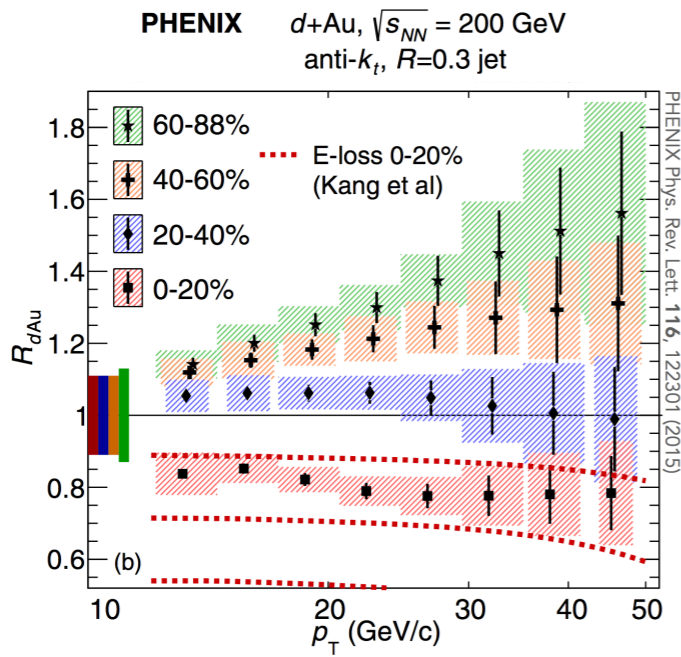


Veronica Verkest (veronica.verkest@wayne.edu), Wayne State University, for the STAR Collaboration

Abstract: We present STAR measurements of long-range correlations between jets and underlying event (UE) in $\sqrt{s_{NN}} = 200$ GeV p+Au collisions at STAR, which will inform open questions regarding jets and hard scatterings. We also investigate the event activity (EA) dependence of high- p_T hadron and jet properties—including fully corrected ungroomed and SoftDrop groomed jet substructure observables—to study the impact of initial and final state effects.

Introduction

- Jet quenching is commonly used to probe for existence and properties of the quark-gluon plasma (QGP)
- Yet ATLAS and PHENIX observed significant jet modification in small systems, such as p+A collisions, which were thought too small a system for QGP formation
- How does the hard scattering in an event affect soft particle production, specifically event activity (EA) and underlying event (UE) at mid-rapidity?

