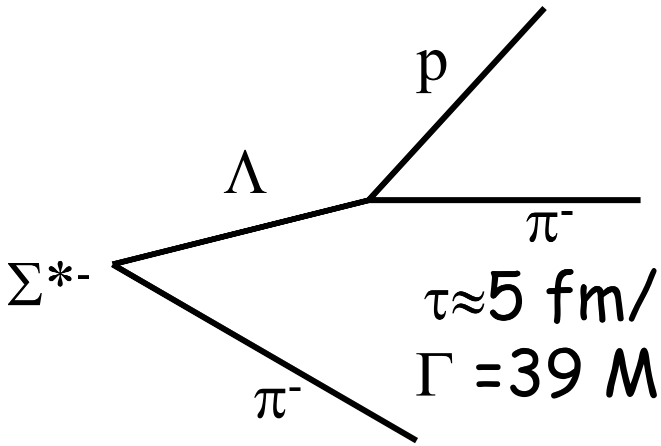
Σ^*(1385) Resonance Studies with STAR

- Motivations
- Techniques and Analysis
- Results
- Conclusions and Future Plans

The branching ratios

$\Sigma^{*-} \rightarrow \Lambda + \pi^-$ 88%

$\Lambda \rightarrow p + \pi^-$ 64%



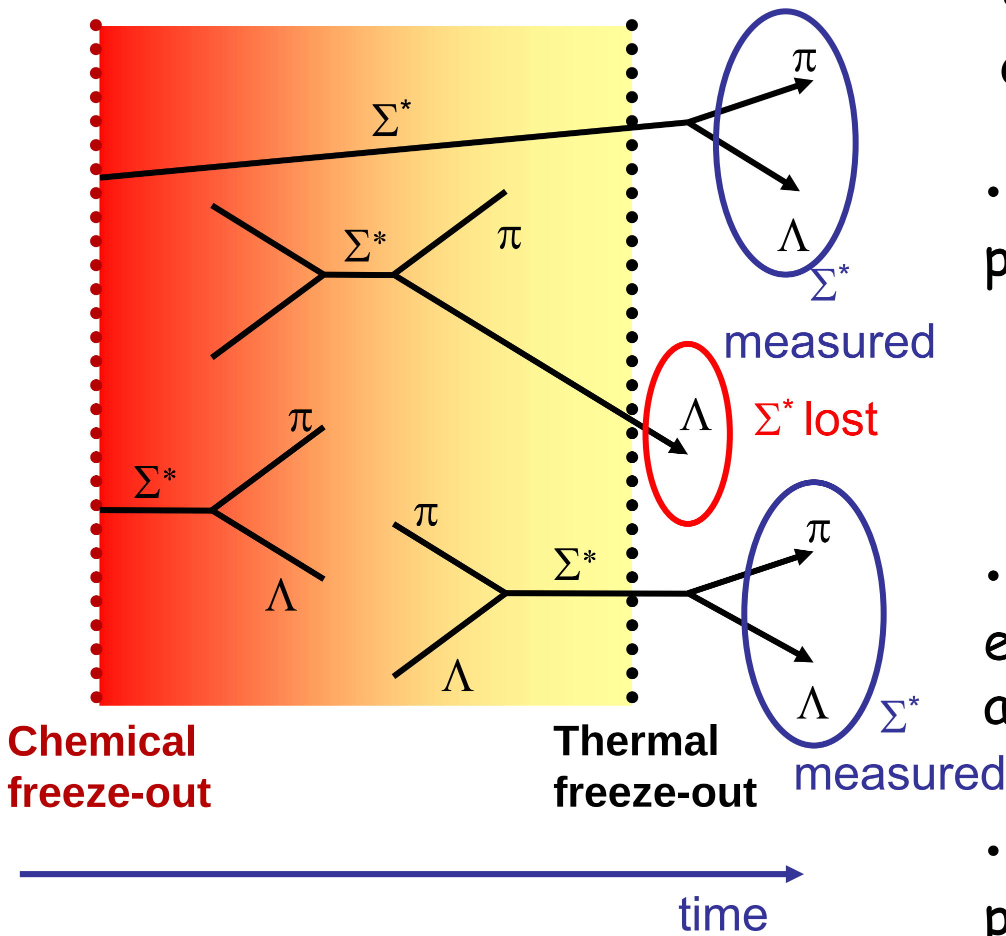
$\tau \approx 5$ fm/c ,

Γ =39 MeV

Sevil Salur Yale University STAR Collaboration

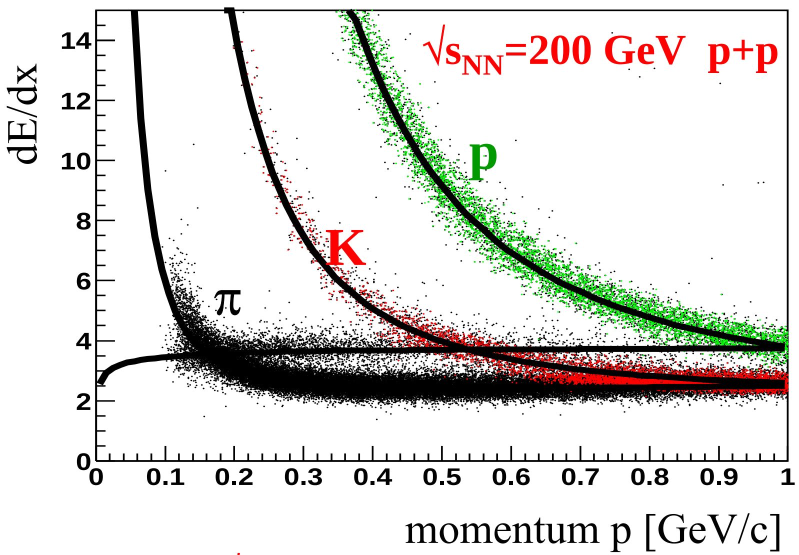
Theoretical Importance of Studying Resonances

