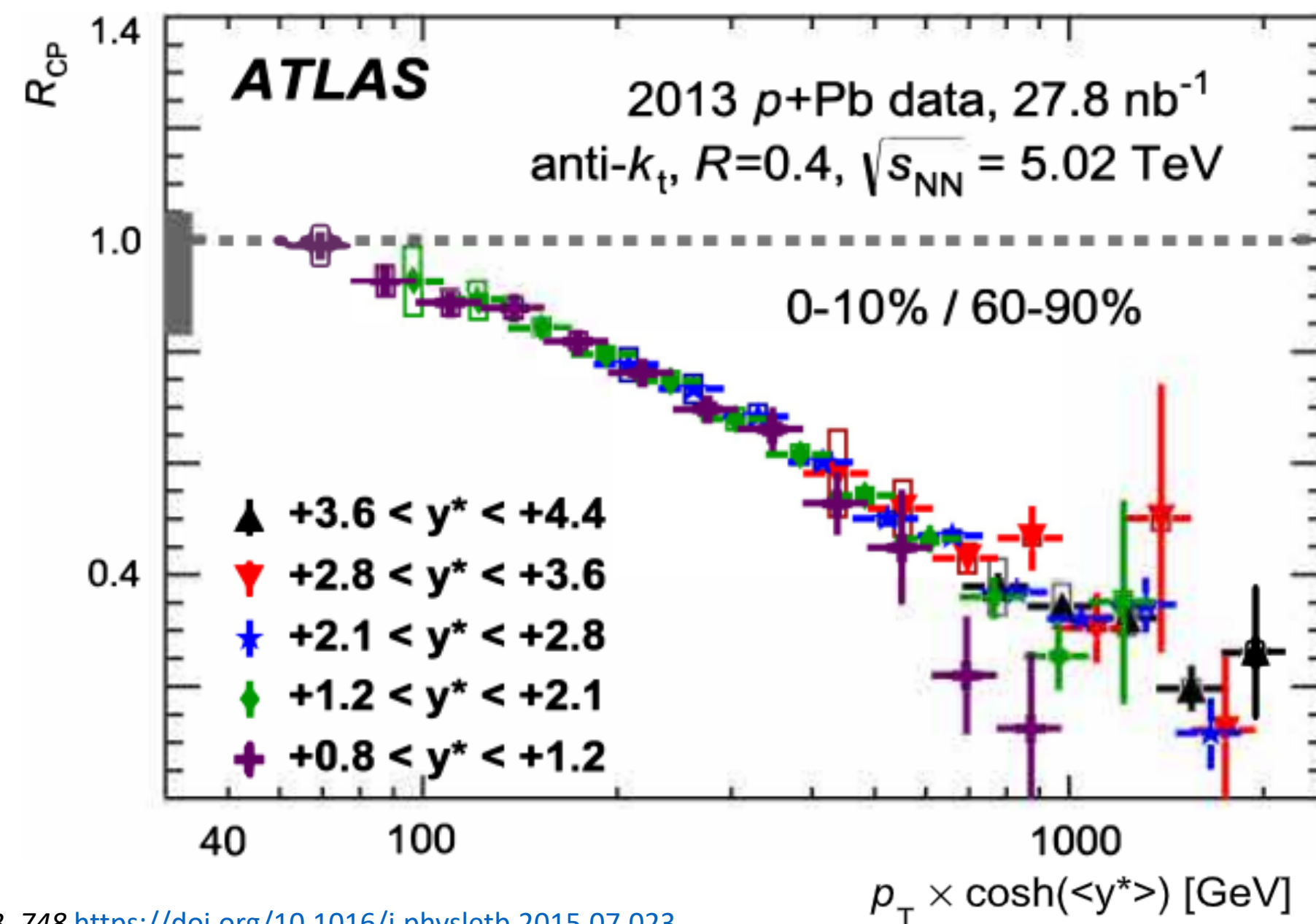


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## Introduction

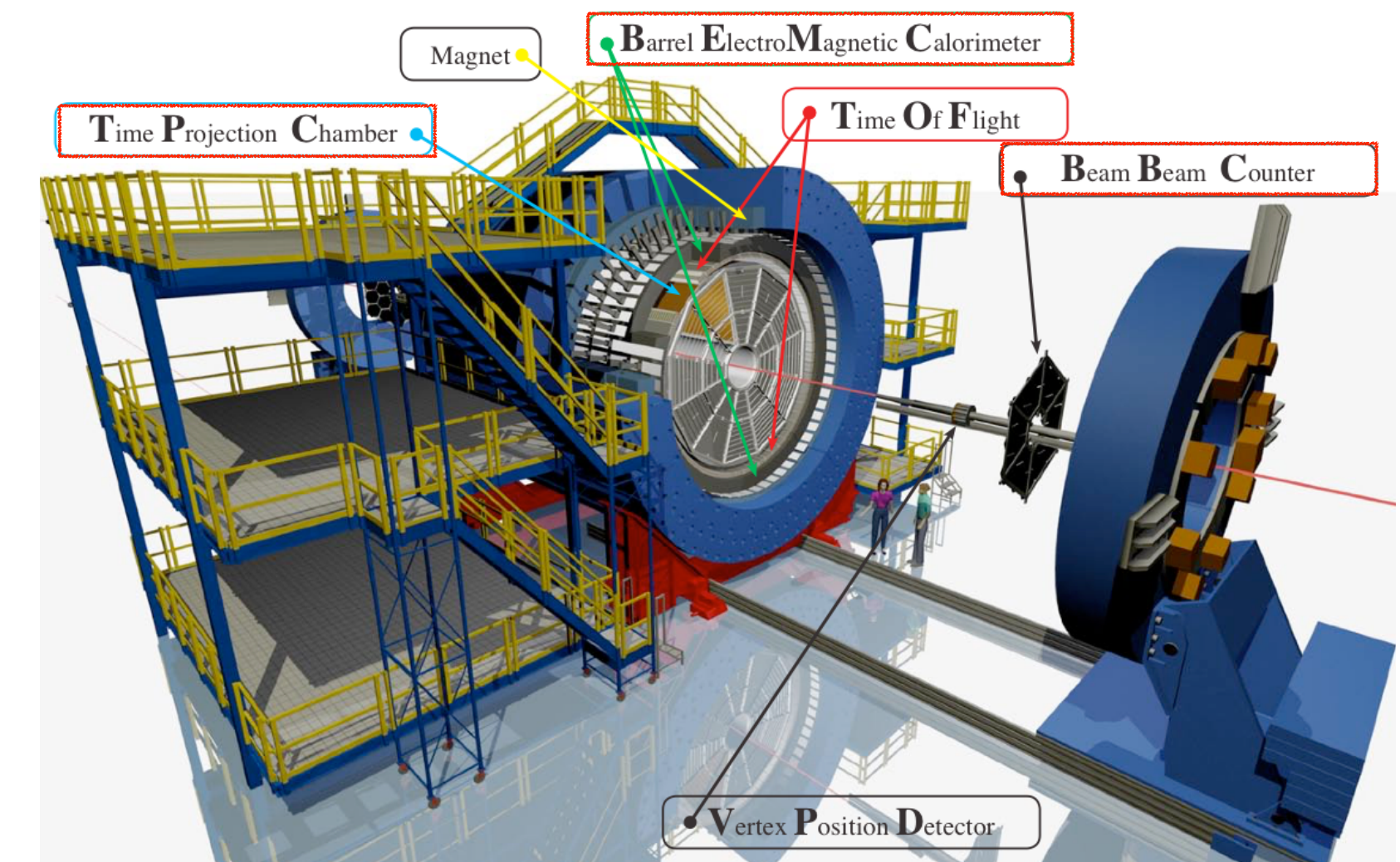
- Unexpected modification of jet yields as a function of centrality in proton-ion collisions at the LHC and RHIC suggests hot or cold nuclear matter effects
- How does the hard scattering in an event affect event activity (EA) and underlying event (UE) at mid-rapidity?



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## Experiment

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



Barrel Electromagnetic Calorimeter (BEMC)

- $\gamma, \pi^0, e^\pm, \dots$   $|\eta| < 1, 0 < \phi < 2\pi$

Time Projection Chamber (TPC)

