Jet Hadronization and Substructure Studies

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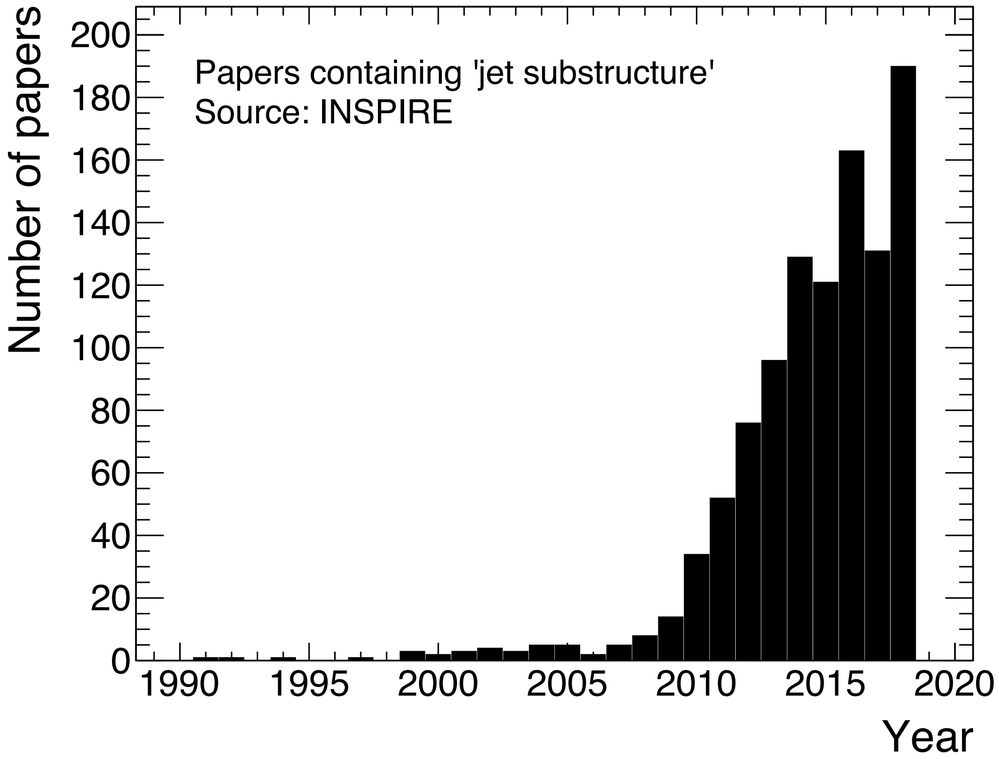
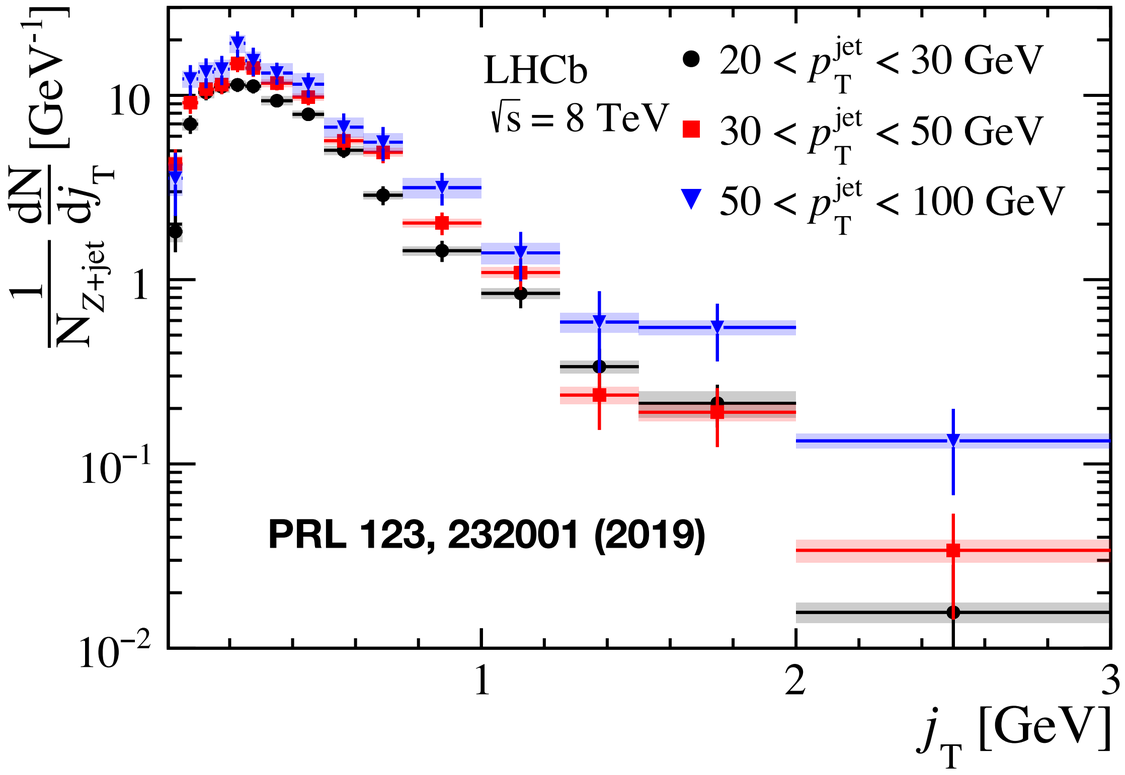
Jet Substructure