Due to the very short lifetime (τ ~ few fm/c) of resonances:



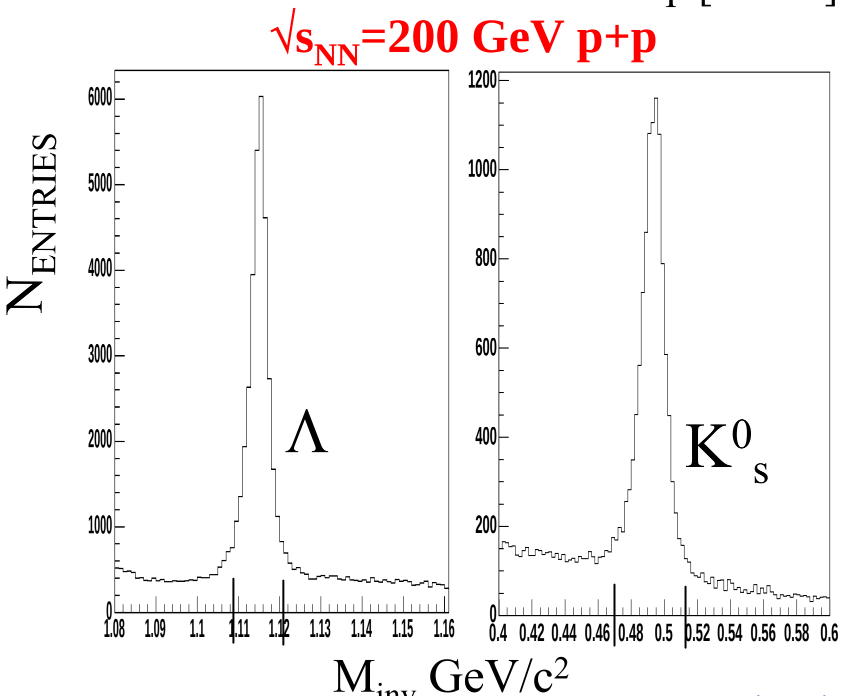
- Large fraction of the decays occur inside the reaction zone
- Possible change in the physical properties:
  - width broadening
  - mass shift
  - change in p_T spectra
- Determination of the hadronic expansion time between chemical and thermal freeze-out
- Information about strangeness production due the strange quark content and high mass of $\Sigma^*(1385)$

