Exploring cold nuclear matter effects in d+Au with high-p_{T} reconstructed jets at PHENIX

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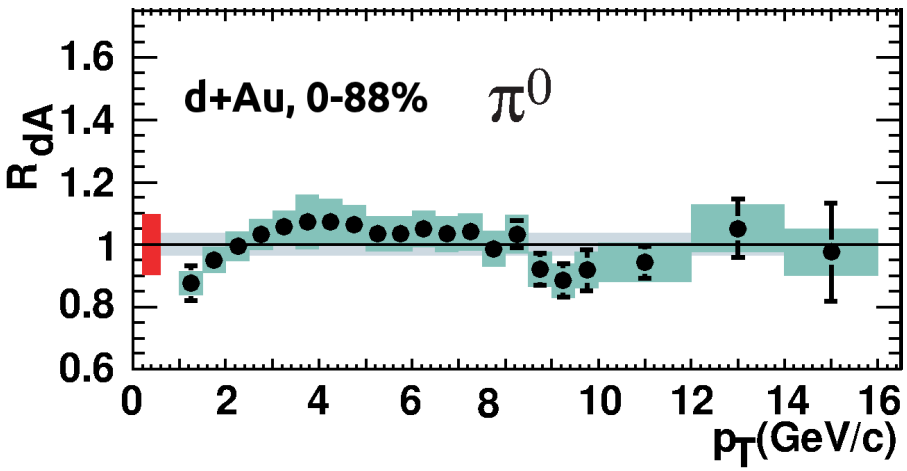
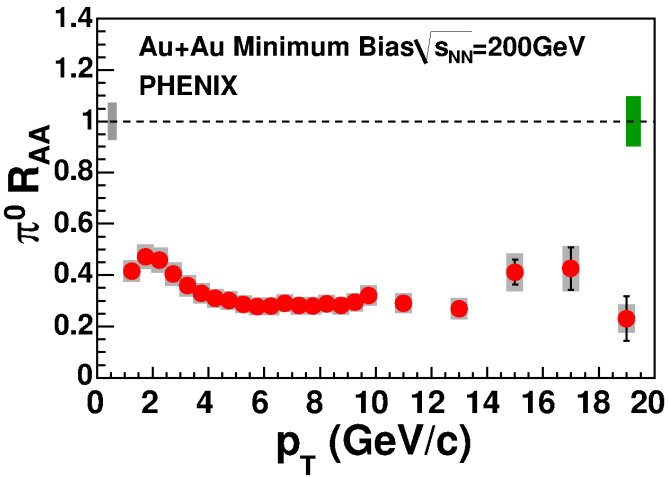
PHENIX

