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New universal parametrization of initial-state fluctuations and its application to event-by-event anisotropy

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We propose a new, universal parametrization of the probability distribution of initial anisotropies in proton-proton, proton-nucleus and nucleus-nucleus collisions. The distribution of fluctuation-driven anisotropies, such as the initial triangularity ε_3, is described by a one-parameter power distribution. When a mean anisotropy in the reaction plane is also present, as in the case of the the initial eccentricity ε_2 in nucleus-nucleus collision, a new parameter must be added: the power distribution is replaced by a new, elliptic power distribution. Our results are in excellent agreement with all Monte-Carlo models of the initial state (Glauber, KLN, IP-Glasma) for all collision systems and all centralities.

We then apply our results to the interpretation of the event-by-event distributions of v_2 and v_3 recently measured by the ATLAS collaboration in Pb-Pb collisions at the LHC. Assuming that anisotropic flow is proportional to the initial anisotropy, $v_n = C_n \varepsilon_n$,
we obtain excellent fits to these data. This procedure gives us direct information on the initial state from data. Our results are compared to several initial-state models. We are also able to extract the hydrodynamic response C_n for $n = 2, 3$ as a function of centrality, without assuming any particular model for the initial state. These results are compared with viscous hydrodynamic calculations of the response.

L. Yan and J. Y. Ollitrault,
"Universal fluctuation-driven eccentricities in proton-nucleus and nucleus-nucleus collisions,"
arXiv:1312.6555 [nucl-th], to appear in Phys. Rev. Lett.

L. Yan, A. M. Poskanzer and J. Y. Ollitrault, in preparation.

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