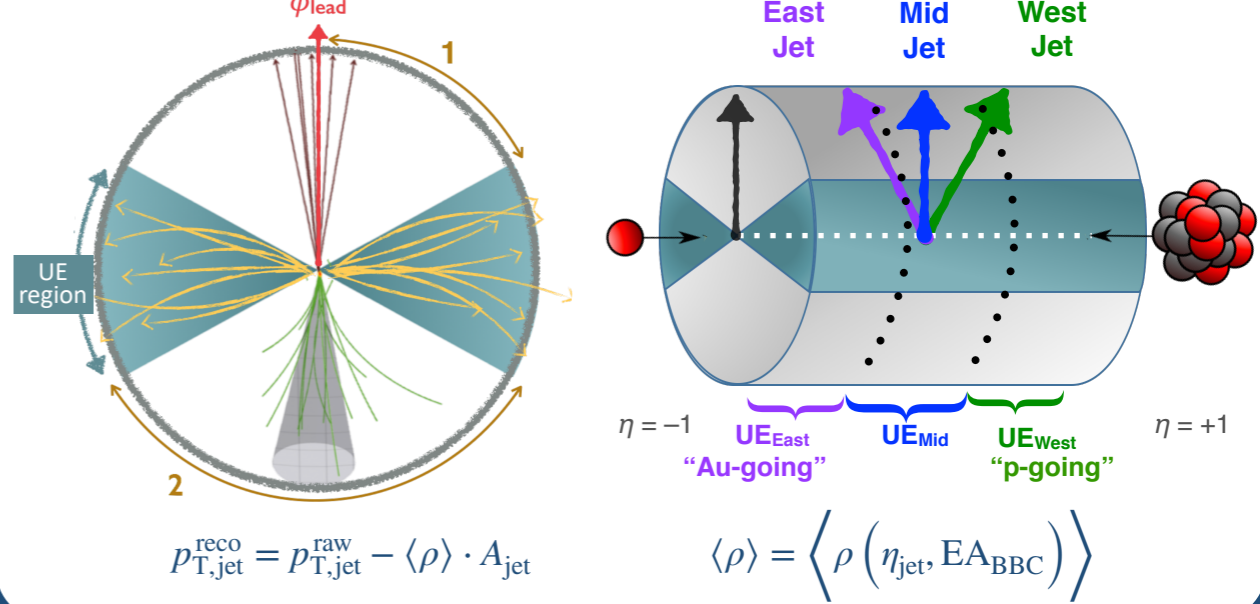


Jet Suppression in ATLAS: Phys. Let. B. 748 <https://doi.org/10.1016/j.physletb.2015.07.023>

Jets and UE measurement method

Charged tracks ($0.2 \leq p_T \leq 30.0$ GeV/c)
Neutral towers ($0.2 \leq E_T \leq 30.0$ GeV)

- $R = 0.4$ anti- k_T jets
- Trigger: BEMC tower with $E_T > 5.4$ GeV
 - Must be within the leading jet radius or the leading jet must be in the trigger recoil region: $|\phi_{lead} - \phi_{trig}| < R$ or $|\phi_{lead} - \phi_{trig}| > \pi - R$
- Jet requirements: $|\eta_{lead}| < 1 - R$ and $10 < p_{T,lead}^{reco} \leq 30$ GeV/c
- UE is defined by charged particle production in $1 < |\phi_{lead} - \phi_{UE}| < \pi - 1$



Experiment and event activity

Barrel Electromagnetic Calorimeter (BEMC)

- $0.2 \leq E_T \leq 30.0$ GeV
- $\gamma, \pi^0, e^+, \dots$ $|\eta| < 1$,
- $0 < \phi < 2\pi$

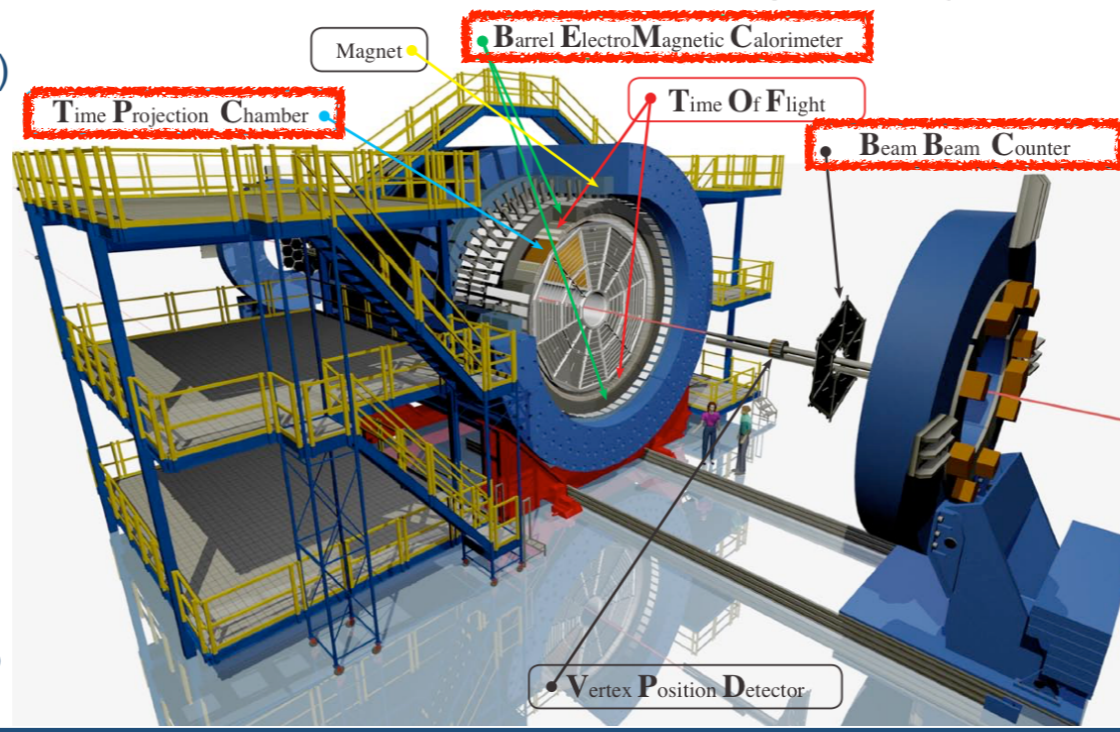
Time Projection Chamber (TPC)

