

1 Probing the parton shower with multi-differential jet
2 substructure measurements in pp collisions at STAR

3 Youqi Song
(For the STAR Collaboration)

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5 Jets are collimated sprays of final-state particles produced from initial high-momentum-
6 transfer partonic scatterings in particle collisions. Since jets are multi-scale objects that
7 connect asymptotically free partons to confined hadrons, jet substructure measurements
8 can provide insight into the parton evolution and the ensuing hadronization processes.
9 Compared to the jets at the LHC, jets produced in $\sqrt{s} = 200$ GeV pp collisions at RHIC
10 have lower transverse momenta and are therefore more susceptible to non-perturbative
11 effects. The jet substructure measurements in the STAR experiment, therefore, provide
12 complementary information about different regimes of quantum chromodynamics. In ad-
13 dition to the inclusive and SoftDrop groomed jet observables, such as jet mass (M), jet
14 charge (Q), groomed jet mass (M_g), groomed jet radius (R_g) and shared momentum frac-
15 tion (z_g), the STAR collaboration has also recently measured the correlations between
16 various substructure observables.

17 We extend the previous studies of multi-dimensional jet substructure observables by
18 studying the correlation between SoftDrop and CollinearDrop groomed jet observables, the
19 latter of which have an enhanced sensitivity to soft radiation within jets. Such correlation
20 measurements reveal the interplay between different stages of the parton shower. In this
21 talk, we present the first measurements of the CollinearDrop groomed jet mass and its
22 correlation with R_g and z_g , in pp collisions at $\sqrt{s} = 200$ GeV. The measurements are
23 fully corrected for detector effects with MultiFold, a novel machine learning method which
24 preserves the correlations in the multi-dimensional observable phase space. We compare
25 our fully corrected measurements with predictions from event generators such as PYTHIA
26 and HERWIG.