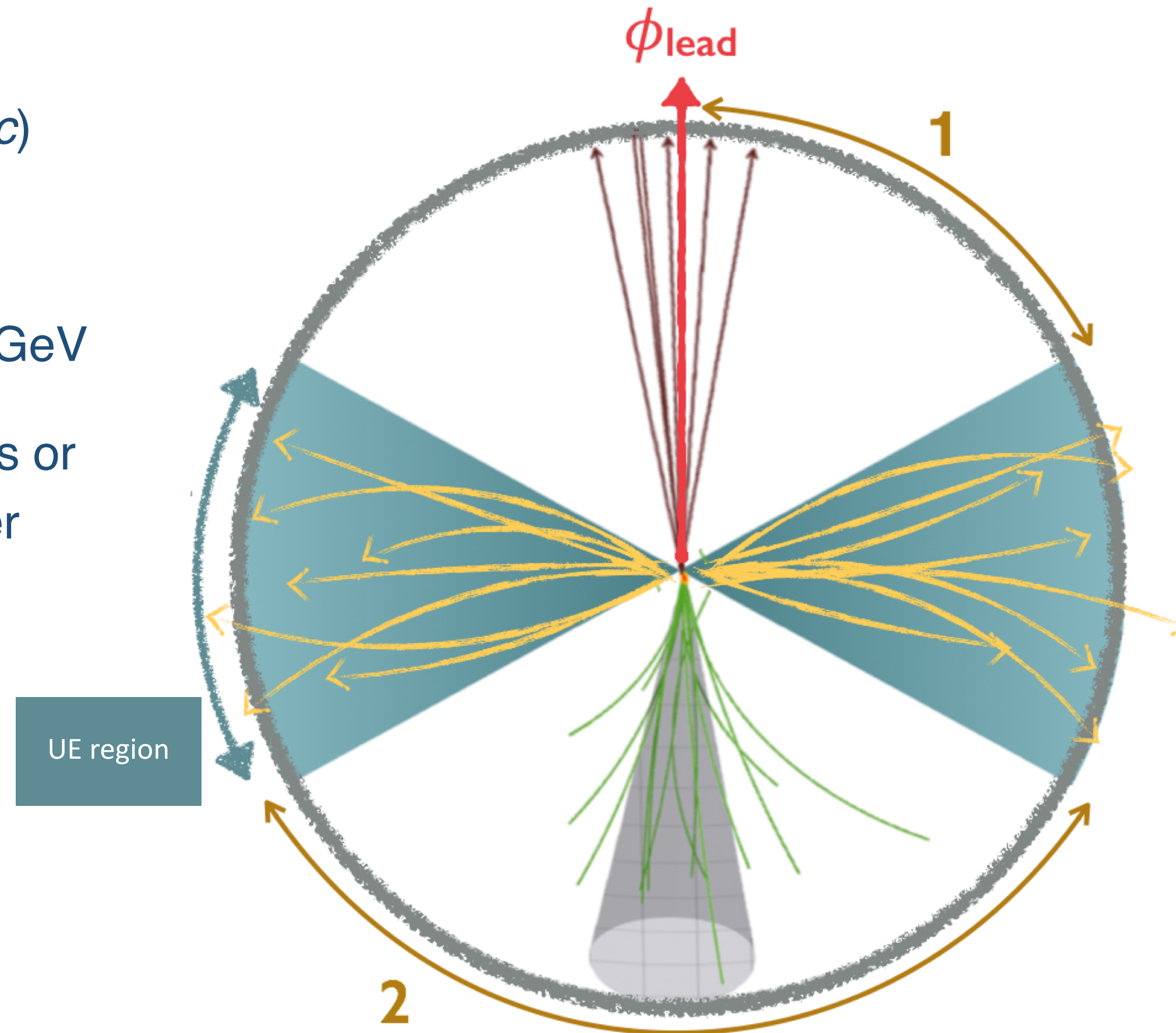
- Charged tracks,  $|\eta| < 1, 0 < \phi < 2\pi$

Beam Beam Counter (BBC)

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

## Jets and underlying event

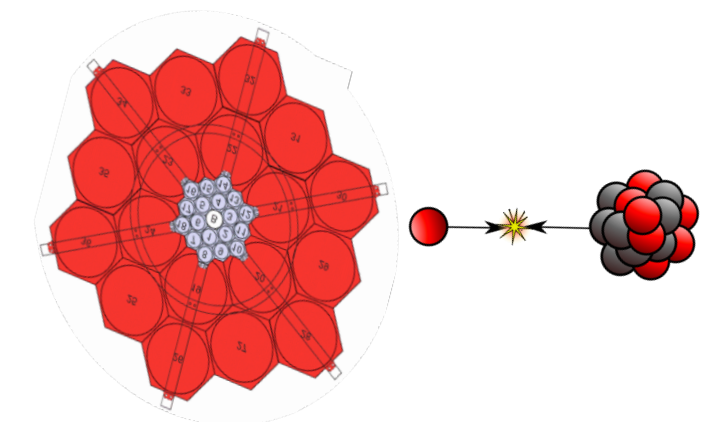
- $R=0.4$  anti- $k_T$  jets
- Charged tracks ( $0.2 \leq p_T \leq 30.0$  GeV/c)
- Neutral towers ( $0.2 \leq E_T \leq 30.0$  GeV)
- Trigger: BEMC tower hit with  $E_T > 5.4$  GeV
  - Must be within the leading jet radius or the leading jet must be in the trigger recoil region:  $\left| \phi_{\text{lead}} - \phi_{\text{trig}} \right| < R$  or  $\left| \phi_{\text{lead}} - \phi_{\text{trig}} \right| > \pi - R$
- Events require  $\left| \eta_{\text{lead}} \right| < 1 - R$  and  $10 < p_{T,\text{lead}}^{\text{reco}} \leq 30$  GeV/c
- UE is defined by charged particle production in  $1 < \left| \phi_{\text{lead}} - \phi_{\text{UE}} \right| < \pi - 1$



