Jet-Substructure Discussion

Fragmentation Functions

Single hadron

Classic Jet Shapes

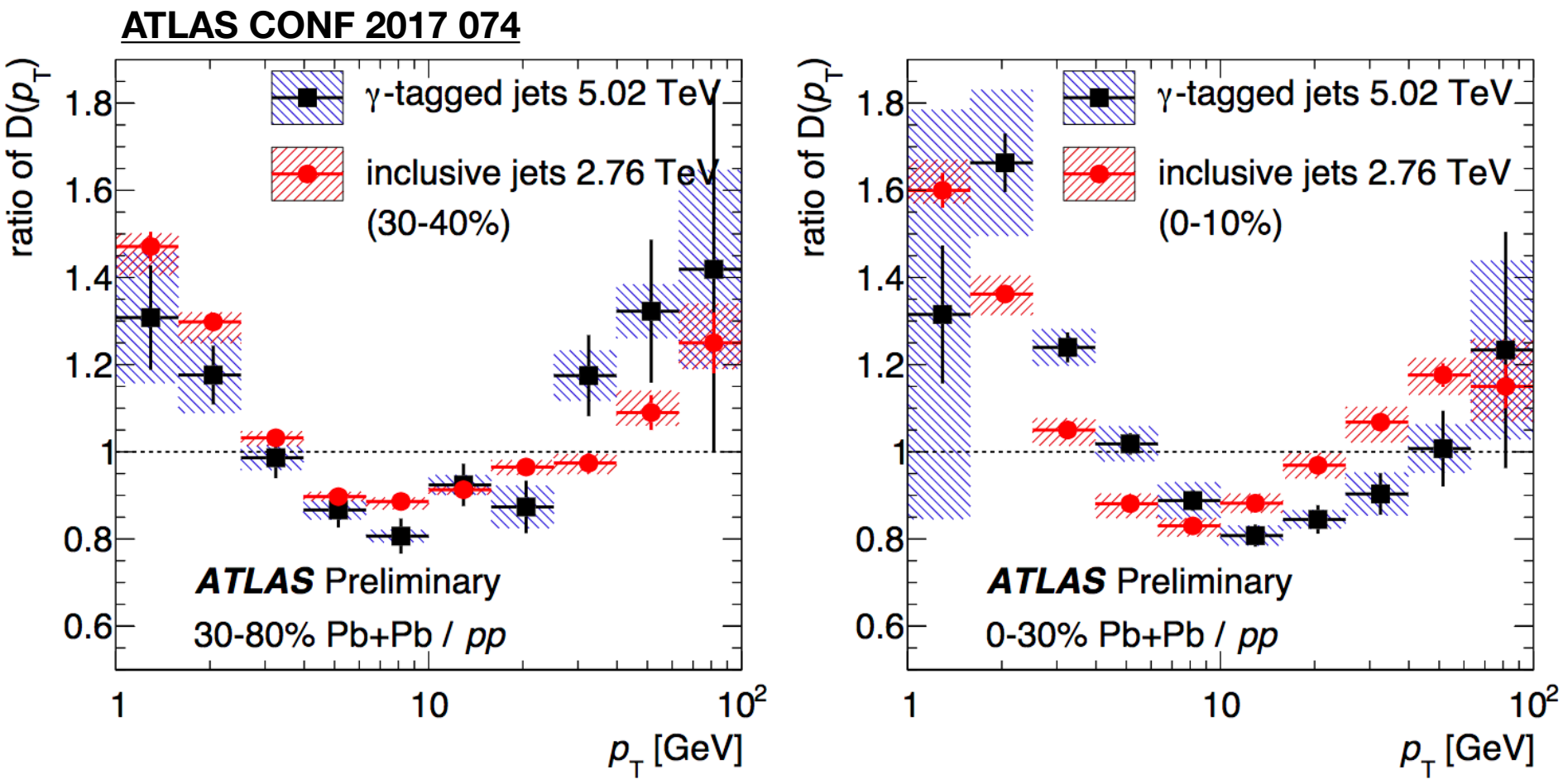
All hadrons

Groomed Observables

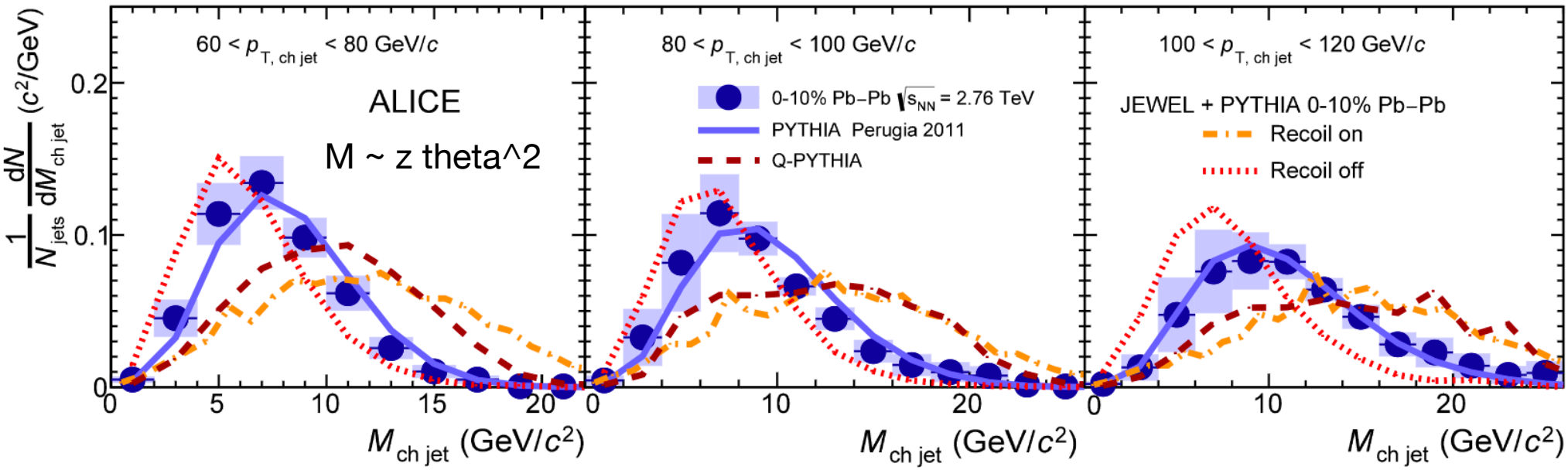
Subset of hadrons

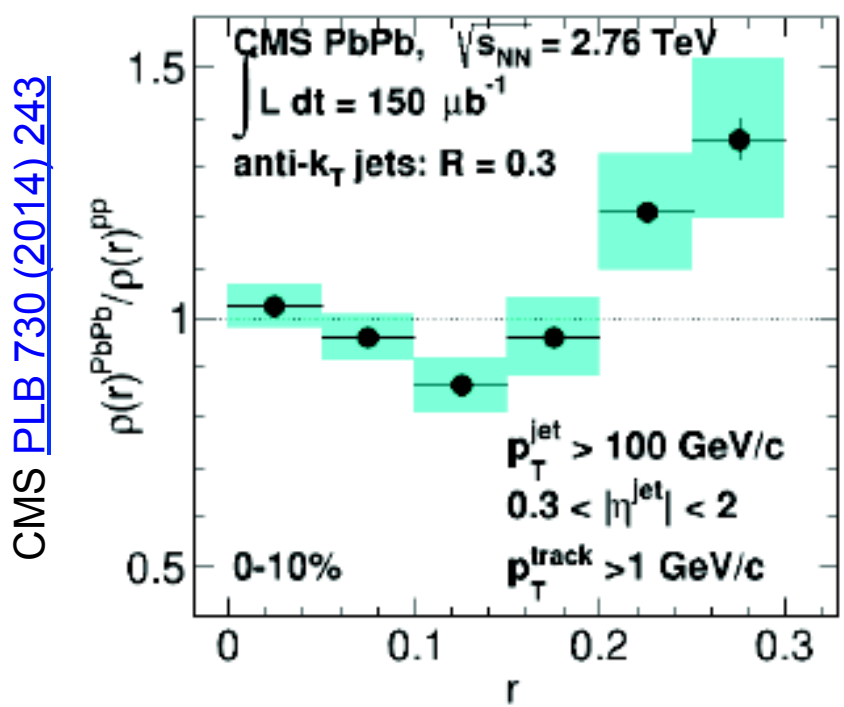
