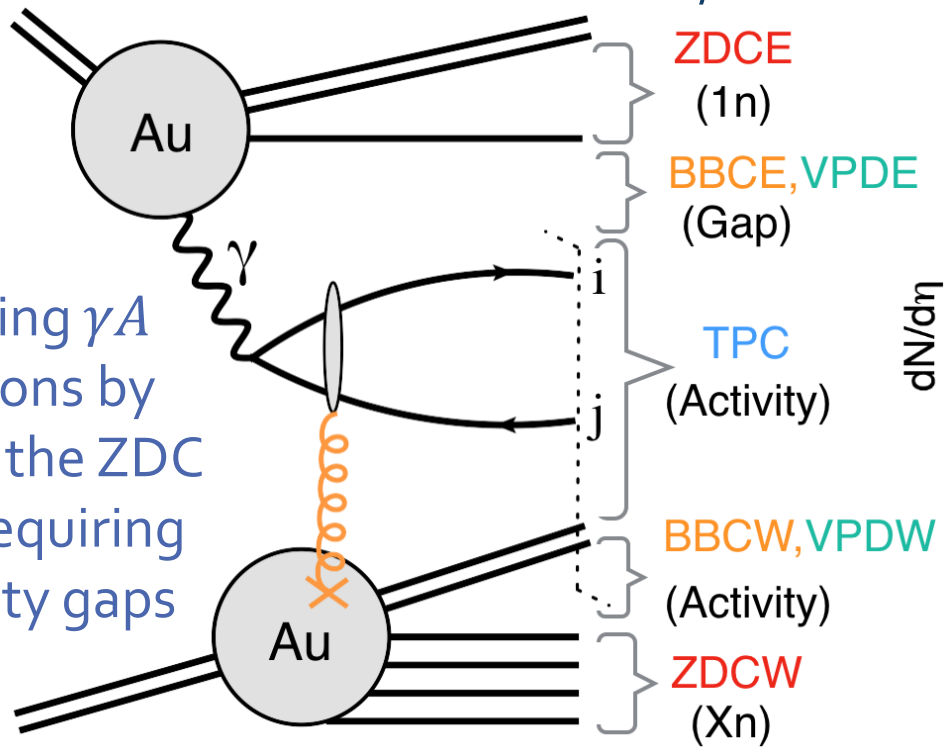
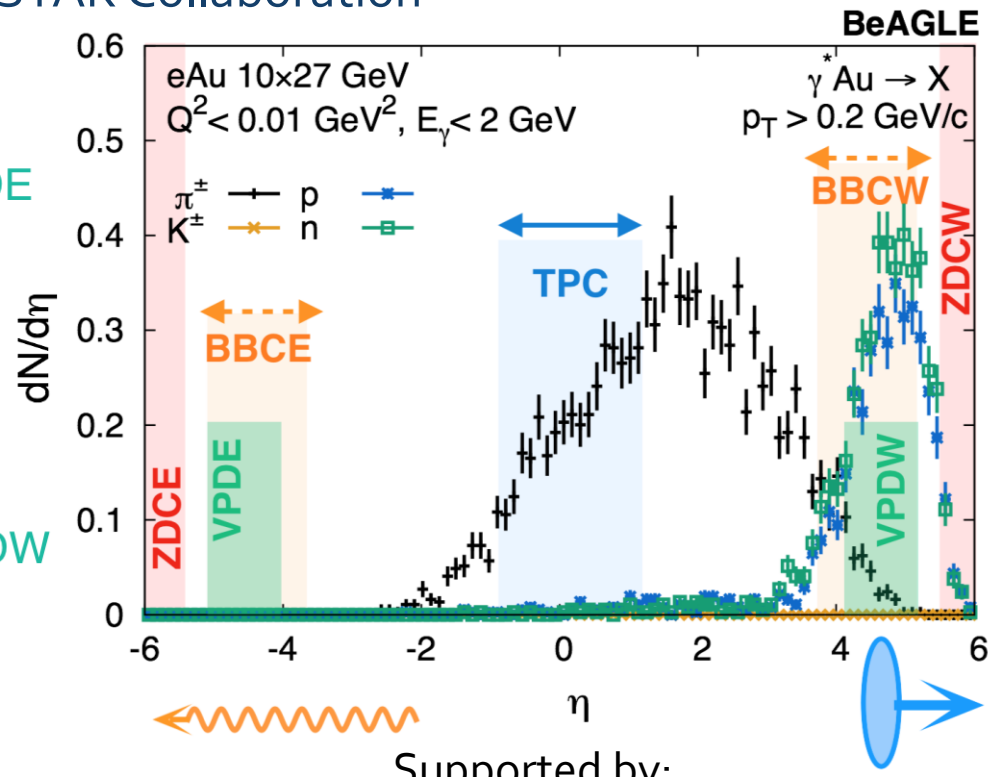
# IDENTIFIED HADRON SPECTRA AND BARYON STOPPING IN $\gamma + Au$ COLLISIONS AT STAR