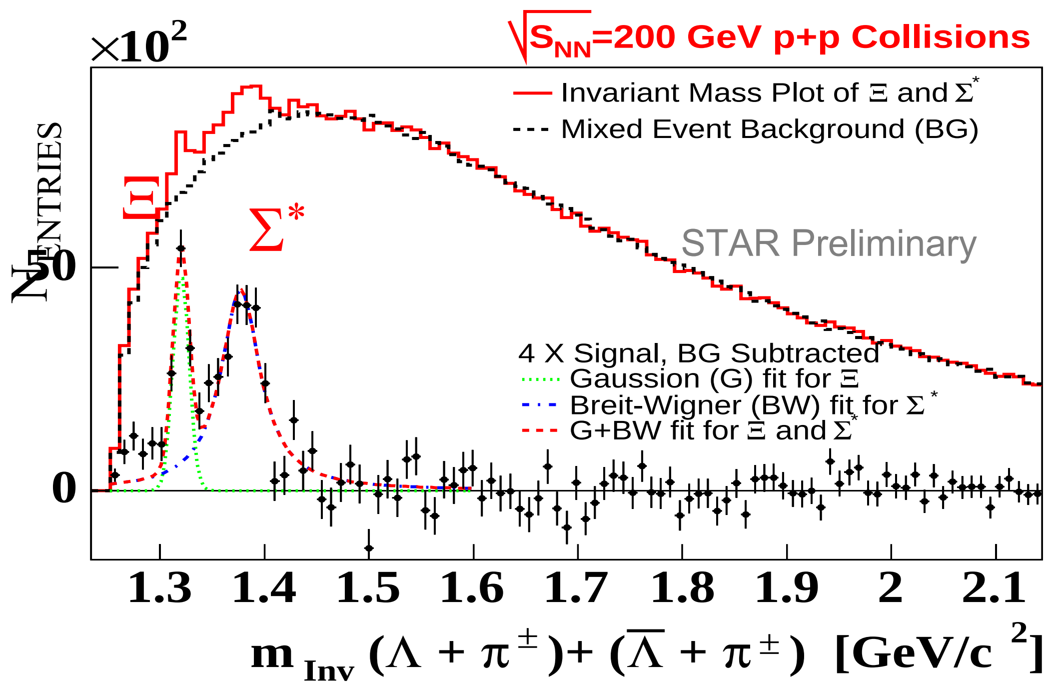
Particle Identification



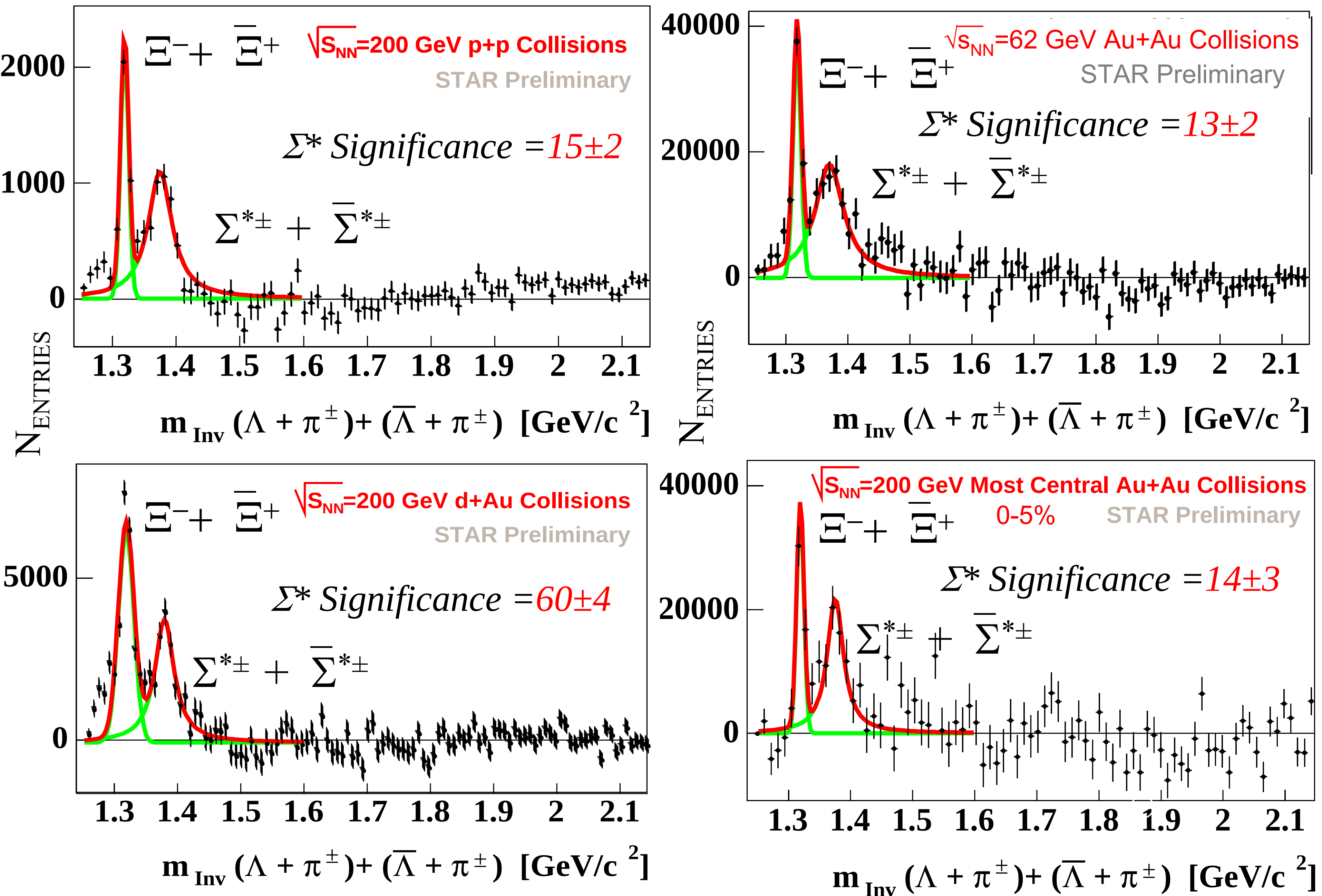
Charged daughter particles are identified by dE/dx in the TPC. Λ's and K^0_s are reconstructed by standard decay topology technique since they have a long lifetime ($c\tau_{\Lambda}$=7.89 cm, $c\tau_{K^0_S}$=2.7 cm)

