R-dependence of j_t spectra in reconstructed jets

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Introduction

The angular/pseudorapidity opening of a jet is produced by two processes: the radiation of gluons resulting in the parton shower, and the non-perturbative processes by which the coloured partons must ultimately hadronize. In the case of heavy ion collisions the final state hadronic configuration is further complicated by the additional gluon bremsstrahlung radiation.
We investigate the prediction of two different Monte Carlo simulation models for the parton energy loss (jet quenching) with respect to the momentum perpendicular to the jet axis, j_t, measured as a function of the distance to the jet axis, R. We report results obtained with PYQUEN [1] and a recent afterburner PYTHIA, q-PYTHIA [2].

Transverse momentum j_t

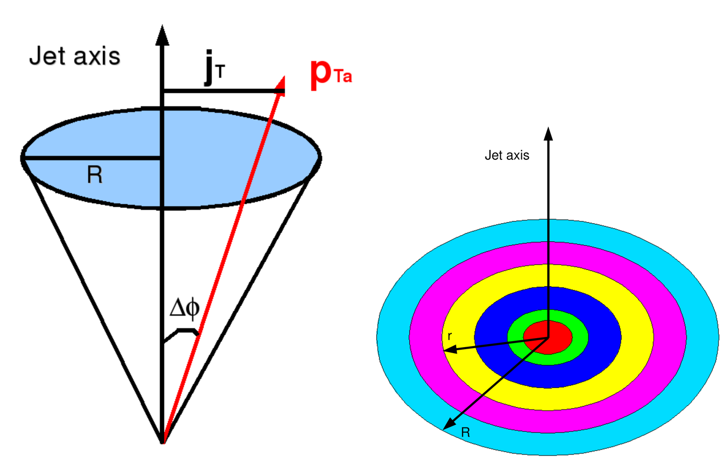
j_t can be modified as a result of the interactions of the partons with the medium. Possible effects are:

- Increase of low-j_t particles due to the emission of low p_t particles close to the jet axis
- Broadening of the j_t distribution = increase of the tails due to "jet heating" (Salgado, Wiedemann)
- Suppression of very high j_t particles at large R due to formation time effects $t_F \sim 1/(\Theta\ j_t)$. Partons produces at high Θ and j_t are produced at approx. the same time as the leading parton. Since they have smaller energies than the leading parton strong quenching can be expected.

One way to investigate the contribution of the different effects is to study the j_t spectra as a function of the distance to the jet axis

- small difference expected for monoenergetic jets in p-p
- Large differences expected due to medium modification
- However non-ideal jet reconstruction (biases) can modify the simple picture.

$$j_t = p_{Ta} sin\Delta\phi$$



Monte Carlo simulation models for the parton energy loss

- PYTHIA 6.4
- Proton - Proton
- Center mass energy: $\sqrt{s_{NN}}$ 5.5 TeV
- $p_T^{hard} = 50$ GeV/c
- Cone Algorithm
- R_c <1
- $|\eta|$ <1.9
- p_T^{cut} <0.3 GeV/c
- E_T >0.5 GeV

PYQUEN (PYthiaQUENched*): Method to simulate the rescattering and energy loss of hard partons in ultrarelativistic heavy ion collisions. Heavy ion event is simulated as a superposition of soft hydro-type state and hard multi-jets.