Nicole Lewis, for the STAR Collaboration

Isolating $\gamma A$ collisions by using the ZDC and requiring rapidity gaps

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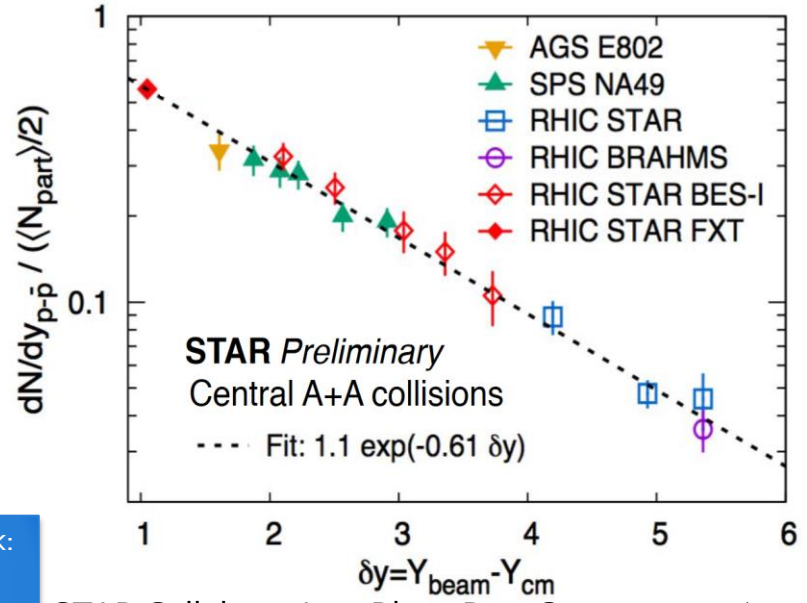
# Motivations

## Baryon Stopping

Energy needed to produce particles in heavy-ion collisions comes from kinetic energy lost by baryons in the colliding nuclei

- Larger effect in collisions with higher multiplicity (smaller impact parameter)
- Net-baryon yield can be estimated from the net-proton yield: difference in number of protons and antiprotons
- Cannot be fully explained by pure string fragmentations

See Ben Kimelman's Talk: QCD matter at finite temperature and density | Tuesday 6:10 pm

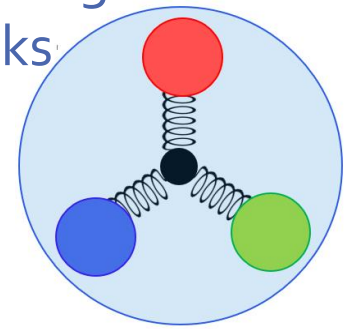



STAR Collaboration, Phys. Rev. C **79**, 034909 (2009)
STAR Collaboration, Phys. Rev. C **96**, 044904 (2017)

## Baryon Junction

Nonperturbative configuration of gluons linked to all three valence quarks

- Carries baryon number
- Theorized to be an effective mechanism of stopping baryons in $pp$ and $AA$