$\Xi \rightarrow \Lambda + \pi^-$ and $\Sigma^{*\pm} \rightarrow \Lambda + \pi^{\pm}$





Background Subtracted Invariant Mass Spectra

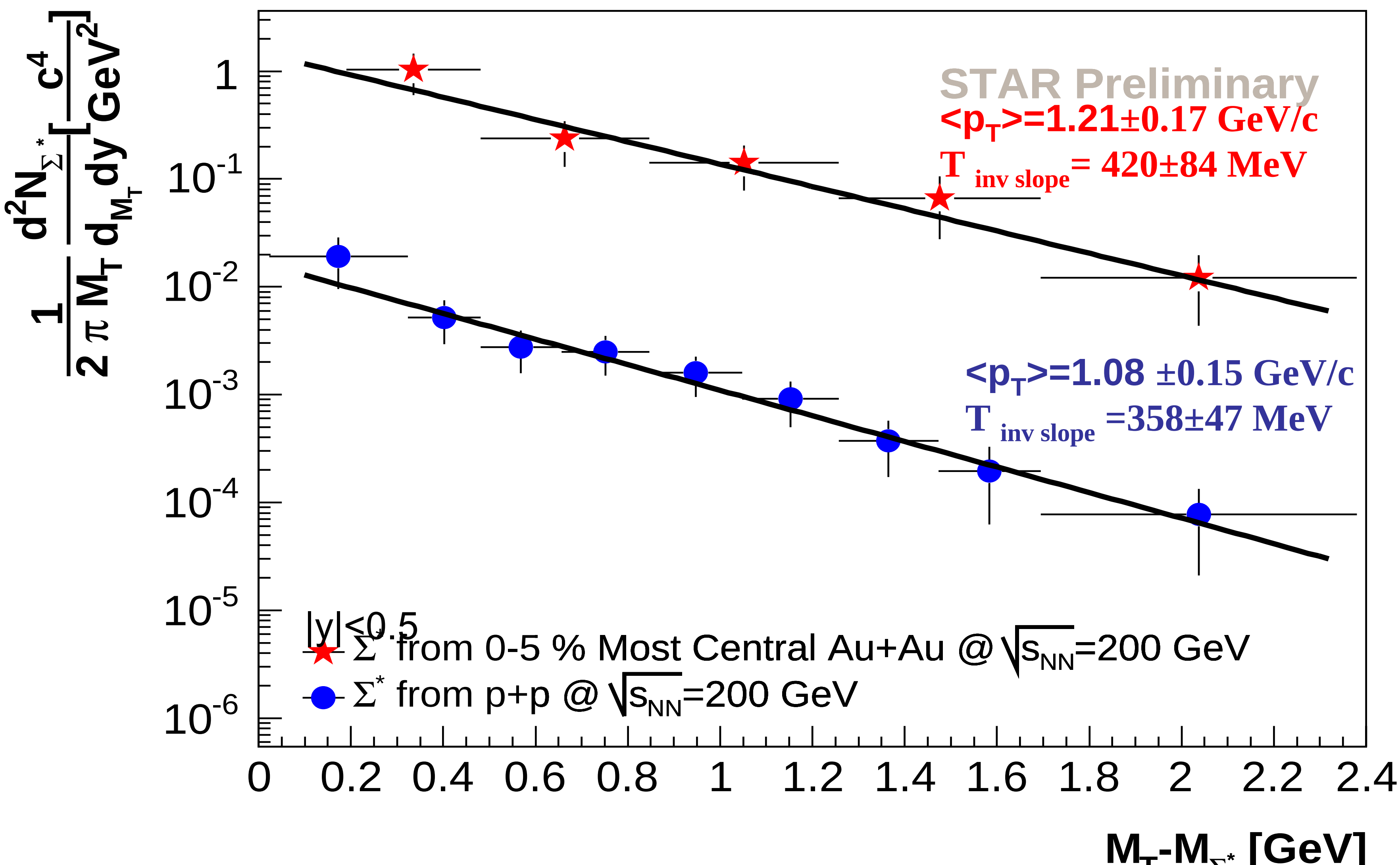


Σ* Corrected p_T Spectra

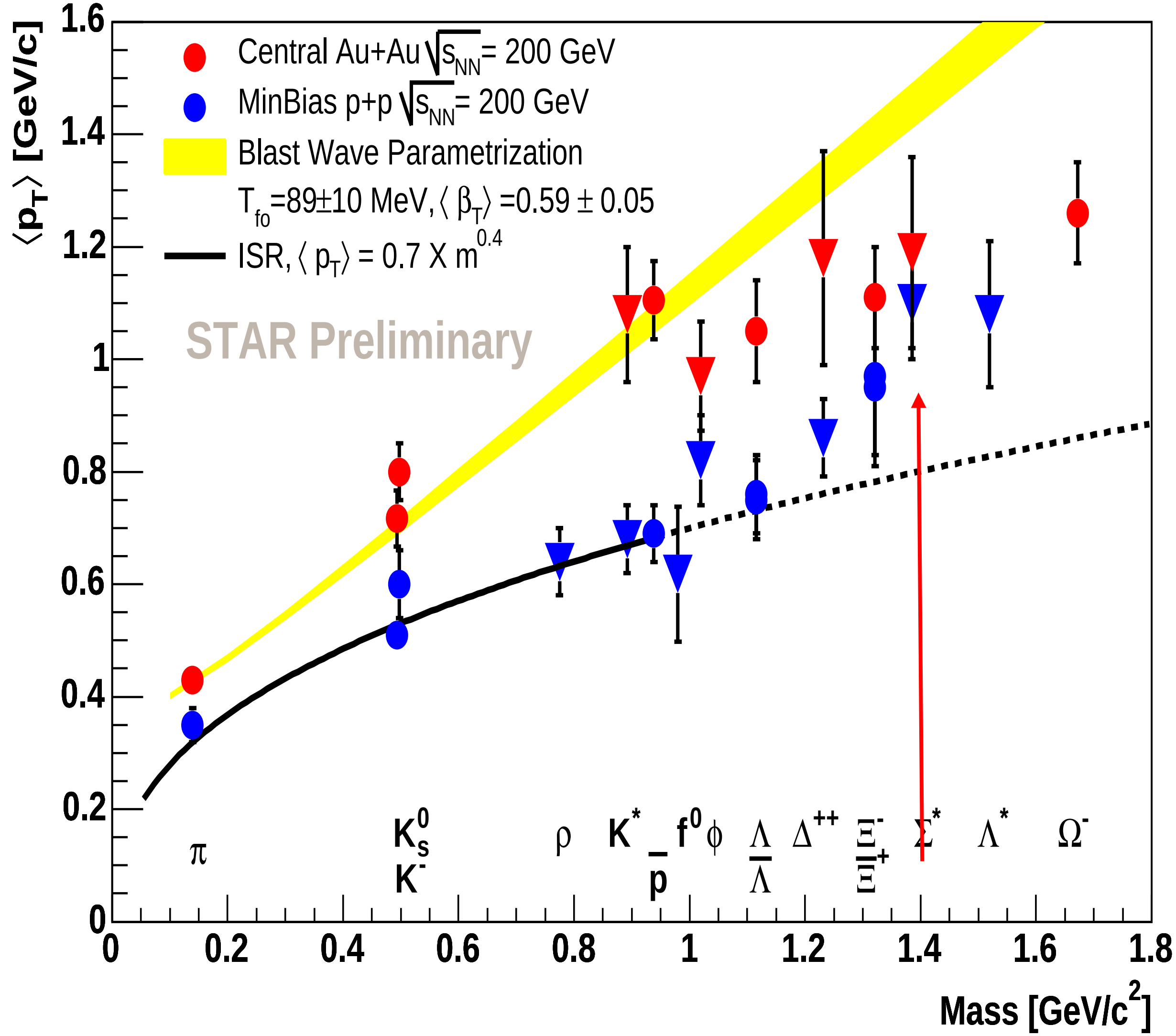
Exponential Fit Function :

$$m_T^2 = m^2 + p_T^2$$

$$\frac{1}{2\pi m_T}\frac{d^2N}{dm_T dy} = \frac{dN/dy}{2\pi T(m_0+T)} e^{\frac{-(m_T-m_0)}{T}}$$



Particle Mass vs $\langle p_T \rangle$



Blast Wave fit for π, k, and p deviates for the heavier particles in Au+Au.

Empirical Parameterization is from ISR π, K, and p (p+p at √s=26 GeV)

STAR π, k, and p $\langle p_T \rangle$ shows the same behavior with ISR

$\langle p_T \rangle$ values merge for Au+Au and p+p for heavier particles.