- Jet substructure studies have exploded in the last decade
- Cover a wide range of physics topics from BSM, deep learning, QCD interactions…
- What can we learn from jet substructure at EIC?



QCD Jet Substructure

- Jet substructure accesses a variety of effects within QCD
  - (TMD) Fragmentation functions
  - Parton shower evolution
  - Nuclear medium effects



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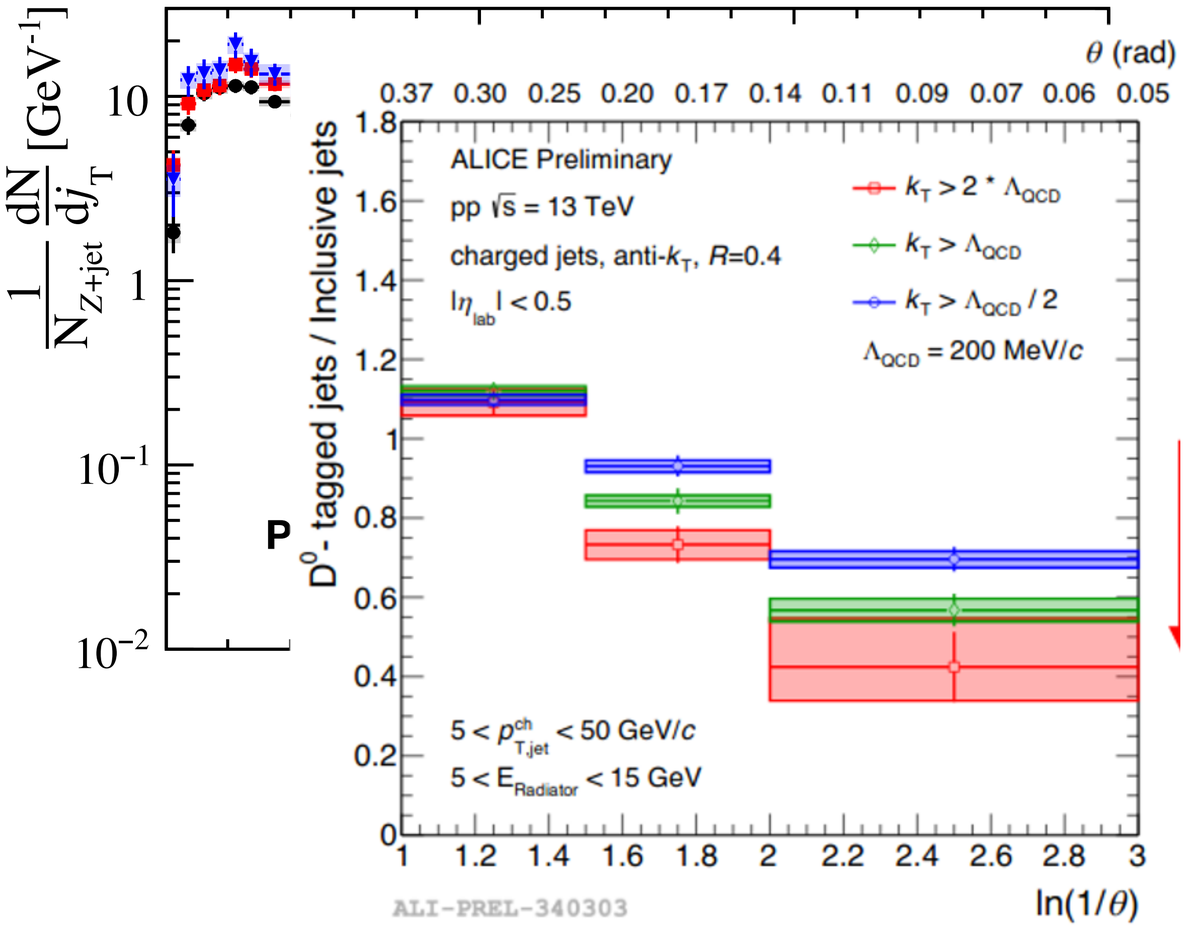

