POLYTECH
Peter the Great
St.Petersburg Polytechnic
University

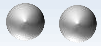
PHENIX

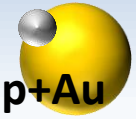
Light Hadron Production in Small Systems at RHIC

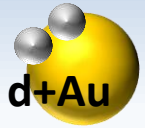
Iurii Mitrankov for the PHENIX

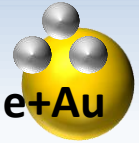
Peter the Great St.Petersburg Polytechnic University

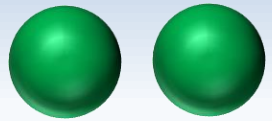
Motivation

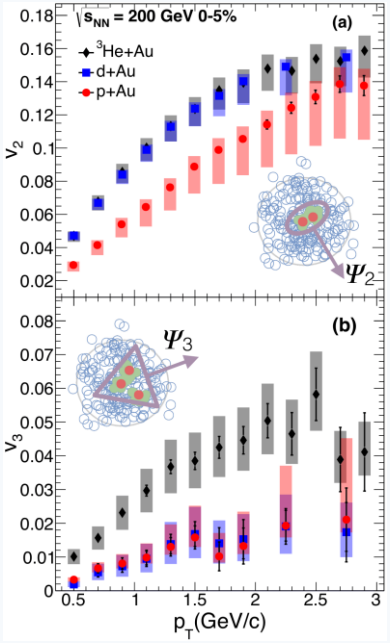












- Flow measurements in small systems → possible QGP droplets formation
- Looking for confirmation and revealing minimal conditions for QGP formation → Hadron production measurements
- Hadron production as a function of :
  - ✓ System size
  - ✓ Flavor → strangeness enhancement
  - ✓ Number of quarks → baryon enhancement

Hadrons in this talk

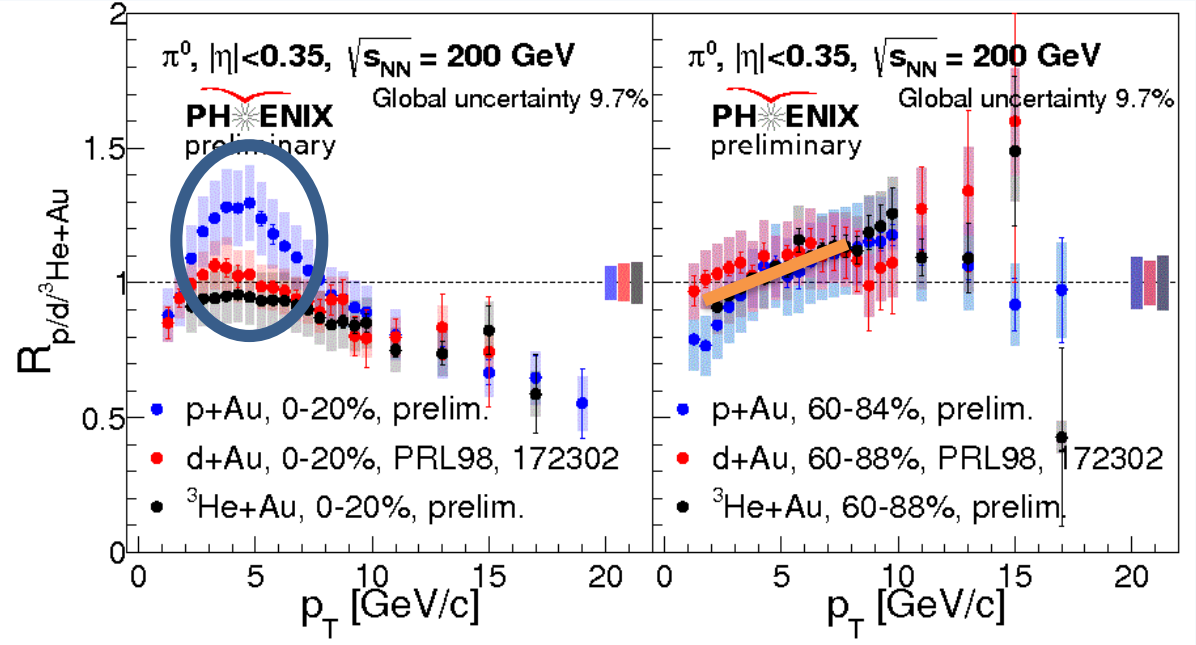
(hidden) strange

h	Quark content	Decay modes	BR, %	Mass, MeV
K^+/K^-	$u\bar{s}\ /\ s\bar{u}$			~495
$K^{0*}/\overline{K^{0*}}$	$d\bar{s}\ /\ s\bar{d}$	$\pi^{\mp}K^{\pm}$	~67	~896
φ	$\sim 0.9999 \cdot s\bar{s}$	K^+K^-	~49	~1019

light flavored

h	Quark content	Decay modes	BR, %	Mass, MeV
π^0	$\frac{u\bar{u}-d\bar{d}}{\sqrt{2}}$	$\gamma\gamma$	~99	~135
π^+/π^-	$u\bar{d}\ /\ d\bar{u}$			~140
$p/\bar{p}$	$uud\ /\ \bar{u}\bar{u}\bar{d}$			~938