Sketches by
J. Thaler

Fragmentation Functions (LHC)



Selection of Classic Jet Shapes (LHC)





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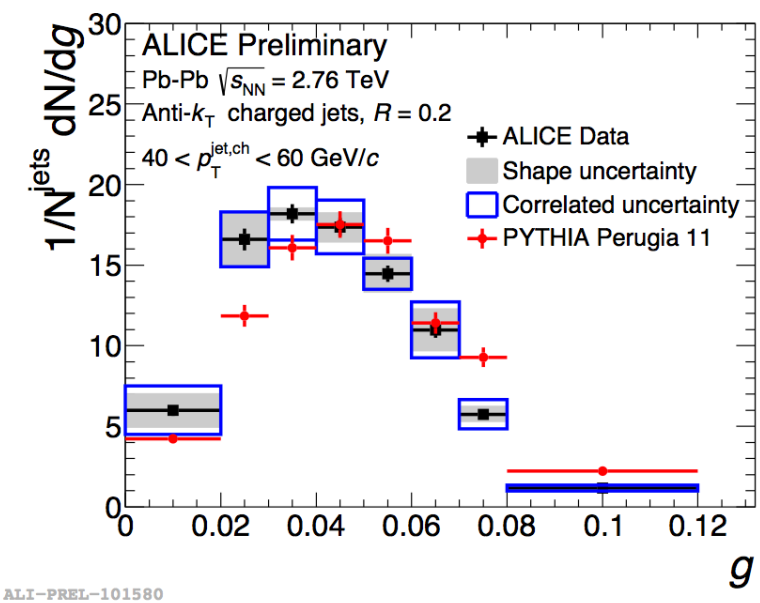
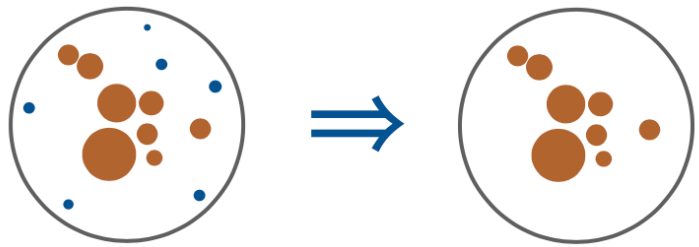