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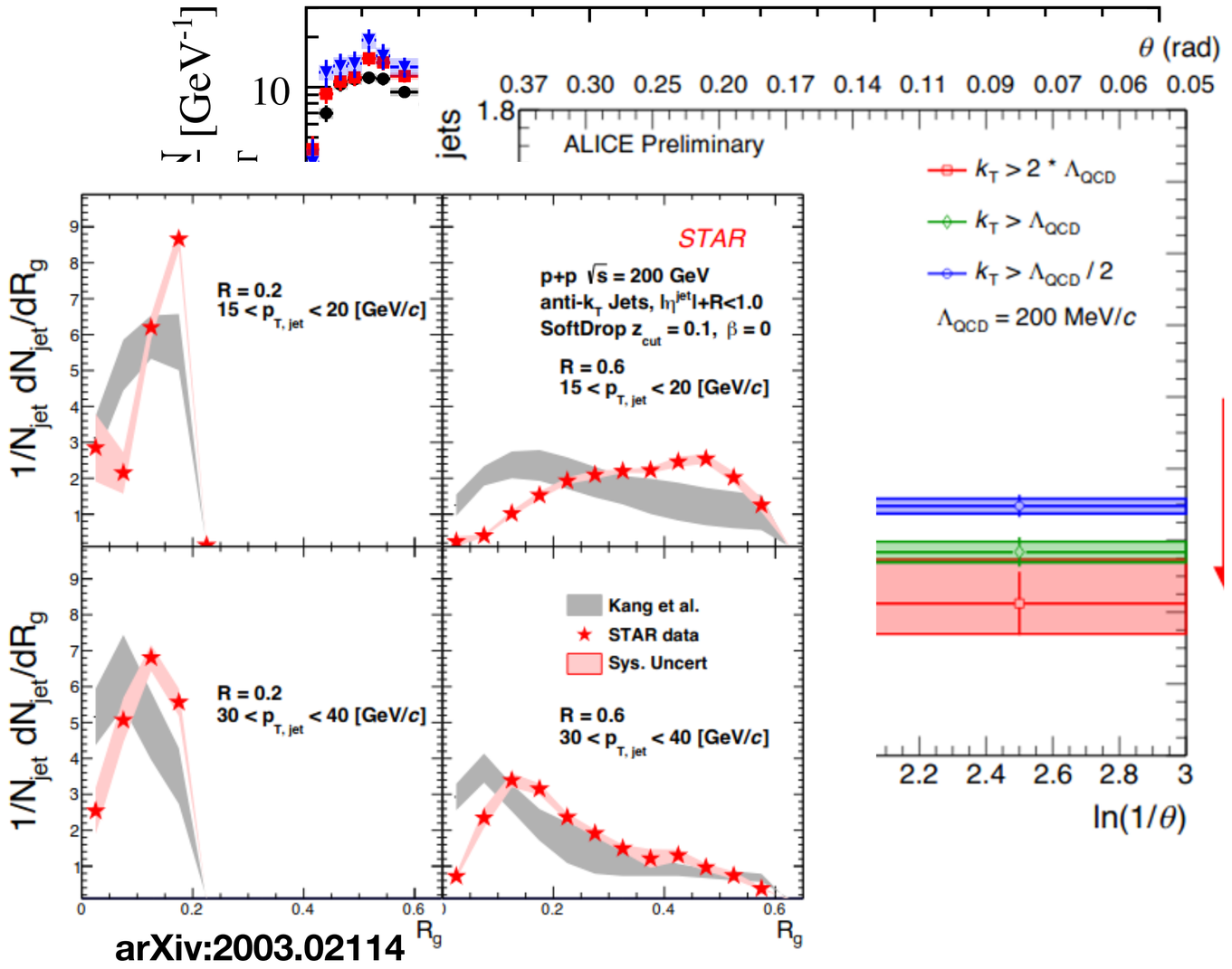