π^0 R_{AB} in p+Au, d+Au, ^{3}He+Au

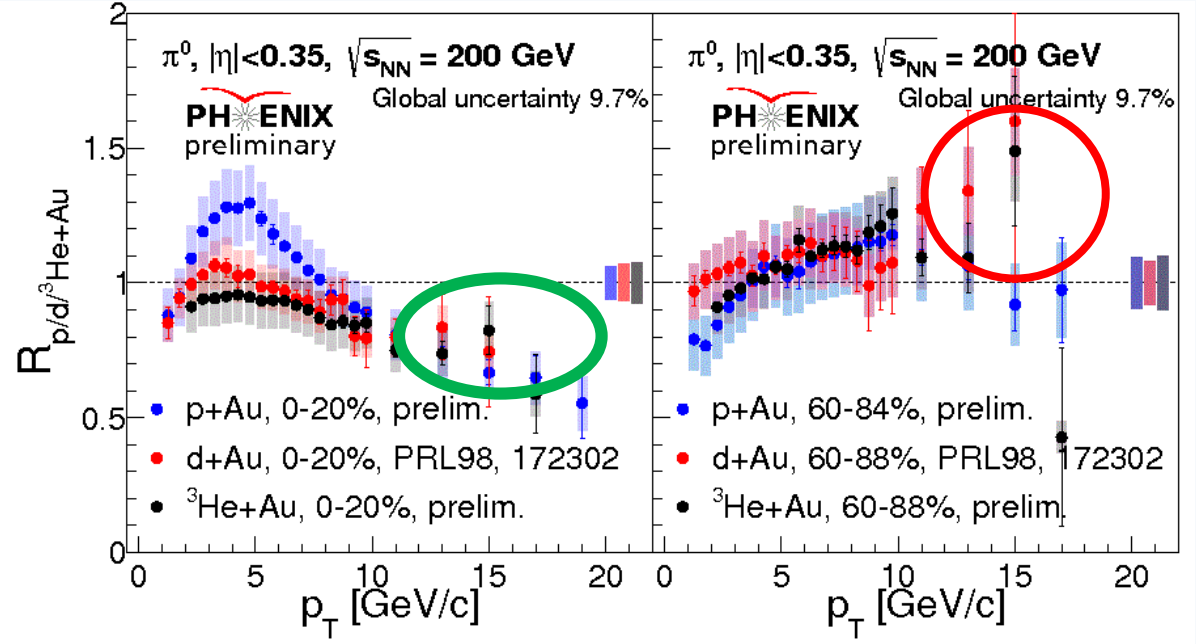


AT INTERMEDIATE p_T RANGE:

Ordering $R_{pAu} > R_{dAu} > R_{HeAu}$ in 0-20%

π^0 and φ $R_{pAu} \approx R_{dAu} \approx R_{HeAu}$ in peripheral collisions

π^0 R_{AB} in p+Au, d+Au, ^{3}He+Au



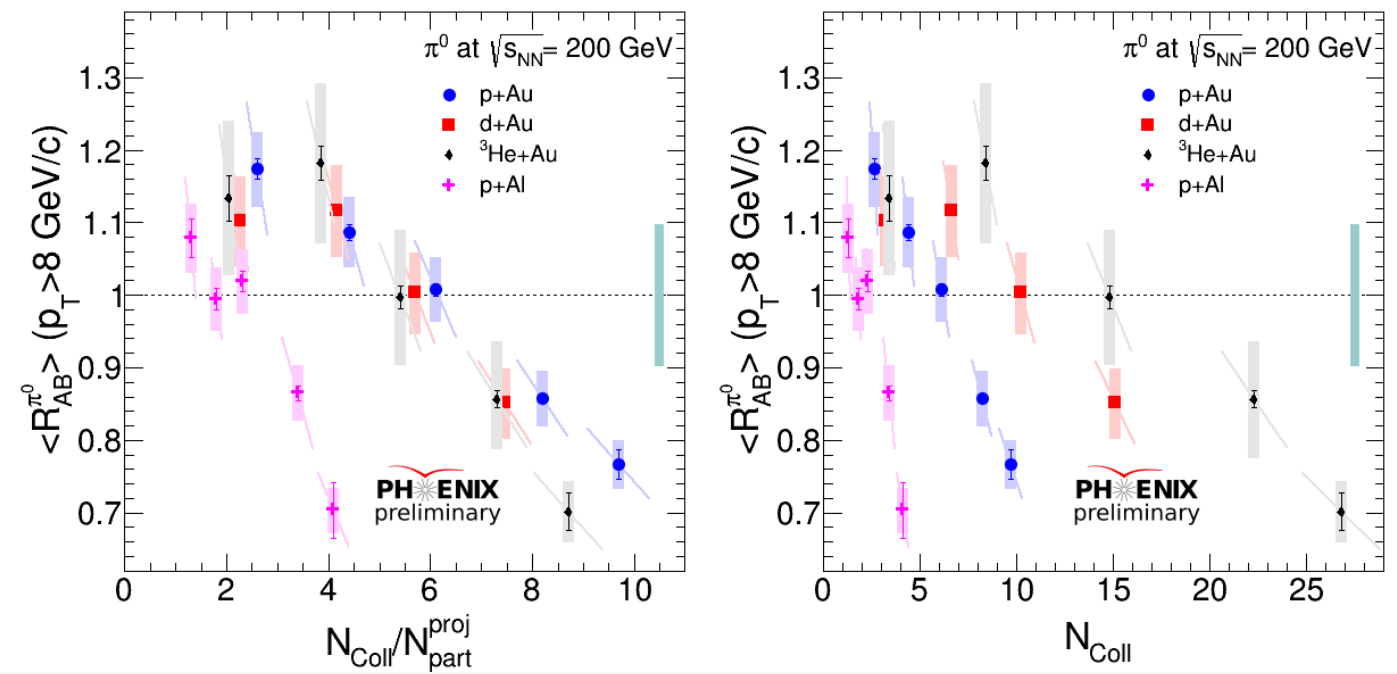
AT HIGH-p_T RANGE:

π^0 R_{AB}'s consistent with each other at high-p_T

A hint of suppression in central collisions for π^0

A hint of enhancement in peripheral collisions

π^0 integrated yields & R_{AB} in p+Al, p+Au, d+Au, ^{3}He+Au



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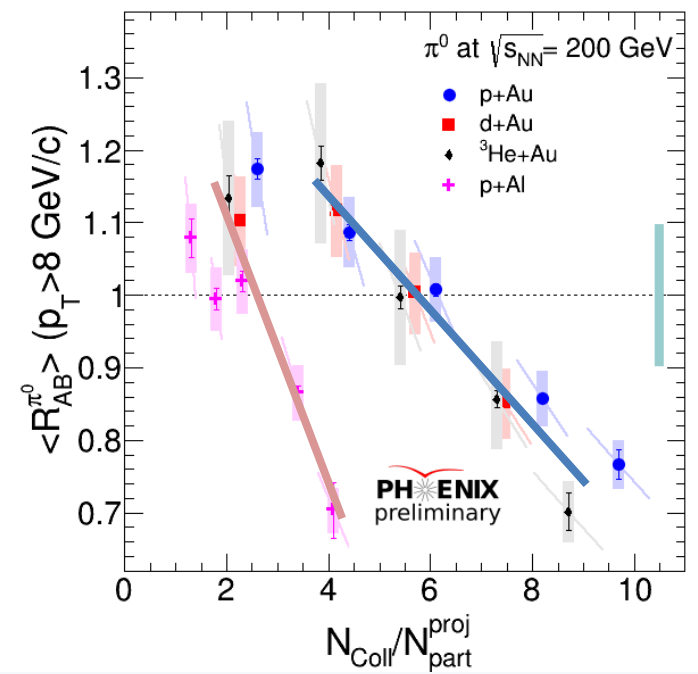


