# $\pi/K/p$ spectra, Au+Au for 7.7, 19.6, 27 GeV UrQMD

Statistics: ~2M

Track cuts:

- PDG  $(\pi^{\pm} = \pm 211, K^{\pm} = \pm 321, p \text{ (p-bar)} = \pm 2212)$
- |y| < 0.1,
- $|\eta| < 0.5$
- $\bullet$  p<sub>T</sub>  $> 0.2~{
  m GeV/c}$

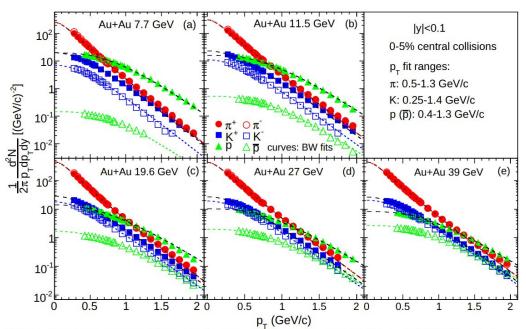
Bin width for spectra: 50 MeV/c

Centrality was calculated using multiplicity.

#### Variation of Tkin with <β> for different centralities and energies

**Simultaneous** fit of the  $\pi\pm$ ,  $K\pm$ , p, and  $\bar{}$  p spectra across all the BES energies.

Experimental results from: Phys. Rev. C 96, 044904 (2017)



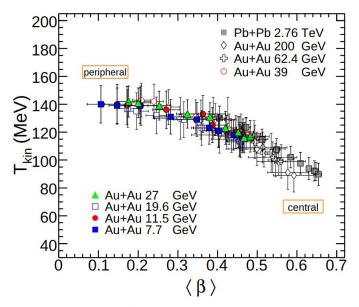


FIG. 37: (Color online) Variation of  $T_{\rm kin}$  with  $\langle \beta \rangle$  for different energies and centralities. The centrality increases from left to right for a given energy. The data points other than BES energies are taken from Refs. [43, 66]. Uncertainties represent systematic uncertainties.

FIG. 36: (Color online) Blast wave model fits of  $\pi^{\pm}$ ,  $K^{\pm}$ , p and  $\bar{p}$   $p_T$  spectra in 0–5% central Au+Au collisions at  $\sqrt{s_{NN}}$  = (a) 7.7 GeV, (b) 11.5 GeV, (c) 19.6 GeV, (d) 27 GeV, and (e) 39 GeV. Uncertainties on experimental data represent statistical and systematic uncertainties added in quadrature. Here, the uncertainties are smaller than the symbol size.

# Blast wave fit of each spectra for 7.7 GeV

 $Au+Au\sqrt{s_{NN}} = 7.7 \text{ GeV}$ 

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0-5%

p<sub>T</sub> GeV/c

p<sub>T</sub> GeV/c

0-5%

0.5

0.5

**UrQMD** 

UrQMD

1.5

1.5

 $10^{-1}$ 

 $10^{-2}$ 

10<sup>-1</sup>

 $10^{-2}$ 

0.5

0.5

 $\frac{dN}{p_T dp_T} \propto \int_0^R r \, dr \, m_T I_0 \left( \right.$  $+\pi^+$ +K+ **+**p 2.5 p<sub>T</sub> GeV/c  $+\pi^{-}$  $+K^{-}$  $+\overline{p}$ 

 $m_{\tau}$  - transverse mass

I<sub>0</sub>, K<sub>1</sub> - Bessel functions

n - exponent of flow

 $\rho$  (r) = tanh<sup>-1</sup> ( $\beta$ )

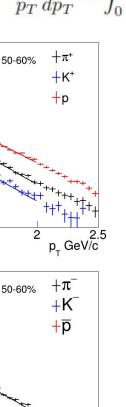
 $\beta = 2 * \beta_S / (2+n)$  $\beta_{\text{S}}$  - surface velocity

velocity profile

50-60% 50-60% 2.5 p<sub>\_</sub> GeV/c

1.5

1.5



# Blast wave fit of each spectra for 19.6 GeV

0-5%

p<sub>T</sub> GeV/c

0.5

1.5

 $10^{-1}$ 

 $10^{-2}$ 

 $10^{-1}$ 

 $10^{-2}$ 

0.5

 $\frac{dN}{p_T dp_T} \propto \int_0^R r dr \, m_T I_0 \left( \frac{p_T \sinh \rho(r)}{T_{\rm kin}} \right)$  $+\pi^+$ Au+Au √s<sub>NN</sub> = 19.6 GeV **UrQMD** 50-60% +K+ 0-5% **+**p p<sub>T</sub> GeV/c 0.5 1.5 0.5 1.5 p<sub>T</sub> GeV/c  $+\pi^{-}$ UrQMD  $Au+Au \sqrt{s_{NN}} = 19.6 \text{ GeV}$ 50-60%