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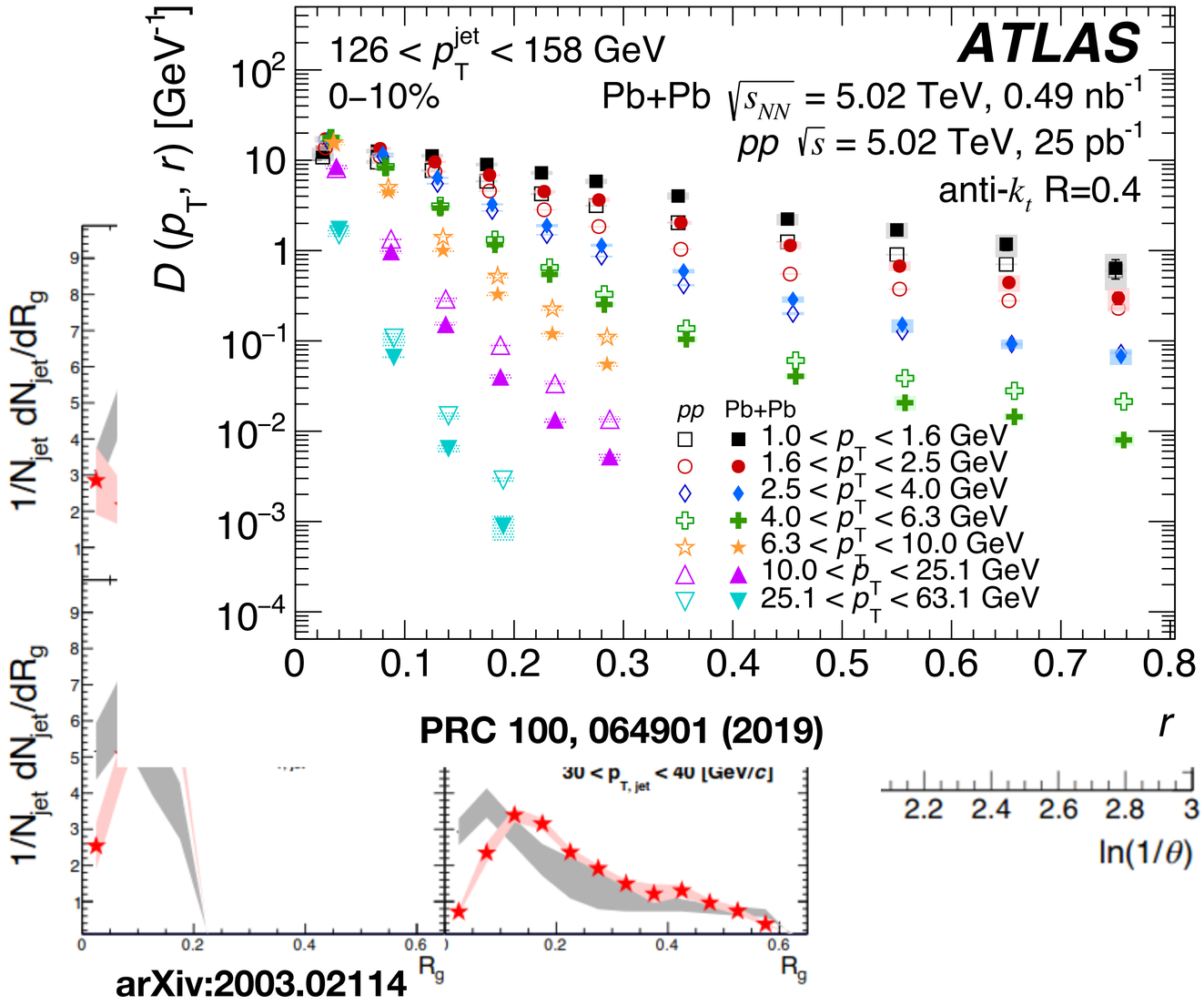
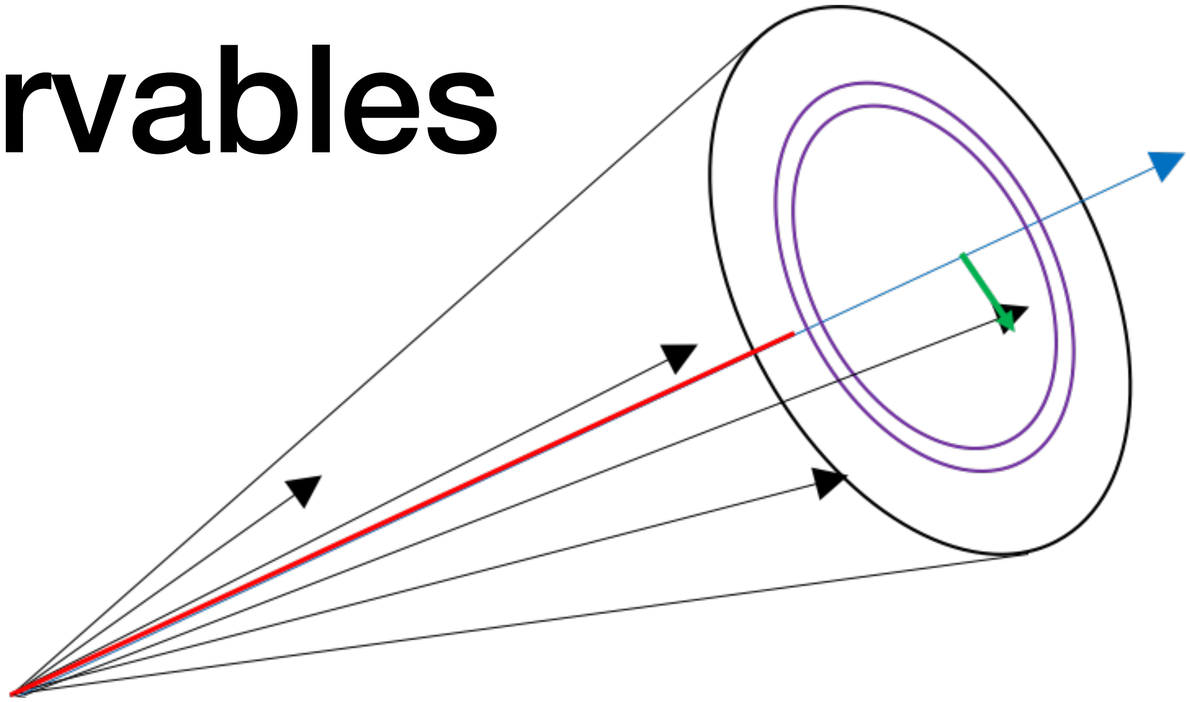