- Charged tracks, $|\eta| < 1$
- $0.2 \leq p_T \leq 30.0$ GeV/c
- $0 < \phi < 2\pi$

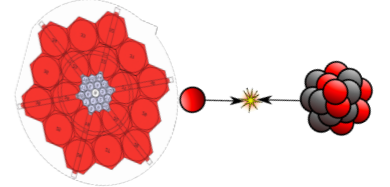
Beam Beam Counter (BBC)

- Scintillator detector
- East inner BBC: $-5.2 < \eta < -3.3$

Solenoidal Tracker At RHIC: $-1 < \eta < 1, 0 < \phi < 2\pi$

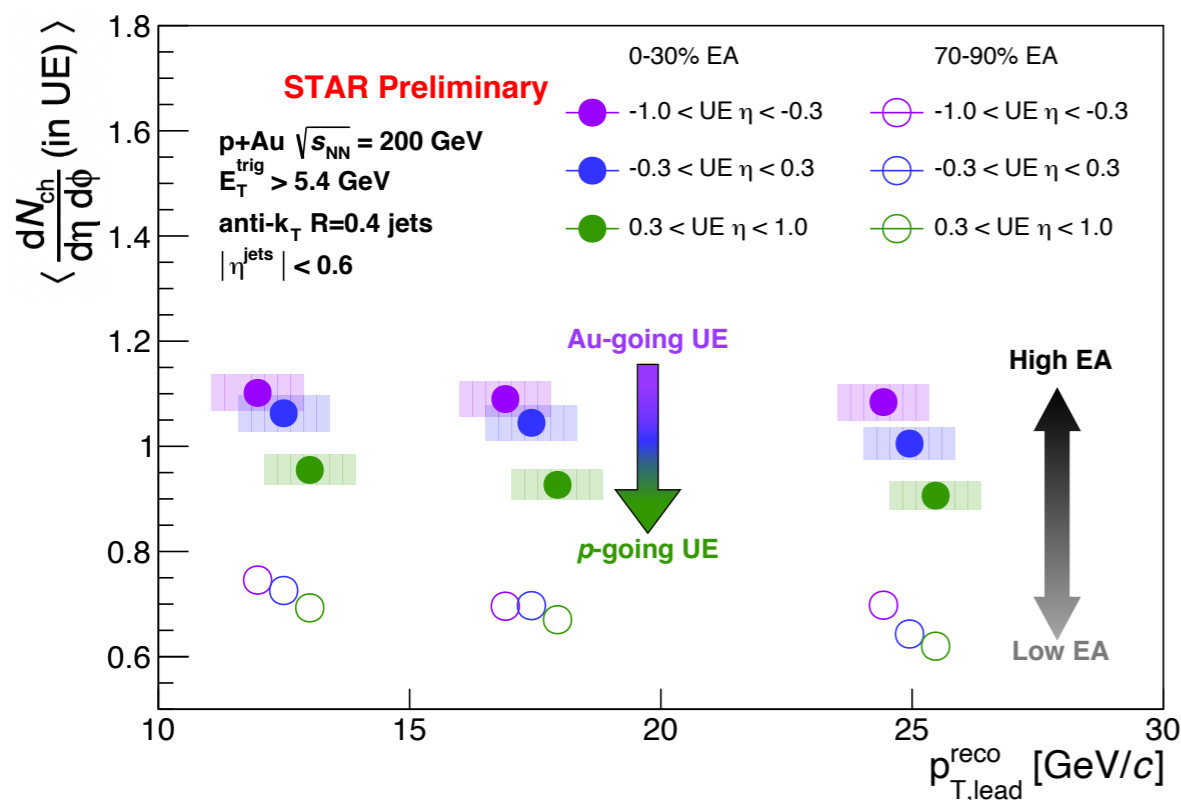


- Event activity (EA) is defined by the distribution of the inner BBC signal sum in the Au-going direction ($-5.2 < \eta < -3.3$)