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

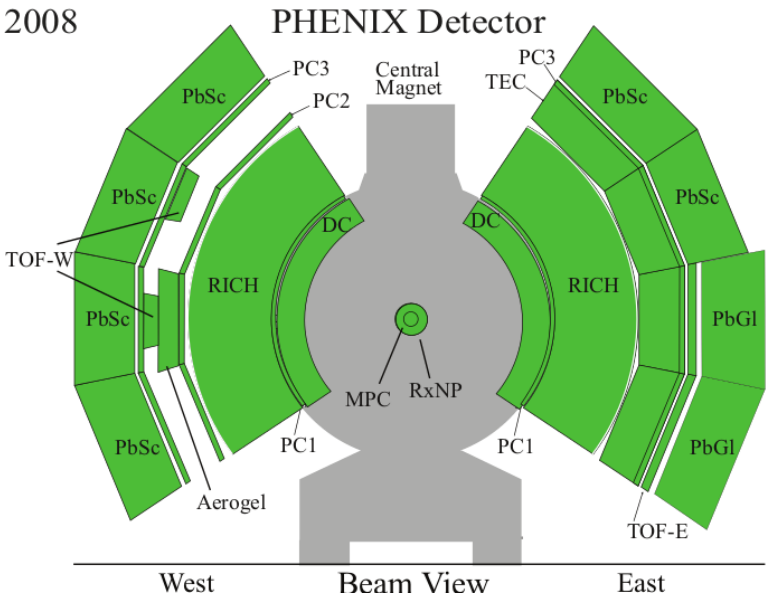
d+Au collisions





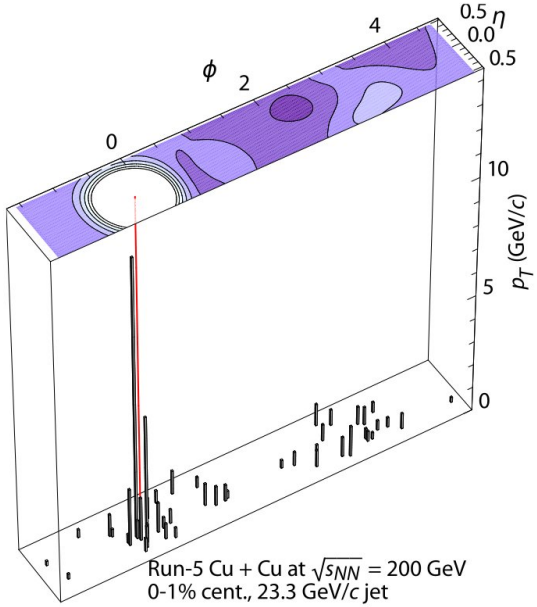
- Baseline for Au+Au collisions:
  - $\Rightarrow$ confirm that suppression is a final state effect
- Probes effects in the cold nucleus:
  - $\Rightarrow$ Cronin enhancement
  - $\Rightarrow$ initial state energy loss
  - $\Rightarrow$ nPDF modification
- At high-x: test pQCD and factorization

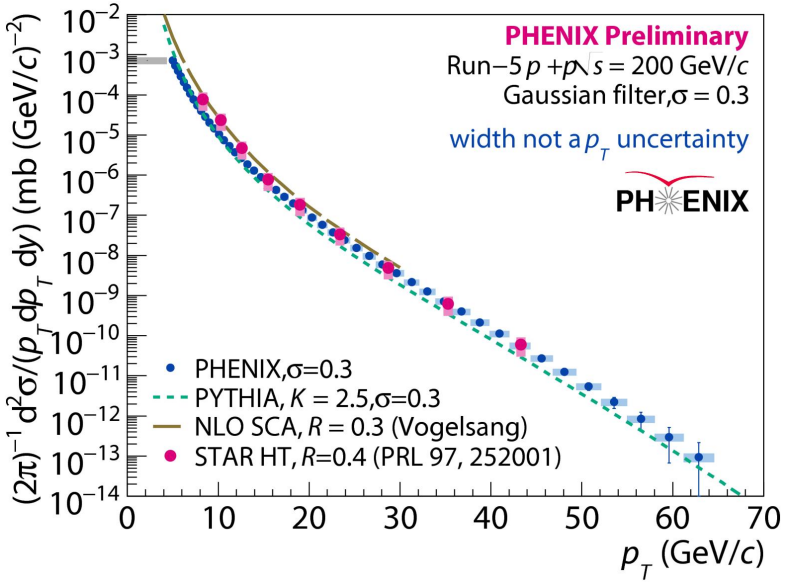
PHENIX detector at RHIC 2008



- Central arm spectrometer, $|\eta| < 0.35$, $\Delta\phi = \pi$
  - $\Rightarrow$ Drift + pad chambers (DC, PC) reconstruct $h^{\pm}, e^{\pm}$
  - $\Rightarrow$ EM calorimeter + RICH reconstruct $\gamma, \pi^0/\eta/etc.$
- RHIC 2008, d+Au, p+p, $\sqrt{s_{\mathrm{NN}}} = 200$ GeV
  - $\Rightarrow$ 30$\times$ improvement in statistics from 2003