FF Observables

- Typically RHIC/LHC analyses use z, j_T, r defined as shown
- Have been used in:
  - Inclusive jet (ATLAS, ALICE, CMS, STAR)
  - Z^0-jet (LHCb)
  - ɣ-jet (ATLAS, CMS)
- Others?
  - e.g. spin sorted (Collins) FF



$$z = \frac{p_{jet} \cdot p_h}{|p_{jet}|^2}$$

$$j_T = \frac{|p_h \times p_{jet}|}{|p_{jet}|}$$

$$r = \sqrt{(\phi_h - \phi_{jet})^2 + (y_h - y_{jet})^2}$$

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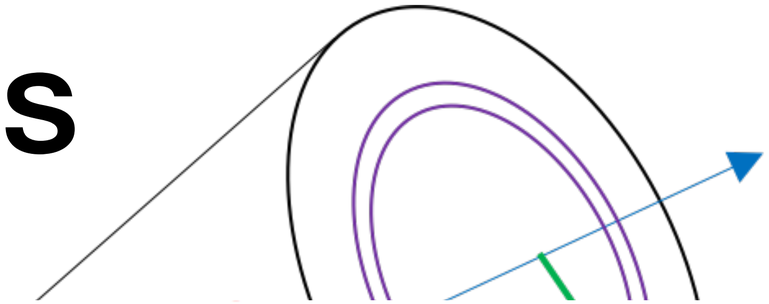