Soft Drop on One Slide



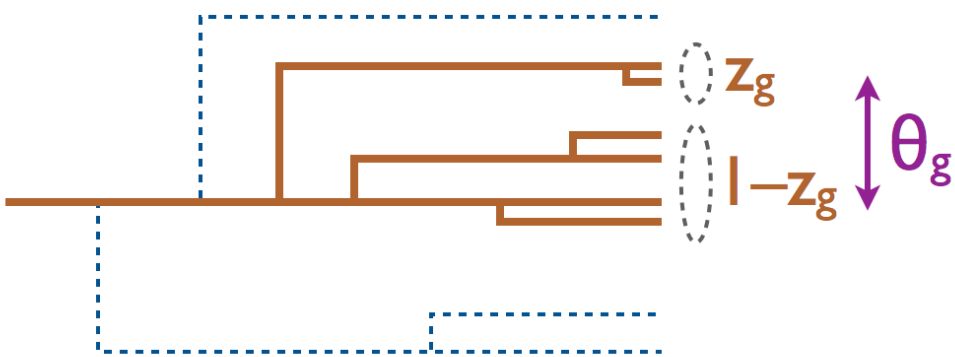
Soft Drop Condition:

$$z > z_{\text{cut}}\,\theta^{\beta}$$

energy threshold

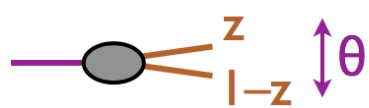
angular exponent

Recursively drop wide-angle soft radiation



Based on declustering an angular-ordered tree

Final jet looks like QCD splitting function



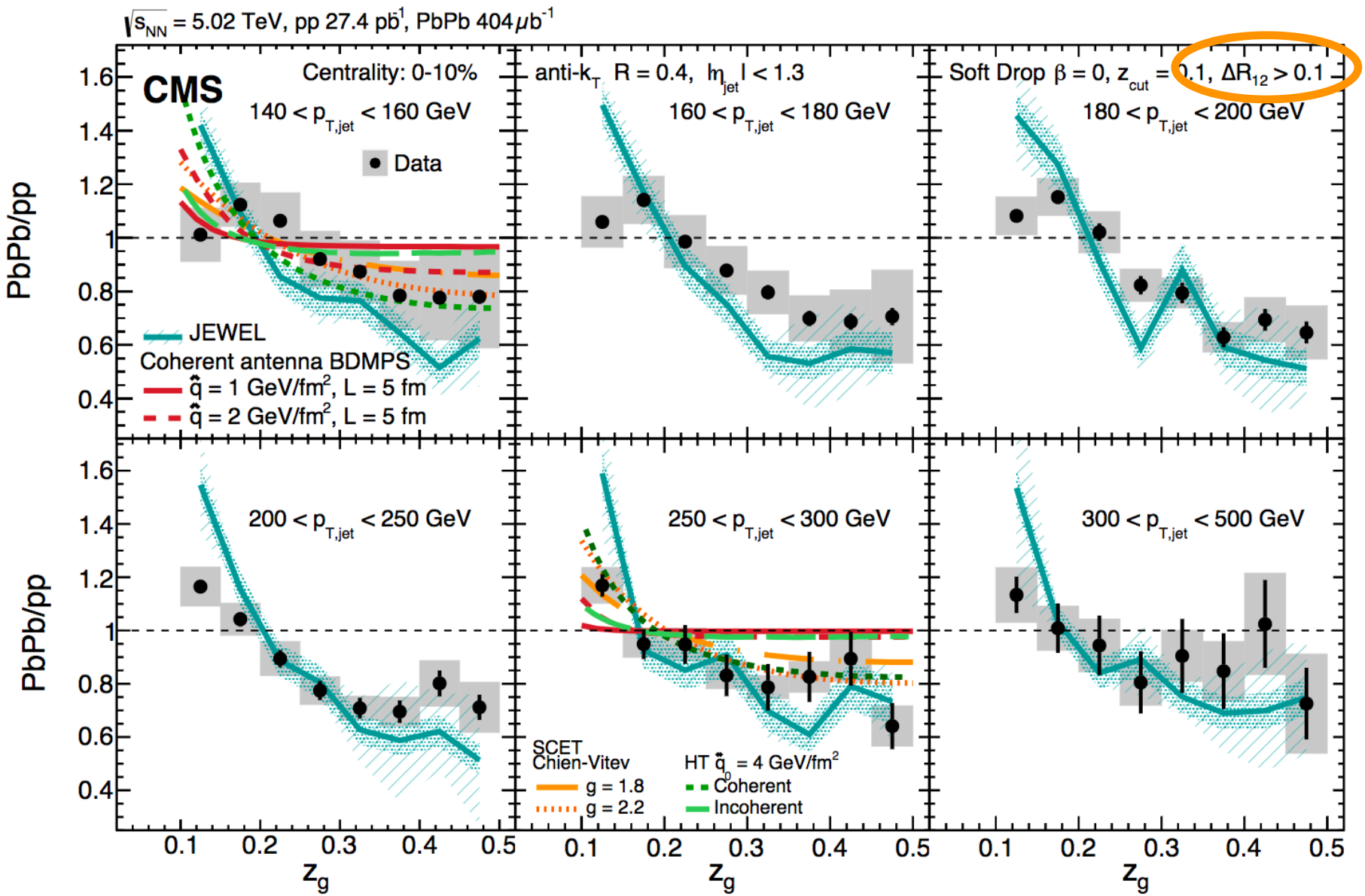
$$\int \frac{\mathrm{d}\theta}{\theta}\,\mathrm{d}z\,P(z)$$