 $\times K_1\left(\frac{m_T\cosh\rho(r)}{T_{\text{Lin}}}\right)$  $m_{\tau}$  - transverse mass  $\rho$  (r) = tanh<sup>-1</sup> ( $\beta$ )

 $+K^{-}$ 

 $+\overline{p}$ 

p<sub>T</sub> GeV/c

1.5

I<sub>0</sub>, K<sub>1</sub> - Bessel functions  $\beta = 2 * \beta_S / (2+n)$  $\beta_{\text{S}}$  - surface velocity n - exponent of flow velocity profile

# Blast wave fit of each spectra for 27 GeV

Au+Au √s<sub>NN</sub> = 27 GeV

**UrQMD** 

10<sup>-2</sup>

0.5

 $\frac{dN}{p_T dp_T} \propto \int_0^R r dr \, m_T I_0 \left( \frac{p_T \sinh \rho(r)}{T_{\rm kin}} \right)$  $\times K_1\left(\frac{m_T\cosh\rho(r)}{T_{\text{him}}}\right)$  $+\pi^+$ +K+

50-60%

p<sub>T</sub> GeV/c

1.5

0-5% **+**p  $10^{-1}$  $10^{-2}$ 2.5 p<sub>T</sub> GeV/c 0.5 1.5 0.5 1.5 p<sub>T</sub> GeV/c  $+\pi^{-}$ UrQMD Au+Au √s<sub>NN</sub> = 27 GeV 50-60%  $+K^{-}$ 0-5%  $+\overline{p}$ 10<sup>-1</sup> ■

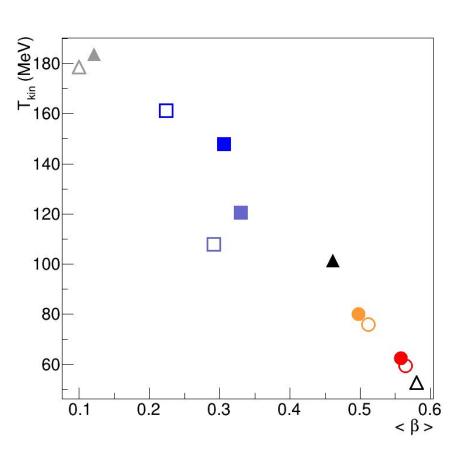
p<sub>T</sub> GeV/c

0.5

1.5

 $m_{\tau}$  - transverse mass  $\rho$  (r) = tanh<sup>-1</sup> ( $\beta$ ) I<sub>0</sub>, K<sub>1</sub> - Bessel functions  $\beta = 2 * \beta_S / (2+n)$  $\beta_{\text{S}}$  - surface velocity n - exponent of flow velocity profile

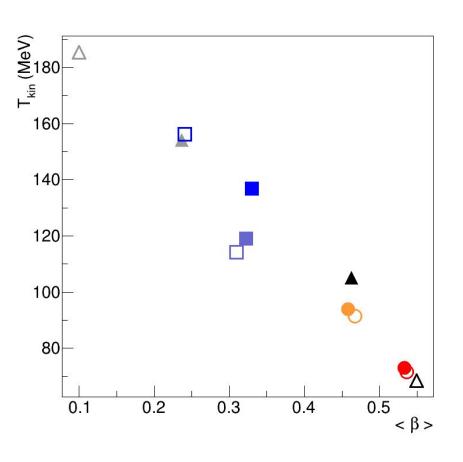
#### Variation of Tkin with <β> for different centralities for 7.7 GeV



**UrQMD** Au+Au  $\sqrt{s_{NN}} = 7.7 \text{ GeV}$ 

- $\pi^+$ , 0-5% **I** K<sup>+</sup>, 0-5% **A** p, 0-5%
- π<sup>+</sup>, 50-60% K<sup>+</sup>, 50-60% ▲ p, 50-60%
- $\bigcirc \pi^-, 0-5\%$   $\square K^-, 0-5\%$   $\triangle \overline{p}, 0-5\%$

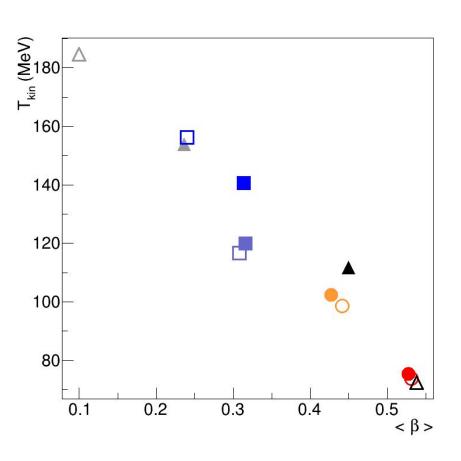
#### Variation of Tkin with <β> for different centralities for 19.6 GeV