- Event activity can be related to impact parameter, and therefore is used for classifying the centrality
 - Low EA: 70-90%
 - High EA: 0-30%



Jet and UE correlation

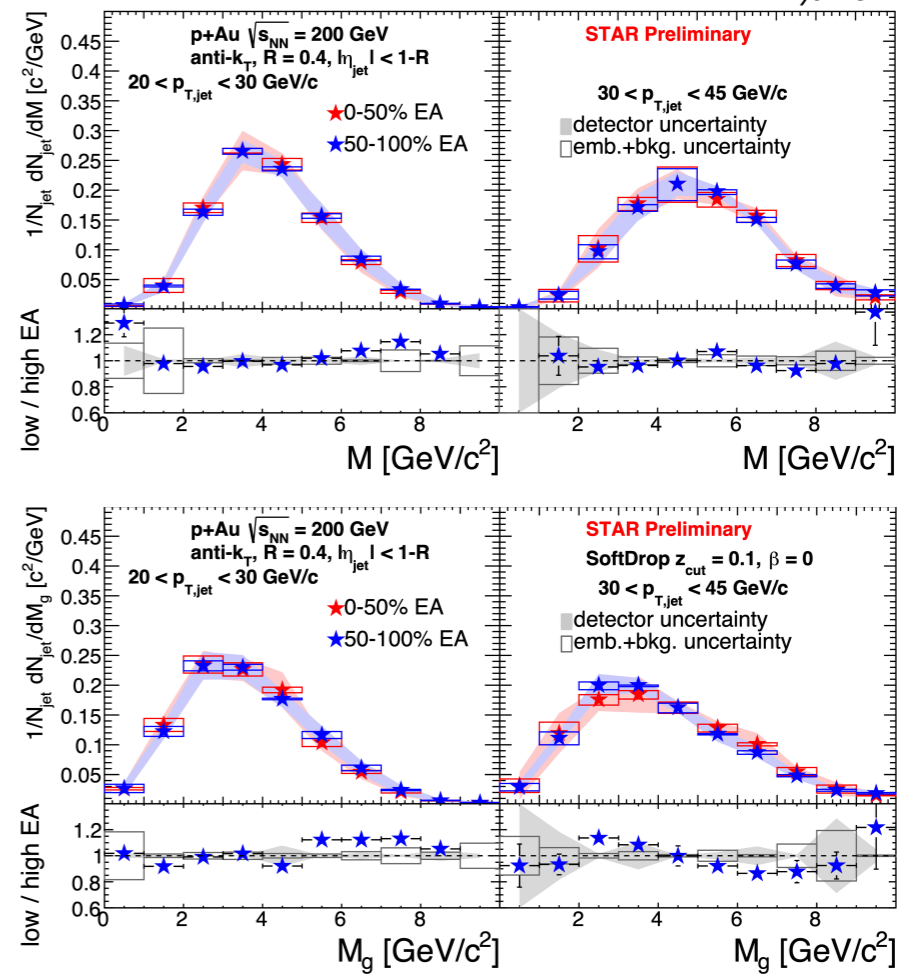
- UE charged particle multiplicity is higher in events with a larger EA as measured by the Au-going BBC ($-5.2 < \eta < -3.3$)
- UE is larger in the Au-going direction, and does not have a significant dependence on leading jet p_T