AP splitting function

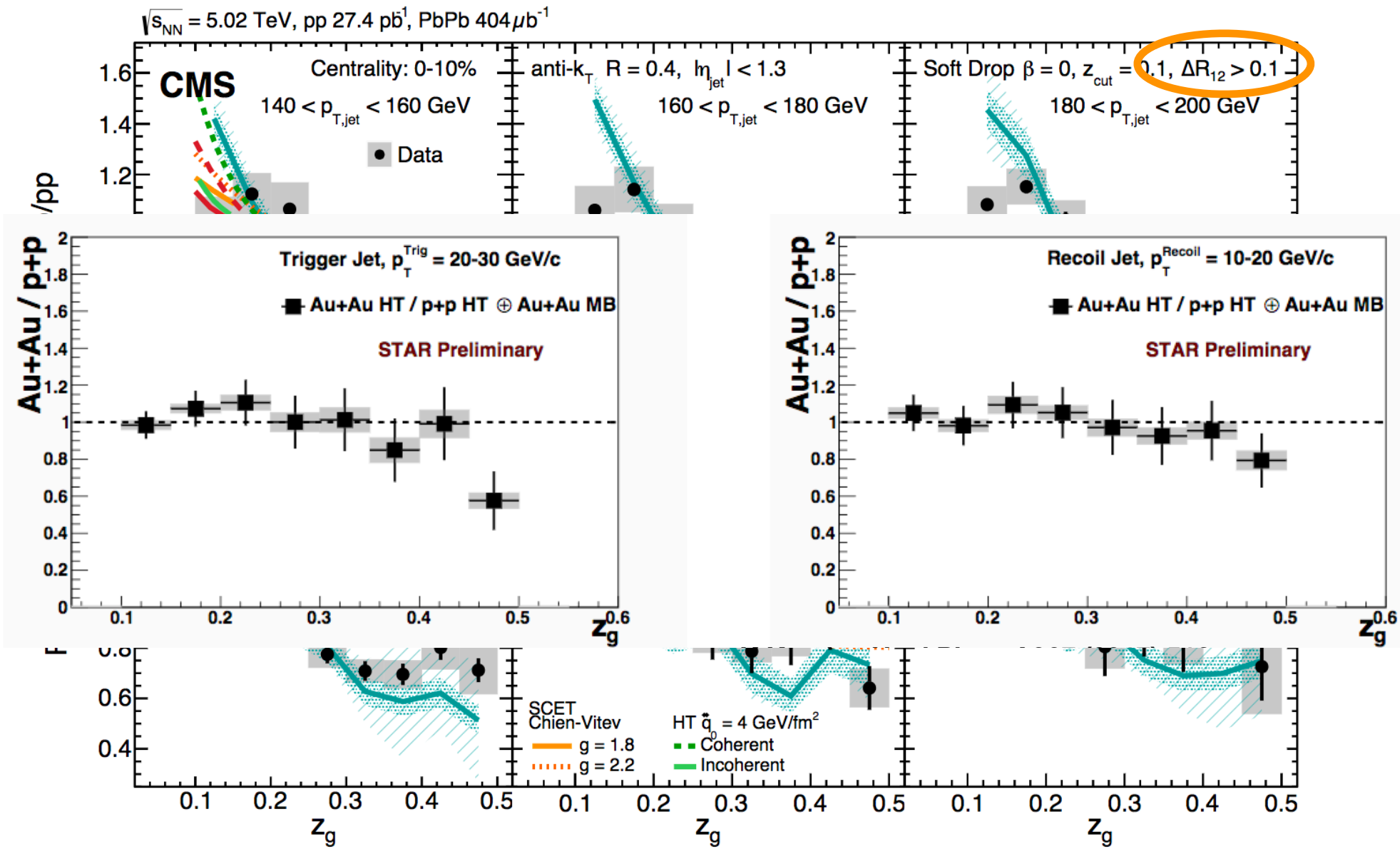
β parameter gives nice handle

[Larkoski, Marzani, Soyez, JDT, 1402.2657]
[see also Butterworth, Davison, Rubin, Salam, 0802.2470; Dasgupta, Fregoso, Marzani, Salam, 1307.0007]

