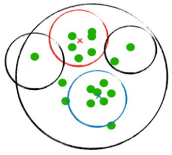
Exploiting jet topological differences in *pp* and Au+Au collisions at $\sqrt{s_{\mathrm{NN}}} = 200$ GeV at RHIC

Raghav Kunnawalkam Elayavalli (raghav.ke@yale.edu),Yale/BNL, *for the STAR Collaboration*

Jets are multi-scale objects, and their characteristic evolution in each scale translates to a varied bounty of jet topologies. In this poster, we present novel measurements of the jet shower in *pp* and Au+Au collisions at STAR and discuss their connection to parton evolution. Formation times measurements in *pp* collisions point to onset of non-perturbative behavior. Measurements of subjet opening angles and formation times are presented for specially selected di-jet events in Au+Au collisions leading towards a first ever space-time study of jet quenching phenomena.

Jet formation time in *pp* collisions

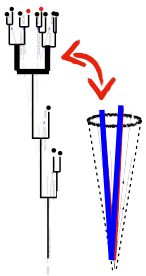
- **SoftDrop selected splits** correspond to mostly early splittings as compared to formation time defined using the **two leading charged particles** which are necessarily hadronized remants of the parton shower.
- **Resolved splittings** (where the leading and subleading charged particles are resolved in the C/A cluster tree) has similar shape as **charged particle formation time** at large values highlighting enhanced impact of non-perturbative QCD corrections at later formation times in the jet clustering tree.
- **Subjet formation time** has similar shape to the **resolved splits** with a large dynamic range (0.5 fm/c – 10 fm/c)

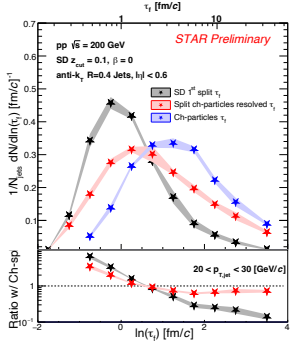


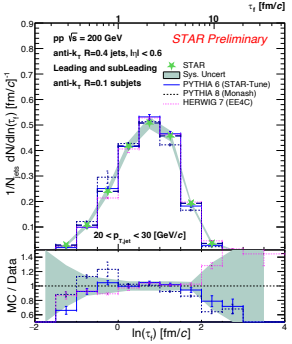
$$z = \frac{p_{\mathrm{T},2}}{p_{\mathrm{T},1} + p_{\mathrm{T},2}}$$

$$\theta = \Delta R\,(1,2); E = E_1 + E_2$$

$$\tau_f = \frac{1}{z \cdot (1-z) \cdot \theta^2 \cdot E}$$

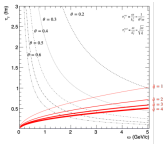




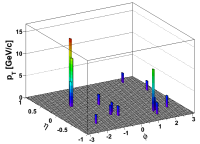


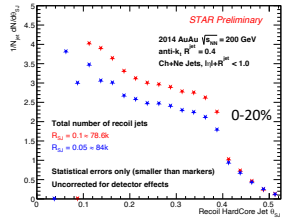
Subjet opening angle and formation time in Au+Au collisions

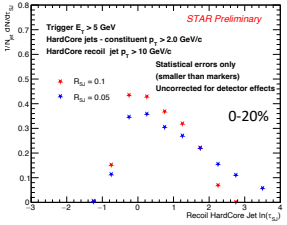
- Au+Au collision dataset from in 2014 provides large statistics to scan across various opening angles and formation times.
- Recoil jet's subjet opening angle and formation time for $R = 0.1$and $R = 0.05$ subjets with constituent $p_T > 2.0$ GeV/c
- Ongoing analysis to study jet quenching observables for jets of different topologies.



- HardCore di-jet selection ensures no combinatorial jets.







- Various opening angle and formation time selections with high statistics

Conclusions

- Comparison of the different splits highlights the transition from pQCD to npQCD.
- Resolved splits show similar shape as the charged particle split at large values occurring in the predominantly non-perturbative region.
- Scan across emission phase-space leads to first ever space-time tomography of the QGP – selections can be varied with different opening angles and formation times.

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The STAR Collaboration
https://drupal.star.bnl.gov/STAR/presentations