## Event activity

- Event activity (EA) is defined by the distribution of the inner BBC signal sum in the Au-going direction ( $-5.2 < \eta < -3.3$ ) in minimum-bias events

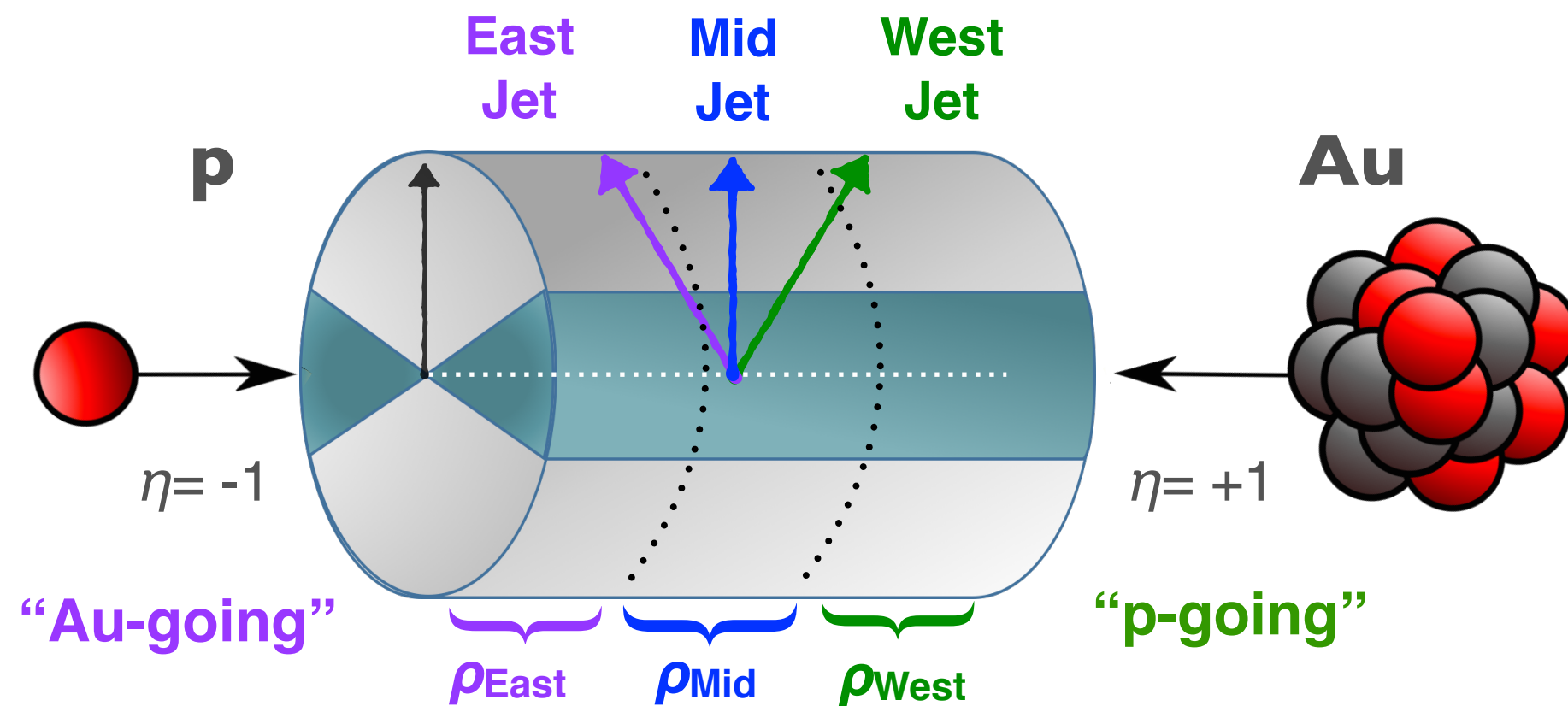
- Low EA: 70-90%
- High EA: 0-30%



- Event activity can be related to impact parameter, and therefore is used as a proxy for centrality

