A step towards tagging of quenched jets

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Different aspects of jet

Different algorithm = different phase space
= different behavior
Correlations

• What can we learn by correlating different observables?

• Can we use one to classify jets and another one to extract physics?

• If we have an observable on the initial opening angle, we can access for example coherence/incoherence effect
Can we “tag” the initial shower shape?
The goal

Find some set of observables that reproduce the properties of the hard splitting, both in vacuum and in medium.
Mapping jet splittings

Decluster jet (C/A) and follow harder branch

\( \ln(z\theta) \)

\( \ln(1/\theta) \)
First step: find a way to slice this plane so that vacuum and jewel results look similar.
Jewel: a case study

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Soft drop grooming

Above line: accepted by grooming

Below line: groomed away
Soft drop grooming

Is there a soft drop grooming setting \((z_{\text{cut}}, \beta)\) that can achieve the goal?

Soft drop condition: \(z_g > z_{\text{cut}} (\Delta R/R_0)^\beta\)
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Classic grooming

Classic: Catches large angle soft particles
Pros and cons

Limited to large angles; groomed-away rate large

Classic: Catches large angle soft particles
$\beta < 0 \ (0.15, -2.00)$

$> 90\%$ jets completely groomed away

Only span part of opening angles
Pros and cons

Focuses on small angle

Very small zg; not experiment friendly

Classic: Catches large angle soft particles

\((z_{\text{cut}}, \beta)\)
Large $\beta$

Very small $z_g$, hard to control experimentally

Only span part of opening angles
Pros and cons

Avoids most soft radiation

Classic: Catches large angle soft particles
\((Z_{\text{cut}} = 0.25, \beta = 0.00)\)

Grooming: flat as a function of opening angle
Has potential to “tag” the initial angle
Distribution looks similar between vacuum and jewel
\( (Z_{\text{cut}} = 0.25, \beta = 0.00) \)

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What can we study?

V-tagged jets, Jet $R_{AA}$
fragmentation function, mass, radial profile

$\Delta R$

Balanced splitting at small angle

Balanced splitting at large angle

Structure of the “recoil”; Coherent emission

Correlate with grooming with $\beta > 0$ to study protected structures
Correlation with other observables: examples
Z-tagged jet

Identify Z boson and look at away-side jet energy

Jets with large-angle balanced splitting lose more energy compared to those with smaller angle
Z-tagged jet

Identify Z boson and look at away-side jet energy

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Groomed PT (0.10, 0.00)

Groomed jet PT with (0.10, 0.00) as a function of opening angle of first uniform splitting

In vacuum, regardless of the opening angle, groomed-away energy is minimal
Groomed PT (0.10, 0.00)

Select only jets with small opening angle, examine groomed jet PT with (0.10, 0.00)

Vacuum ~ no-recoil > recoil

Opening angle of first balanced splitting = 0.1-0.2
(0.5, 1.5) grooming setting

Stronger grooming at large angle
Weak grooming at small angle
Focus on the core of the jet
First balanced splitting at small angle: measure of the amount of recoil
Groomed PT (0.50, 1.50)

First balanced splitting at large angle: how is the leading subjet modified when there is large scale structure?
Summary and outlook

- There is potential in tagging initial splitting properties with one observable and looking at other observables
  - Potential probe of coherence emission and many other aspects of jets
- Work is ongoing to search for better taggers, and to strengthen the tagging properties
- Apply on other types of generators
- Study of effect from background subtraction
Backup Slides Ahead