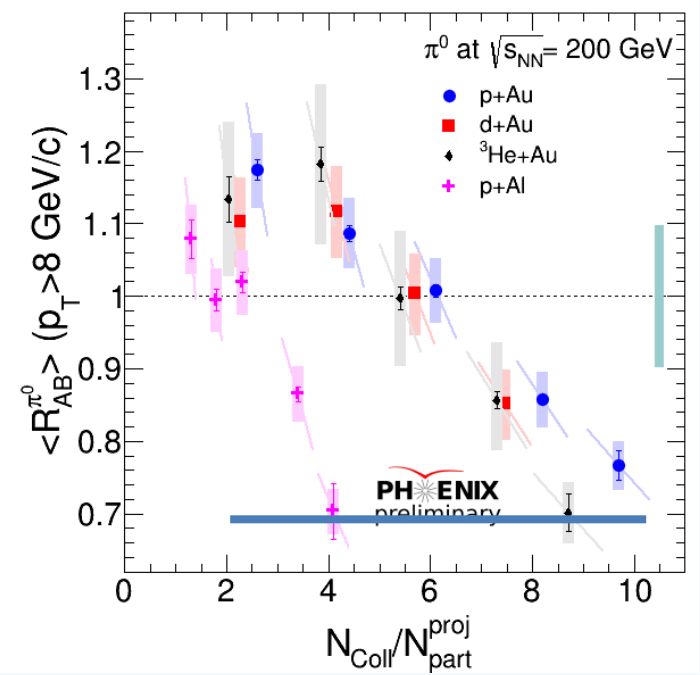
- π^0 R_{AB}'s seem to scale with N_{coll}/N_{part}^{proj} for systems with same target at high-p_T

  The interactions of each projectile nucleon with the target nucleons are mostly independent

- The suppression level of π^0 R_{AB} is the same for both Al and Au targets

  Suppression is not related to energy loss

π^0 integrated yields & R_{AB} in p+Al, p+Au, d+Au, ^{3}He+Au



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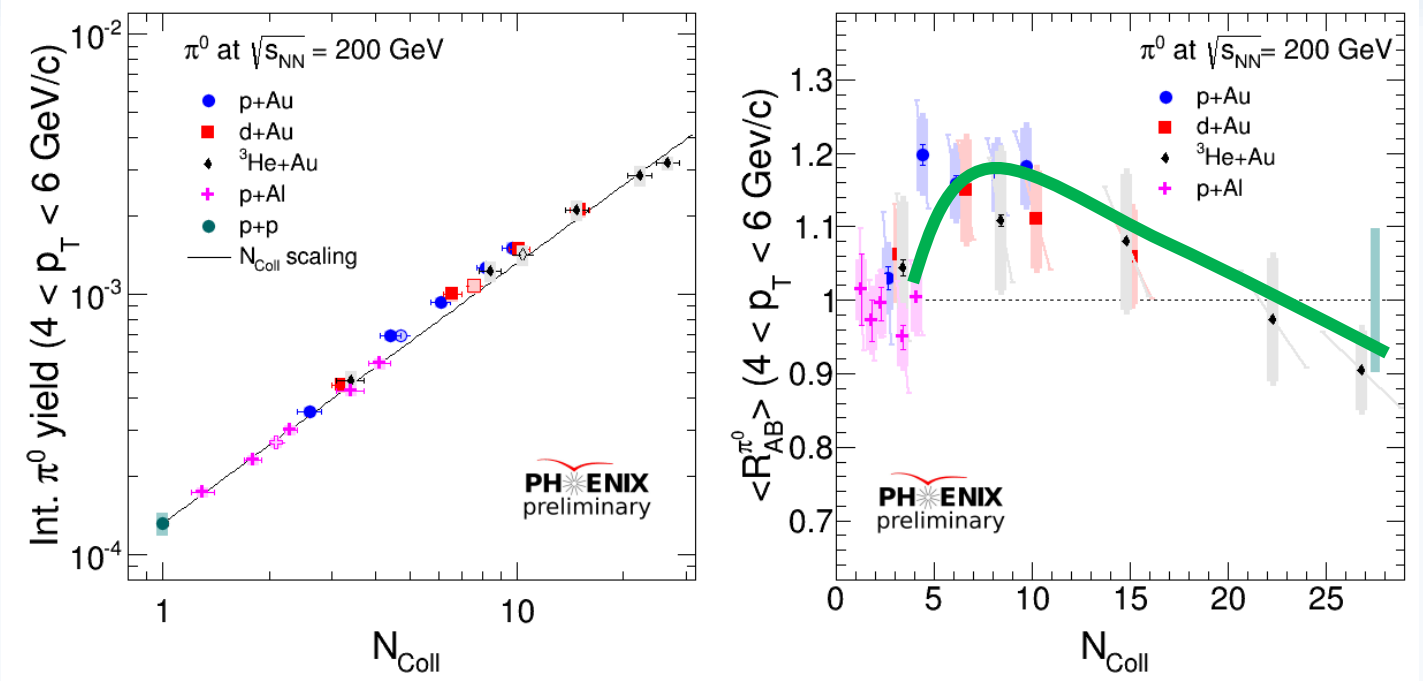
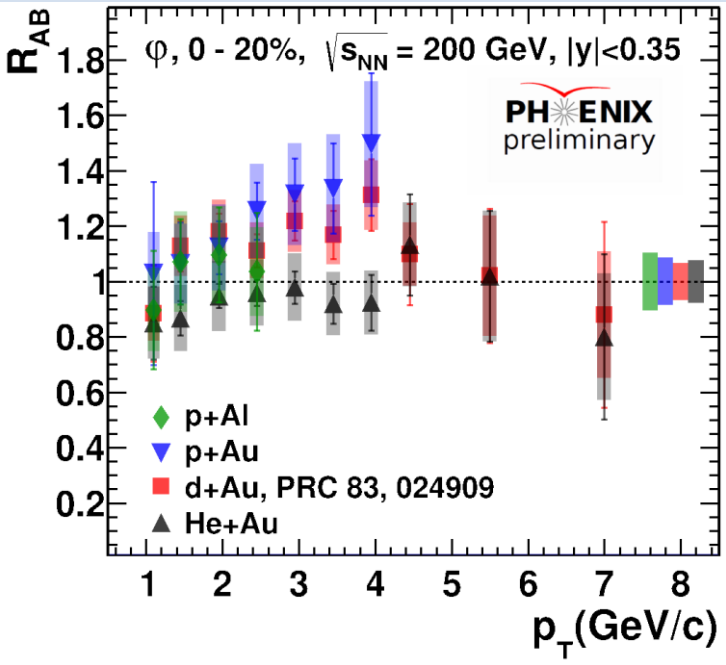
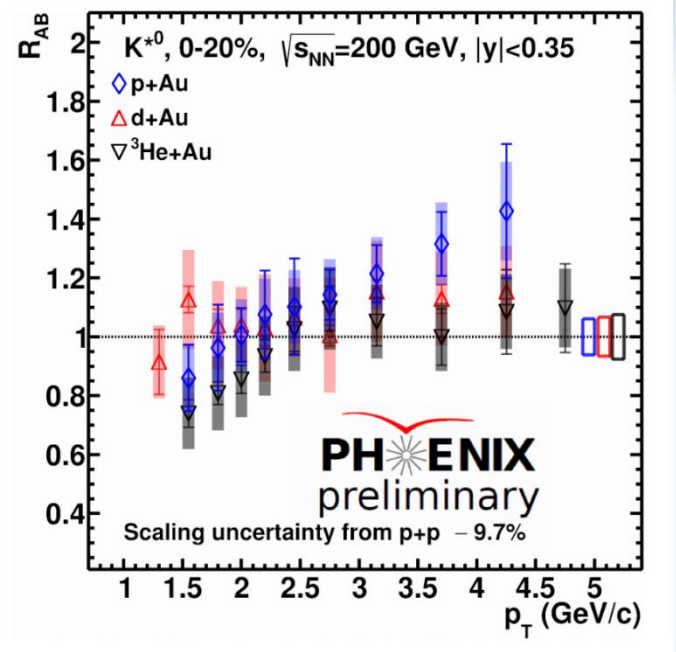
π^0 integrated yields & R_{AB} in p+Al, p+Au, d+Au, ^{3}He+Au



