JEWEL

HEPIC-Instituto de Física

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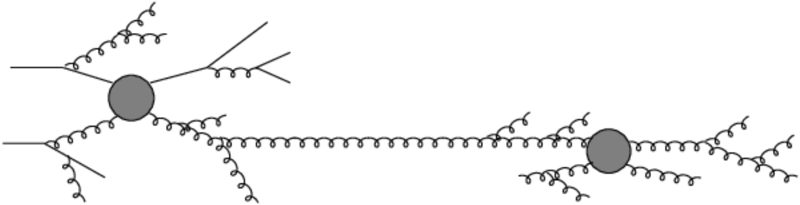
Content

Content

Something to think here

So far, I have developed a simulation in the following conditions

- JEWEL in its standard form;
- JEWEL with TRENTo initial conditions;
- JEWEL coupled with v-USPhyrdo simulations;



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Observables chosen

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- jet mass;

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Physics of JEWEL

The use of perturbative approach is dealt with by making use of a probabilistic interpretation of the Sudakov form factor:

$$S_a(t_h, t_c) = \exp\left\{ -\int_{t_c}^{t_h} \frac{dt}{t} \int_{z_{min}}^{z_{max}} dz \sum_b \frac{\alpha(k_\perp^2)}{2\pi} \hat{P}_{ab}(z) \right\} \quad (1)$$

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Wich means we can take it as the probability that a parton a emites no resolvable radiation between the scales t_c and t_h.

Physics of JEWEL

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Besides that, the medium, seen as a collection of scattering centers by the parton, also has the probability of interaction.
This probability is given by the regular cross-section of a $2 \to 2$ process,given by:

$$\sigma_i(E,T) = \int_0^{|\hat{t}|_{max}(E,T)} d|\hat{t}| \int_{x_{min}(|\hat{t}|)}^{x_{max}(|\hat{t}|)} dx \sum_{j\in\{q,\bar{q},g\}} f_j^i(x,\hat{t}) \frac{\mathrm{d}\sigma}{\mathrm{d}\hat{t}}(x\hat{s},|\hat{t}|) \quad (2)$$

Content

Initial Conditions

The model employed by JEWEL is a variant of Bjorken model that approachs the initial contitions by the definition of the nuclear thickness function:

$$T(x,y) = \int dz \rho(x,y,z) \tag{3}$$

Initial Conditions

The nuclear thickness functions are then used to define a reduced thickness by:

$$
\begin{aligned}
n(b,x,y) = {} & T_A(x-\frac{b}{2},y)\left(1-\exp\left(\sigma_{NN}T_B(x+\frac{b}{2},y)\right)\right) \\
& + T_B(x+\frac{b}{2},y)\left(1-\exp\left(\sigma_{NN}T_A(x-\frac{b}{2},y)\right)\right)
\end{aligned} \tag{4}
$$

Where σ_{NN} is the nuclear cross-section and b is the impact parameter.

Initial Conditions

This reduced thickness is then applied to take a map of the initial energy density:

$$\epsilon(x, y, b, \tau_i) = \epsilon_i \frac{n_{part}(x, y, b)}{< n_{part} > (b = 0)} \tag{5}$$

Where $< n_{part} > (b = 0) \approx \frac{2A}{\pi R_A}$.

Initial Conditions

The value of ϵ_i is determined by an initial temperature given as a parameter to JEWEL. This translation is made through the use of the relation $\epsilon_i \propto T_i^4$.

Initial Conditions

The new feature added in this work regarding the initial conditions is also the vertex production of the high energy partons. Here the production vertex is randomly chosen from a 2D spatial distribuition function proportional to T^4. This is necessary if one desires to have consistency with arbitrary entropy distributions.

Content

Medium Evolution

In the case of v-USPhydro, the evolution is given entirely by a hydro simulation. Otherwise(TRENTo and Glauber), the medium evolution is performed analytically by use of:

$$\epsilon(x, y, b, \tau) = \epsilon_i(x, y, b, \tau_i) \left(\frac{\tau}{\tau_i}\right)^{-\frac{4}{3}} \tag{6}$$

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This that the temperature evolves according to:

$$T(x, y, b, \tau) \propto \epsilon(x, y, b, \tau_i)^{1/4} \left(\frac{\tau}{\tau_i}\right)^{-\frac{4}{3}} \tag{7}$$

Content

Jet Algorithms

Today, the main type of algorithm to cluster particles from a given event into jets, thus defining a jet, are the sequential recombination algorithms. They define a distance functions between particles:

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$$d_{ij} = \min(p_{ti}^{2p}, p_{tj}^{2p}) \frac{\Delta R_{ij}^2}{R^2} \tag{8}$$

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$$d_{ij} = \min(p_{ti}^{2p}, p_{tj}^{2p})\frac{\Delta R_{ij}^2}{R^2} \quad (8)$$

Then a process of iteration is realized, where the particles with minimum d_{ij} are combined to form the given jets.

Jet Algorithms

Once the jets are found, one class of the possible observables are the jet shape observables.

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These reflect mush of the evolution that occurs in the jet formation, as well as the process of hadronization.

