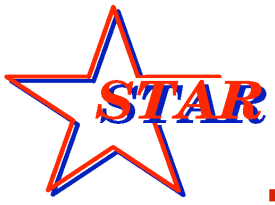


Highlights from STAR

Kai Schweda
Lawrence Berkeley National Laboratory
for the STAR Collaboration

Physics Goals

Identify and study the properties of matter with partonic degrees of freedom:

- nuclear effects at intermediate and high p_T

initial conditions

parton energy loss due to interaction in dense matter

- bulk properties

collision dynamics

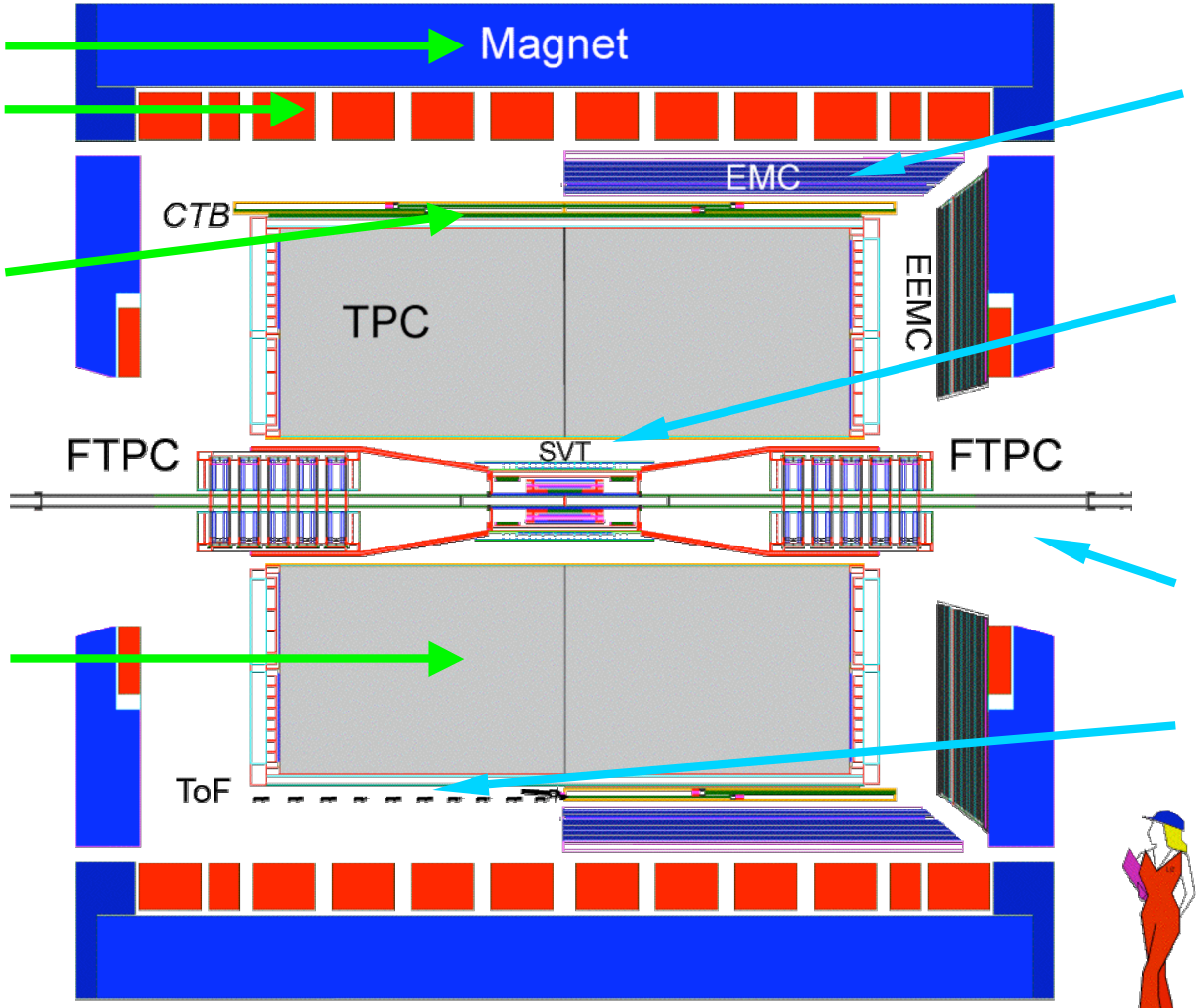
collective motion with partonic degrees of freedom

partonic equation of state

Outline

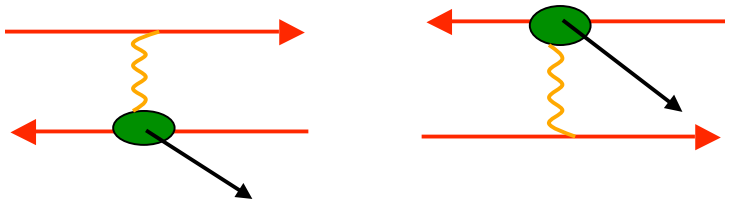
1) Introduction
2) Ultra peripheral collisions
3) Results from intermediate and high p_t (above 2GeV/c)
   - suppression of particle yields
   - jet-like correlations
4) Results of bulk properties
   - azimuthal anisotropy
   - particle distributions and yields
5) Open charm measurements in d + Au
6) Summary

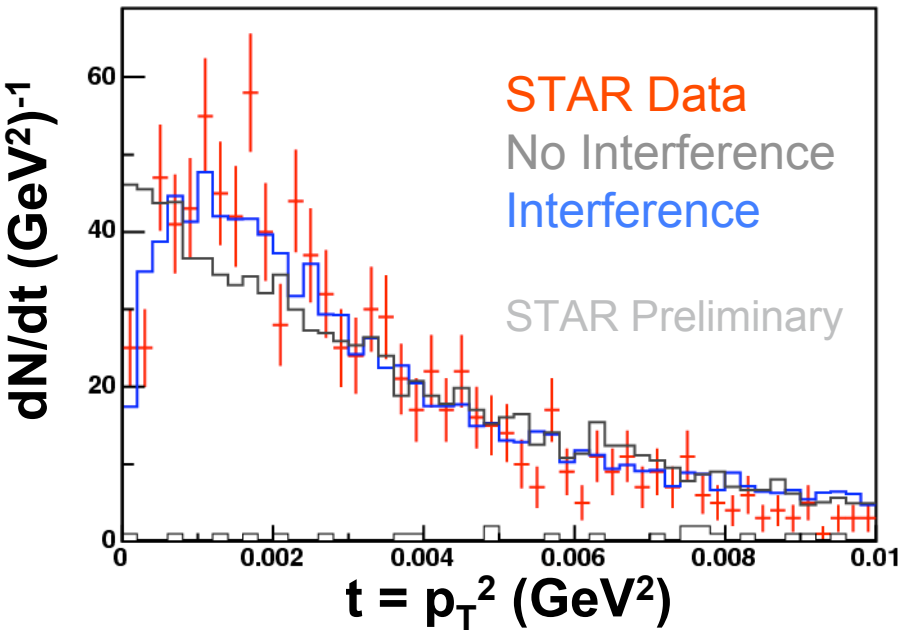
The STAR Detector



Ultra Peripheral Collisions in STAR:

Interference in Au + Au → Au*Au*ρ⁰





• AuAu→Au*Au* e⁺e⁻:strong field QED

Au+Au at 200 GeV

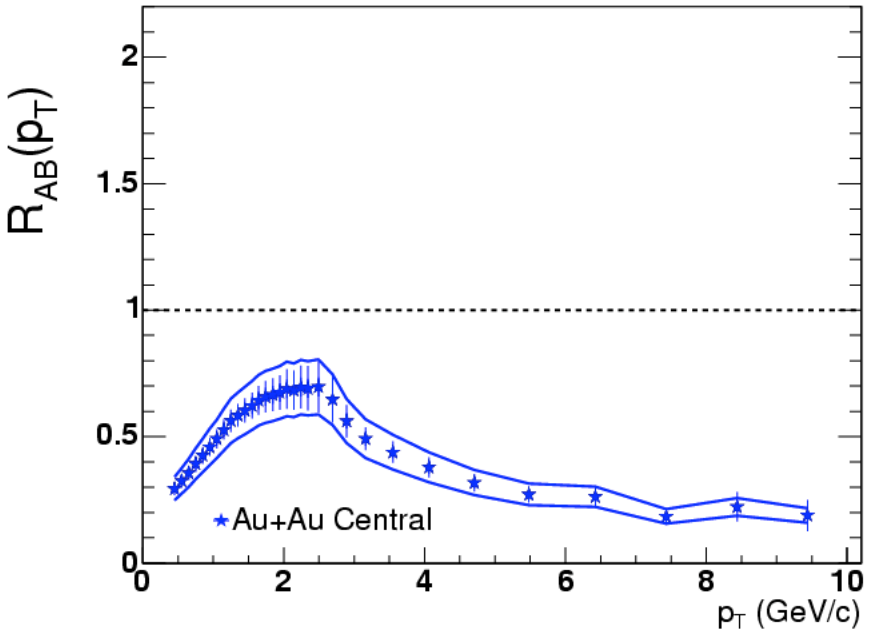
Two indistinguishable possibilities:

1) A photon from nucleus 1 scatters from 2
2) A photon from nucleus 2 scatters from 1

- Clear signal of interference!
- ρ⁰ wave function non-local !
- Wave functions contains all amplitudes long after the ρ⁰-decay

See poster by S.R. Klein, HBT10.

d+Au at High-pt

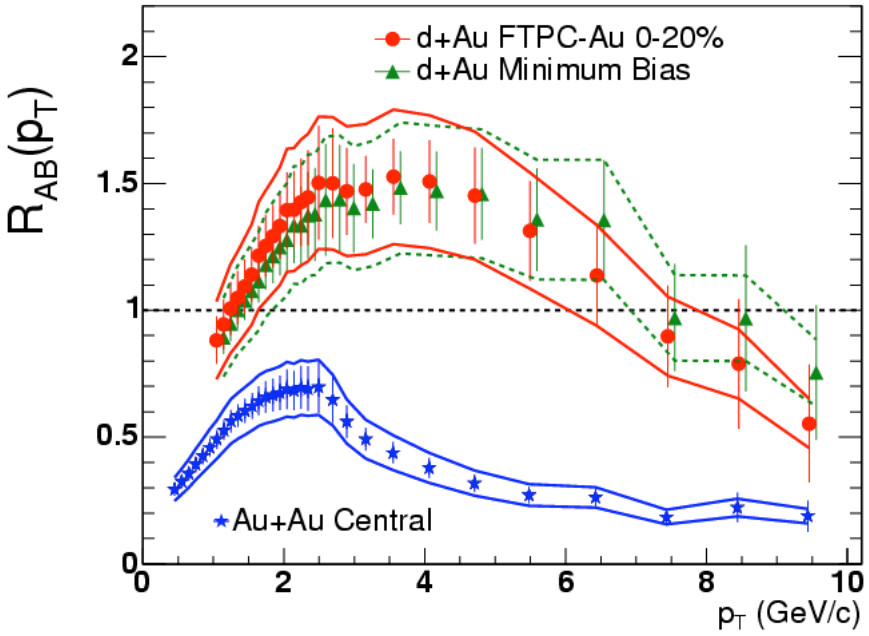


- Au + Au, $R_{AA} << 1$; d+Au, $R_{dAu} > 1$
- p+p, away side jet exists
- Au + Au, away-side correlation suppressed
- d+Au, away-side correlation exists

→ jet quenching ?

J. Adams et al., Phys. Rev. Lett. 91, 072304 (2003).

d+Au at High-pt



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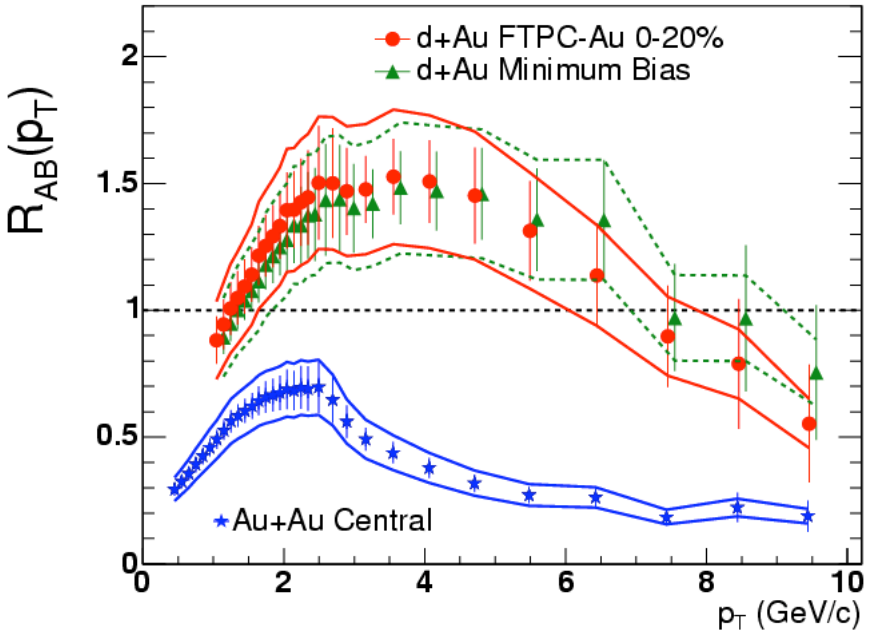

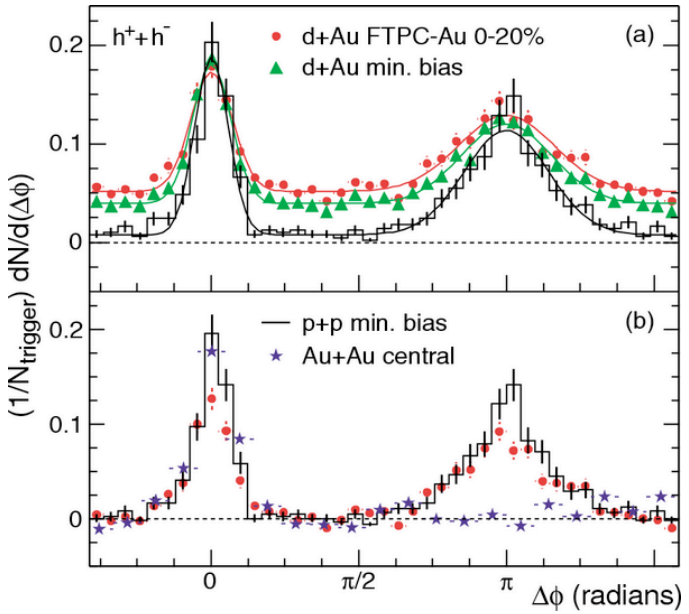

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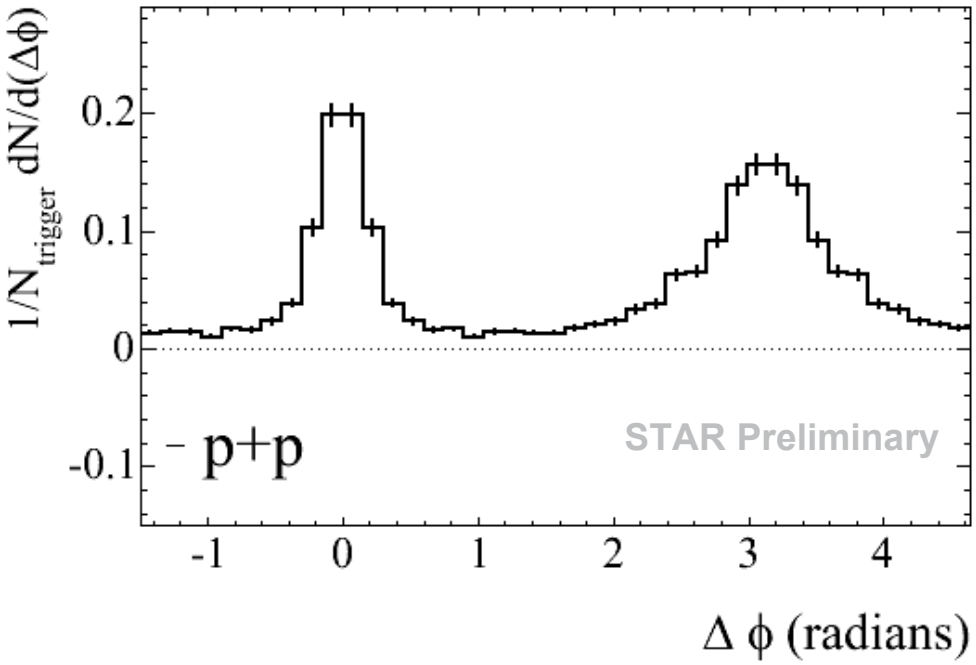
Triggered Correlation Studies

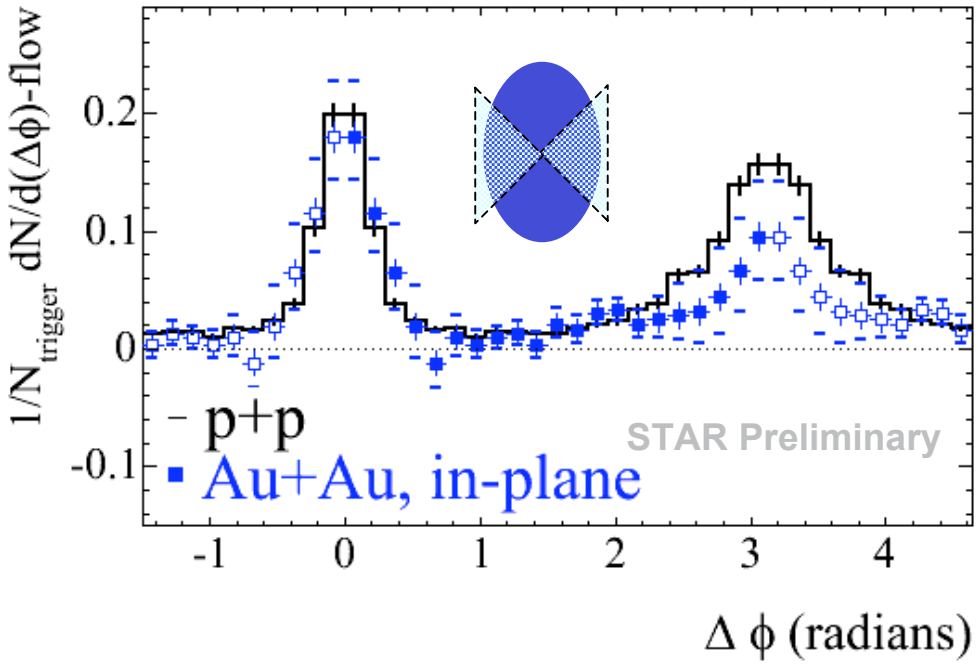


- Au+Au: Away-side suppression is larger in the out-of-plane direction compared to in-plane
- blue band: <pt> in away-side correlation, decreases with centrality
- solid line: $<p_t>$ of bulk, increases with centrality → transverse radial flow

→ jet quenching ?

