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Constraining initial stages of heavy-ion collisions from RHIC and LHC data

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We propose a systematic approach for constraining models of initial conditions using a combined analysis of elliptic v_2 and triangular v_3 flow data with viscous hydrodynamic calculations. For v_2 and v_3 harmonics the hydrodynamic response to the initial state is dominated by linear response, which means v_2 is proportional to the ellipticity ε_2 and v_3 is proportional to the triangularity ε_3, i.e. $v_n = C_n\varepsilon_n$, where C_n is the linear response coefficient. Experimental data on elliptic and triangular flow, combined with the calculation of C_n in relativistic hydrodynamics, provide us with rms values of initial anisotropies ε_2 and ε_3. By varying free parameters in hydrodynamic calculations, we get an allowed region in the (rms ε_2, rms ε_3) plane. Thus we are able to compare Monte Carlo models of the initial state with the allowed region and exclude several of these models. We provide a simple test that can be performed on any candidate model to determine its compatibility with data. We also illustrate that the effect of changing the granularity of the initial state is similar to changing the medium properties, making these effects difficult to disentangle using only these data.

[Reference: E. Retinskaya, M. Luzum and J. -Y. Ollitrault, Phys. Rev. C 89, 014902 (2014)]

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