At moderate p_T π^0 R_{AB} scales with N_{coll}

φ R_{AB} in small systems K^{*0}



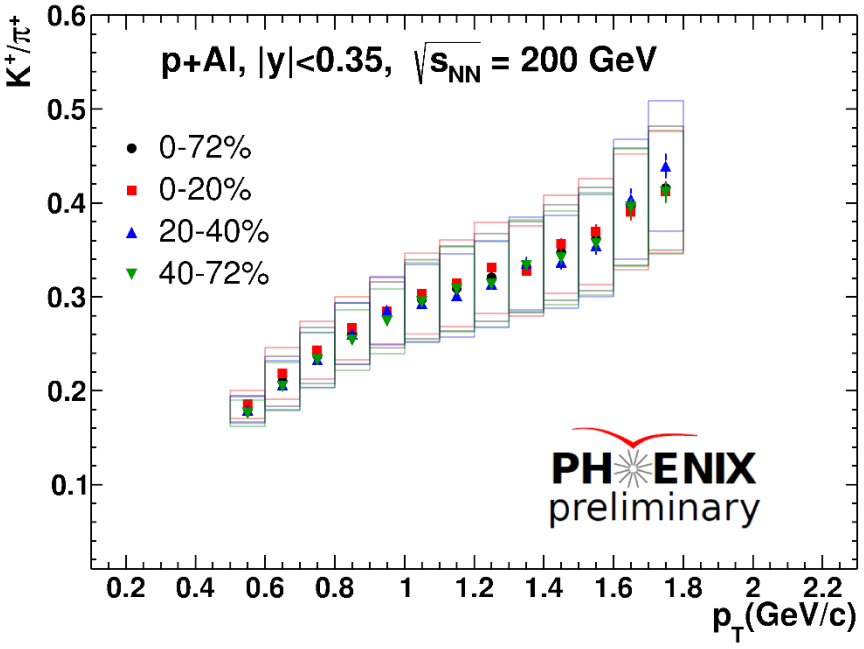


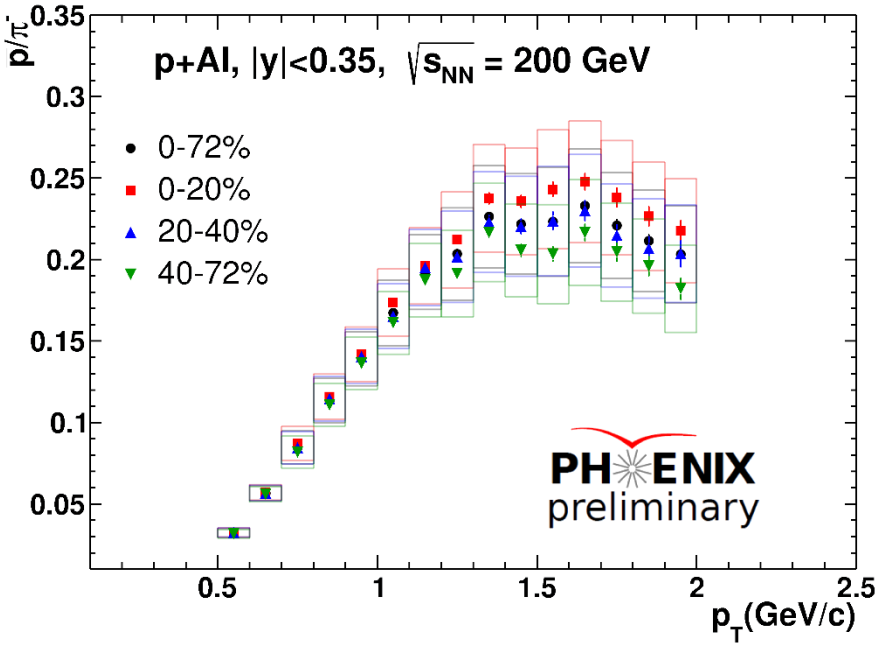
A hint of ordering at moderate p_T for φ and K^{*0}:

$$R_{pAu} > R_{dAu} > R_{HeAu}$$

A hint of suppression at high p_T for φ-meson

Ratio in small systems

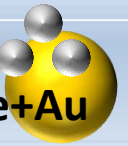


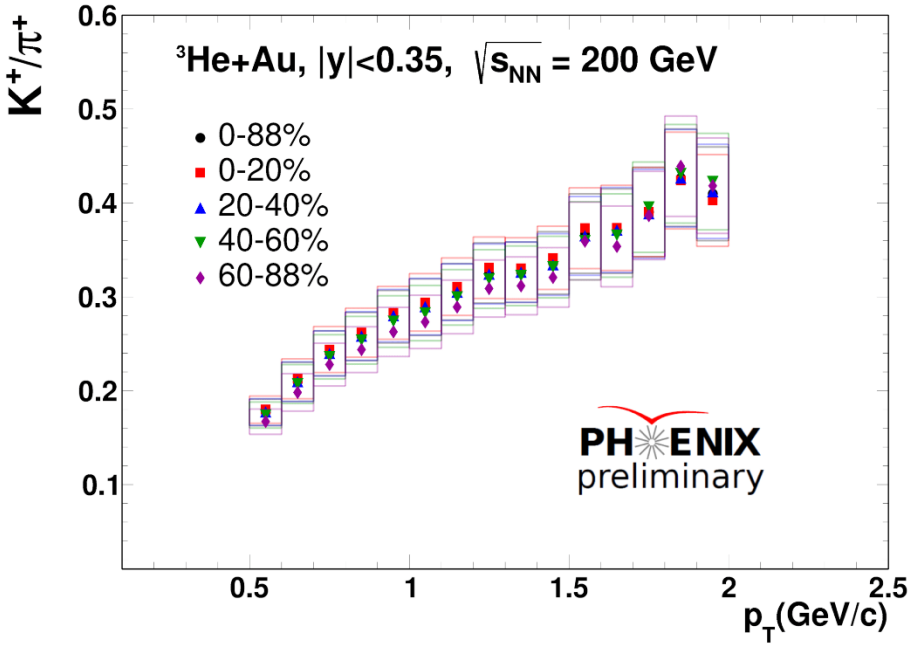


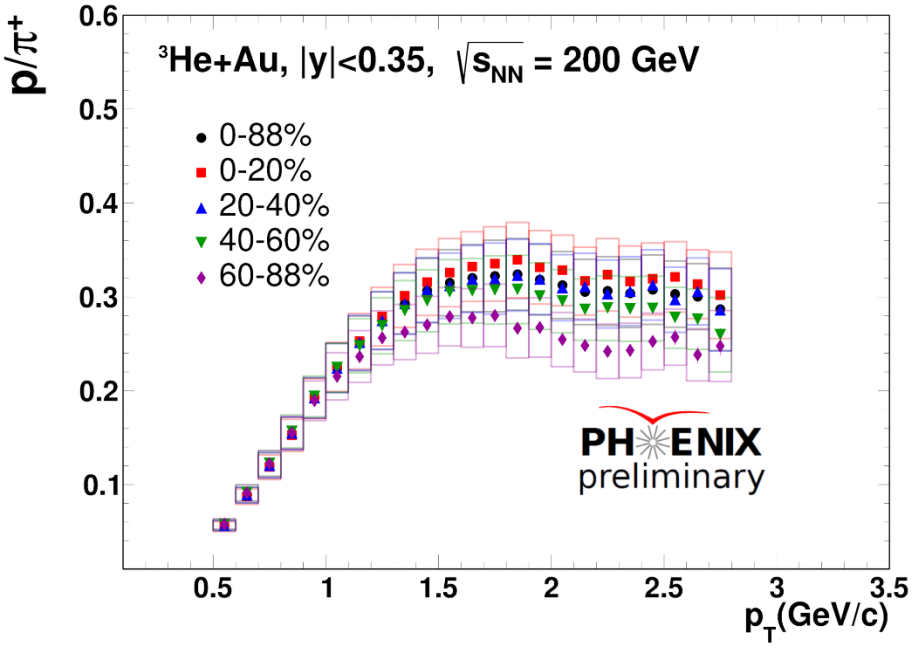
No strangeness enhancement

A hint of proton enhancement

Ratio in small systems



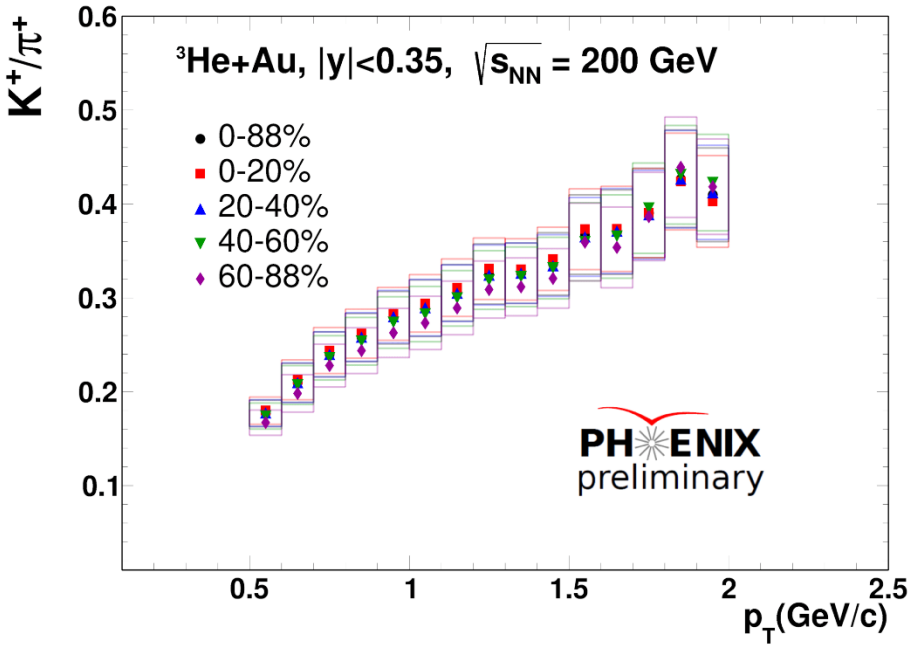


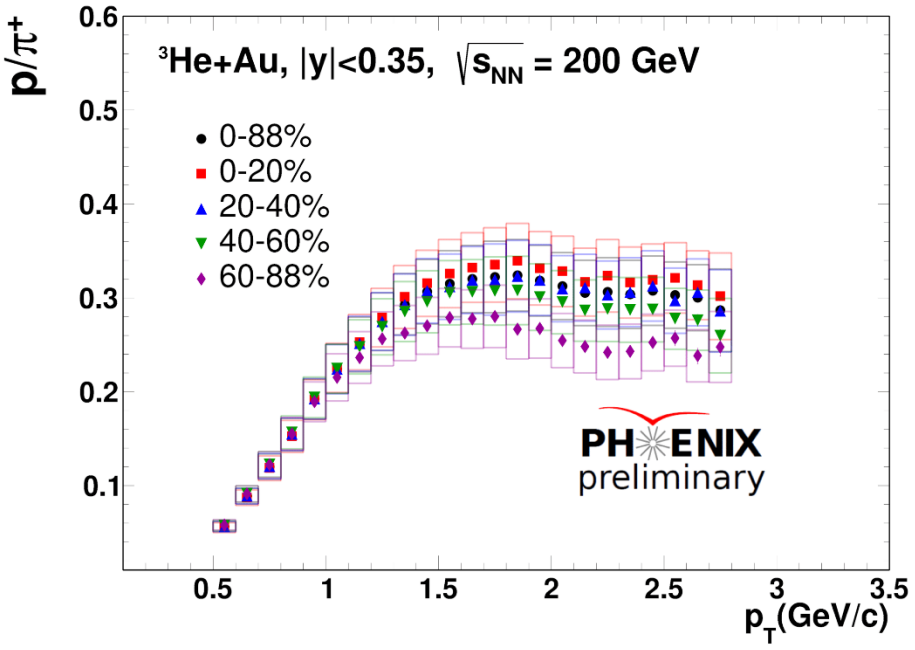