See talk by F. Wang, P1 Fri and A.H. Tang P3 Thu..

Triggered Correlation Studies



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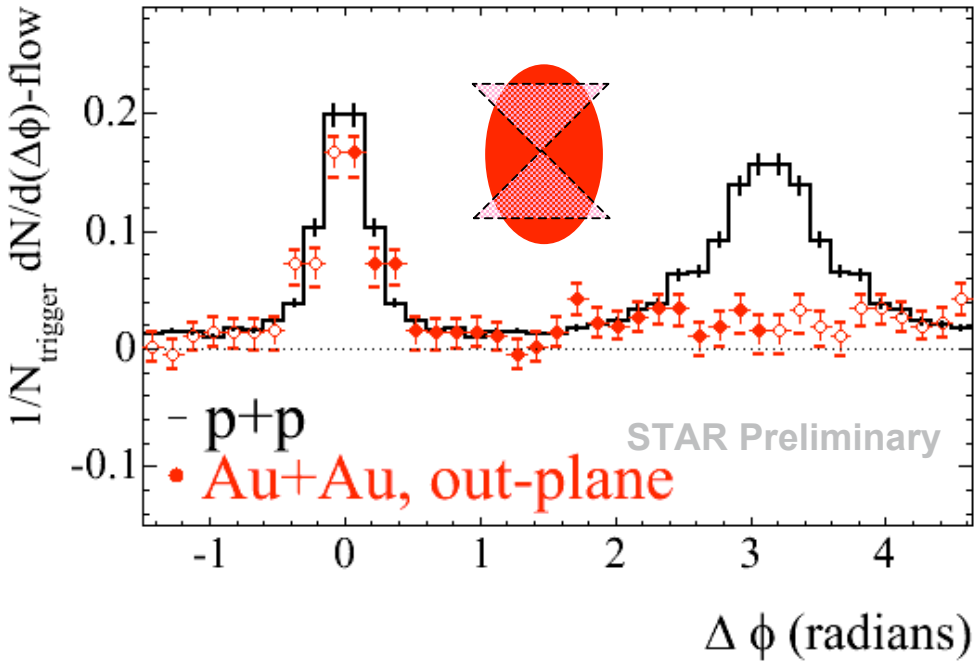

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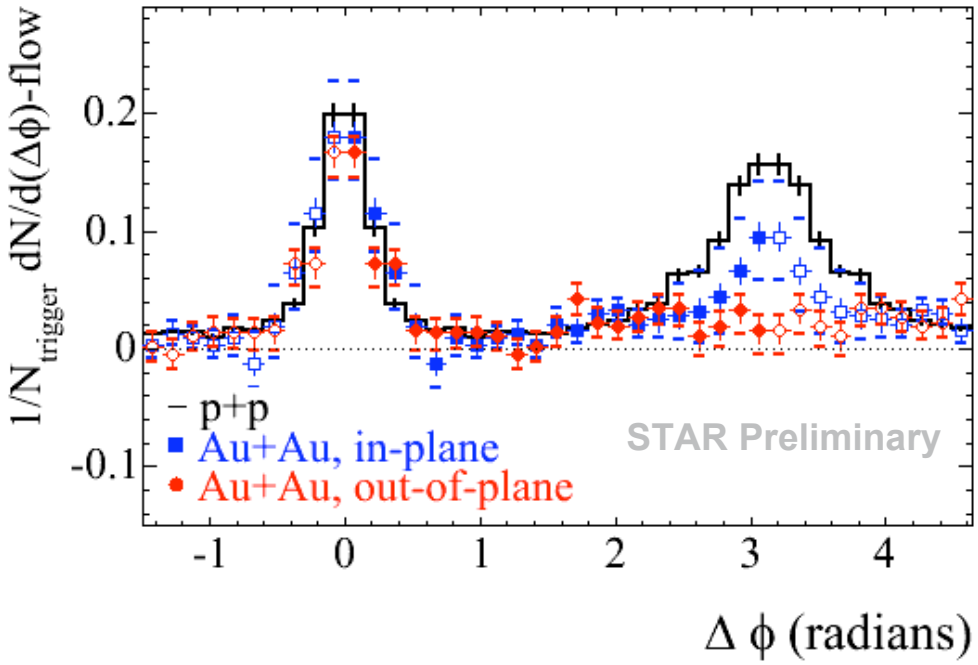

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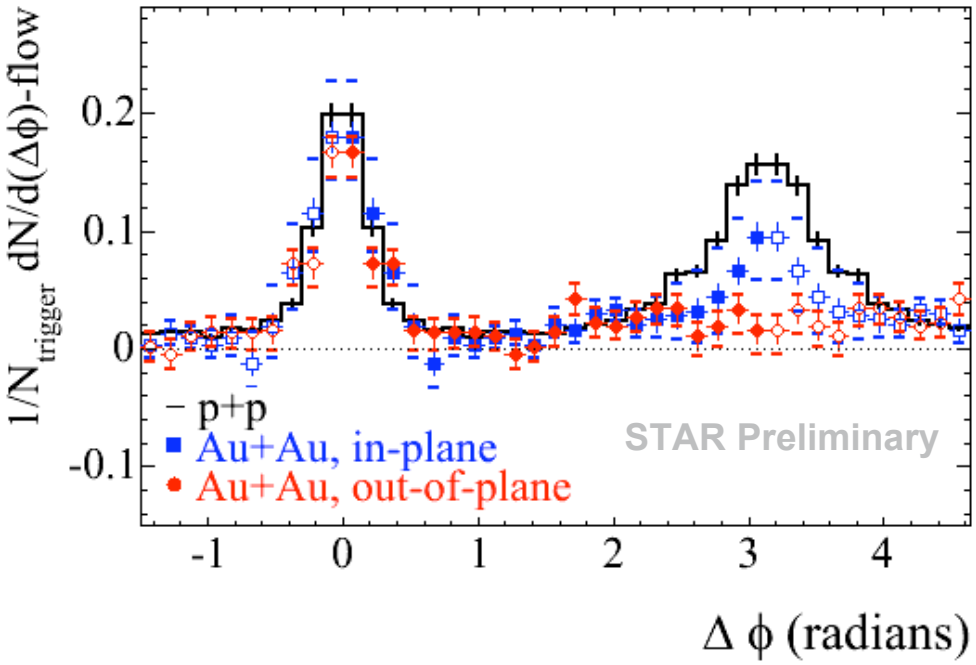

