Novel sub-jet observables for quenched jets

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Which jet is quenched which one is not?
How different MC models modify the jet structure? How to tell them apart?
"Easy-to-measure" and experimentally robust observables?
AND theoretically rigorous / well defined observables?

A direction matching all criteria: colinear and infrared safe observables with strong sensitivity to the jet structure - SUB-JETS.

Jet finder: anti-kT, R=0.4

Observables: multiplicity, leading and sub-leading sub-jets with r < R reconstructed with kT and anti-kT algorithms

Event generators:
- MC PYTHIA (used as a reference - vacuum jets)
- Q-PYTHIA and JEWEL (in-medium modified jets)

Jet Quenching Models

Q-PYTHIA:
- Medium-modified version of PYTHIA 6;
- Radiative energy loss of type BDMPS-Z;
- Modification of the vacuum splitting functions:

\[ P_{\text{tot}}(z) = P_{\text{vac}}(z) \rightarrow P_{\text{tot}}(z) + \Delta P(z, t, q, L, E) \]

\[ \Delta P(z, t, q, L, E) \approx \frac{2\pi dP_{\text{med}}}{dzdt} \]
- Quenching parameter: transport coefficient average of squared transverse momentum acquired by the particle, kT / mean free path:

\[ \hat{q} = \frac{k_T^2}{\lambda} \]

JEWEL:
- Medium-modified version of PYTHIA 8;
- Contains both elastic and radiative energy loss (does not make distinction between the two);
- All medium interactions described at leading order by 2->2 QCD matrix elements;
- Implemented the Landau-Pomeranchuk-Migdal effect

Different quenching - different sub-jet structure

Jets with the same energy have a very different substructure.

Strong sensitivity to the details of modeling: the fraction of energy carried by the leading sub-jets.
New directions - more definitions possible - search for novel, robust, experimentally "preferred" observables.

Select samples of quenched jets

Jet multiplicity is sensitive to quenching strength (qhat).
Promising tool for distinguishing quenched from unquenched jets?

Future work

- Improve/develop observables with different jet quenching models;
- Detail studies with heavy-ion underlying event backgrounds & include experimental effects

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