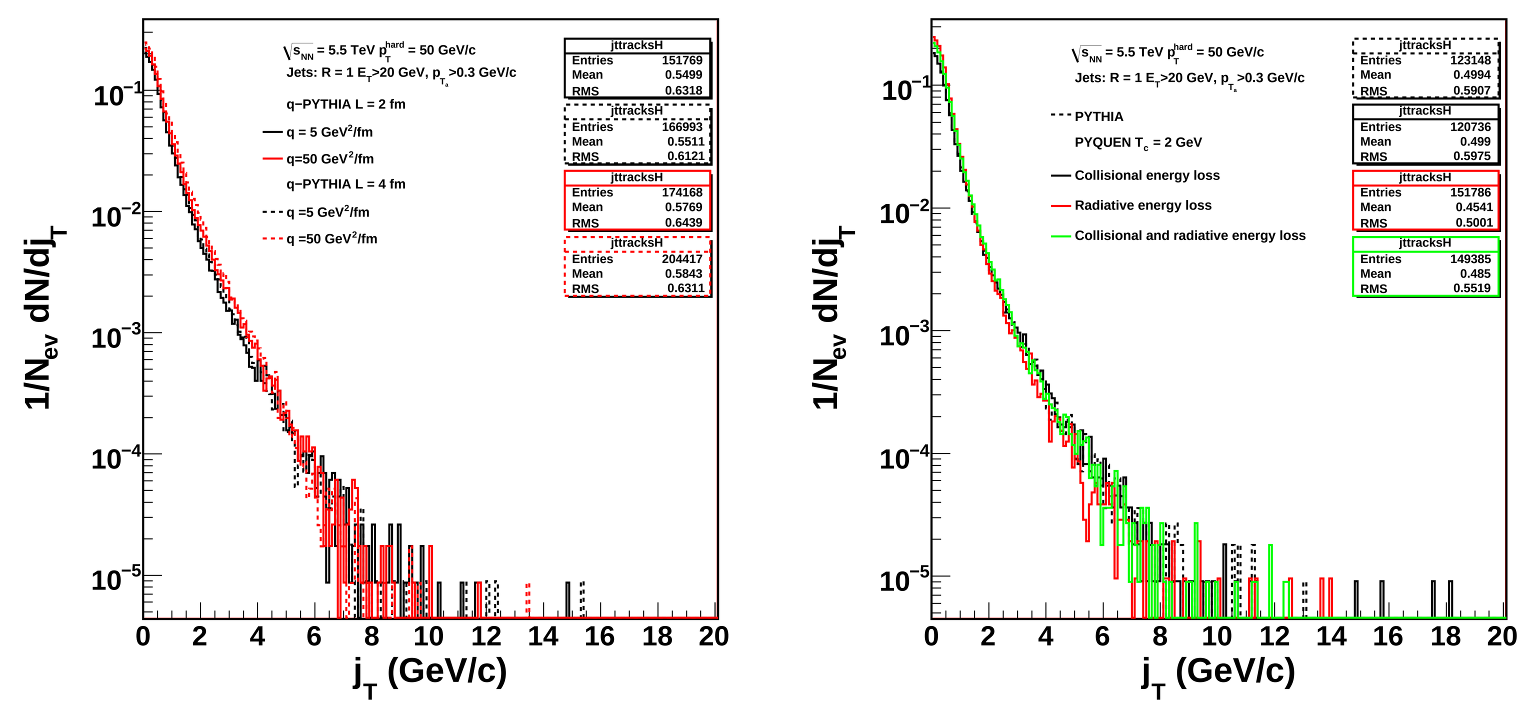
1. Energy loss (ienglu): Radiation and collision
2. T_0=2 GeV: Initial temperature of plasma
3. τ_0=0.1 fm/c: Proper time of plasma formation
4. n_f=0: Number of active quark flavors in plasma
5. Angular distribution of emitted gluons (ianglu): small-angular=0

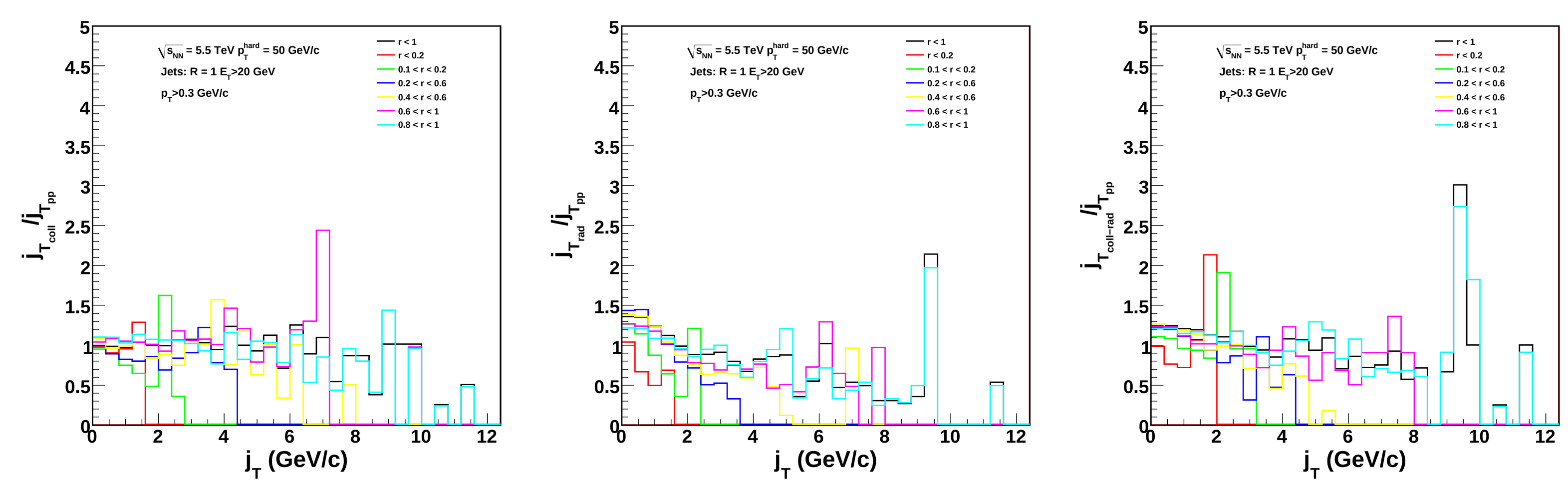
q-PYTHIA **: Monte Carlo implementation of medium-induced gluon radiation in the final-state branching process. Medium effects are introduced through an additive term in the vacuum splitting functions