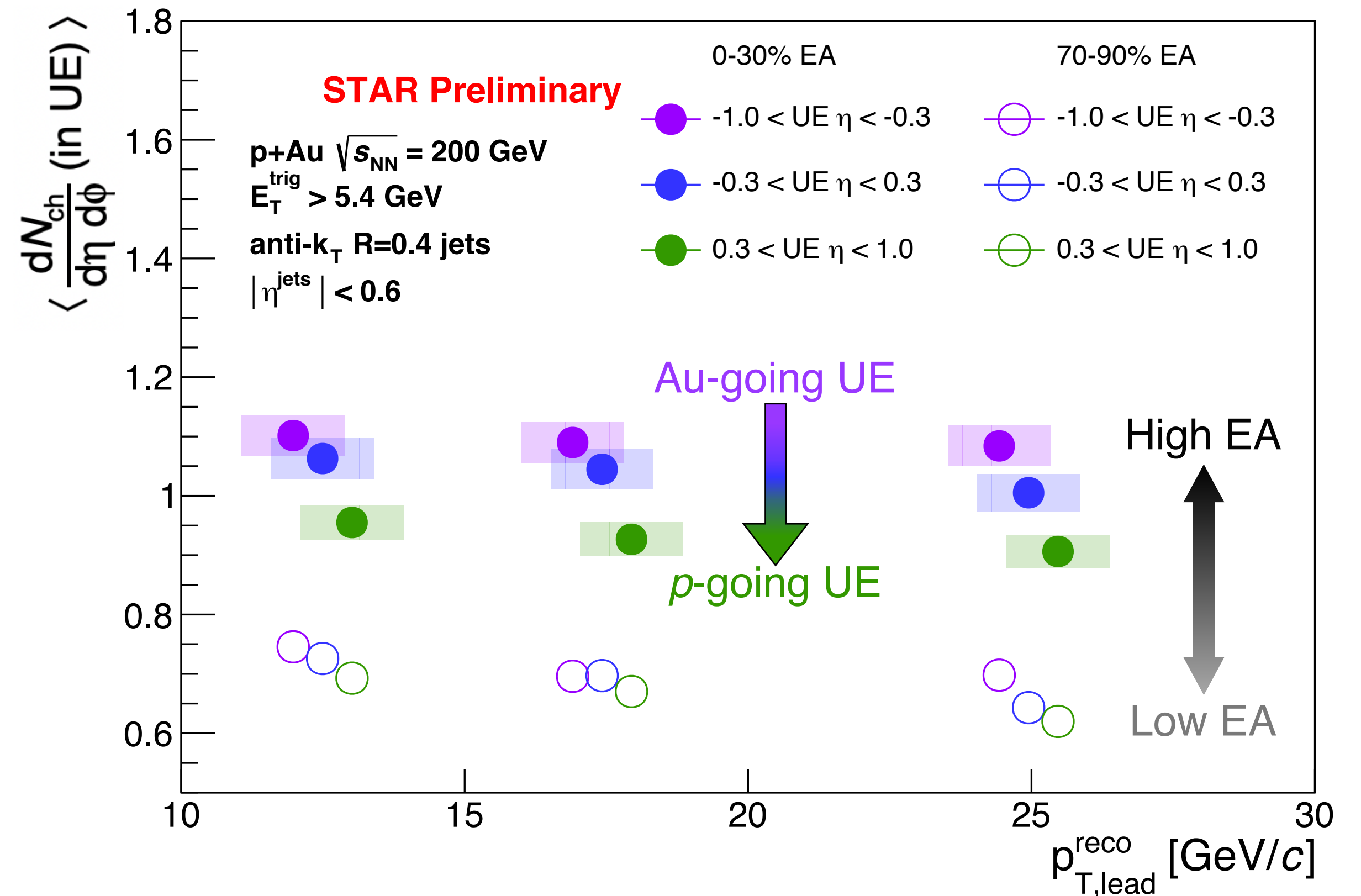
## Event activity correlations

- Mean  $p_T$  of UE particles (not shown) is independent of jet and EA observables
- 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  $p_T$