**UrQMD** Au+Au  $\sqrt{s_{NN}} = 19.6 \text{ GeV}$ 

- π<sup>+</sup>, 50-60%
   K<sup>+</sup>, 50-60%
   p, 50-60%
- $\bigcirc \pi^{-}$ , 0-5%  $\square K^{-}$ , 0-5%  $\triangle \overline{p}$ , 0-5%
- $\bigcirc$   $\pi^-$ , 50-60%  $\square$  K $^-$ , 50-60%  $\triangle$   $\overline{p}$ , 50-60%

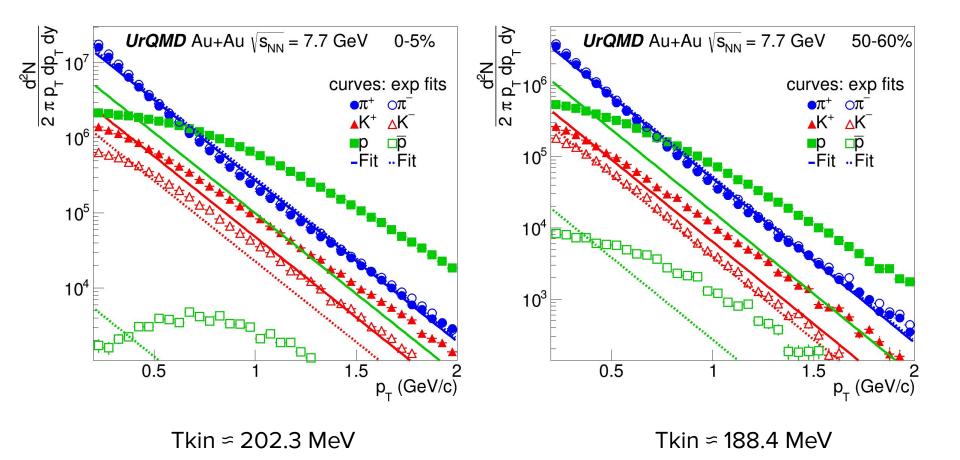
#### Variation of Tkin with <β> for different centralities for 27 GeV



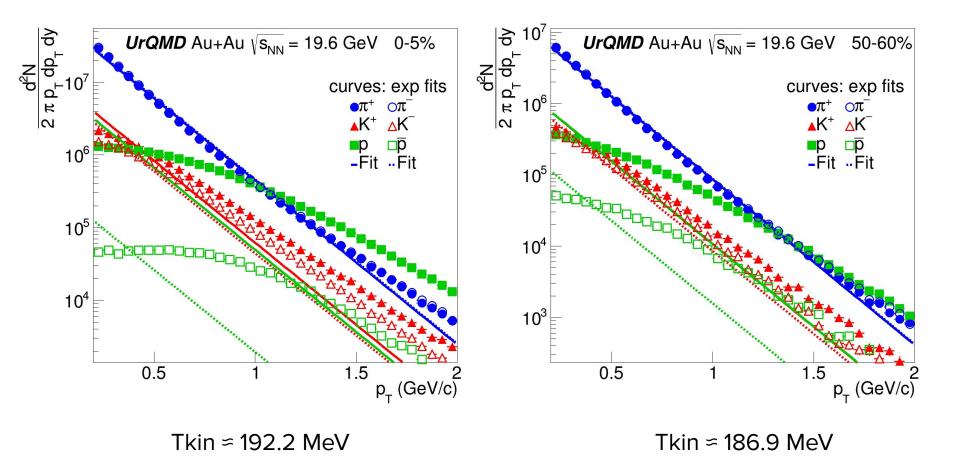
**UrQMD** Au+Au  $\sqrt{s_{NN}} = 27 \text{ GeV}$ 

- $\pi^+$ , 0-5% **I** K<sup>+</sup>, 0-5% **A** p, 0-5%
- π<sup>+</sup>, 50-60%
   K<sup>+</sup>, 50-60%
   p, 50-60%
- $\bigcirc \pi^{-}$ , 0-5%  $\square K^{-}$ , 0-5%  $\triangle \overline{p}$ , 0-5%

