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A study of vorticity formation in high energy nuclear collisions

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We present a quantitative study of vorticity formation in peripheral ultrarelativistic heavy ion collisions at $\sqrt{s_{NN}} = 200$ GeV by using the ECHO-QGP numerical code, implementing relativistic dissipative hydrodynamics in the causal Israel-Stewart framework in 3+1 dimensions with an initial Bjorken flow profile. We consider and discuss different definitions of vorticity which are relevant in relativistic hydrodynamics. After demonstrating the excellent capabilities of our code, which proves to be able to reproduce Gubser flow up to 8 fm/c, we show that, with the initial conditions needed to reproduce the measured directed flow in peripheral collisions corresponding to an average impact parameter $b = 11.6$ fm and with the Bjorken flow profile for a viscous Quark Gluon Plasma with $\eta/s = 0.1$ fixed, a vorticity of the order of some 10^{-2} c/fm can develop at freezeout. The ensuing polarization of Λ baryons does not exceed 1.4\% at midrapidity. We show that the amount of developed directed flow is sensitive to both the initial angular momentum of the plasma and its viscosity.

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