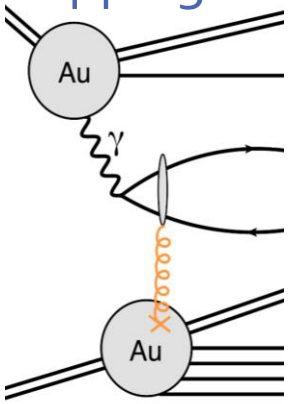


D. Kharzeev, Physics Letters B 378, 238-246 (1996)

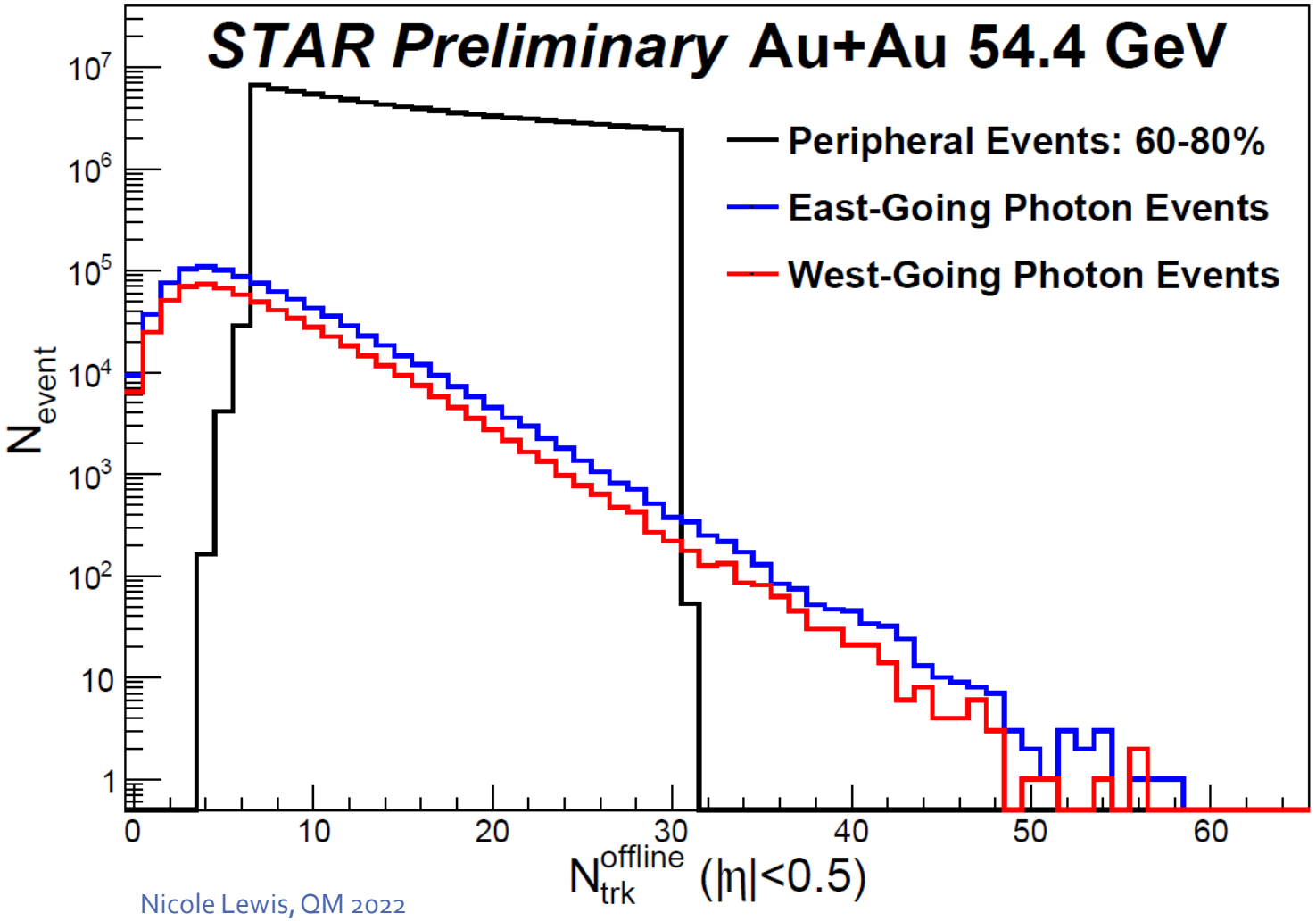
## Photonuclear Events

Can be used to study baryon stopping with the cleanest possible process

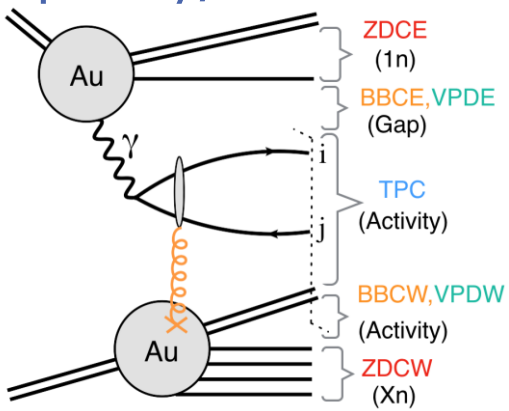
- $q\bar{q}$ + Baryon Junction producing a midrapidity proton
- $q\bar{q}$ pair would not be able to stop baryons if the baryon number was carried by all three valence quarks



# Defining $\gamma A$ and Peripheral $AA$ Event Classes




Most photonuclear events have low multiplicity, concentrated at equivalent $\mathrm{Au} + \mathrm{Au}$ centrality of roughly 80%




Using peripheral events as a baseline comparison, multiplicity consistent with $60 - 80\%$ $\mathrm{Au} + \mathrm{Au}$

