesting correlation functions]

Response functions [Stefan?]

Linear and non-linear response functions

[ratios of v_n / ϵ_n , ratios of v_n 's for central and non-central collisions]

Initial conditions [Björn?]

Fluctuations from nucleonic scales

Fluctuations from sub-nucleonic scales

How does initial state affect extraction of QGP properties?

Close-to or far-from-equilibrium fluid dynamics

Fluid dynamic as a close-to-equilibrium approximation, standard derivative expansion scheme

Hydro-like descriptions further away from equilibrium
[including some non-hydro modes]

Transport approaches

Flow-like signatures from kinetic theory or single scattering approximation
[alternative to hydro paradigm? How many interactions are needed?]

Alternative transport models such as AMPT etc.

System size dependence [Björn?]

Xenon-Xenon and other ion species
[Smaller collision systems scan to avoid centrality biases?]
[Analysis/measurement of deformation possible?]

Vorticity and polarization [Stefan]

[general motivation and interest, are there additional measurements possible with the upgrades & more statistics]