No strangeness enhancement

Proton enhancement

Ratio in small systems

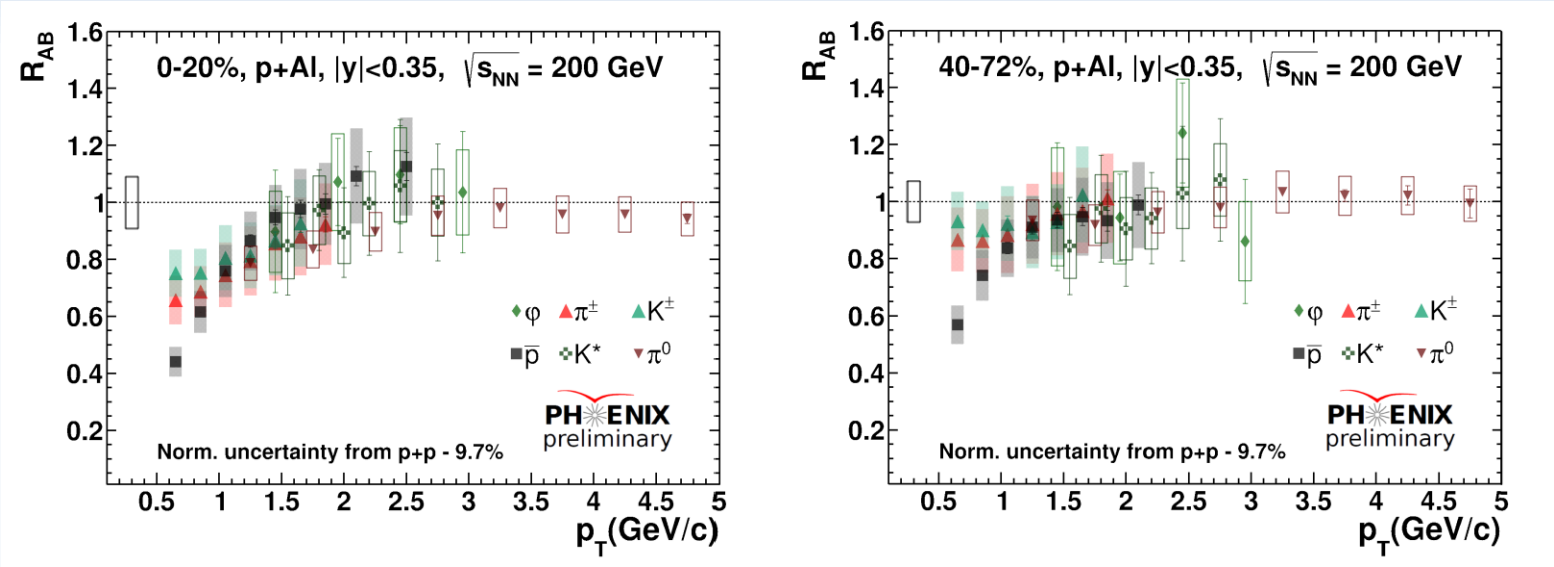




Radial flow or recombination

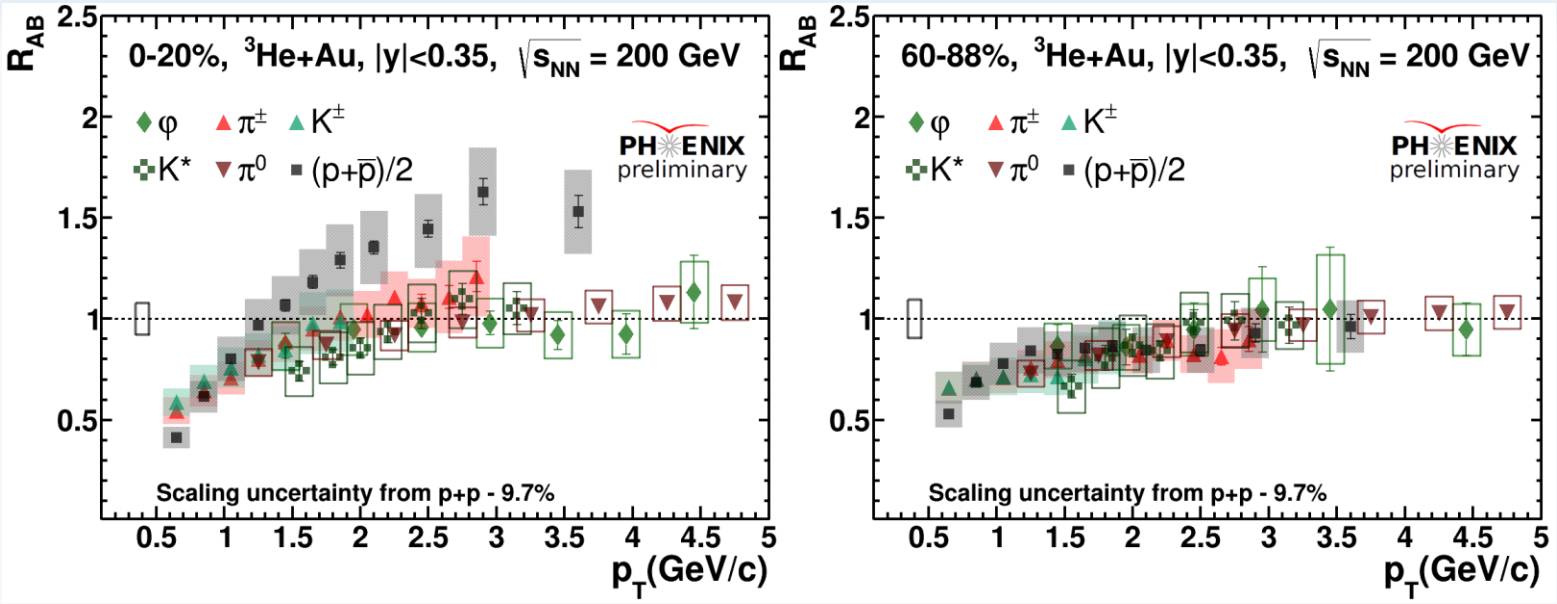
R_{AB} in small systems

p+Al



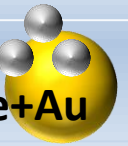
- φ & K^{0*} R_{AB} follows other light mesons R_{AB}
- antiprotons R_{AB} also follows all mesons R_{AB}