LHC and RHIC SofDrop z_g

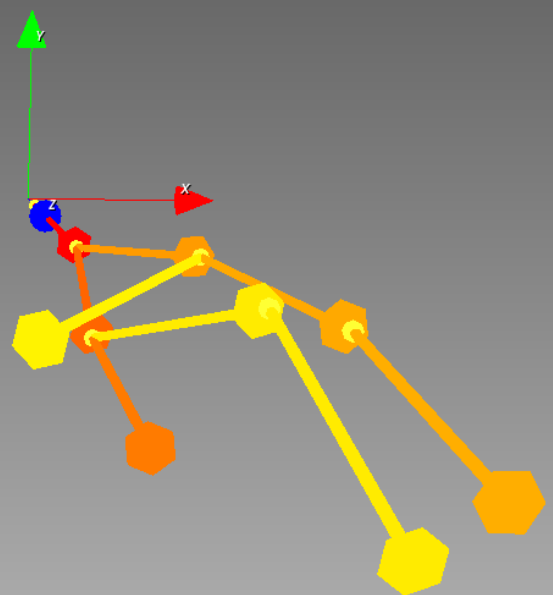


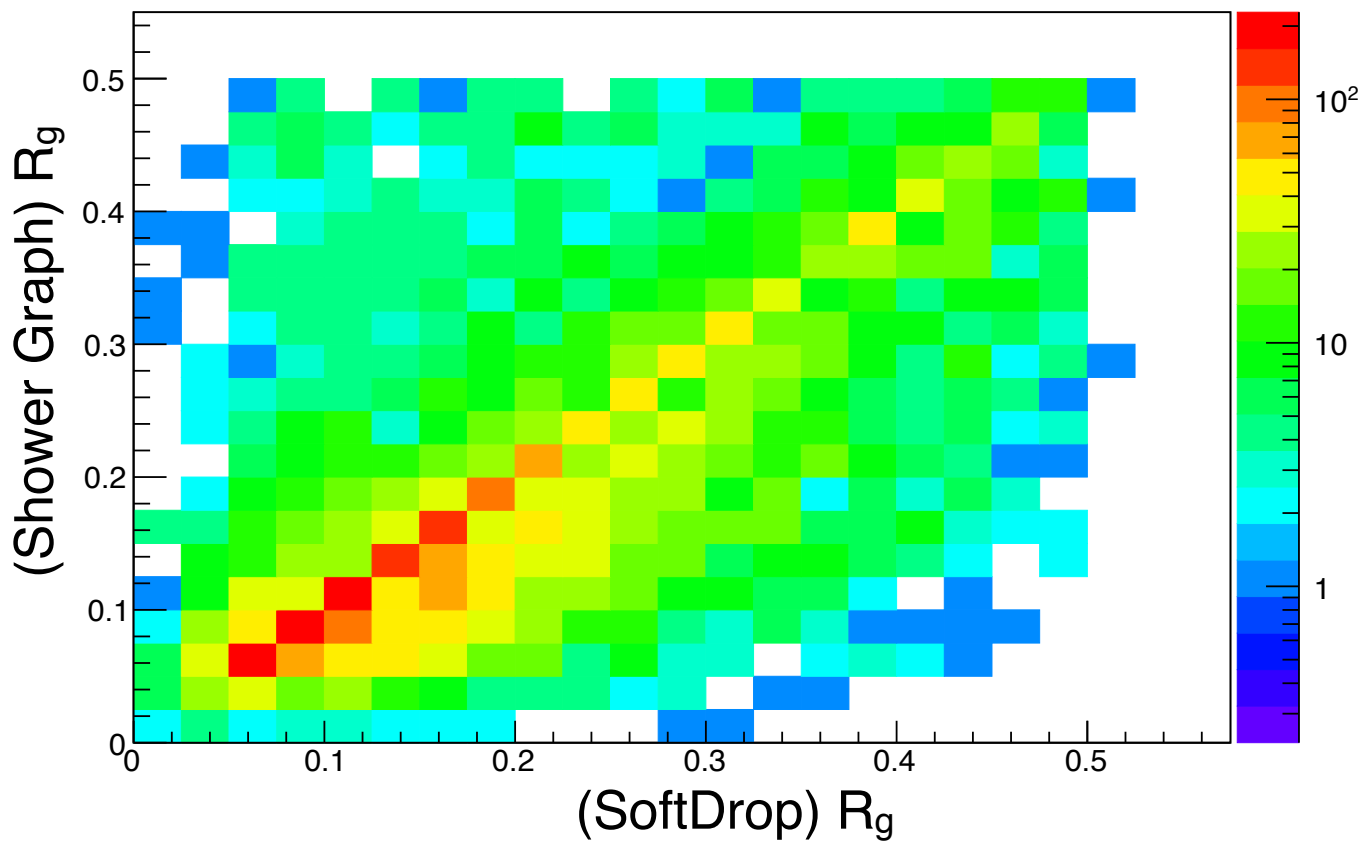
LHC and RHIC SofDrop z_g



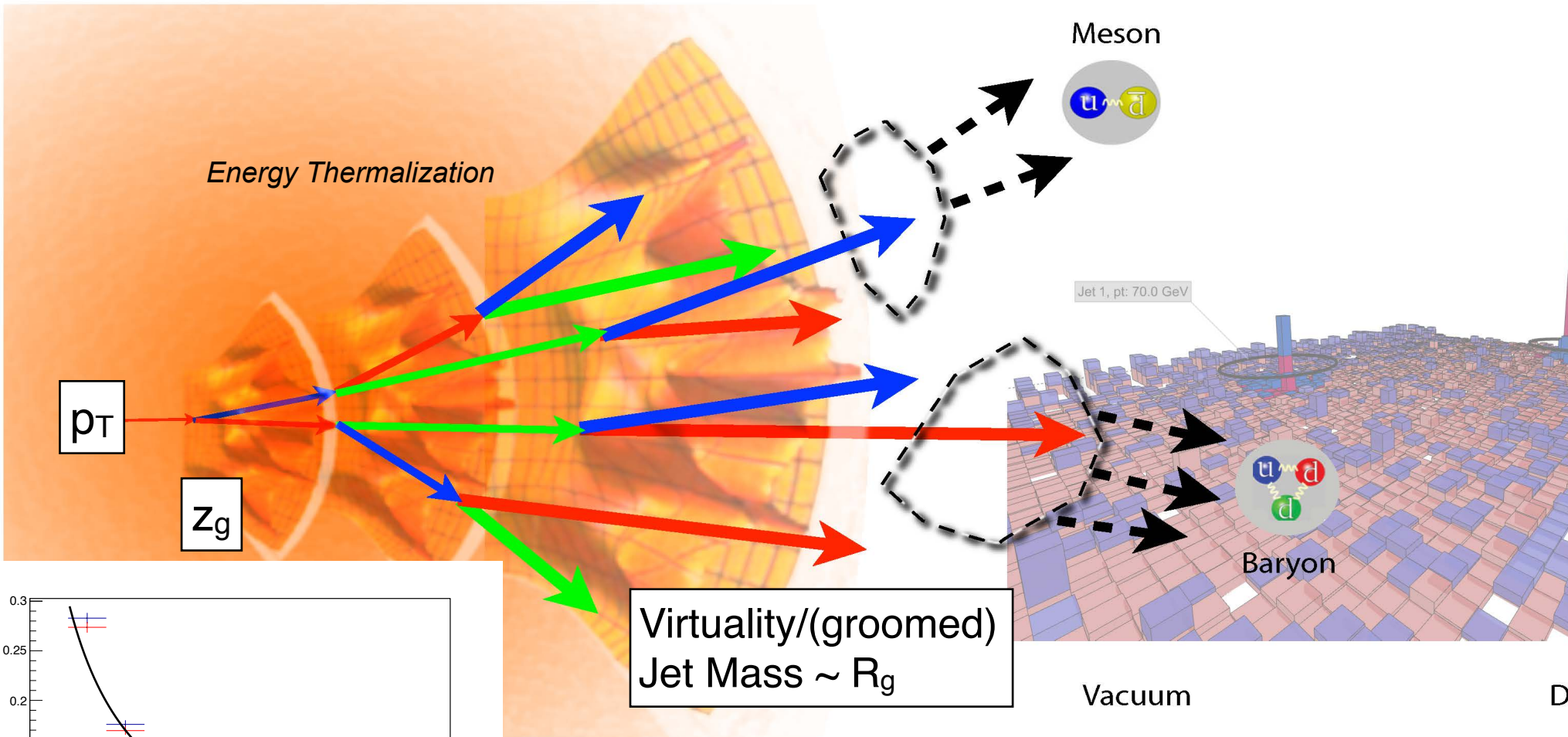
SoftDrop vs Parton Shower *Graph* (Pythia8 Parton Level)

