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Tagging the initial state gluon in the Z+jet process

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Angularity definition

Angularities are a class of observables of interest for jet phenomenology at the LHC. They are defined by
\begin{equation}
$\lambda_\alpha^\kappa=\sum_{i\in\text{jet}}\left(\frac{p_{T,i}}{\sum_{j\in\text{jet}}p_{T,j}}\right)^\kappa \left(\frac{\Delta_i}{R_0}\right)^\alpha$
\end{equation}
where R_0 is the jet radius and
\begin{equation}
$\Delta_i=\sqrt{(y_i-y_\text{jet})^2+(\phi_i-\phi_\text{jet})^2}$
\end{equation}
is the Euclidean azimuth-rapidity distance of particle i from the jet axis.
The most standard example of jet angularity is the jet mass corresponding to $\kappa = 1$, $\alpha = 2$.

A pheno study of jet angularities

In [1] we present a phenomenological study of angularities on the highest transverse-momentum jet in LHC events that feature the associate production of a Z boson and one or more jets. In particular, we study angularity distributions that are measured on jets with and without the Soft Drop grooming procedure. We begin exploring state-of-the-art MC parton shower simulations and we qualitatively assess the impact of NLO matching and merging procedures, then we move to analytic resummation of large logarithms at NLL accuracy. Matching to NLO results is performed in order to achieve NLL' accuracy.

Its application as a jet-flavour tagger

In [2] we use previous results to build a tagger able to determine the flavour of the leading jet in the Z+jet process with some level of confidence. The quark/gluon tagging procedure is achieved through a cut on a jet angularity and it is theoretically well-defined since it exhibits infrared and collinear safety. Now, tagging the flavour of the jet as quark-initiated, we show that it is possible to enhance significantly the initial-state gluon contributions. Exploiting both resummation and MC simulations, we perform a study of their efficiencies and their dependence on non-perturbative effects, for different angularities and different levels of grooming. The first application we want to investigate for our results is to assess in more detail the impact of these types of observable in fits of parton distribution functions.

References:

[1] Jet Angularities in Z+jet production at the LHC - S. Caletti, O. Fedkevych, S. Marzani, D. Reichelt, S. Schumann, G. Soyez, V. Theeuwes; in preparation.
[2] Tagging the initial-state gluon - S. Caletti, O. Fedkevych, S. Marzani, D. Reichelt; in preparation.

Primary author: Mr CALETTI, Simone (INFN - National Institute for Nuclear Physics)

Presenter: Mr CALETTI, Simone (INFN - National Institute for Nuclear Physics)

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