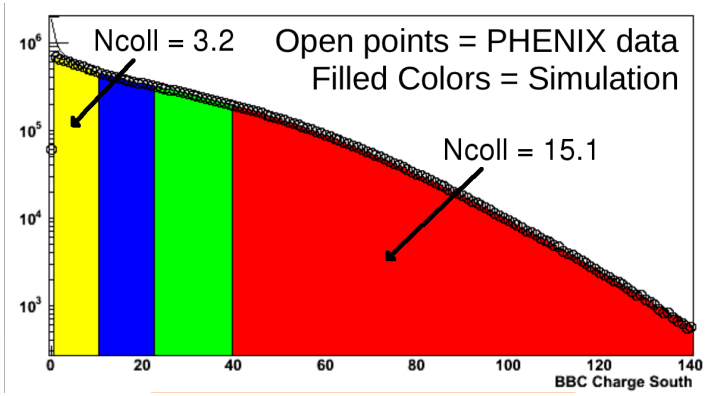
Gaussian filter algorithm





- Reconstruct jets from tracks + clusters
  - $\Rightarrow$ better measure of fragmenting parton p_{T}
  - $\Rightarrow$ greater kinematic reach + statistics than identified hadrons
- Gaussian filter algorithm
  - $\Rightarrow$ developed for use in HI collisions
  - $\Rightarrow$ successfully benchmarked by PHENIX in p+p collisions

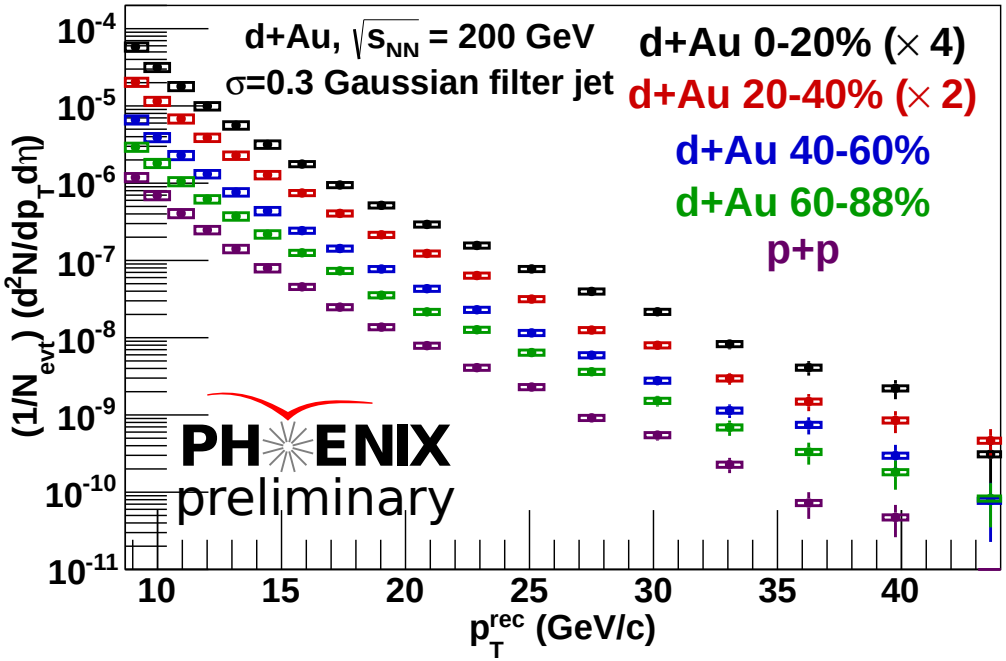
Centrality in d+Au



cent.	$\langle N_{\rm coll} \rangle$	yield corr.
0-20%	15.1 ± 1.0	$-6 \pm 1\%$
20-40%	10.2 ± 0.7	$+0 \pm 1\%$
40-60%	6.6 ± 0.4	$+3 \pm 2\%$
60-88%	3.2 ± 0.2	$+3 \pm 6\%$

- Au-going beam-beam counter (BBC), $3.1 < \eta < 4.9$
  - $\Rightarrow$ signal modeled with Glauber simulation + NBD
  - $\Rightarrow$ sees 88% of the inelastic d+Au cross-section
- Yields corrected for autocorrelation in BBC signal
- $R_{\rm dA} = (1/N_{\rm evt}^{d+Au})(dN^{d+Au}/dp_{\rm T})/\langle T_{\rm AB} \rangle d\sigma^{p+p}/dp_{\rm T}$
  - $\Rightarrow$ $R_{\rm dA} = 1 \Rightarrow$ **geometric scaling expectation**