# $p_T$ Dependence of Particle Ratios in $\gamma A/AA$

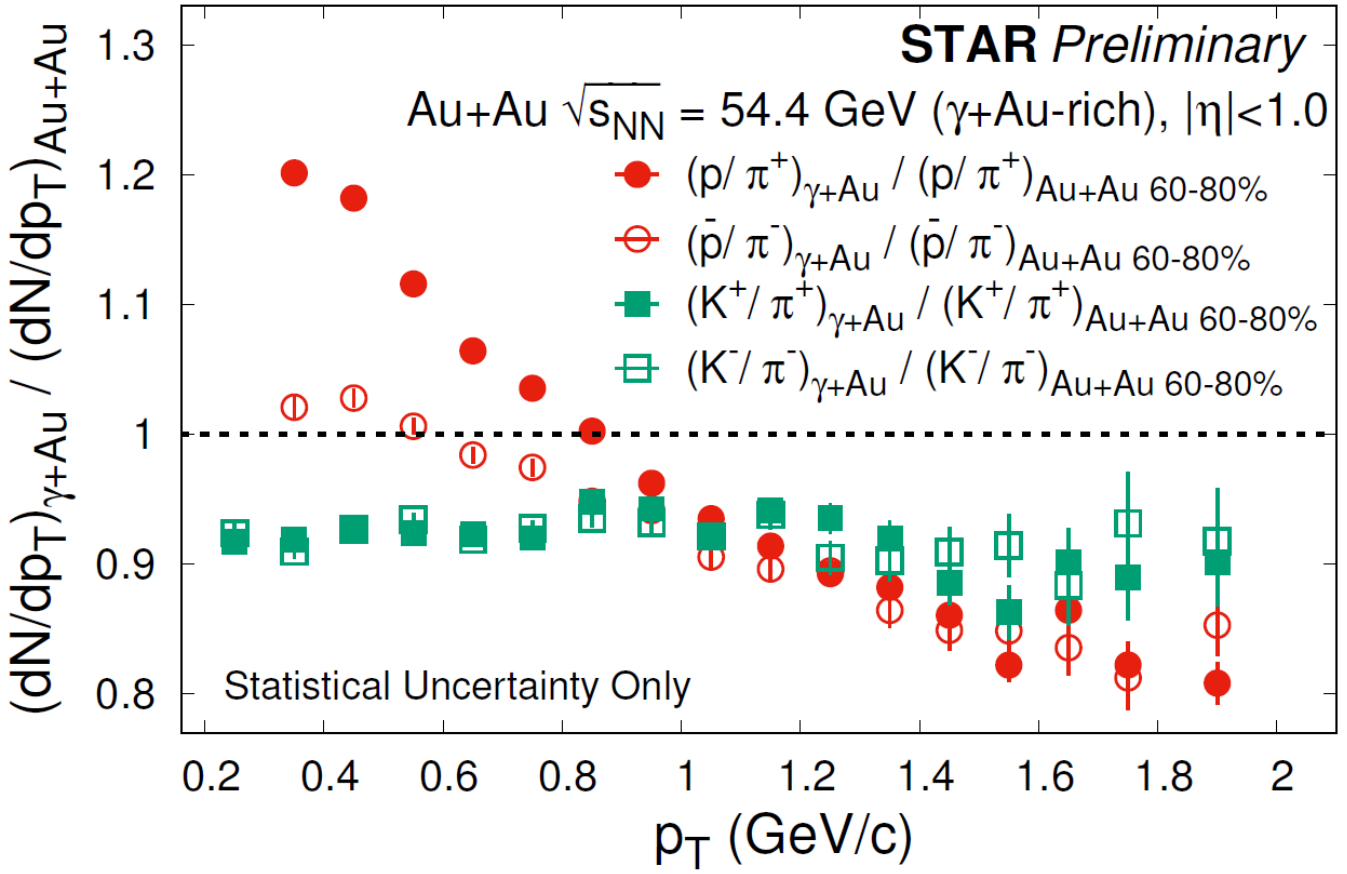
Double ratio

$K/\pi < 1$ and flat with $p_T$