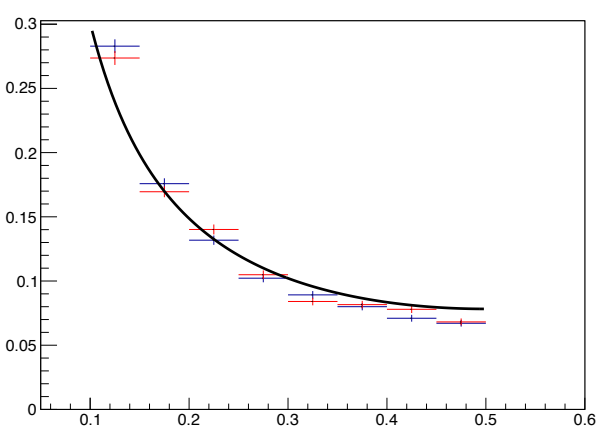
Pythia8 Shower pT~40 GeV
(a *simple* one)



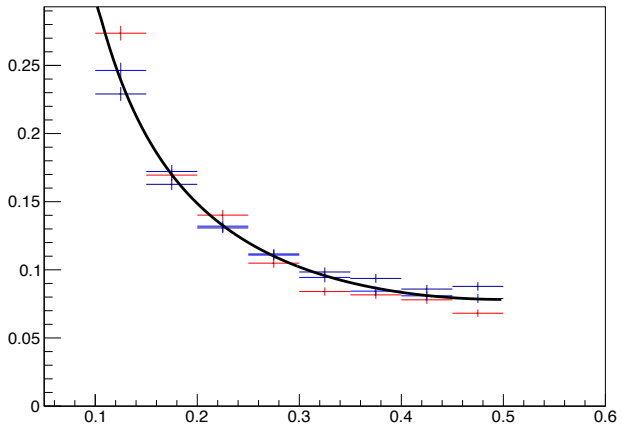


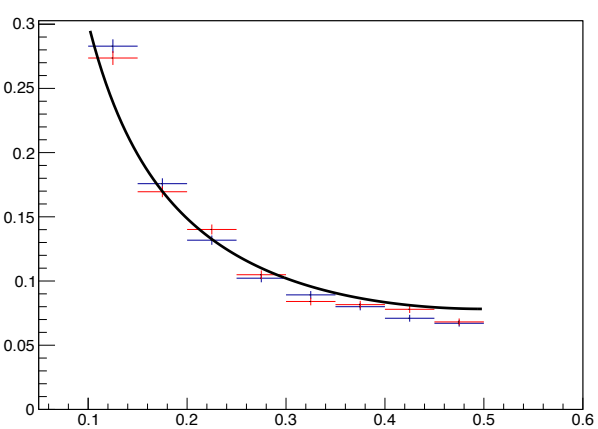
Experimental Access to *full* Parton Shower Evolution