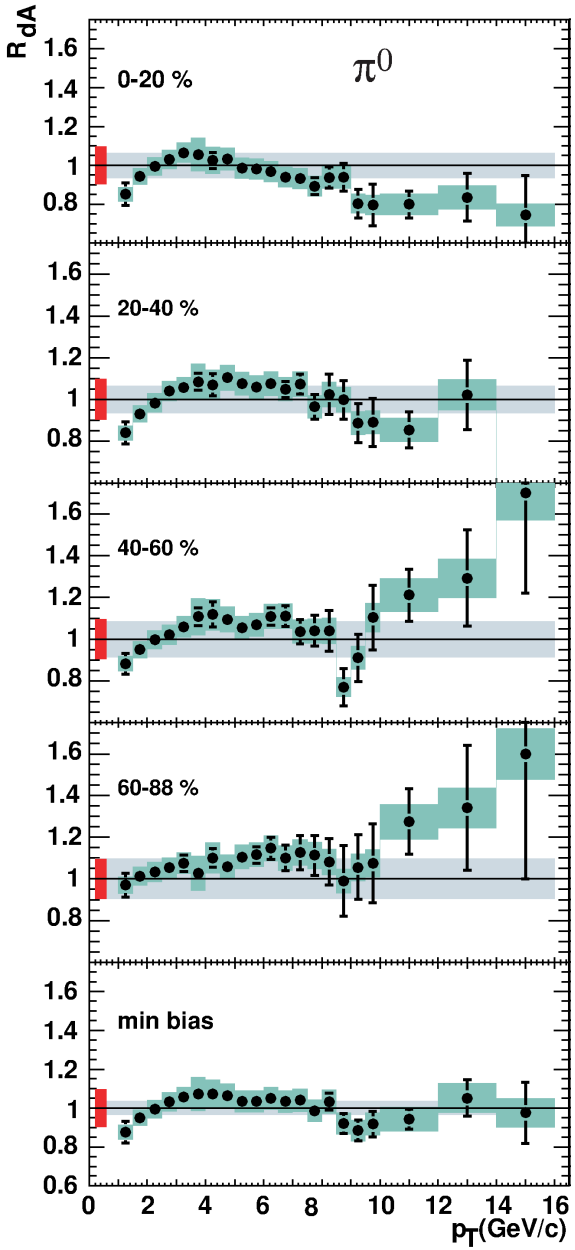
Jets in d+Au



- Reconstructed Gaussian filter jets, 9 to 40 GeV/c
- Corrected for effects from UE fluctuations

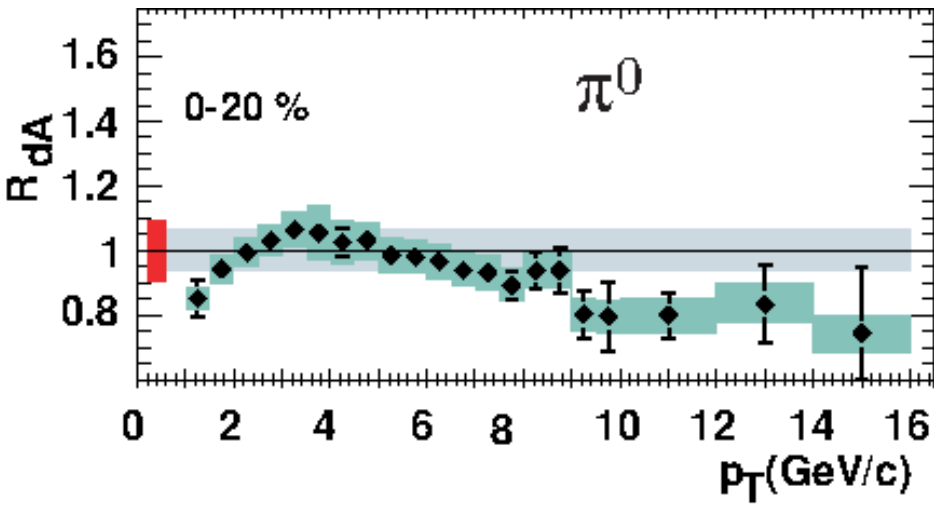
  $\Rightarrow$ plotted at the p+p-**equivalent detector scale**
- $< 5\%$ combinatoric ("fake") jet rate added as systematic