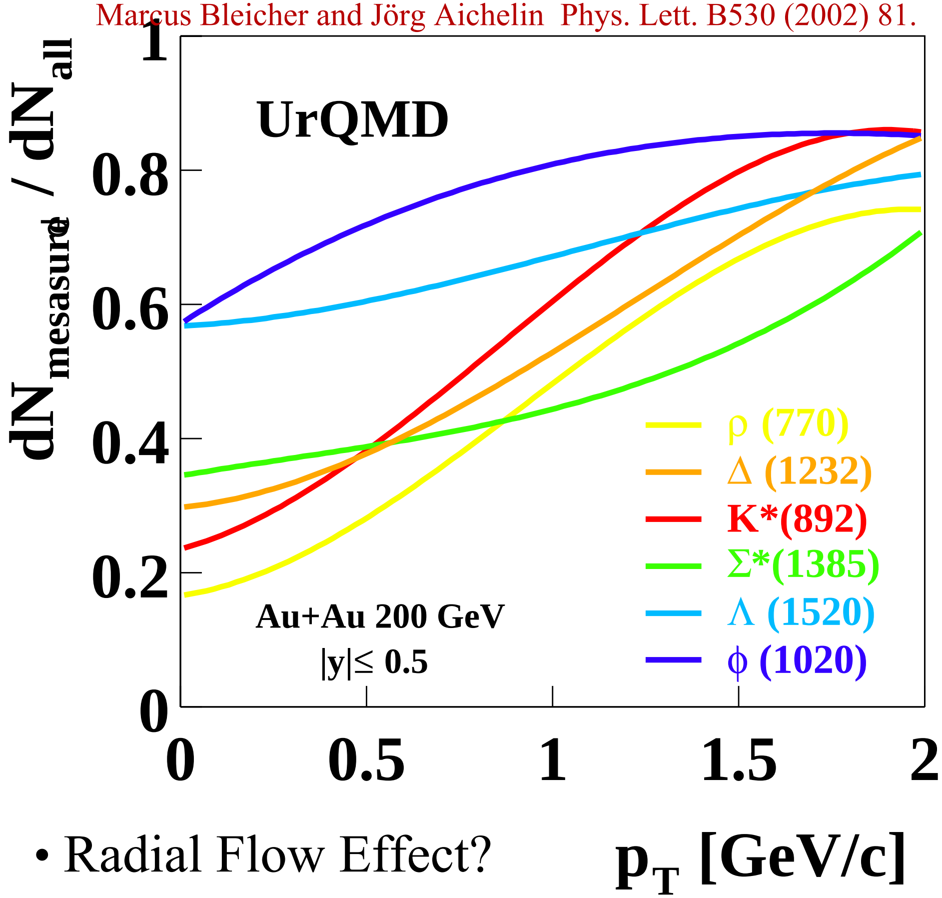
- Are heavier particles produced predominately in more violent p+p collisions?
- Do heavier particles flow less in Au+Au with respect to π?

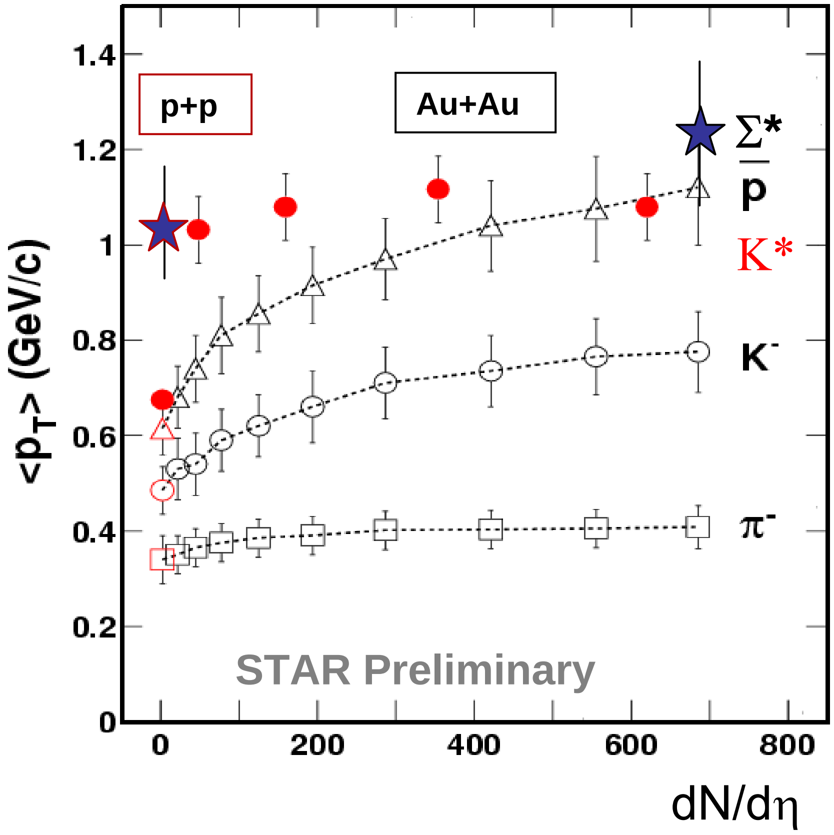
$\langle p_T \rangle$

There is no increase within the errors in Σ^* $\langle p_T \rangle$ from p+p to Au+Au.

UrQMD predicts increased signal loss at low p_T due to more rescattering than regeneration → $\langle p_T \rangle$ is higher.

Marcus Bleicher and Jörg Aichelin Phys. Lett. B530 (2002) 81.





- Radial Flow Effect?