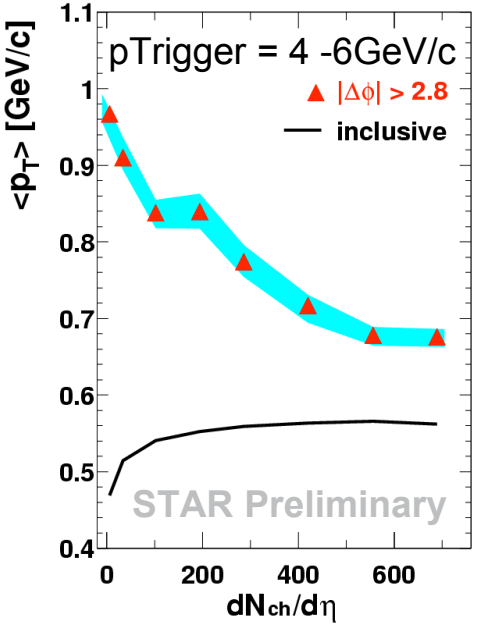

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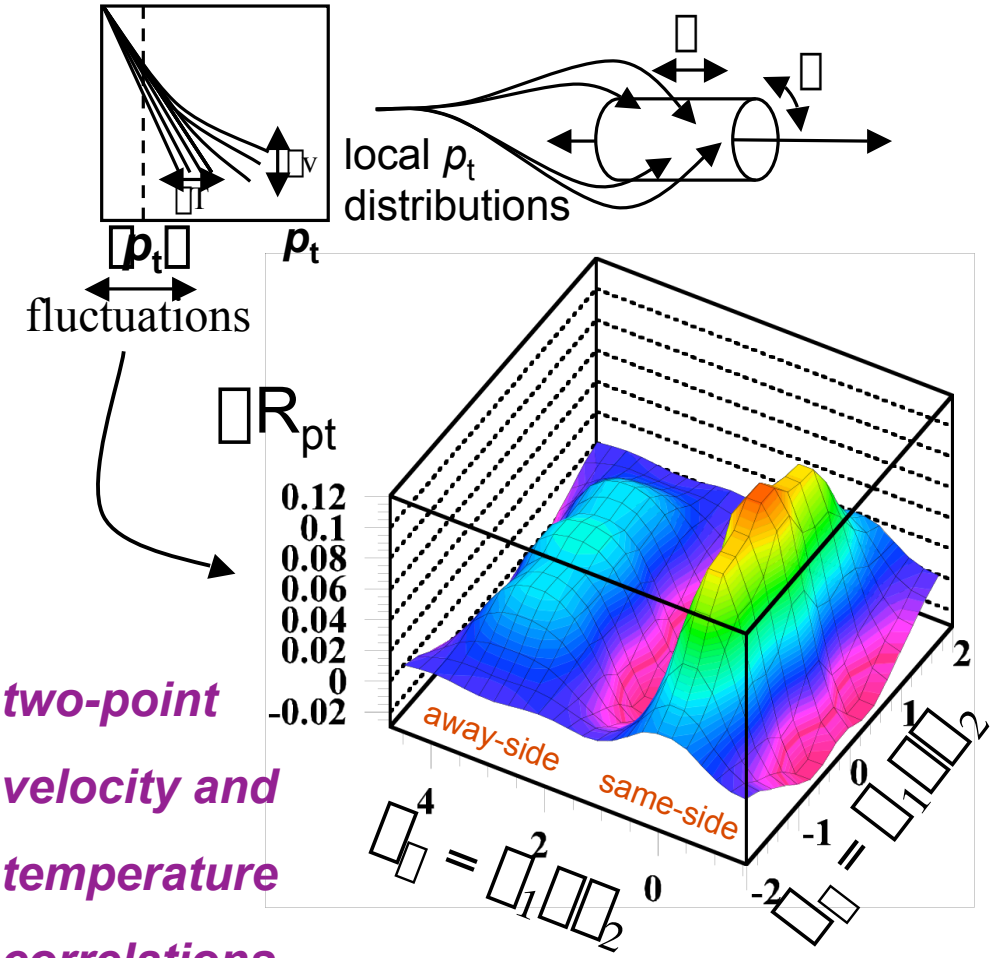
Two-Particle p_t Correlations



two-point velocity and temperature correlations

Au+Au @200GeV, 20 – 30% central, $|\eta| < 1$

Dipole and quadrupole terms removed.

Observation, with centrality p_t = 0.15 – 2.00 GeV/c

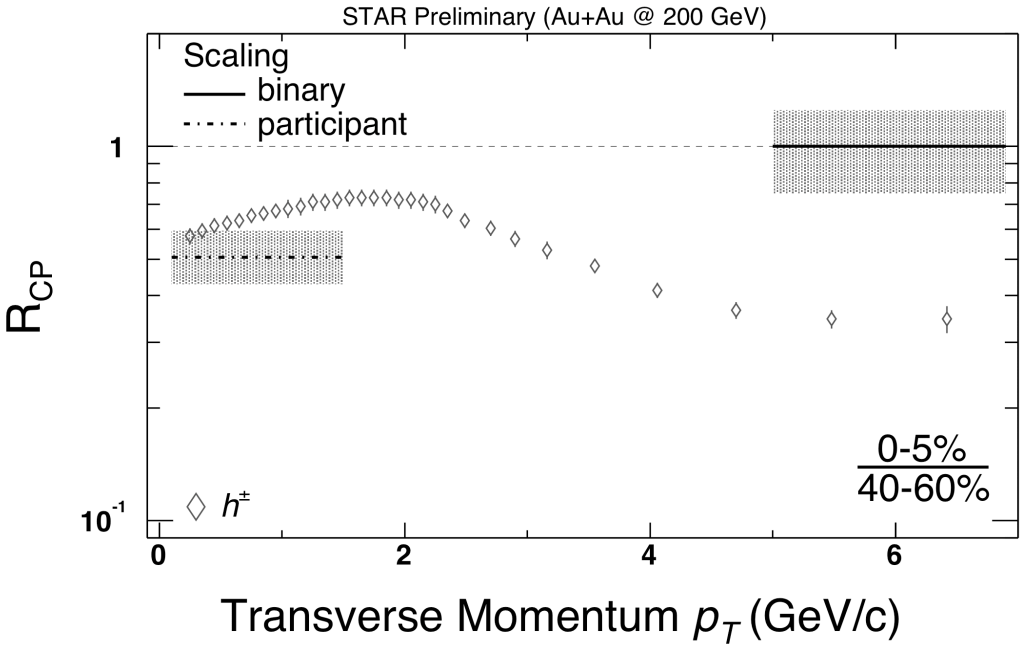
- Suppression of away/same-side amplitude ratio
- Elongation of same-side peak on η_Δ (possibly related to longitudinal expansion)
- Narrowing of same-side peak on ϕ_Δ

More on correlations from STAR:

See talk by G. Westfall, P4 Fluctuation and Corr. Fri;

See posters by J.G. Cramer, M. Kopytine, J. Porter, D. Prindle, C. Pruneau, J. Putschke, R.L. Ray; Cor5-9, 19, 22, 26.

R_{CP} of Strange Hadrons



- Two groups ($2<p_t<6$GeV/c):
  - K^0_s, $K^{\pm}$, K^*, □ → mesons
  - □, □, □ → baryons
- dependence on number of valence quarks
- limited to $p_t<6$GeV/c ?
- hadron production from quark coalescence ?

See talk by M. A.C. Lamont, P1 Thu.

See posters by H. Long Strange13, J. Ma Spectra31 and H. Zhang Spectra38.

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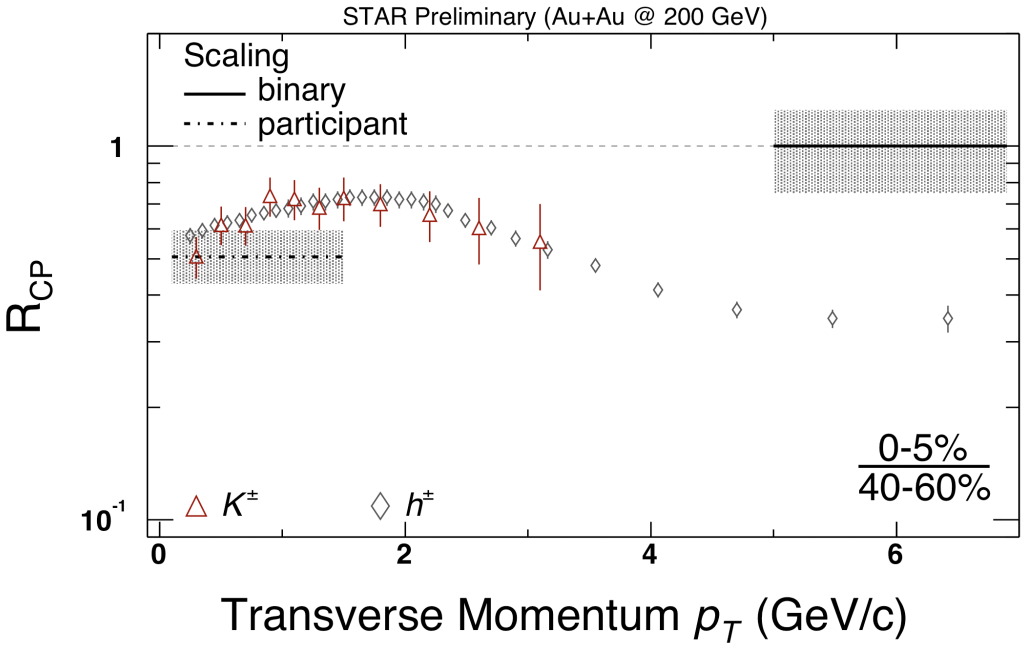

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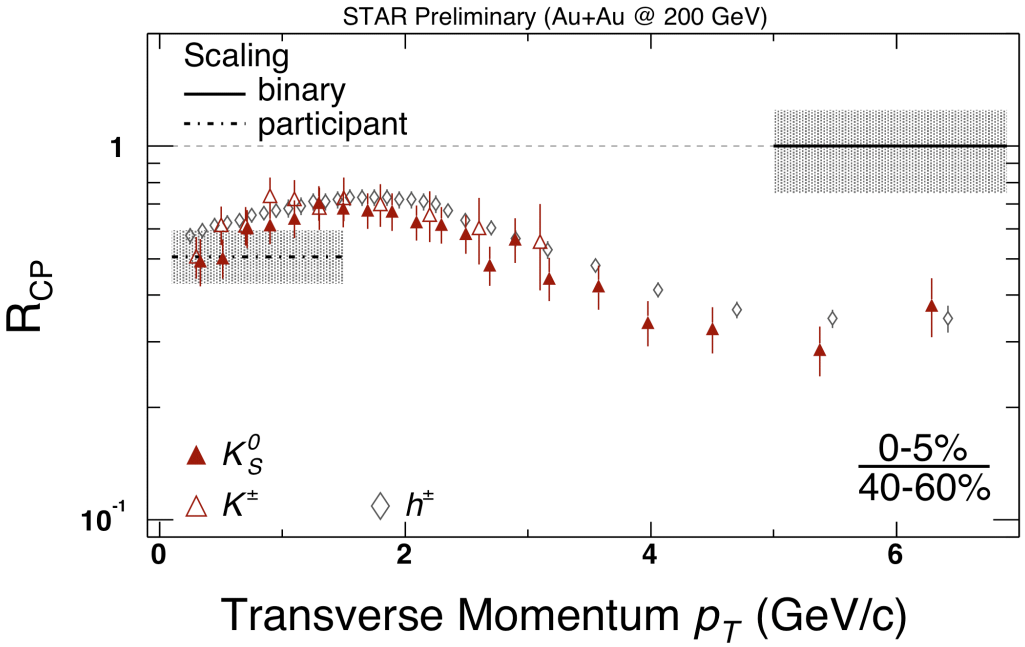

