

Universality aspects of quantum corrections to transverse momentum broadening in QCD media

Transverse momentum broadening (TMB) of energetic partons in QCD matter plays a central role in a variety of processes studied at colliders to probe QCD, ranging from TMD gluon distributions that encode information on the 3D structure of the proton and nuclei in electron-proton or proton-proton collisions to jet suppression in heavy ion collisions.

In this talk, based on [1,2], we study the leading quantum corrections to the TMB distribution of high energy partons in large QCD media. We show that the resummation to all orders of double logarithmic contributions from gluon radiation in the presence of a saturation boundary yields a universal distribution for large system sizes. This universal distribution exhibits anomalous scaling of super diffusive type, in contrast with normal diffusion seen at tree level, and a heavy tail at large transverse momentum, akin to Lévy random walks. Exploiting a formal analogy with traveling waves in reaction-diffusion processes, we derive the universal pre-asymptotic solutions for fixed [1] and running coupling [2]. We finally discuss possible applications to small- x phenomenology. In particular, we argue that our formulas can provide a model-independent functional form for the initial condition of the BK-JIMWLK evolution equations.

Refs:

[1] Paul Caucal and Yacine Mehtar-Tani (BNL), 2109.12041 [hep-ph]

[2] Paul Caucal and Yacine Mehtar-Tani (BNL), in preparation

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