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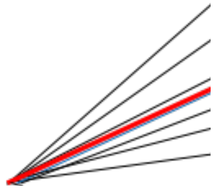
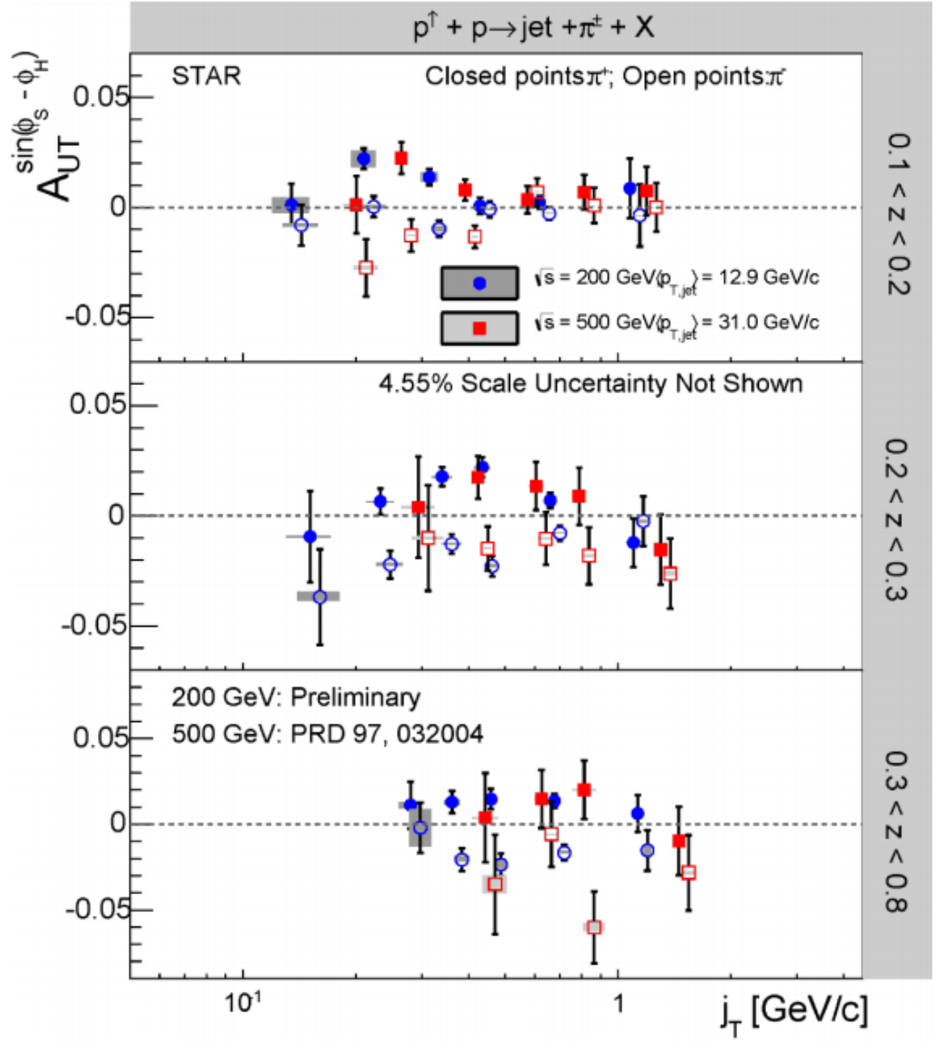
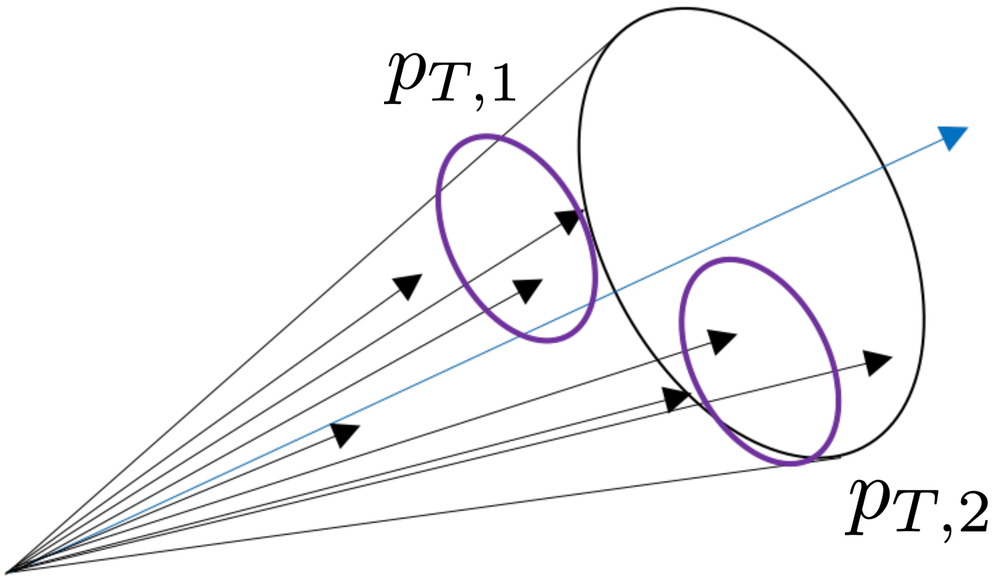




Groomed Jet Observables

- Many analyses now use the soft drop grooming algorithm to remove soft, wide angle radiation from jet
- Intended to try to identify radiation associated with hard scattered Parton
- Observables of interest:
  - R_g, z_g - sensitive to DGLAP splitting function
  - Look at others? E.g. m, m_{SD}
  - Open to suggestions