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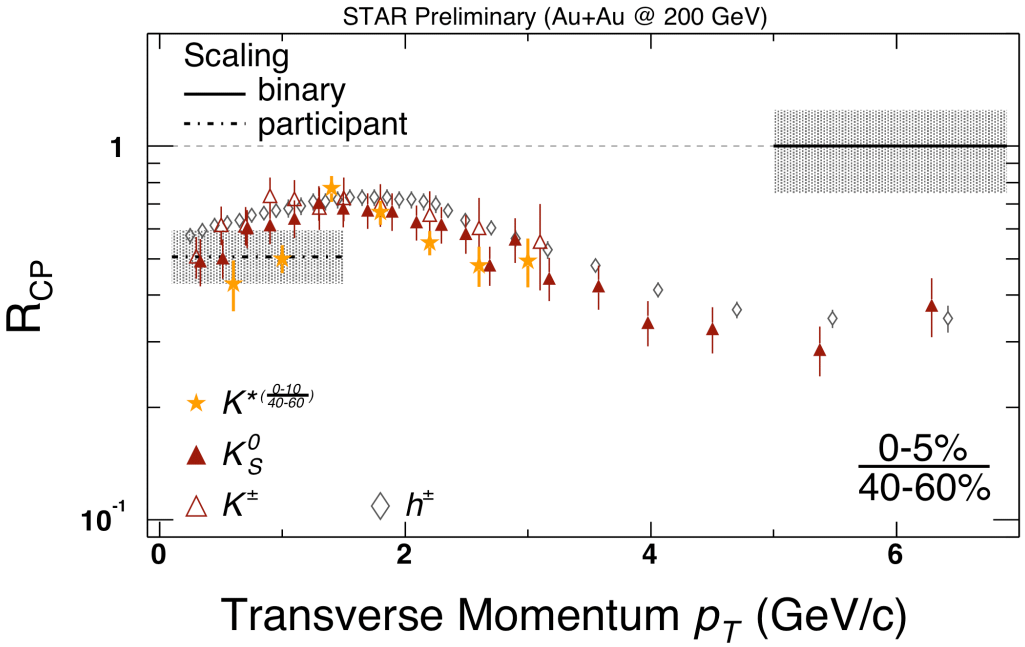

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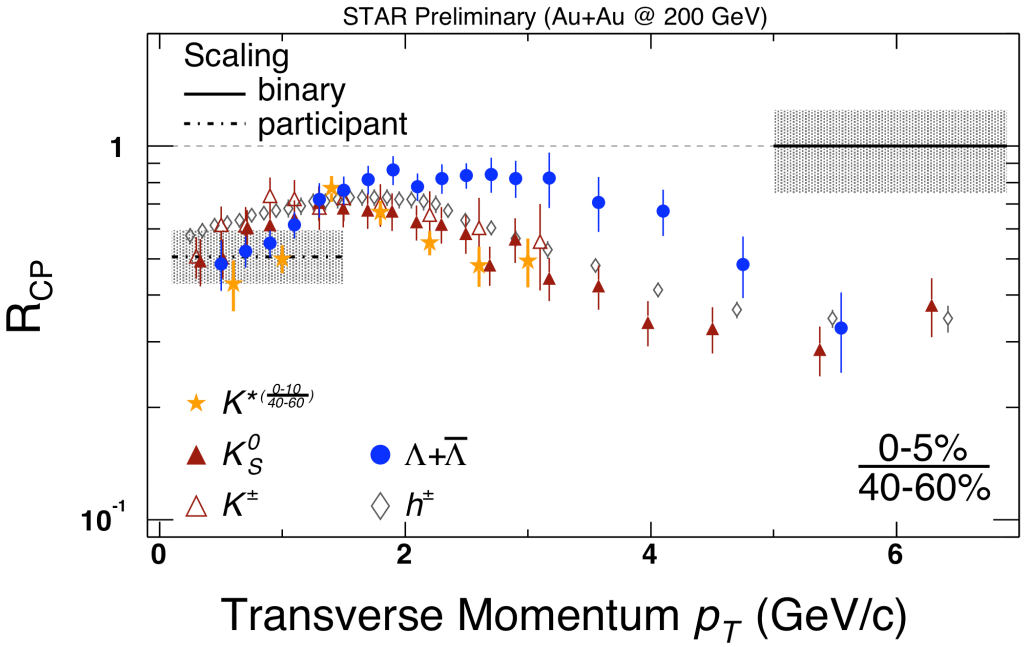

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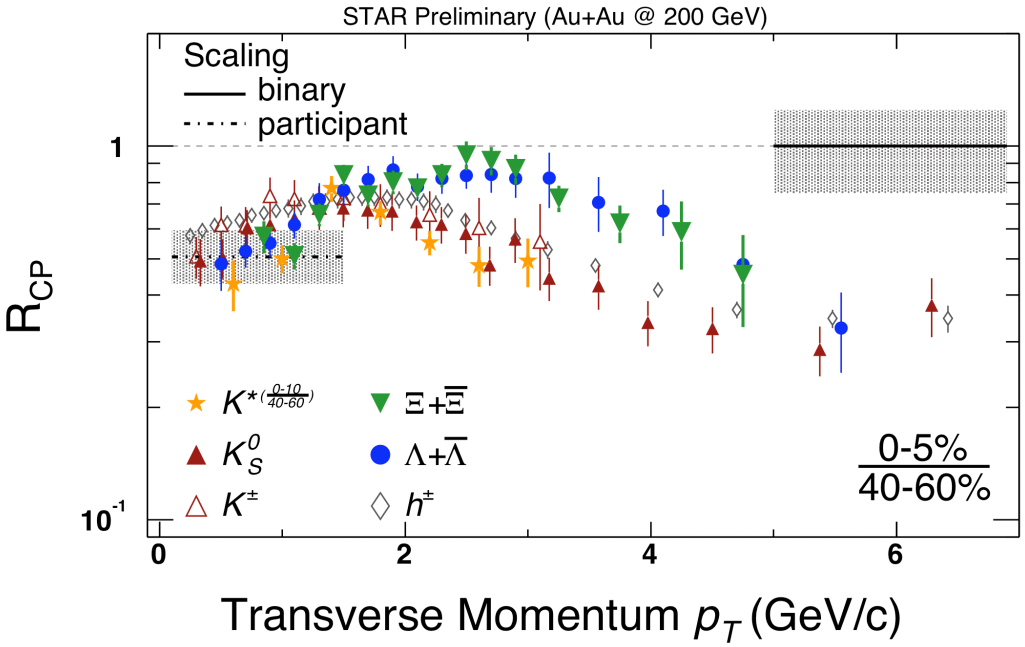

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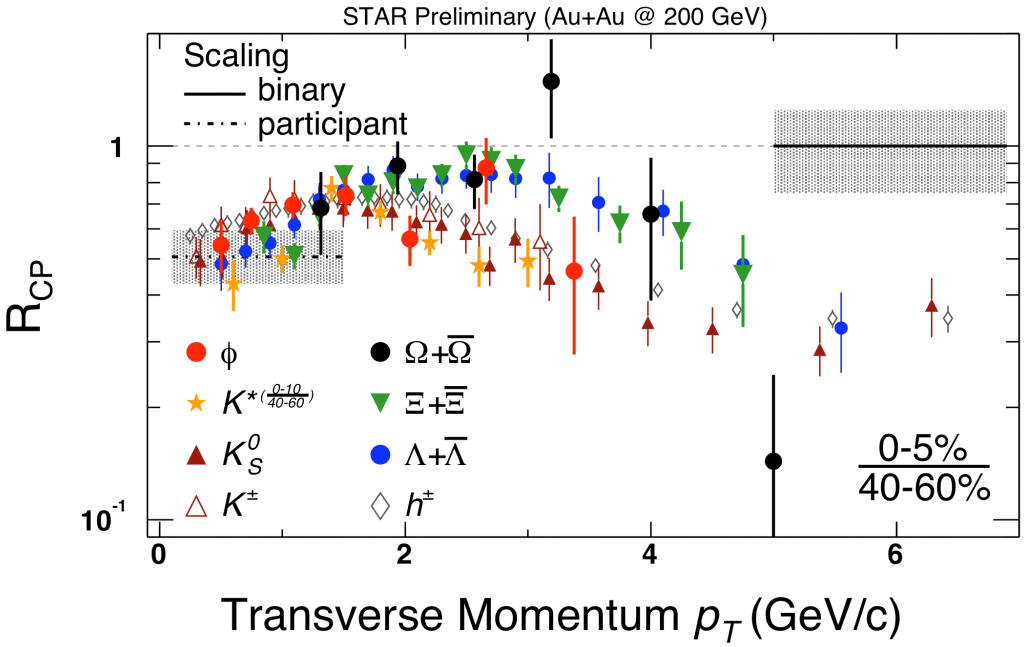