→ less access to strangeness in $\gamma A$ events

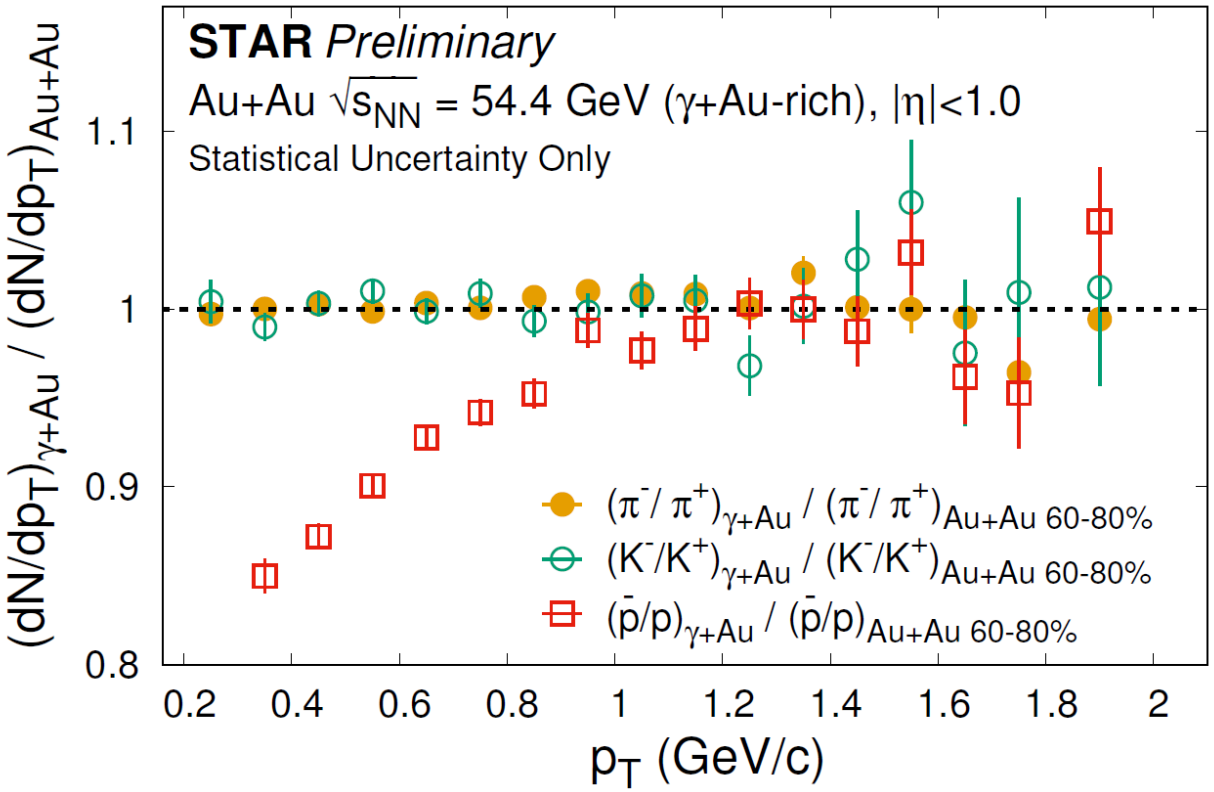
$\bar{p}/\pi$ and $p/\pi$ steeper than $K/\pi$
→ larger radial flow in $60-80\%$ Au + Au

