Effects of transverse momentum broadening of parton cascades from coherent emissions and scatterings in a medium

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BDIM evolution equation for in-medium evolution of gluon jets:

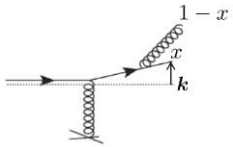
[Blaizot, Dominguez, Iancu, Mehtar-Tani: JHEP 1406 (2014) 075]

$$\frac{\partial}{\partial t}D(x,\mathbf{k},t) = \alpha_s \int_0^1 dz \int \frac{d^2q}{(2\pi)^2}\left[2\mathcal{K}(\mathbf{Q},z,\frac{x}{z}p_0^+)D\left(\frac{x}{z},\mathbf{q},t\right) - \mathcal{K}(\mathbf{q},z,xp_0^+)\,D(x,\mathbf{k},t)\right] + \int \frac{d^2\mathbf{l}}{(2\pi)^2}C(\mathbf{l})\,D(x,\mathbf{k}-\mathbf{l},t)$$

$D(x,\mathbf{k},t)$ …leading jet particle fragmentation function

t …time

Kinematical variables:



Momentum distribution: $p \to xp$

Momentum transfer: $p \to p + \mathbf{k}$

Coherent branching:

…emission of particles while simultaneous scatterings occur – considers interference effects

…reproduces radiation spectra found by Baier, Dokshitzer, Mueller, Peigné, Schiff, and Zakharov (**BDMPS-Z**)

Scattering off medium particles:

…only transfers in transverse momenta

…also has structure of a gain and a loss term:

$$C(\boldsymbol{q}) = w(\boldsymbol{q}) - \delta(\boldsymbol{q})\int d^2\boldsymbol{q}'w(\boldsymbol{q}')$$

Monte-Carlo algorithm to solve BDIM equation:

cf. [Kutak,Płaczek, Straka: Eur.Phys.J. C79 (2019) no.4, 317]

parametrization of medium:

…constant medium:

t=4fm/c extension

$\hat{q}$…average transverse momentum transfer

n=0.243 GeV^3…medium density

m_D=0.993 GeV…debye mass

initial jet particle energy: E=100 GeV

Cases of jet-medium interaction:

- noncollinear vs. collinear (averaged over **Q**) branching
- scattering: potential q^{-4}, Debye-screened potential, no scattering, or Gaussian broadening (with collinear splitting)

Results:

[Blanco, Kutak, Płaczek, Rohrmoser, Straka, JHEP 04(2021)014]

$$\tilde{D}(x,k_T,t) = 2\pi k_T D(x,k_T,t)$$