$$z_g = \frac{\min(p_{T,1}, p_{T,2})}{p_{T,1} + p_{T,2}}$$

$$R_g = \Delta R(p_{T,1}, p_{T,2})$$

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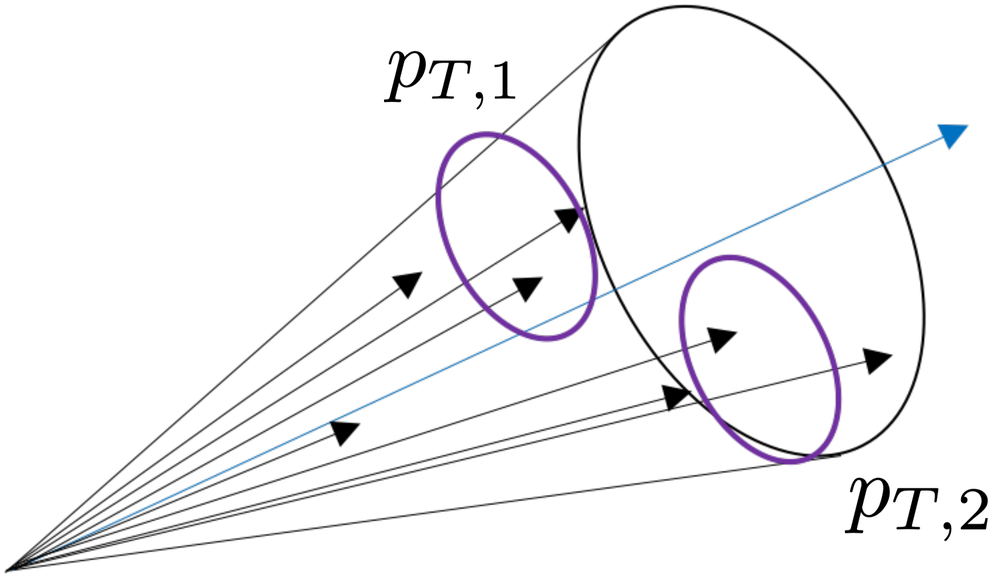

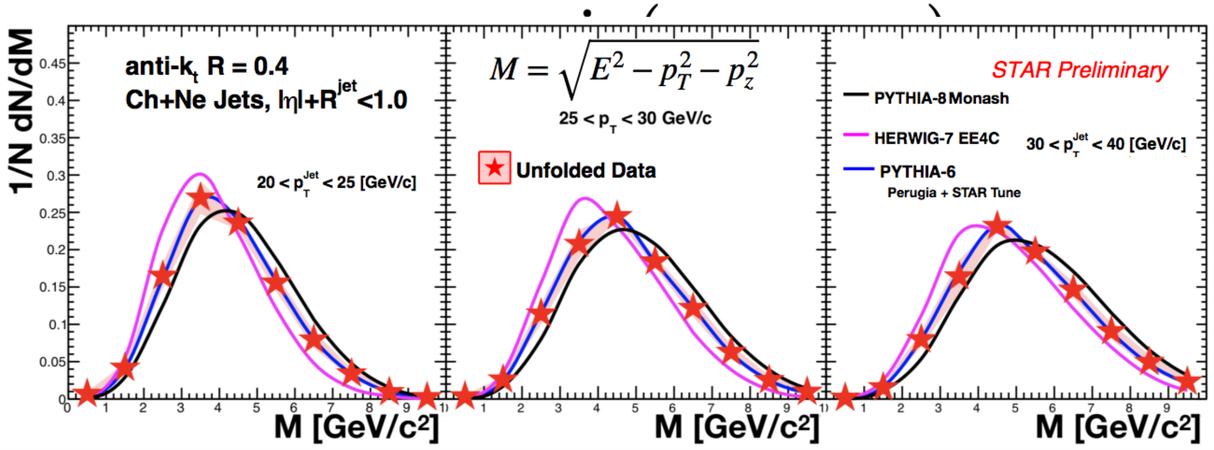

YR Plans

- Setting up simulation/analysis framework with EICSmear to fast simulate DIS events
- Plan to look at single hadrons-in-jets, soft drop groomed jets
  - Inclusive and HF jets
- Things we will look at to begin:
  - Jet and substructure observables reconstruction performance for given detector geometry/resolution
  - Statistical projections for various beam energies (?)
  - Others? Any suggestions welcome!