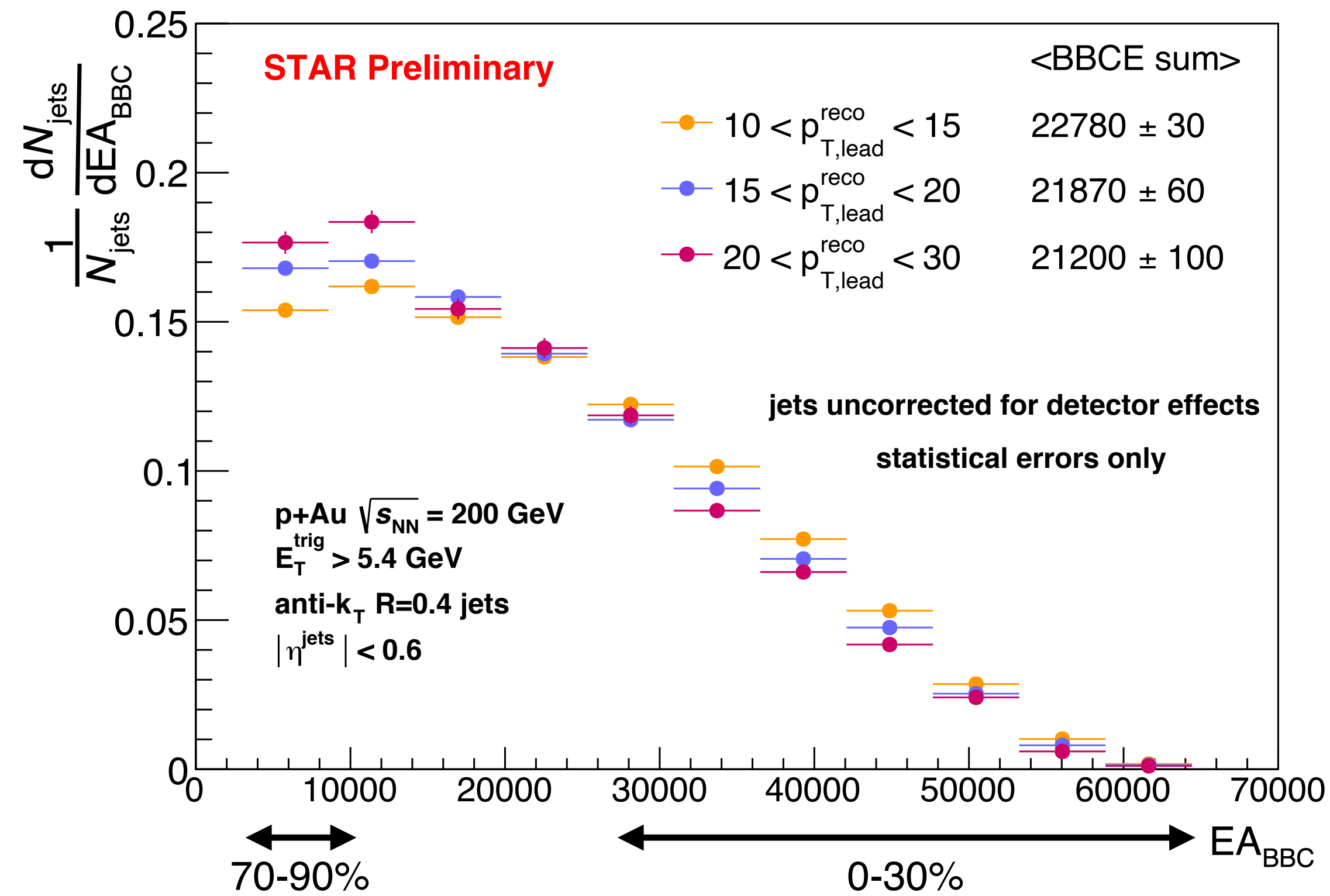
$$p_{T,\text{jet}}^{\text{reco}} = p_{T,\text{jet}}^{\text{raw}} - \langle \rho \rangle \cdot A_{\text{jet}}$$

$$\langle \rho \rangle = \left\langle \rho \left( \eta_{\text{jet}}, \text{EA}_{\text{BBC}} \right) \right\rangle$$

