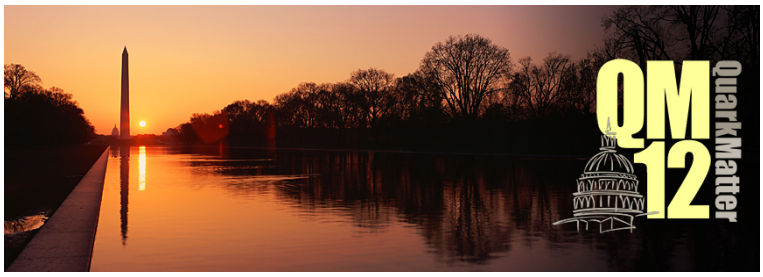

Contribution ID: **29** Type: **Poster**

QGP shear viscosity from combined analysis of elliptic and triangular flow

Thursday, 16 August 2012 16:00 (2 hours)

The Quark-Gluon Plasma (QGP) created in heavy-ion collisions is well described by viscous hydrodynamic simulations. A key QGP transport coefficient, its specific shear viscosity eta/s, can be extracted by comparing such simulations with experimental data. Previous extractions gave (eta/s)_QGP ˜ (1-2.5)/(4\pi) where the ˜100% uncertainty arises mainly from ambiguities in the initial fireball shape and density profile. To obtain (eta/s)_QGP with better precision, the ambiguities in the initial conditions must be addressed.

Published extractions of the specific shear viscosity have relied on elliptic flow measurements and the fact that eta/s suppresses elliptic flow. It was recently realized that higher order harmonic flows are suppressed even more strongly with increasing eta/s, and that the recently measured triangular flow allows to simultaneously constrain eta/s and the initial conditions: viable initial conditions should describe the elliptic and triangular flows v2 and v3 simultaneously with the same eta/s. We have performed such a simultaneous analysis of v2 and v3 [1]. We show that the normalized elliptic and triangular flow coefficients v2/ecc2 and v3/ecc3 (where ecc_n are the n-th order eccentricities of the initial state) can be obtained with 10-15% accuracy using single-shot hydrodynamical simulations where the initial conditions are averaged before hydrodynamical evolution, instead of the more realistic but costly event-by-event hydrodynamical approach where averaging is done only after separate evolution of each fluctuating initial condition.

For elliptic flow we find that, within 10-15%, v2/ecc2 = v2{2}/ecc2{2} = v2{4}/ecc2{4} where the expression on the left is obtained from single-shot hydrodynamics while the cumulant expressions on the right are extracted from event-by-event hydrodynamics. For triangular flow we find, at the same level of precision, that v3/ecc3=v3{2}/ecc3{2} \neq v3{4}/ecc3{4}. The ALICE data for charged hadron elliptic and triangular flow from Pb-Pb collisions at the LHC [2] are shown to obey these approximate (in-)equalities. Our hydrodynamic analysis [1] shows that the ALICE v2 and v3 data [2] can be explained simultaneously, at all collision centralities, if (eta/s)_QGP \approx 1/(4\pi). This requires MC-Glauber initial conditions which have smaller ecc2 than CGC-motivated MC-KLN initial conditions. For MC-KLN initial conditions the v2 data require larger (eta/s)_QGP ˜ (2-2.5)/(4\pi) which, however, then underpredicts the measured triangular flow by 35-40%. We conclude that the large v3 measured at the LHC requires either almost minimal QGP shear viscosity (eta/s)_QGP \approx 1/(4\pi), or a presently unknown mechanism for increasing the triangularity fluctuations in the initial state by ˜50%.

[1] Zhi Qiu, Chun Shen, and Ulrich Heinz, "Hydrodynamic elliptic and triangular flow in Pb-Pb collisions at sqrt(s)=2.76 A TeV," Phys. Lett. B707, 151-155 (2012).

[2] K. Aamodt et al. (ALICE Coll.), "Higher harmonic anisotropic flow of charged particles in Pb-Pb collisions at sqrt(s_NN)=2.76 TeV," Phys. Rev. Lett. 107, 032301 (2011).

Primary author: Dr QIU, Zhi (Ohio State University)

Co-author: Prof. HEINZ, Ulrich (Ohio State University)

Presenter: Dr QIU, Zhi (Ohio State University)

Session Classification: Poster Session Reception

Track Classification: Global and collective dynamics