Jet mass as a function of EA

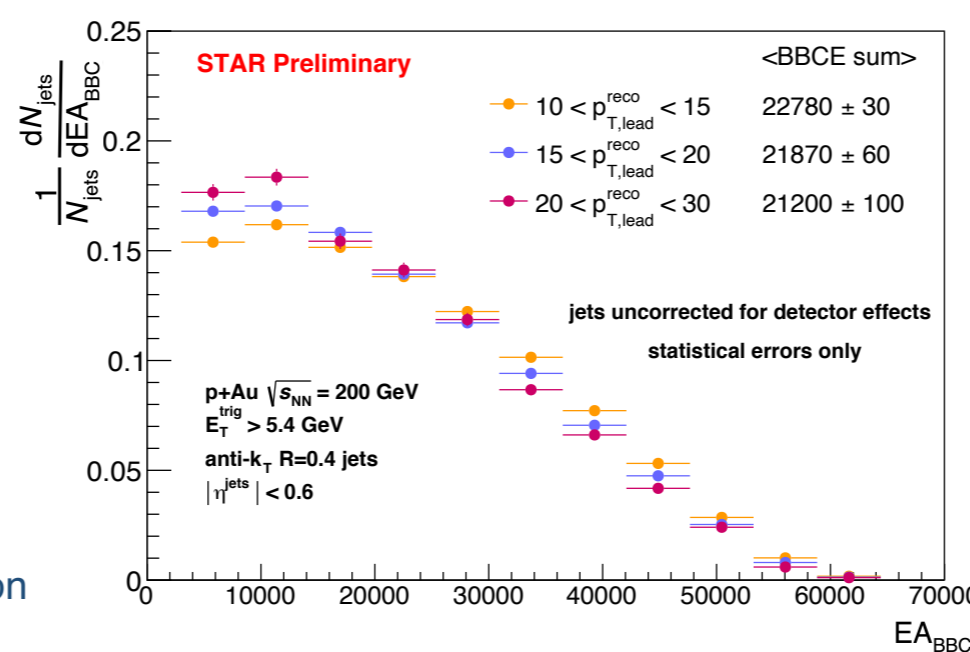
$$M = \sqrt{E^2 - p^2}$$

- No significant change of the jet mass with EA
 - No signs of medium-induced modification to jet mass
- Consistent with QCD predictions and jet mass measured in p+p



Activity-dependent jet yields

- Anti-correlation between EA_{BBC} and leading jet p_T
 - Events binned by higher (lower) jet p_T have a lower (higher) average EA_{BBC} , naively classified as more peripheral (central)
- Yield of semi-inclusive high- p_T jets per charged hadron trigger is suppressed in high EA_{TPC} events relative to low EA_{TPC} events, where EA_{TPC} is the charged UE p_T density at mid-rapidity ($|\eta| < 1$)
 - Similarly for EA_{BBC} (not shown)
- The suppression is comparable for jets on the trigger and recoil side



Conclusion

- EA correlated with UE multiplicity and anti-correlated with high- Q^2 jets despite large separation in rapidity
 - Dependence of soft particle production (EA and UE) on the initial hard jet scattering
- Semi-inclusive jet spectra suppressed at both high EA_{BBC} and high EA_{TPC}
- Jet mass and groomed jet mass independent of EA—no signs of medium-induced jet mass modification
 - Indicates EA vs. Q^2 correlations from early time effects, not jet quenching
- Jet quenching disfavored by STAR jet measurements in p+Au collisions