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Hot spots and gluon field fluctuations as causes of eccentricity in small systems

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We calculate eccentricities in dilute-dense limit of pA collisions, by calculating correlations functions of the energy density field of the Glasma immediately after the collision event at proper time $\tau = 0^+$. The proton is treated as a collection of a finite number of hot spots of Gaussianly distributed color charges, as in the IPGlasma setup. The correlations of its color charges are assumed to be Gaussian and are described by the MV model. However, instead of performing averages using Monte Carlo implementations we calculate the color charge and hot spot averages analytically to allow for better control over model parameters. The nucleus is taken to be an infinite sheet of color charge, and its color charge correlations are also assumed to be Gaussian and are described by the GBW model. For the nucleus we evaluate the full nonlinear Gaussian color charge correlations and the proton is expanded to the first order in the proton saturation scale in the dilute limit. We proceed to compute the one and two point functions for the energy density, performing the CGC and hot spot averaging procedures analytically. We then use these results to compute eccentricities originating from proton and nucleus side fluctuations separately, and find that proton fluctuations are the dominating source of eccentricity and the nucleus color fluctuations only give a negligible correction.

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