Experimental Access to *full* Parton Shower Evolution



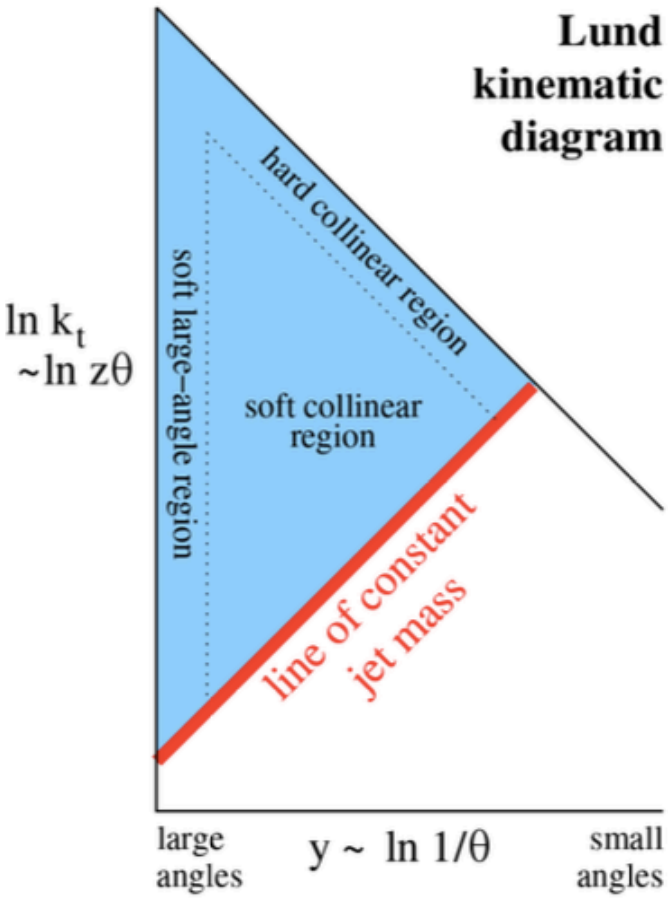


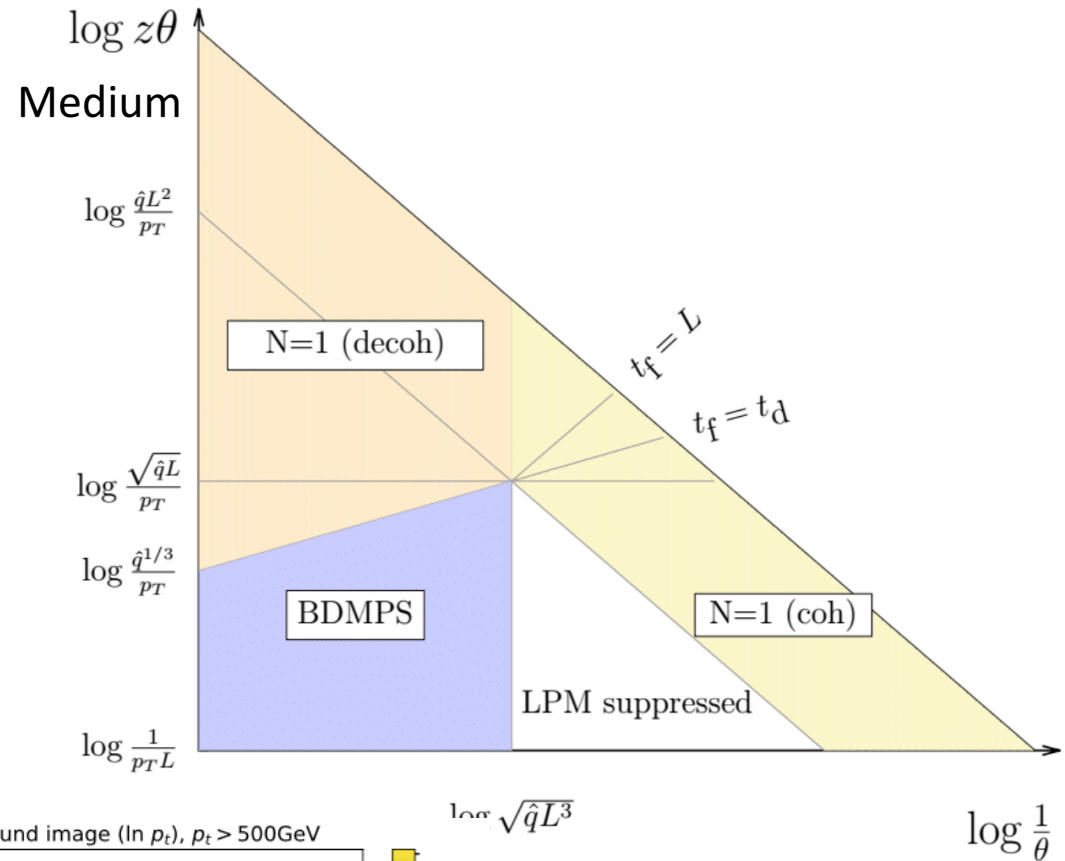
Energy, Splitting Function and virtuality direct input/ connection in/to pQCD jet quenching calculations!

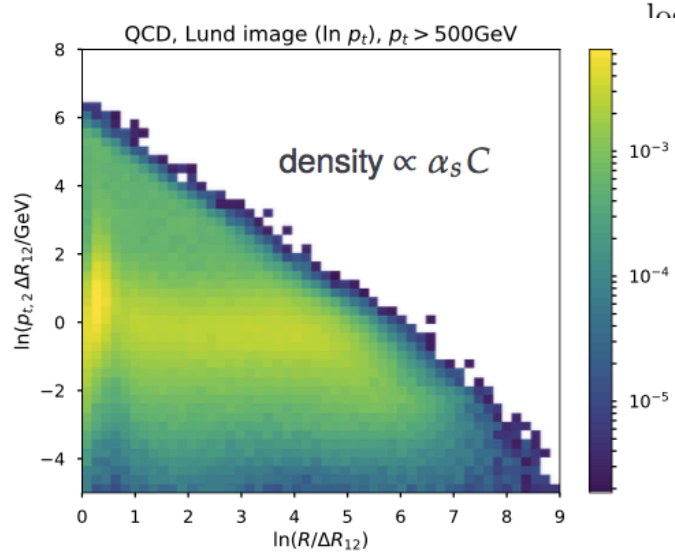
More needed to constraint energy loss models?