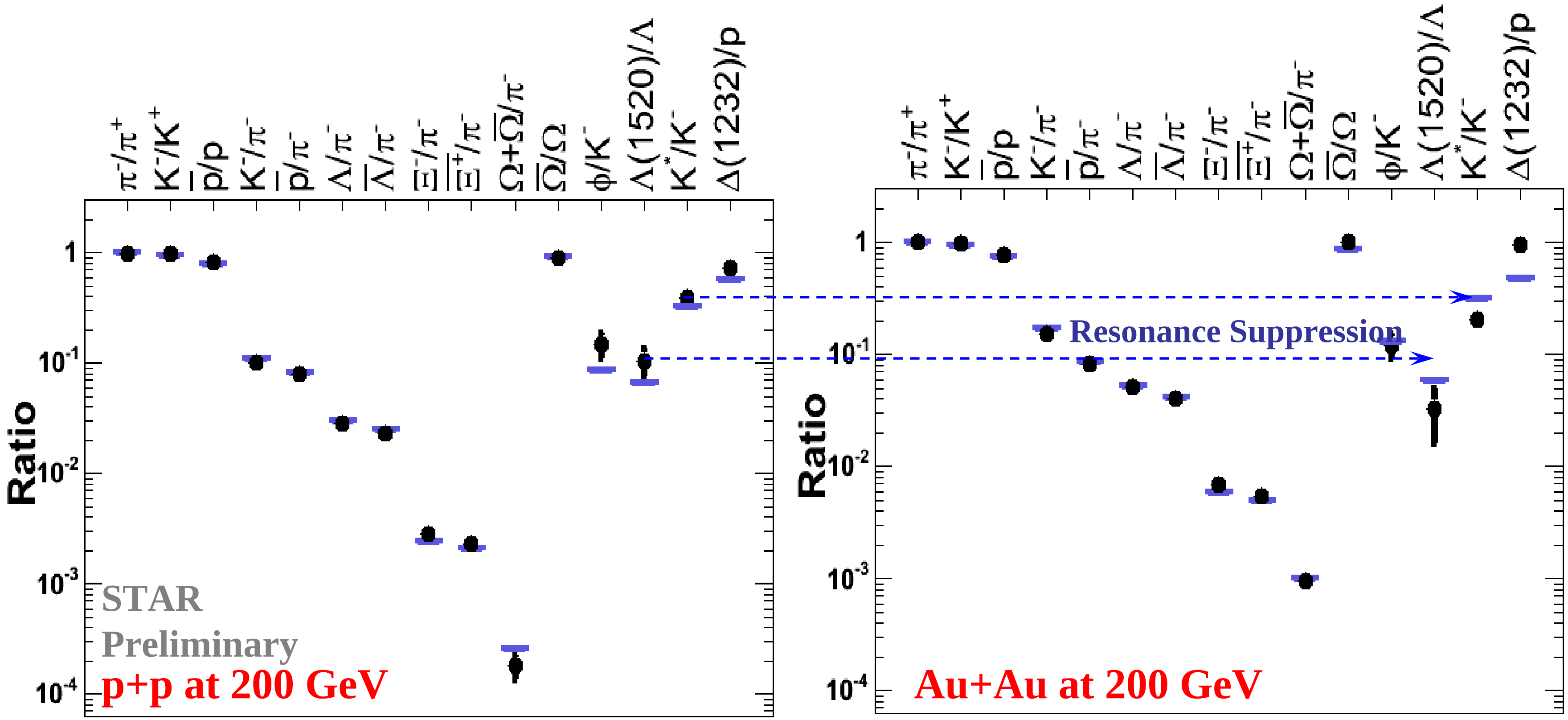
$\langle p_T \rangle$ for K* shows different behavior than p,K,π vs centrality.

Σ^*(1385) measurement in different centralities is on the way…

Statistical Model Particle Ratios

Ideal hadron resonance gas thermally and chemically equilibrated with grand canonical partition function for the density of particles ρ_I