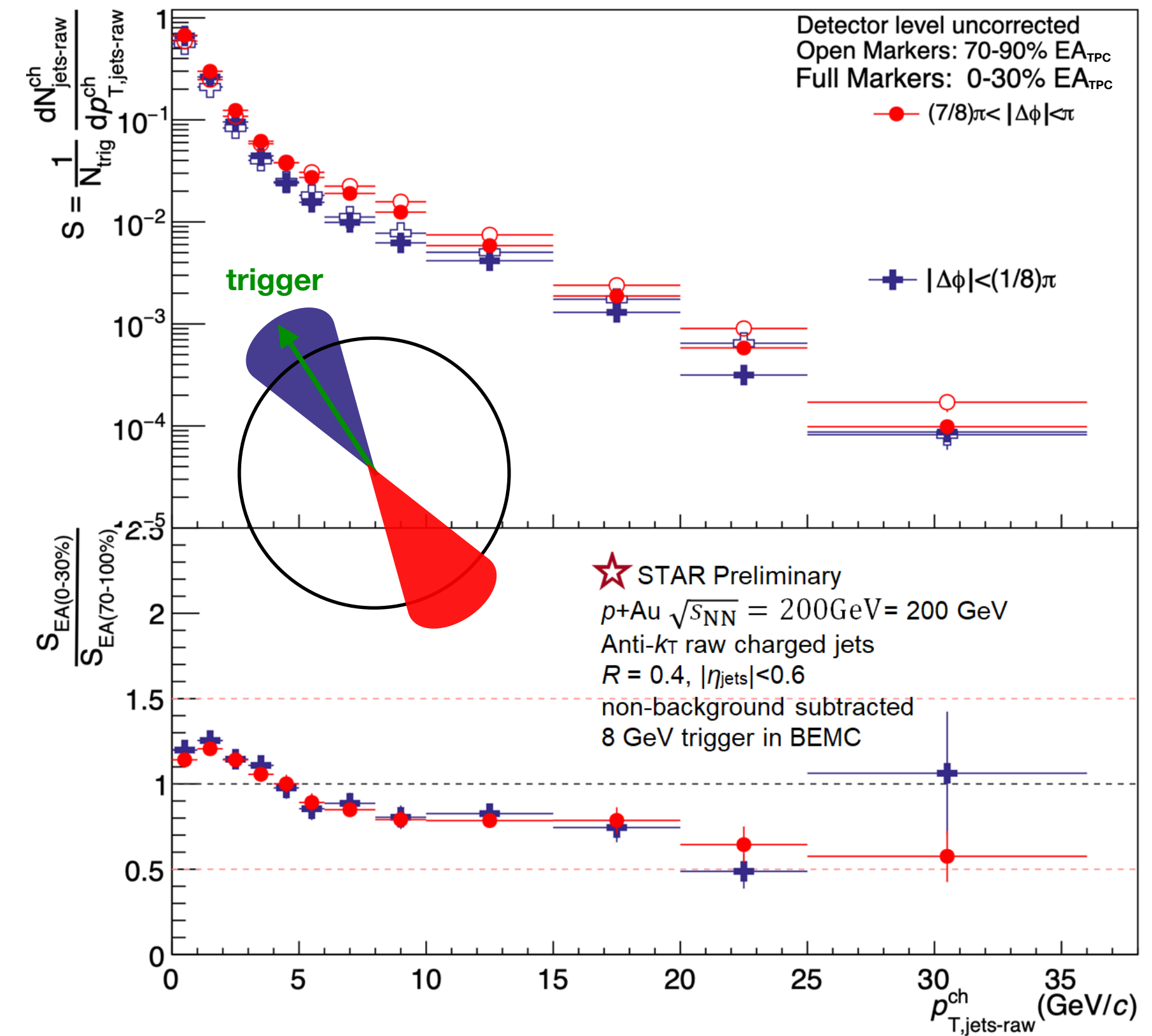


## Activity-dependent jet yields

- The distribution of  $EA_{BBC}$  is inversely correlated to leading jet  $p_T$ 
  - Events binned by higher (lower) jet  $p_T$  have a lower (higher) average  $EA_{BBC}$ , naively classifying these as more peripheral (central)