Following subsequent splits → Timeline

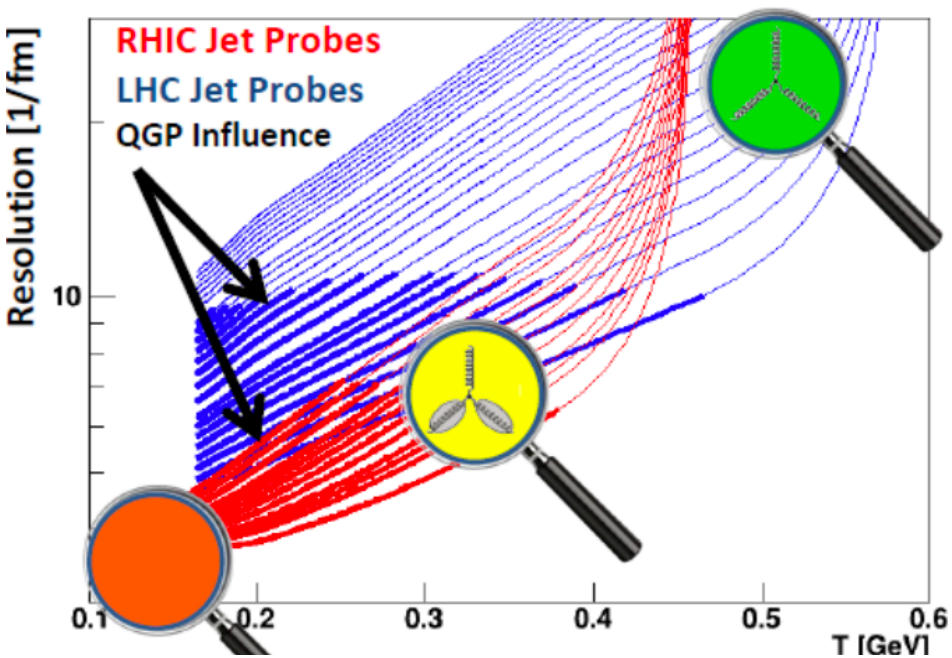
(Recursive SoftDrop) Lund Diagram

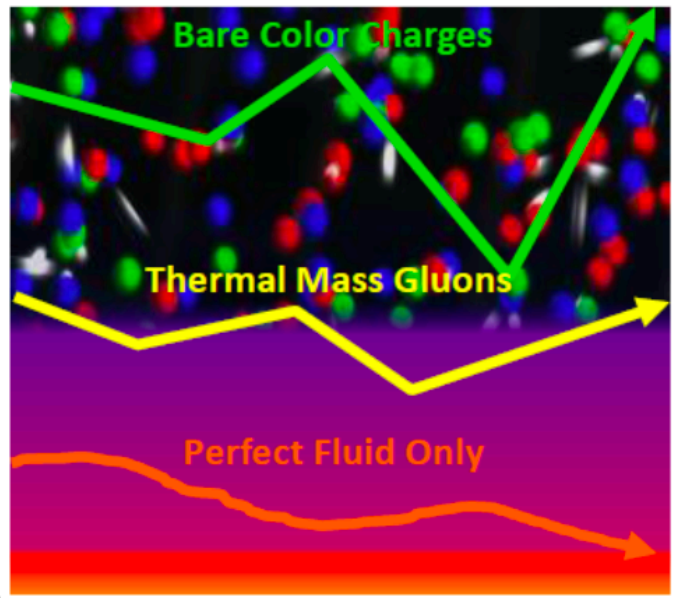






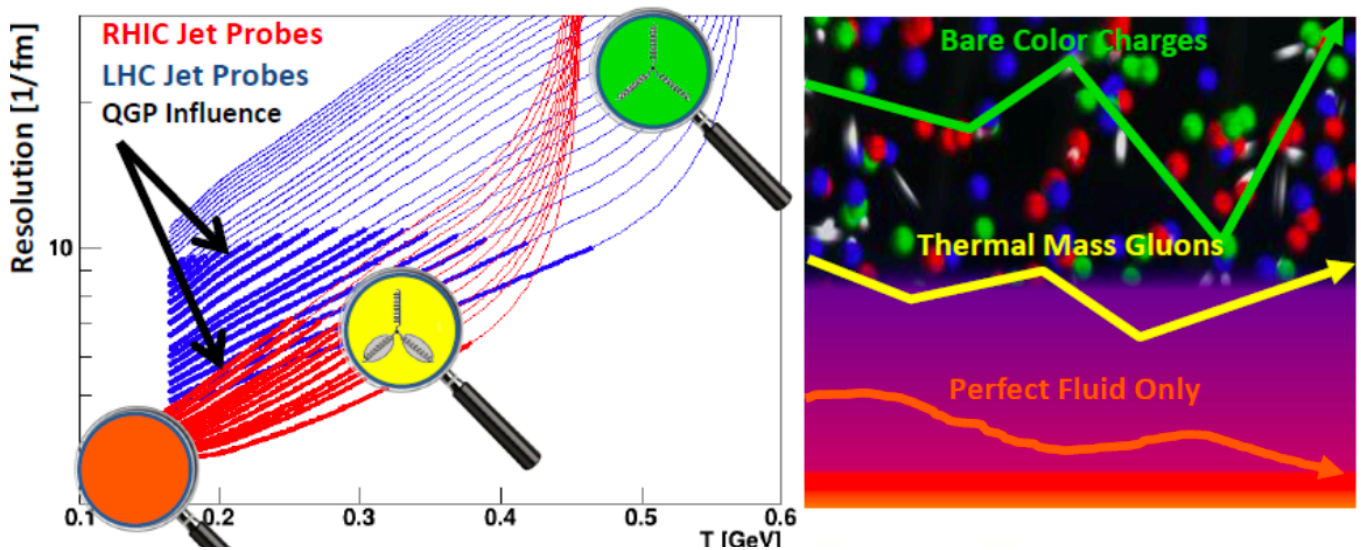
More differential with Jet-Substructure Observables





- What would be really cool is an observable (built using softdrop and substructure techniques?) that remembers the initial jet mass, i.e. what the jet mass or opening angle would have been in the absence of any parton energy loss or wake. If we could compare jets in pp and PbPb with the same value of such an observable, the differential jet shape ratio would then give direct access to transverse kicks, and K.

More differential with Jet-Substructure Observables



Utilizing the *multi-scale* aspects of jets via jet mass, grooming R_g … (recursively if needed) to tag/select jets (branchings) in energy and resolution scale and *combine with standard quenching observables*.

Besides experimental limitations, is such an approach conceptually sufficient?

***Large amount* of potential substructure observables exp. accessible:**
To some extent these observables are not independent.
Can we define a set of most *promising/sensitive* observables?