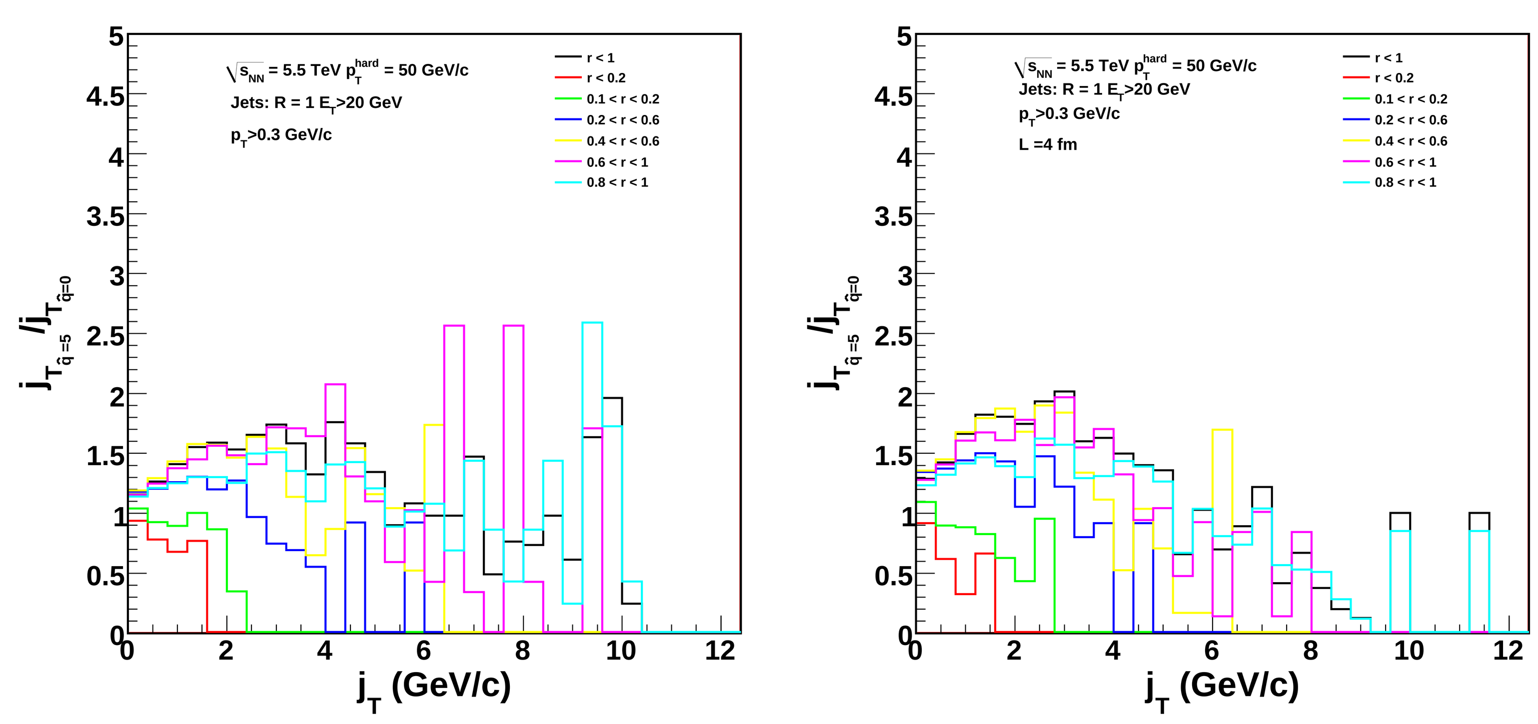
- AliPythia Quench setter
- if Quench==4, call q-Pyshow
- New setters for the transport coefficient and the initial medium length $\hat{q}$ and L $\hat{q} = 0, 5, 50 GeV^2/fm$, $L = 2fm$
- Include user-defined subroutine for the geometry and the position of the hard scattering