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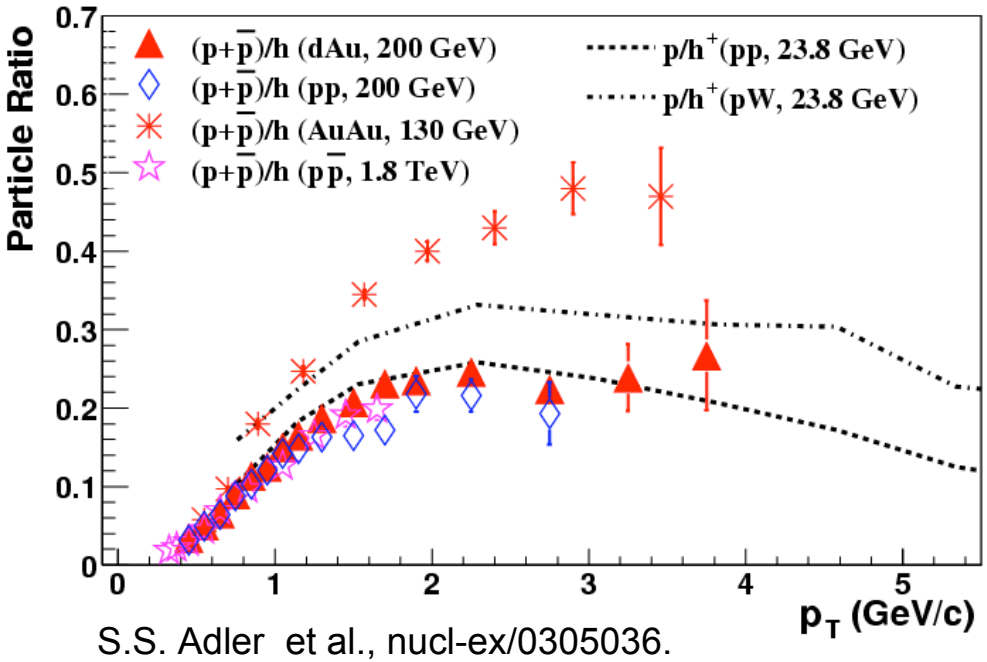
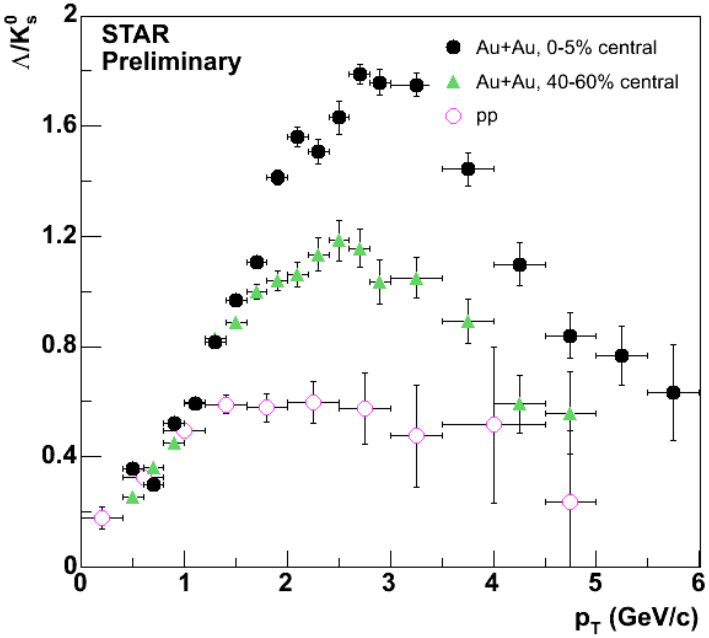
Baryon Enhancement



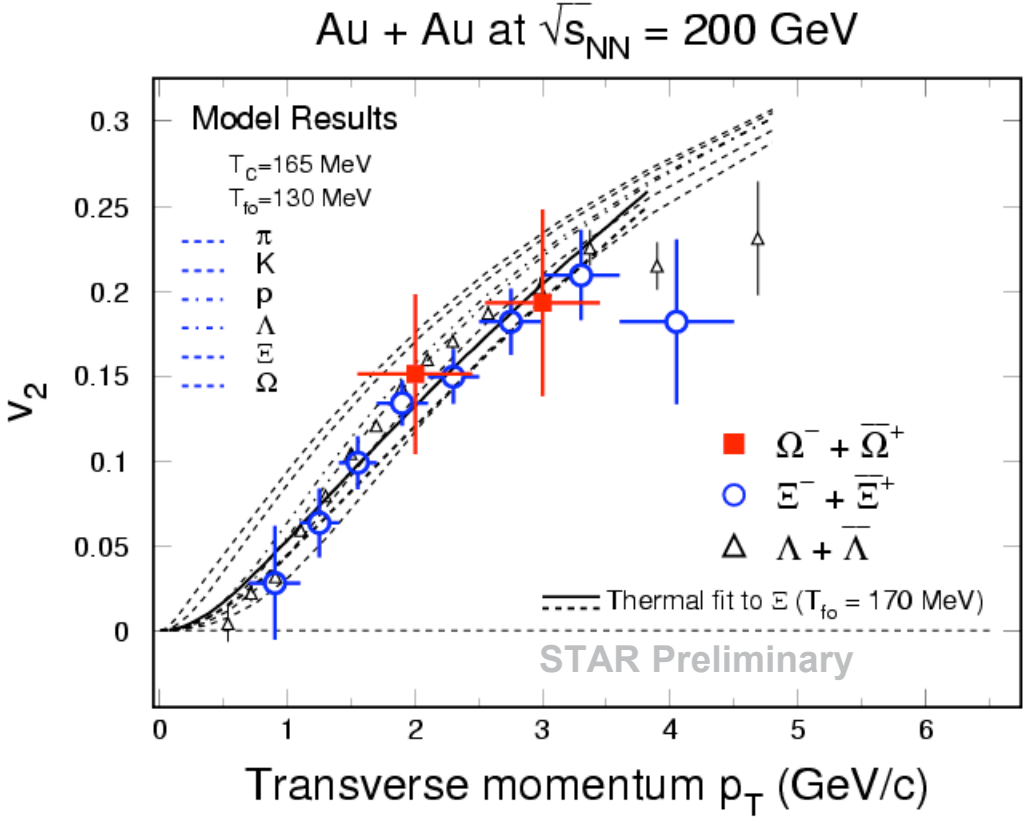
S.S. Adler et al., nucl-ex/0305036.



- p+pbar/h enhancement in Au + Au not fully explained by Cronin effect
- Strong baryon/meson modification in Au + Au also in □/K^0_s ratio

See talks by L. Ruan, P2 Thu, L. Barnby, P1 Thu, M. A.C. Lamont, P1 Thu.

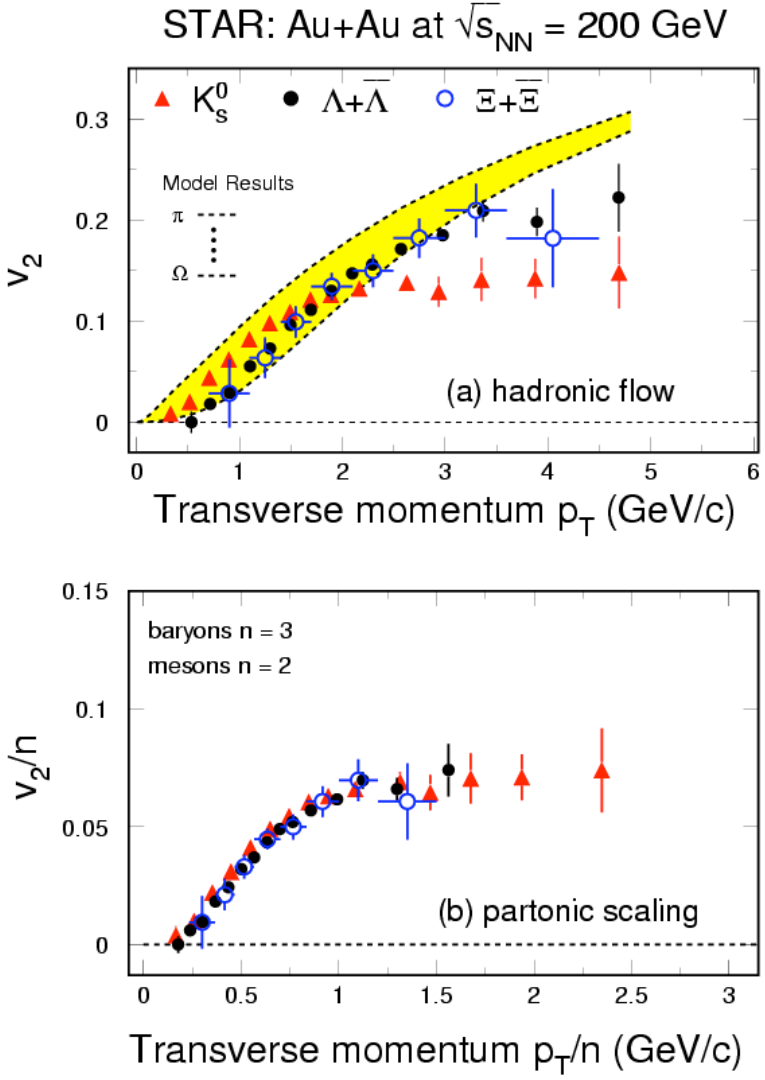
Multi-Strange Baryons v_2



- Multi-strange baryons
  - and show collectivity !