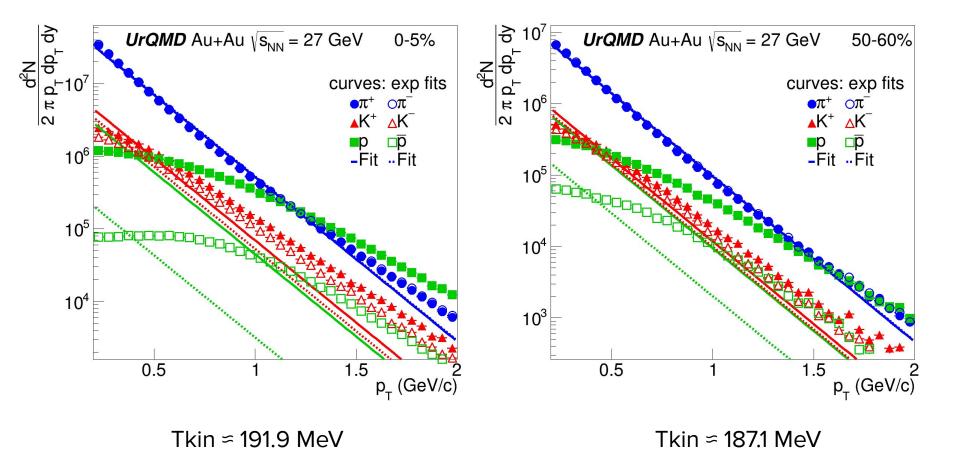
# Exponential fits of $\pi \pm$ , $K \pm$ , p and $\bar{}$ p pT spectra for 7.7 GeV



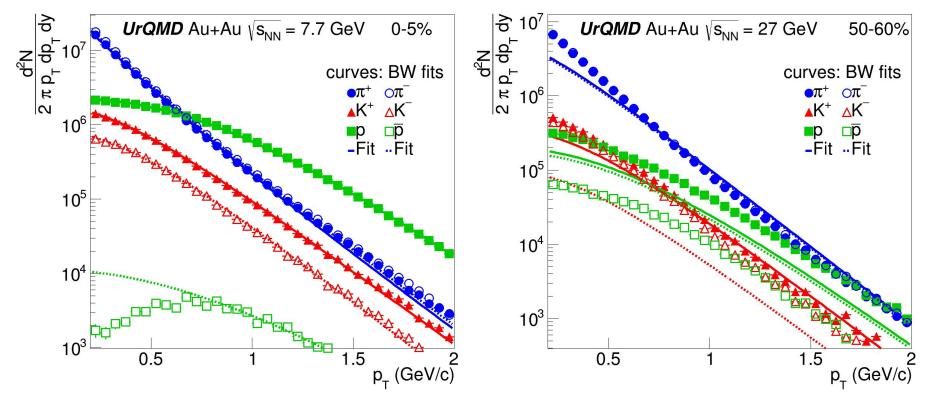
# Exponential fits of $\pi \pm$ , $K \pm$ , p and $\bar{}$ p pT spectra for 19.6 GeV



# Exponential fits of $\pi \pm$ , $K \pm$ , p and $\bar{}$ p pT spectra for 27 GeV



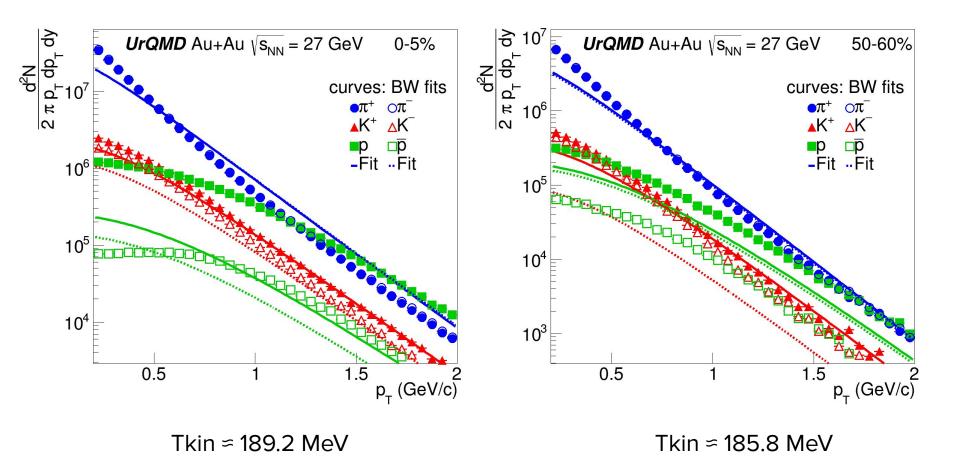
# Blastwave fits of $\pi \pm$ , K $\pm$ , p and $\bar{}$ p pT spectra for 7.7 GeV



Tkin ≈ 98.4 MeV

Tkin = 139.8 MeV

# Blastwave fits of $\pi \pm$ , $K \pm$ , p and $\bar{}$ p pT spectra for 27 GeV



# Blastwave fits of $\pi \pm$ , $K \pm$ , p and $\bar{}$ p pT spectra for 19.6 GeV