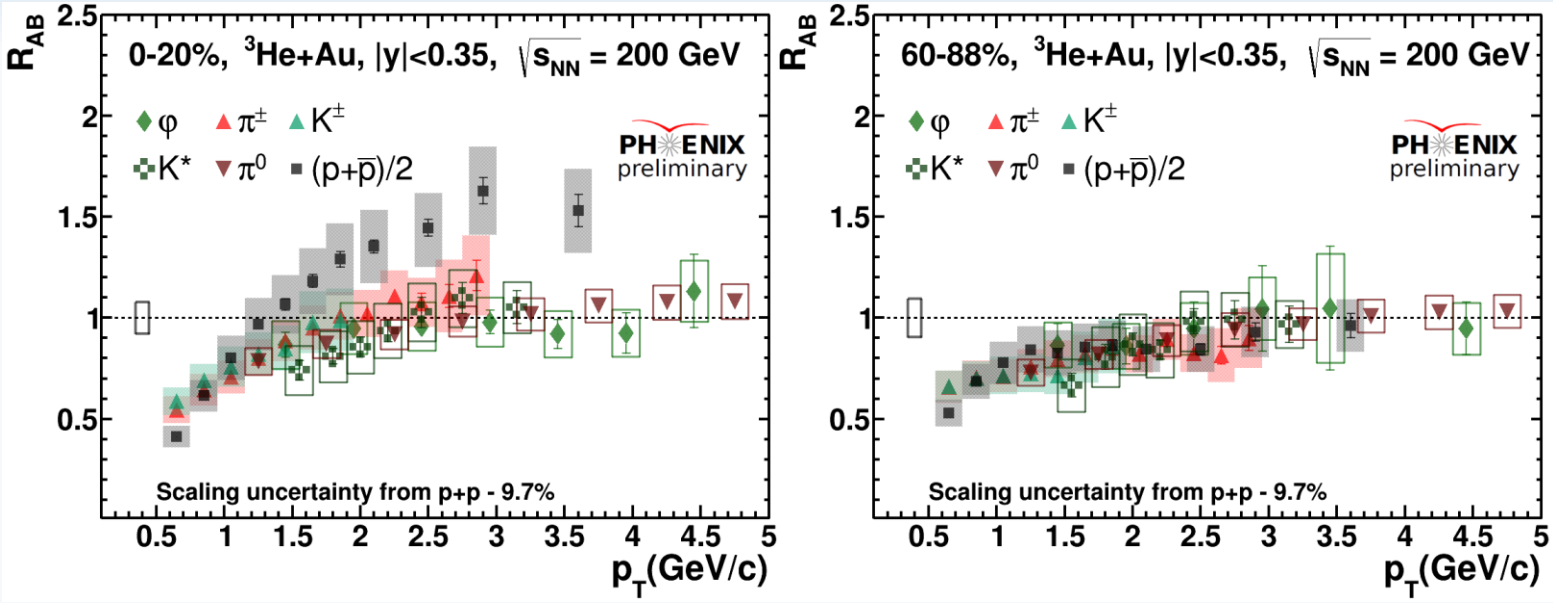
R_{AB} in small systems



- φ & K^{0*} R_{AB} follows other light mesons R_{AB}
- Protons yields are enhanced in 0-20% ^{3}He+Au, as in *p/d*+Au

R_{AB} in small systems

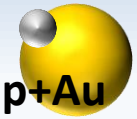


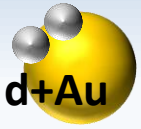


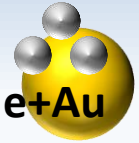
✓ Recombination can explain protons $R_{AB} > \varphi\ R_{AB}$

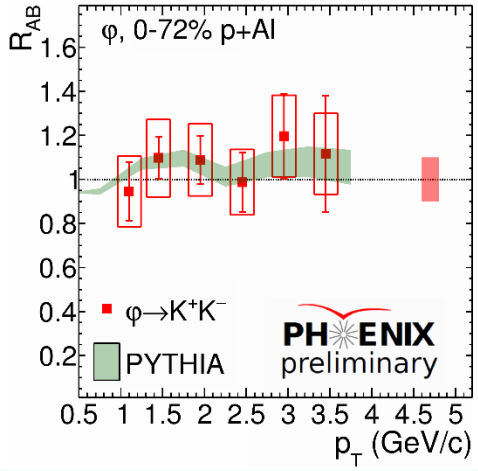
X ~~Radial flow~~

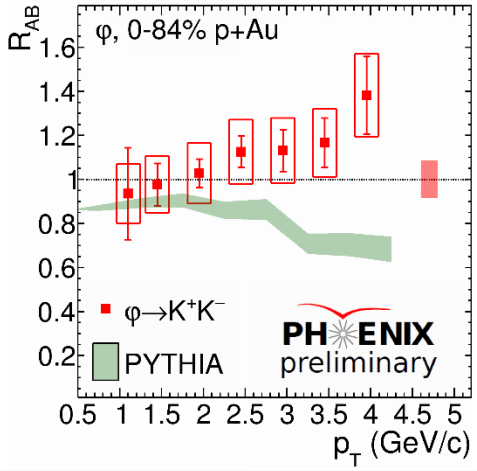
R_{AB} in small systems

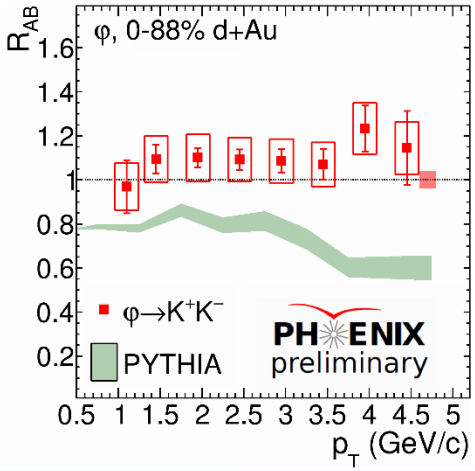


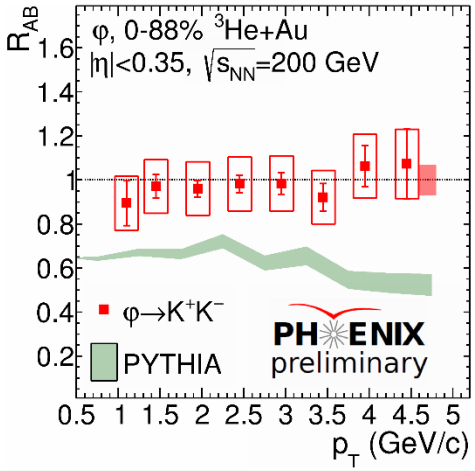








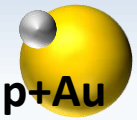


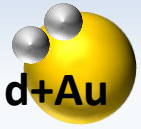


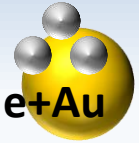
✓ Pythia 8 is in well agreement with R_{pAl} for φ