**$\bar{p}/\pi^- < p/\pi^+$ for $p_T \lesssim 1$ GeV/$c$**
**→ soft baryon stopping**

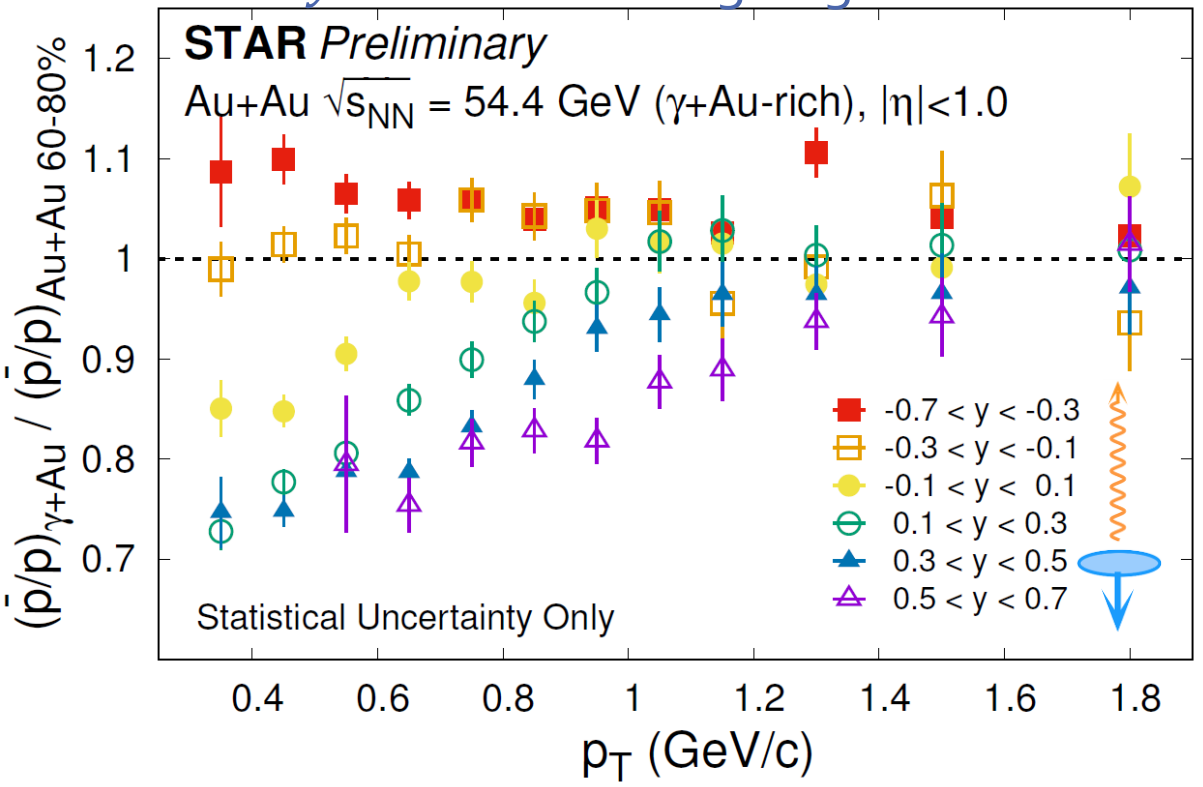
Not corrected for efficiency, but largely canceled in the ratio



# Low $p_T$ Baryon Enhancement in $\gamma A$




$y > 0$ is in the $A$-going direction




Double ratio: $\bar{p}/p < 1$ at lower $p_T$

- Soft baryon stopping that is **stronger** in $\gamma A$ compared to peripheral $AA$
- Ratio is smaller at higher rapidity ($A$-going side)