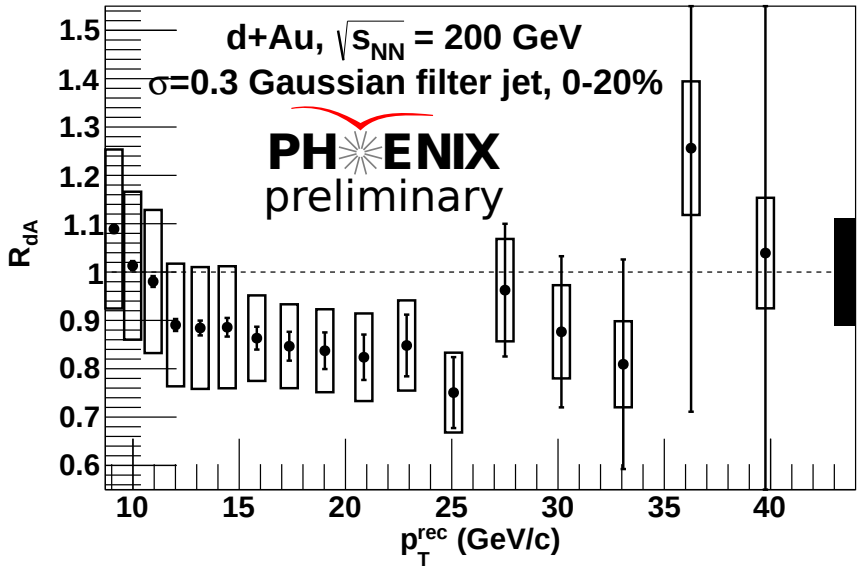
Cold nuclear matter in 2007



- PHENIX π^0 result from 2003 data:
  - $\Rightarrow$ weak centrality dependence
  - $\Rightarrow$ Phys. Rev. Lett. **98**, 172302 (2007)
- Hints of interesting high-p_{T} behavior
  - $\Rightarrow$ but low statistics
  - $\Rightarrow$ probe with **reconstructed jets**

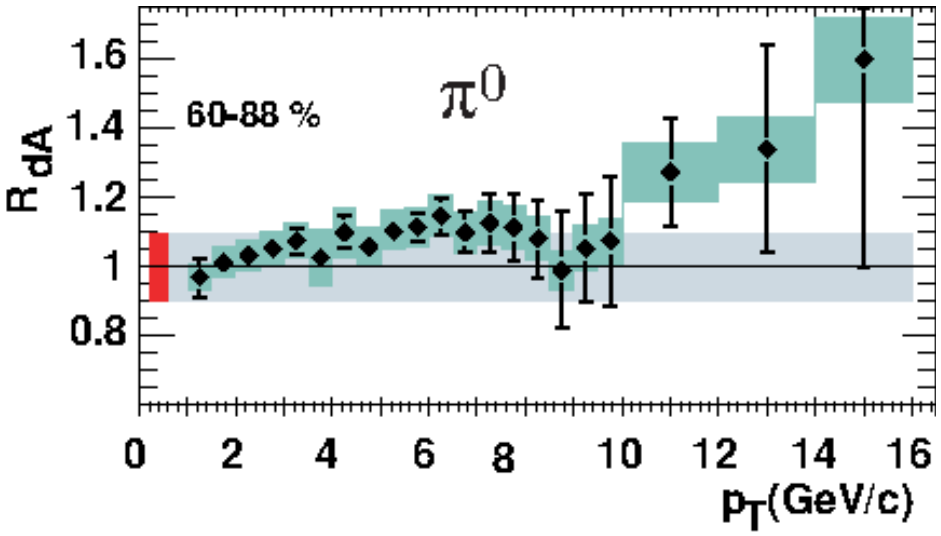
High-p_{T} R_{dA}: 0-20%

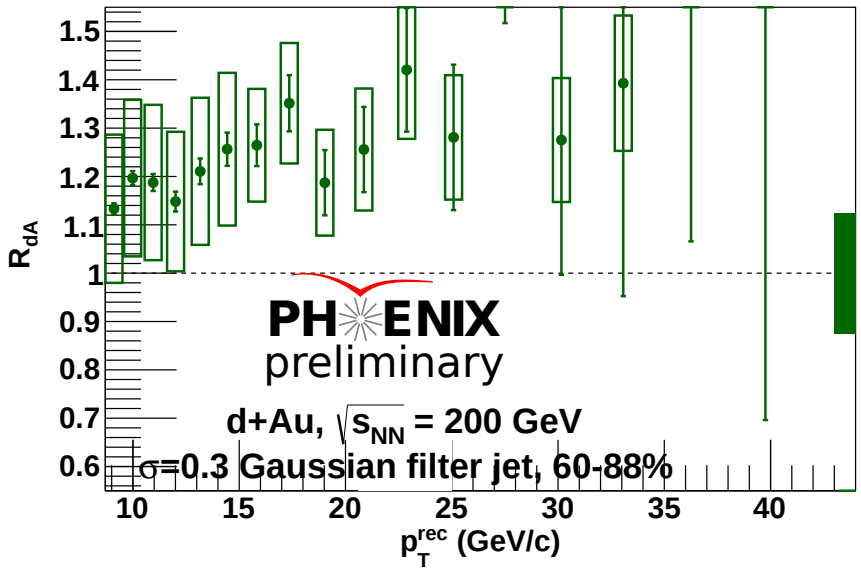




- mild suppression, $R_{\mathrm{dA}} \approx 0.85$
  - $\Rightarrow$ initial state E-loss?
  - $\Rightarrow$ nPDF modification?

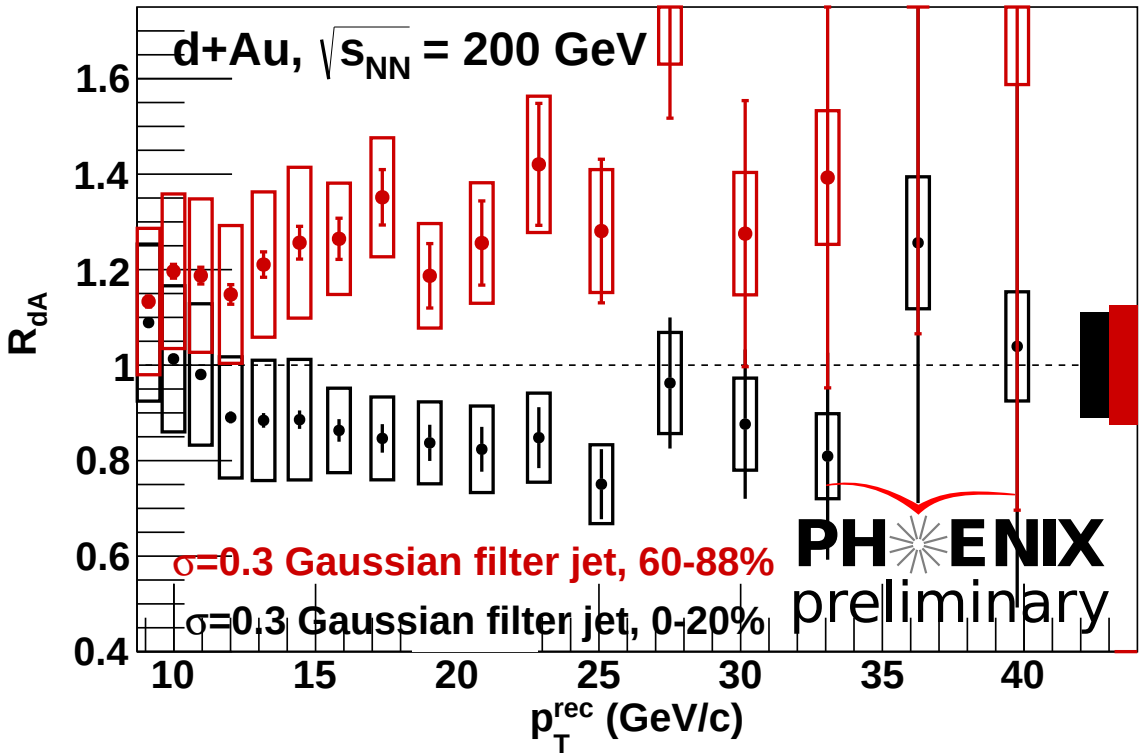
High-p_{T} R_{dA}: 60-88%





- moderate enhancement, $R_{\mathrm{dA}} \approx 1.3$
  - $\Rightarrow$ unexpected deviation from geometric scaling

High-p_{T} R_{dA}: summary



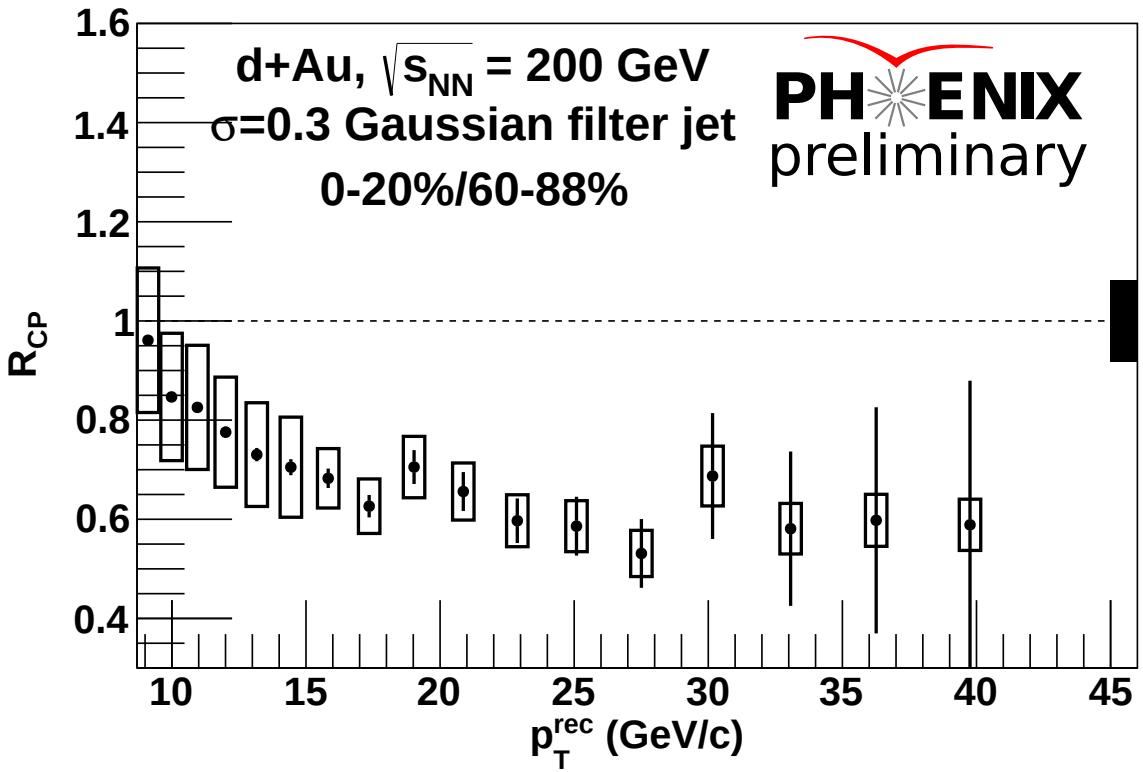
- No (strong) CNM effects at $p_{\mathrm{T}} = 9$ GeV/c
- Centrality dependence for $p_{\mathrm{T}} > 15$ GeV/c
- p+p normalization introduces significant systematics...

High-p_{T} central/peripheral R_{CP}

- $R_{\mathrm{CP}} = \dfrac{(1/\mathbf{N}_{\mathrm{coll}}^{\mathbf{0-20\%}})(1/N_{evt}^{0-20\%})(dN^{0-20\%}/dp_{\mathrm{T}})}{(1/\mathbf{N}_{\mathrm{coll}}^{\mathbf{60-88\%}})(1/N_{evt}^{60-88\%})(dN^{60-88\%}/dp_{\mathrm{T}})}$