Content

SoftDrop Procedure

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The SoftDrop condition is:

$$\frac{\min(p_{T1}, p_{T2})}{p_{T1} + p_{T2}} > z_{cut} \left(\frac{\Delta R_{12}}{R_0} \right)^{\beta} \tag{9}$$

SoftDrop Procedure

Once the condition has been applied, the quantity:

$$\frac{\min(p_{T1}, p_{T2})}{p_{T1} + p_{T2}} \tag{10}$$

Reflects an observable that is usually related to the first splitting of the parent parton.

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Reflects an observable that is usually related to the first splitting of the parent parton.
This can be seen in the results of the fact that they follow the Altarelli-Parisi splitting functions.

Content

Angularity

This variable is defined as:

$$g = \frac{\sum_i p_i^T \Delta R_i}{p_J^T} \tag{11}$$

It measures how spread out is a jet.

Content

p_D^T

This variable is defined as:

$$p_D^T = \frac{\sqrt{\sum_i {p_i^T}^2}}{p_J^T} \tag{12}$$

It measures the *hardness* of a jet. It is closer to one if one or a few particles carry most of the jet momenta.

Content

x_J

The x_J variable is simply the ratio of the subleading jet transverse momentum to the leading jet transverse momentum. It is a *traditional* jet quenching variable. The usual interpretation is that, quite often a pair of partons will traverse different path lengths, resulting in different quenching experienced by these partons. This variable attempts to quantify this phenomena.

Content

Jet v_2

This variable is also related to path length dependency. It is the second harmonic contribution to the jet medium angular correlation. In central collisions, it is also an indicative of fluctuating initial conditions.

Content

Current Work

In this work, currently four different types of simulations were performed. The first is JEWEL on its default mode. The other ones had a modification such that a code was inserted in order to allow it to read an external temperature profile on a given grid. The temperature on arbitrary points are given by a bicubic interpolation. On this mode we had the following:

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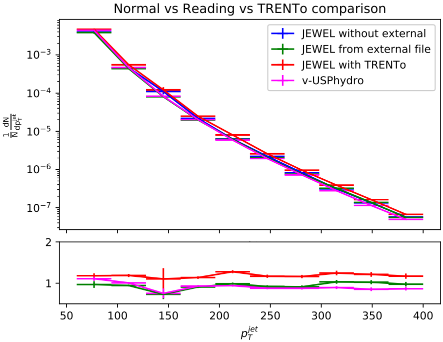
- JEWEL+PYTHIA default;
- JEWEL+PYTHIA with TRENTo initial conditions;
- JEWEL+PYTHIA+v-USPhydro;

Current Work

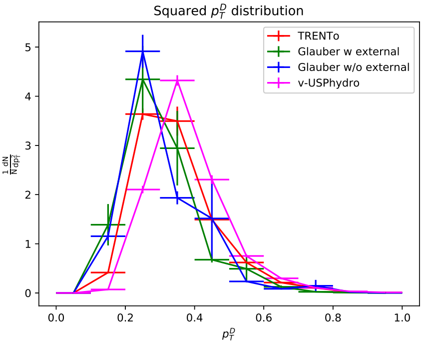
The first results for the jet transverse momentum are given here:



These results represent a well predicted observable and therefore represent a good check on to whether the simulations are consistent.

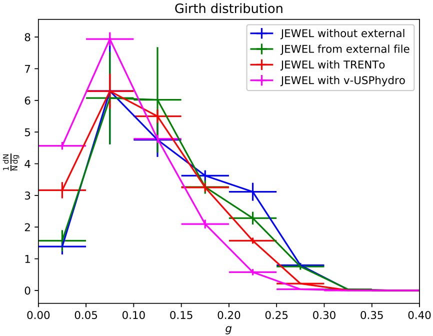
Current Work

The first results for the p_T^D momentum are given here:



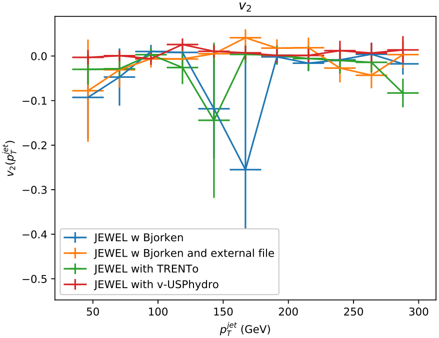
Current Work

The first results for the *girth* momentum are given here:



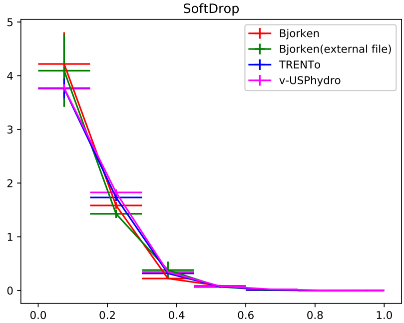
Current Work

The first results for the jet v_2 momentum are given here:



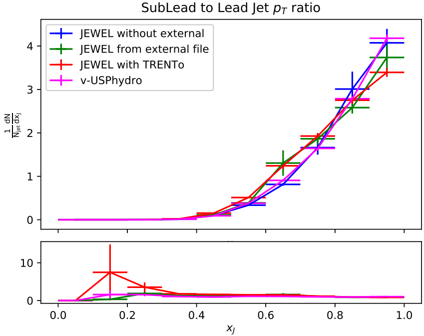
Current Work

The first results for the *grooming* are given here:



Current Work

The first results for the LeSub are given here:



Current Work

The first results for the jet mass are given here: