AZIMUTHAL CORRELATIONS OF FORWARD DIJETS IN D-AU COLLISIONS

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Studying correlations of forward dijets in proton-nucleus collisions will further test the Color Glass Condensate (CGC) picture of the nuclear wavefunction at small-x. I will focus on correlations in azimuthal angle. They were measured in the first d-Au run at RHIC and the second run will provide the opportunity to turn the qualitative CGC estimations into a quantitative description, as was done in the case of single particle production at forward rapidities. I will derive forward inclusive dijet production in the scattering of a dilute hadron p off an arbitrary dense target A, whose partons with small fraction of momentum x_A are described by a CGC. This is of relevance for measurements of two-particle correlations $pA \to h_1 h_2 X$ with h_1 and h_2 detected in the proton direction.

While this process is probing small$-x$ partons in A, only high-momentum valence partons of p contribute to the scattering, and with RHIC kinematics, the dominant partonic subprocess is $qA \to qgX$. This two-particle spectrum can be expressed in terms of correlators of Wilson lines. Computing the correlators with a Gaussian CGC wavefunction allows to include (in the large$-N_c$ limit) both multiple scattering and non-linear QCD evolution at small$-x$ (so-called Balitsky-Kovchegov evolution). The cross-section for the production of the quark-gluon dijet (with respective transverse momenta $q_\perp$ and $k_\perp$ and rapidities $y_q > 0$ and $y_k > 0$) reads:

$$\frac{d\sigma^{pA\to qgX}}{d^2k_\perp d^2q_\perp dy_k dy_q} \propto \frac{\alpha_S C_F}{4\pi^2} x_p q(x_p, \Delta^2) \sum_{\lambda\alpha\beta} \left| I^\lambda_{\alpha\beta}(z, k_\perp - \Delta; x_A) - \psi^\lambda_{\alpha\beta}(z, k_\perp - z\Delta) \right|^2 F(x_A, \Delta^2)$$

$$\text{with} \qquad \begin{array}{l} 1/z - 1 = |q_\perp|\, e^{y_q - y_k}/|k_\perp| \\ \Delta = k_\perp + q_\perp \end{array} \quad , \qquad \begin{array}{l} \sqrt{s}\; x_p = |k_\perp| e^{y_k} + |q_\perp| e^{y_q} \\ \sqrt{s}\; x_A = |k_\perp| e^{-y_k} + |q_\perp| e^{-y_q} \end{array} \quad .$$

The dilute hadron contributes via the quark distribution function $q(x_p, \Delta^2)$. By contrast, the CGC cannot be described only by its (unintegrated) gluon distribution function $F(x_A, \Delta^2)$: the so-called k_T-factorization framework is not applicable (it would if there was no other x_A dependence). As the valence quark emits the virtual gluon via lowest-order pQCD Bremsstrahlung (the associated wavefunction is $\psi^\lambda_{\alpha\beta}$ where λ, α and β are polarization and spin indices) it interacts coherently with the dense small$-x$ gluons in A, which modifies the $q \to qg$ splitting and yields the factor $\sum_{\lambda\alpha\beta} \left| I^\lambda_{\alpha\beta}(x_A) - \psi^\lambda_{\alpha\beta} \right|^2$. Details can be found in [1].

Considering the correlations in azimuthal angle, we obtain that the perturbative back-to-back peak of the azimuthal angle distribution (which we recover for very large momenta) is reduced by initial state saturation effects. As the momenta decrease closer to the saturation scale ($Q_s \simeq 2$ GeV), the angular distribution broadens. But at RHIC energies, saturation does not lead to a complete disappearance of the back-to-back peak.

References

[1] Cyrille Marquet, *Nucl. Phys.* **A**, in press, arXiv:0708.0231.