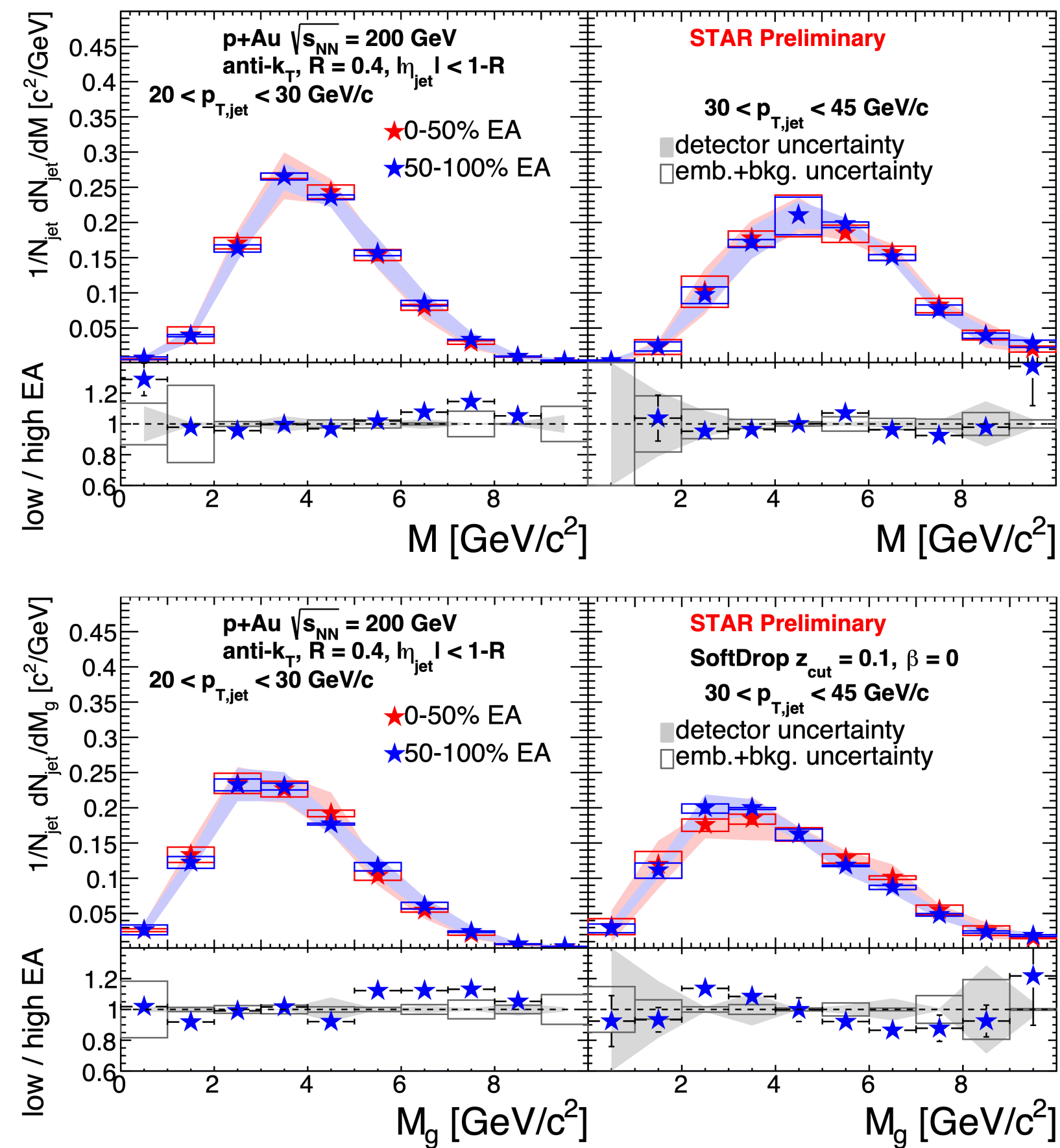
- Yield of high- $p_T$  jets per trigger is suppressed in high  $EA_{TPC}$  events relative to low  $EA_{TPC}$  events, where  $EA_{TPC}$  is the charged UE  $p_T$  density at mid-rapidity ( $|\eta| < 1$ )
- The suppression is comparable for jets on the trigger and recoil side



## Jet mass as a function of EA

- No significant change of the jet mass with EA—especially at lower jet  $p_T$  bins
- Consistent with QCD predictions and STAR  $pp$  data

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## Conclusion

- EA correlated with high- $Q^2$  jets and UE despite large separation in rapidity
  - Dependence of soft particle production on the initial hard scattering
- Semi-inclusive jet spectra suppressed at both high- $EA_{\text{BBC}}$  and high- $EA_{\text{TPC}}$
- Jet mass and groomed jet mass independent of EA
  - Indicates EA vs.  $Q^2$  correlations from early time effects, **not** jet quenching
- Jet quenching in  $p$ +Au collisions is disfavored —no sign of final state hot nuclear matter effects