Event-by-Event Simulations of Jet Modification Using the MATTER Event Generator

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Code Flowchart

Glauber + Hydro

PYTHIA

MATTER

Calculation

Recombination

medium profile
initial density profile

shower partons

shower hadrons

initiating parton

shower partons
MATTER

• Modular All Twist Transverse Elastic scattering and Radiation
MATTER details

Few scatterings per emission limit

All of this evolution is hiding within $\hat{q}$.

Light quark modification is sensitive to the high $Q^2$, low-$x$ part of the in-medium gluon distribution.
\[ \bar{z} = \frac{z + z'}{2} \quad \partial z = z - z' \]

\[ \int_0^\infty d^4 \bar{z} \exp[i(\partial q)\bar{z}] \]

\[ \int d^4 \partial z \exp[i\partial zq] \]

\( \partial q \) is the uncertainty in \( q \)
A reasonable uncertainty is: $\partial q << q$

Assume a Gaussian distribution around $q^+$

Set functional form for the width by imposing:

$$<\tau> = 2q^- / Q^2$$

To get $z^-$ distribution, only need to assume $\partial q^+$ distribution

Sample the in medium modified Sudakov form factor to get virtuality at each step

$$\rho(\delta q^+) = \frac{\exp[-(\delta q^+)^2/2(2q^+)^2/\pi]}{\sqrt{2\pi}(2q^+)^2/\pi]}$$
The Sudakov form factor:

\[ S_\zeta(Q^2_0, Q^2) = \exp\left[- \int_{2Q^2_0}^{Q^2} \frac{d\mu^2}{\mu^2} \frac{\alpha_S(\mu^2)}{2\pi} \right] \times \int_{Q_0/Q}^{1-Q_0/Q} dy P_{qg}(y) \left\{ 1 + \int_{\zeta_i}^{\zeta_i+\tau^-} d\zeta K_{p^-\mu^2} \right\} \]

\[ K_{p^-\mu^2}(y, \zeta) = \frac{2q}{\mu^2} \left[ 2 - 2 \cos \left\{ \frac{\mu^2(\zeta - \zeta_i)}{2p^-y(1-y)} \right\} \right] \]

Which is valid while \( A \frac{\hat{q}\tau}{\mu^2} \lesssim 1. \)
$R_{AA}$ for jets compared to CMS

Doga Gulhan – Report from CMS; HP2016
$R_{AA}$ for LHC for varying $q_0$ compared to CMS