See talk by J. Castillo, P3 Thu.

Quark Coalescence



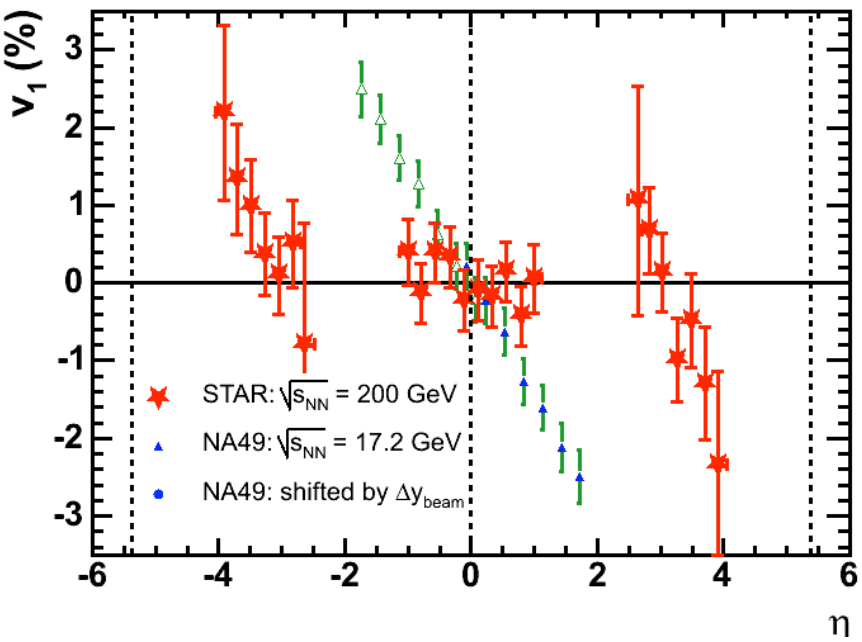
- Meson – baryon Effect ?
- Exp. data consistent with quark coalescence scenario
- We need v_2 of □ and □^{0}
- Pentaquark* □$^+$(uudds), n=5 ?

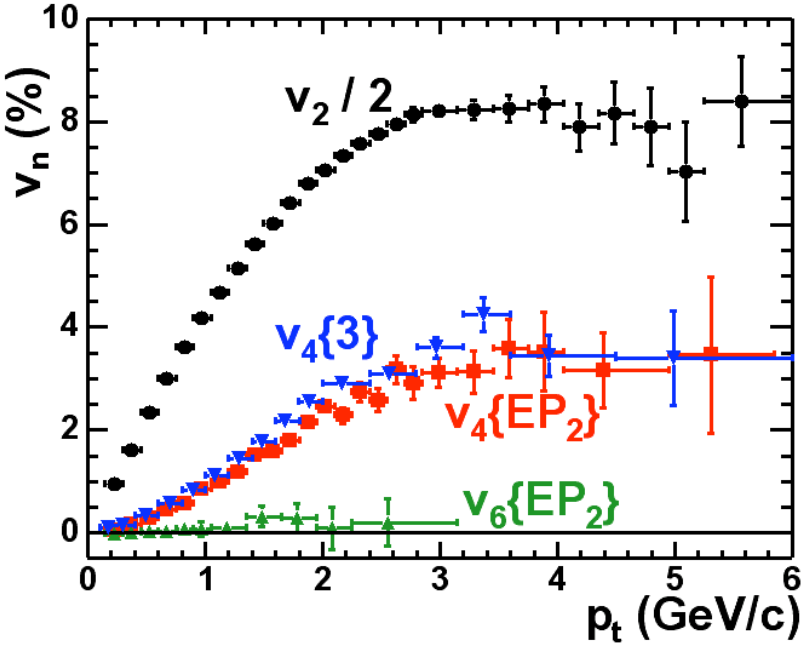
S.A. Voloshin, Nucl. Phys. A715, 379 (2003).
Z. Lin et al., Phys. Rev. Lett., 89, 202302 (2002).
R. Fries et al., nucl-th/0306027.
D. Molnar and S.A. Voloshin, PRL 91, 092301(2003).

*LEPS: Phys. Rev. Lett. 91, 012002-1 (2003).

See talk by J. Castillo, P3 Thu, and posters by S. Salur Strange2 and P. Sorensen Flow13.

First Measurement on v_1,v_4, v_6

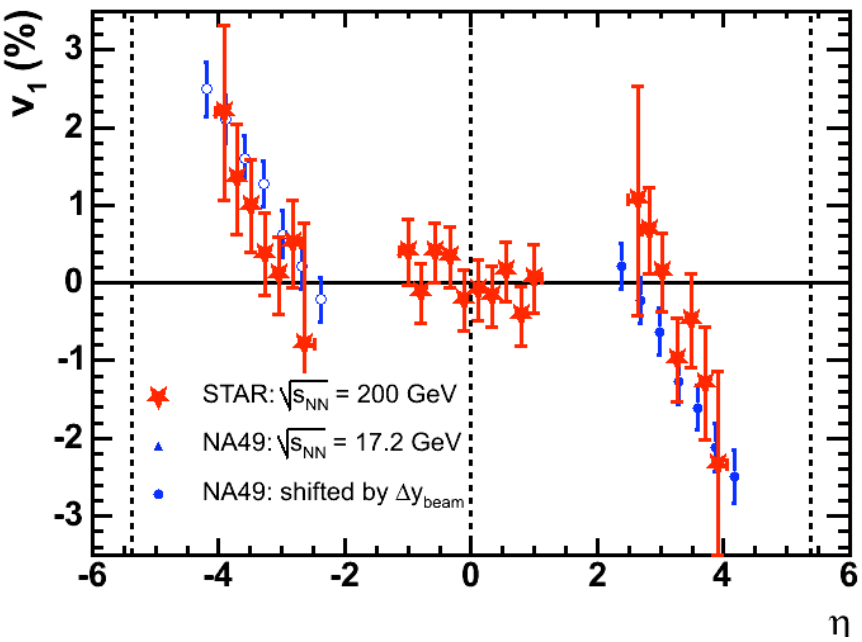


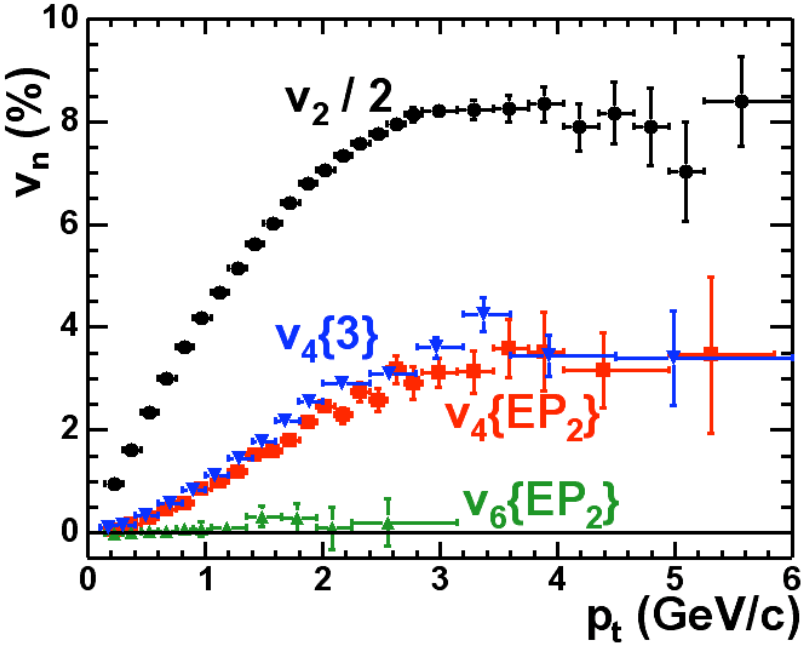


- v_1 flat around mid-rapidity
- v_4, v_6 more sensitive to initial conditions
- v_2 is positive - in plane elliptic flow

See talks by A. Poskanzer and A. Tang, P3 Thu; see poster by M. Oldenburg Flow2.