Input: measured particle ratios → *Output:* T_{ch} and μ_B

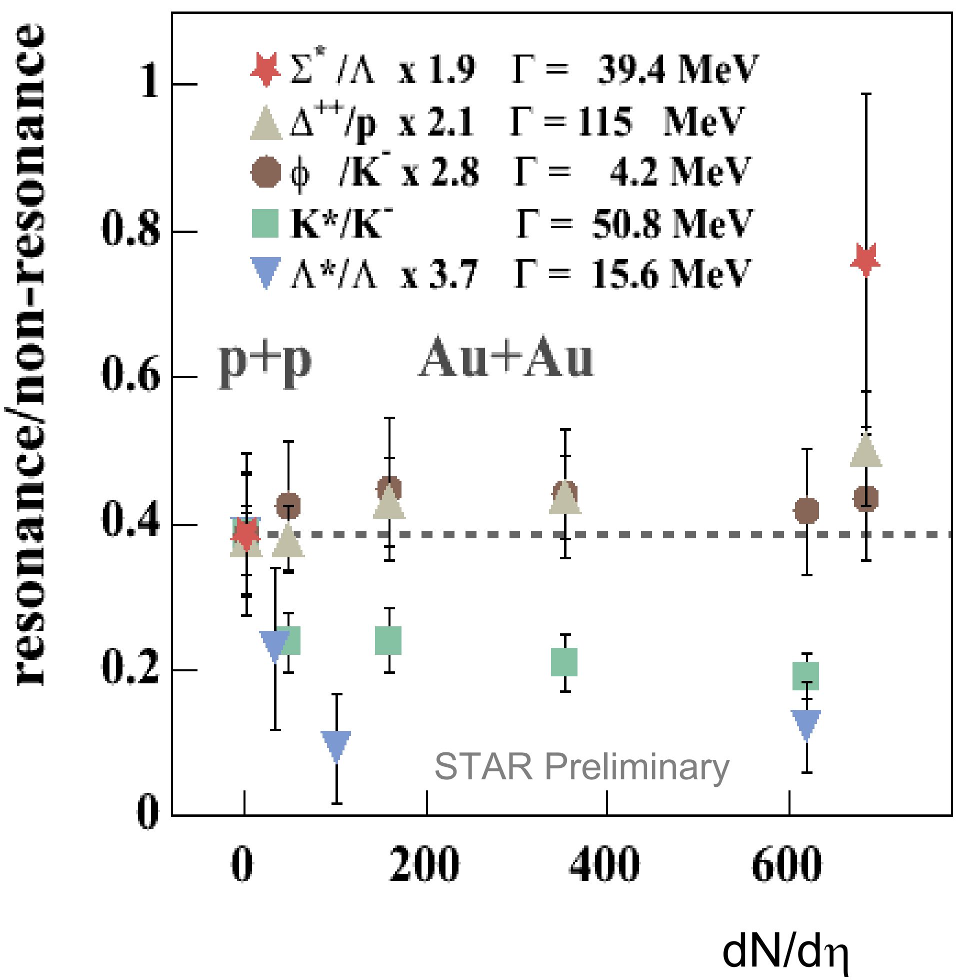


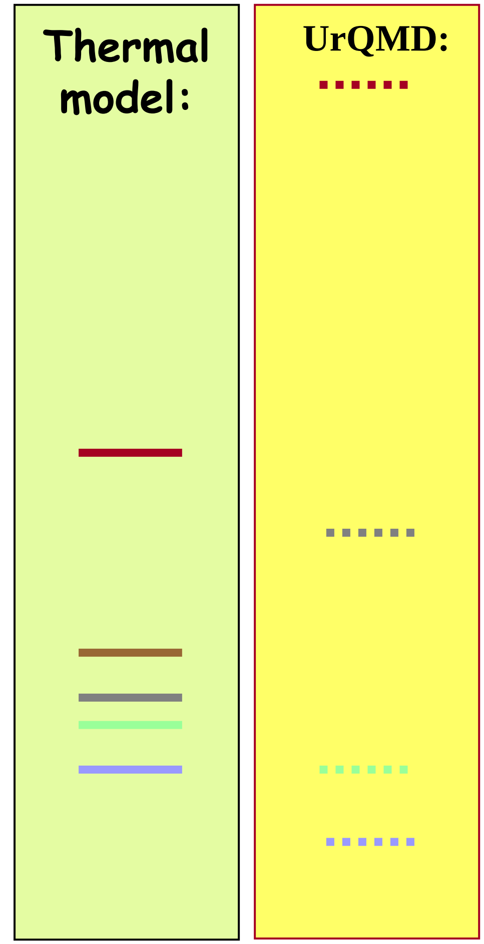
Stable particle ratios are well described for T_{ch}=160 MeV

Resonance ratios are not well described for T_{ch} = 160 MeV,

F. Becattini; P. Braun-Munzinger, M.Kaneta,J. Stachel, D. Magestro, J.Rafelski, J.Sollfrank et al.

Σ* Yields in p+p and Au+Au





P. Braun-Munzinger et.al., PLB 518(2001) 41
D.Magestro, M. Kaneta private communication
Marcus Bleicher and Jörg Aichelin
Phys. Lett. B530 (2002) 81. M. Bleicher and Horst Stöcker .Phys.G30 (2004) 111.

Re-scattering and regeneration are needed !

Conclusions & Near Future Plans

•Resonances can be clearly reconstructed via event mixing techniques in all collision environments with STAR. There is no strong increase of $\langle p_T \rangle$ from p+p to 0-5 % Central Au+Au. Less radial flow ? Different production mechanisms (jets in p+p)?

•There is no suppression or enhancement in the ratios of Σ^*/Λ in p+p and 0-5% Central Au+Au collisions within the errors.

Models (Thermal, UrQMD) do not describe the resonance ratios

Re-scattering and regeneration are needed in Au+Au Collisions.

•Much more data is available in the disks !!! Better centrality measurement for Σ^*. Au+Au at $\sqrt{s_{NN}}$=200 GeV 50 Million Events taken. (35 times the current data).

•We use these techniques to search for exotic particles like dibaryons and pentaquarks.

More to come soon...