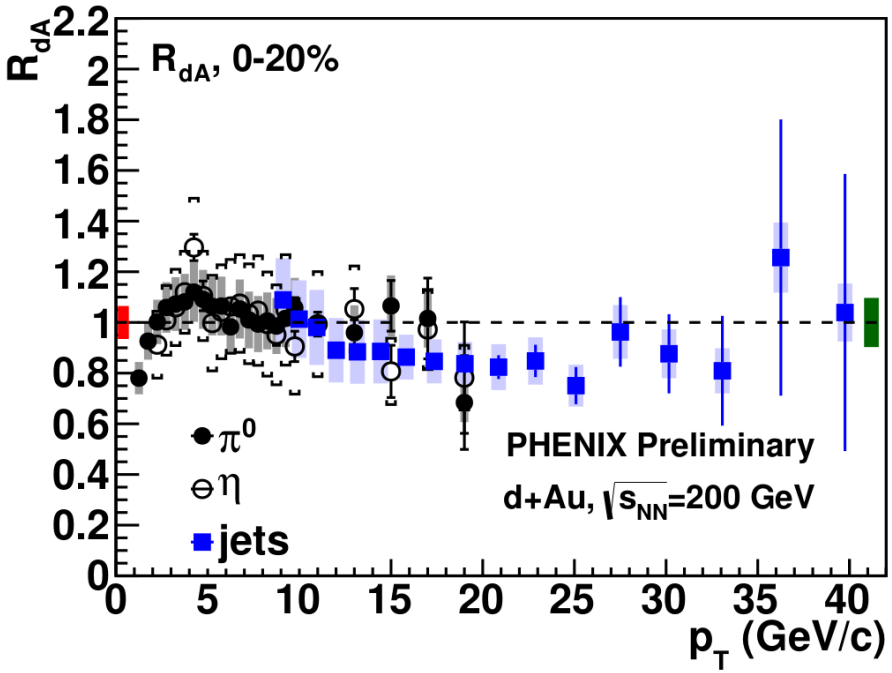
  $\Rightarrow$ probes *relative central vs. peripheral* jet production

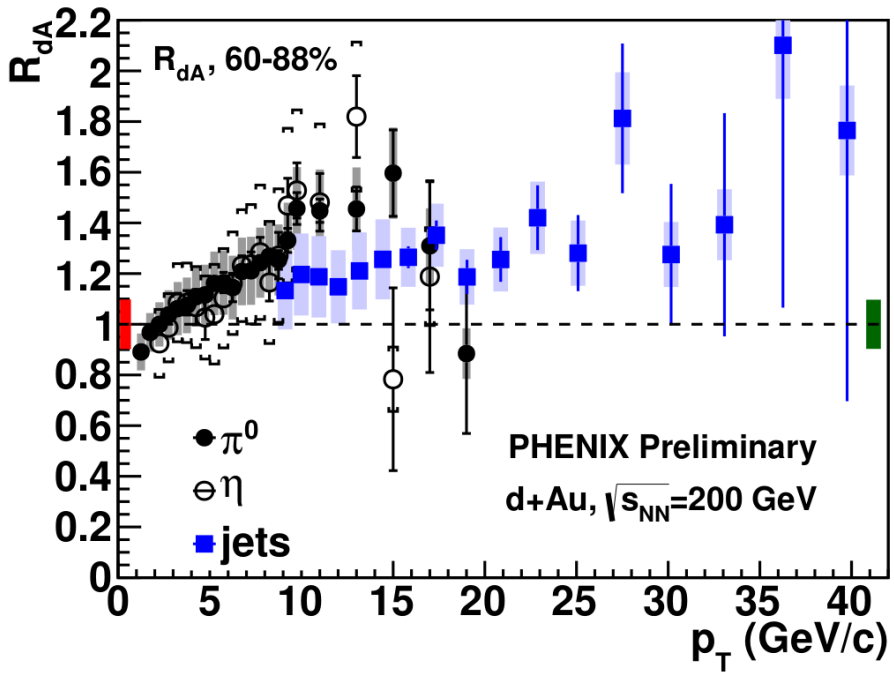
  $\Rightarrow$ no p+p reference $\Rightarrow$ reduced systematics



- Large effect for $p_{\mathrm{T}} > 20$ GeV/c, $R_{\mathrm{CP}} \approx 0.6$!

Agreement from π^0s and ηs





- Preliminary π^0, η measurement, RHIC 2008 data
  - $\Rightarrow$ **hadrons** and **jets** have different energy scales
  - $\Rightarrow$ different systematics, sensitivites, p+p references

Outlook

- PHENIX has measured high-p_{T} jet production in d+Au
  - $\Rightarrow$ using reconstructed jets, 9 to 40 GeV/c
  - $\Rightarrow$ extends earlier single hadron measurements

- Strong, robust centrality dependence of jet production
  - $\Rightarrow$ high-p_{T} centrality bias?
  - $\Rightarrow$ not understood aspect of d behavior?
  - $\Rightarrow$ new physics effect?

- Implications for centrality, p+A, CNM!
  - $\Rightarrow$ further work is in progress

BACKUP