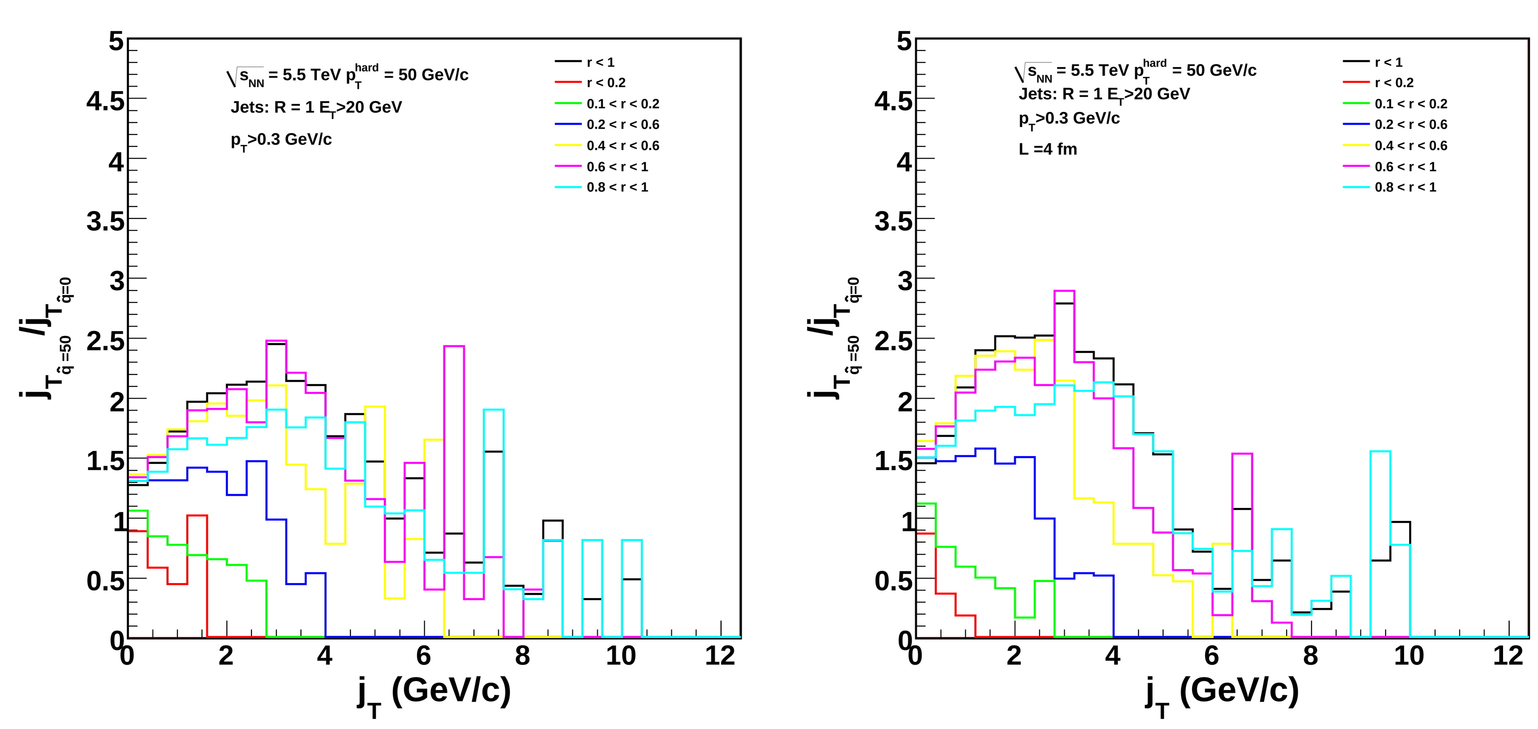
1. For an initial parton along the z-axis starting in the center of a medium
2. For a parton at midrapidity inside a cylinder
3. For a brick defined by planes (x,y,0) and (x,y,L)

Results









Conclusions

The simulations demonstrate a good sensitivity of this differential j_t parameter to the mechanism of radiative energy loss employed by the models.

References

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