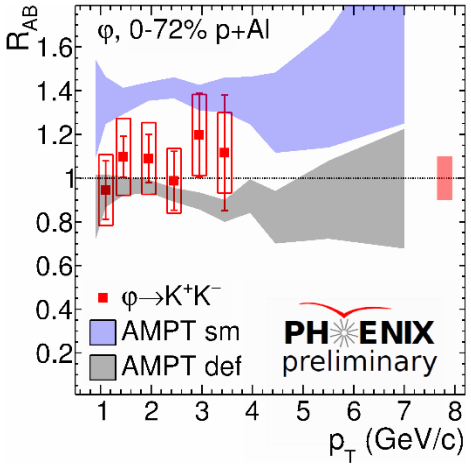
X Pythia 8 underestimates φ R_{AB} in p/d/^{3}He+Au

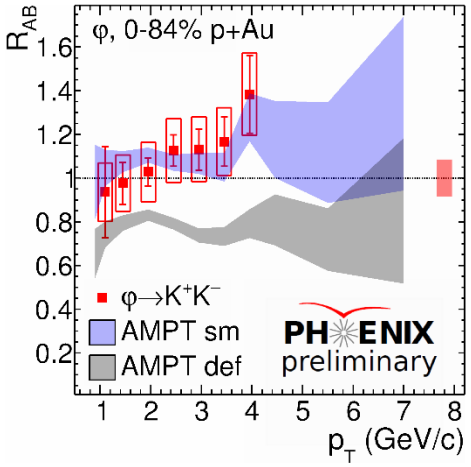
R_{AB} in small systems

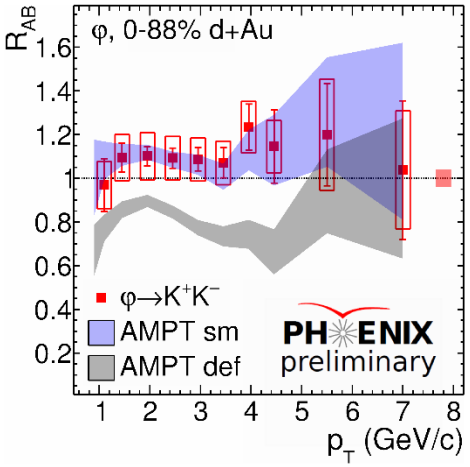


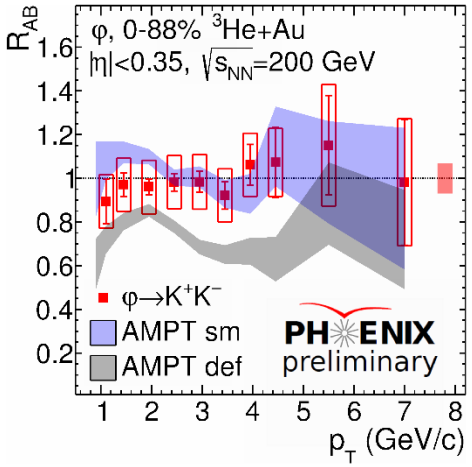






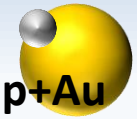


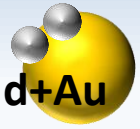


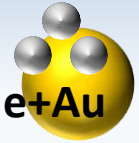


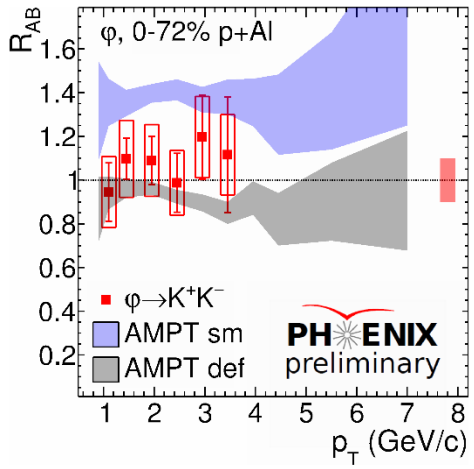
- φ R_{pAl} is well estimated by default AMPT calculations
- String melting AMPT well predicts φ yields in p/d/^{3}He+Au

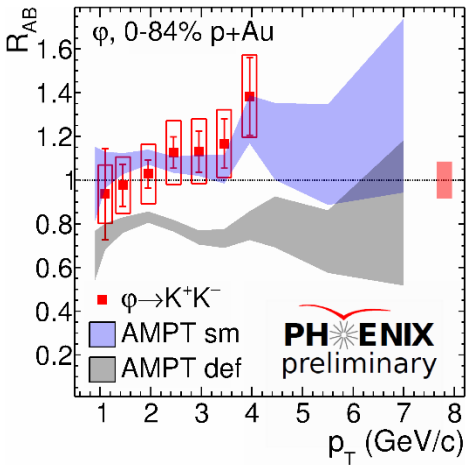
R_{AB} in small systems

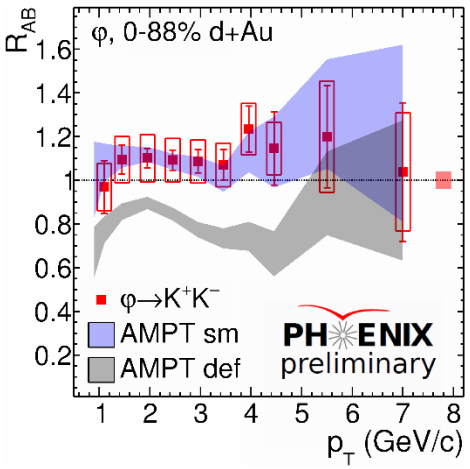


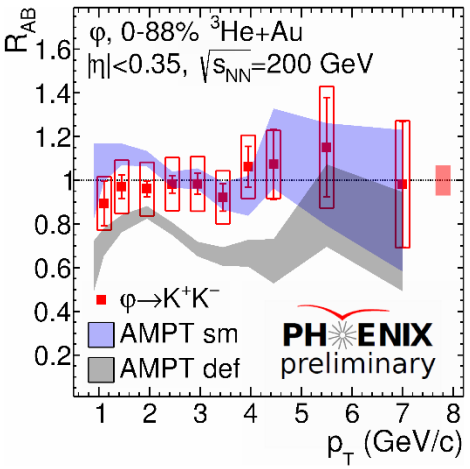












Minimal conditions to form QGP might lie in between p+Al and p+Au

Summary

Small systems:

Minimal conditions to form QGP might lie in between

p+Al and p+Au:

- ✓A hint of proton enhancement in p/d/^{3}He+Au
- ✓String melting AMPT φ $R_{p/d/^3He+Au}$ & Pythia and def AMPT for φ R_{pAl}

The current data does not contradict small QGP droplets formation in p+Au, d+Au, 3He+Au

- X But NO strangeness enhancement and parton energy loss observed in small systems

Thank you for your attention!