First Measurement on v_1,v_4, v_6





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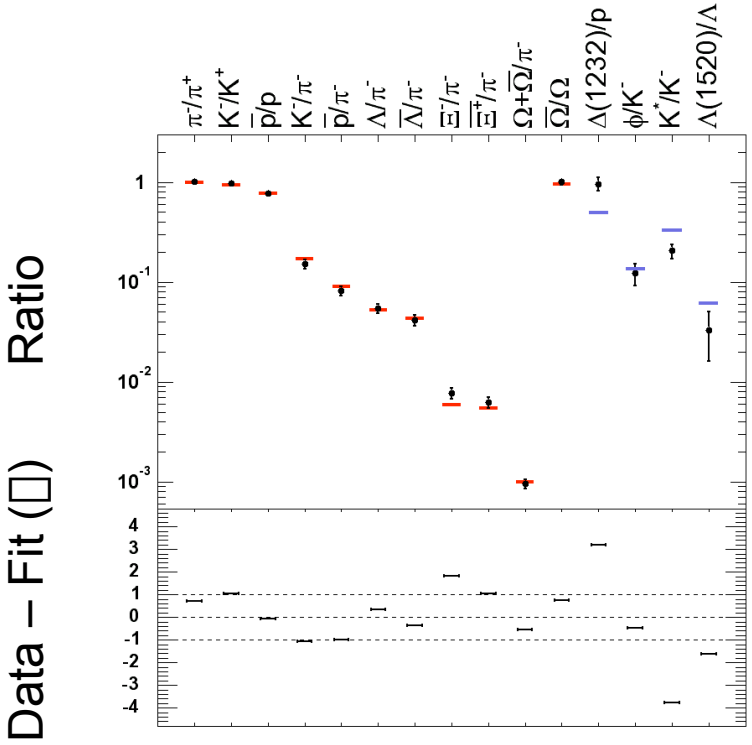
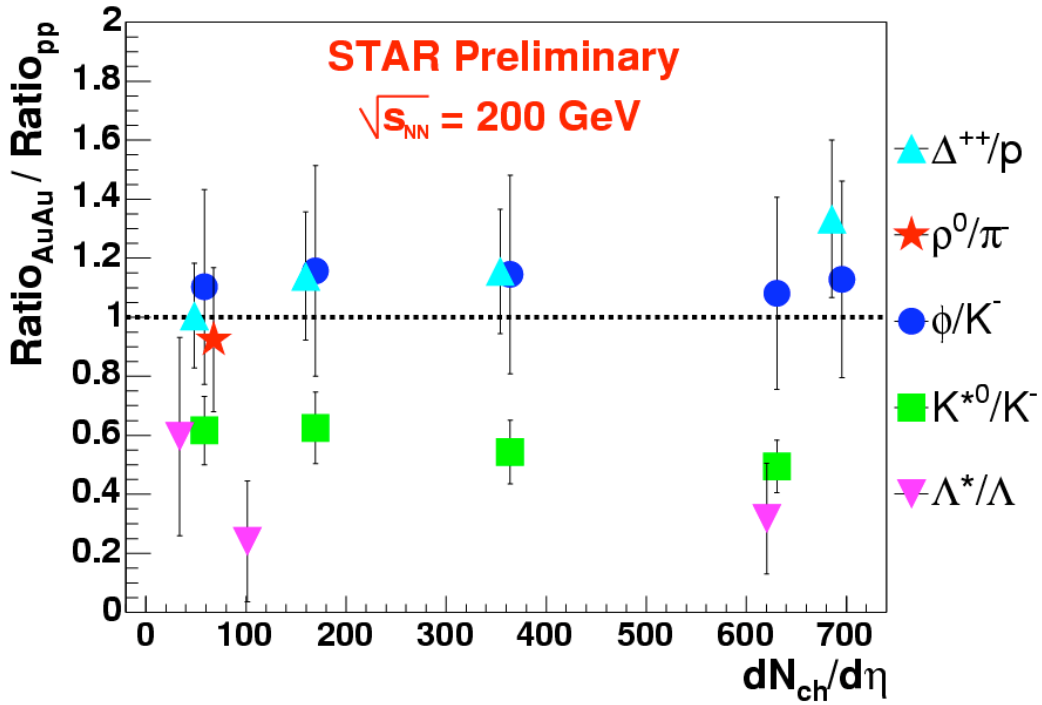
Particle Yields and Ratios



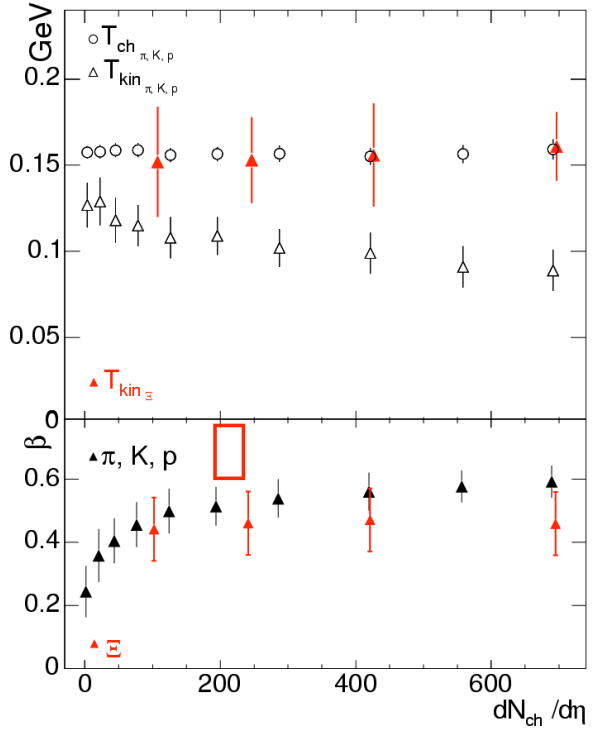


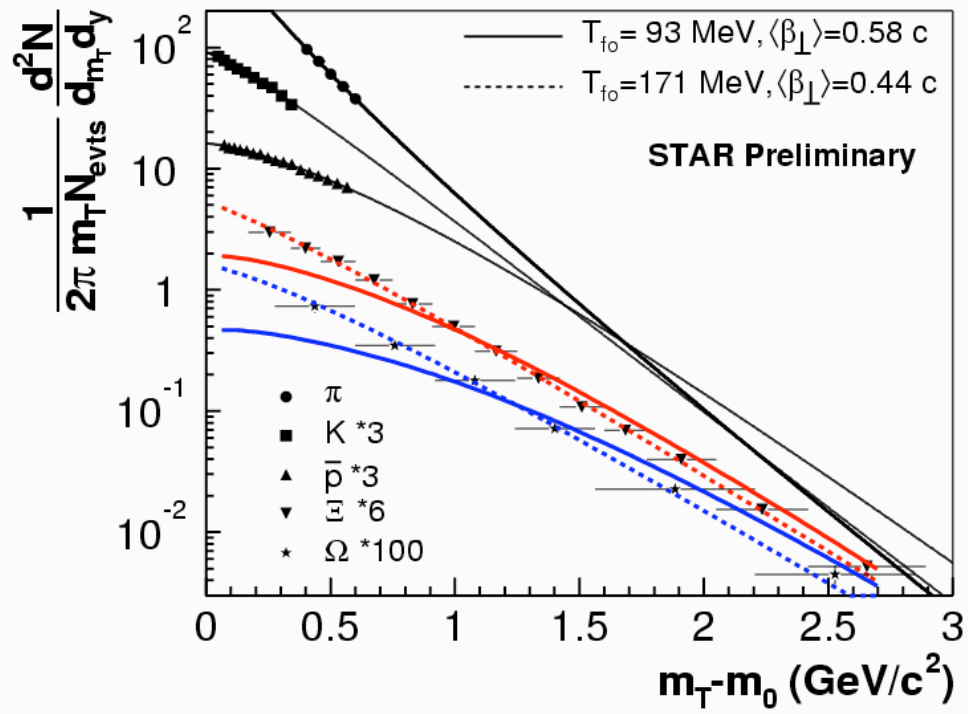
- Particle ratios well described by T_{ch} = 160±10 MeV, μ_B = 24 ±5 MeV
  γ_s = 1
- Resonance ratios modified from pp to Au+Au
- → Hadronic Re-scatterings!

J.Sollfrank et al. PRC59(1999)1637.

See talk C. Markert, P2 Fri and posters by O. Barannikova Spectra25 and H. Zhang Spectra35.

Kinetic Freeze-out





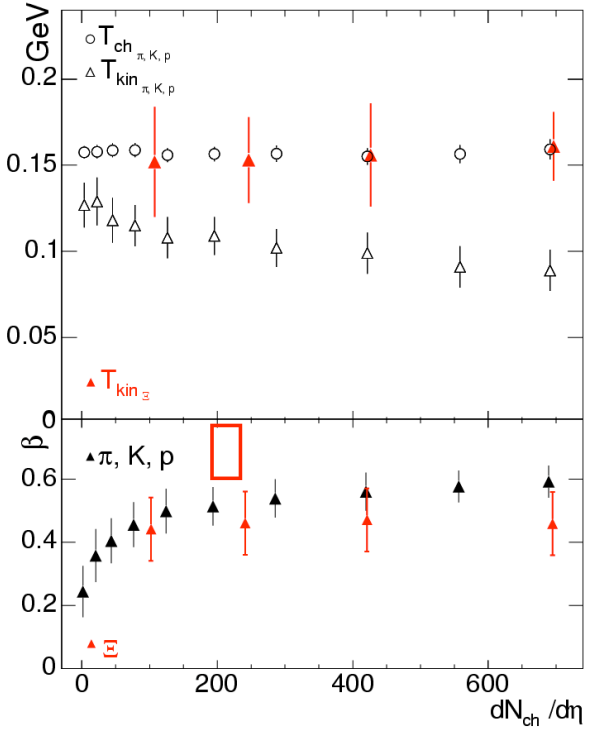
- π,K,p: T_{kin} decreases with centrality
- Ξ: T_{kin} = const., coincides with T_{ch} !
- Study Ξ-Ω space-time emission

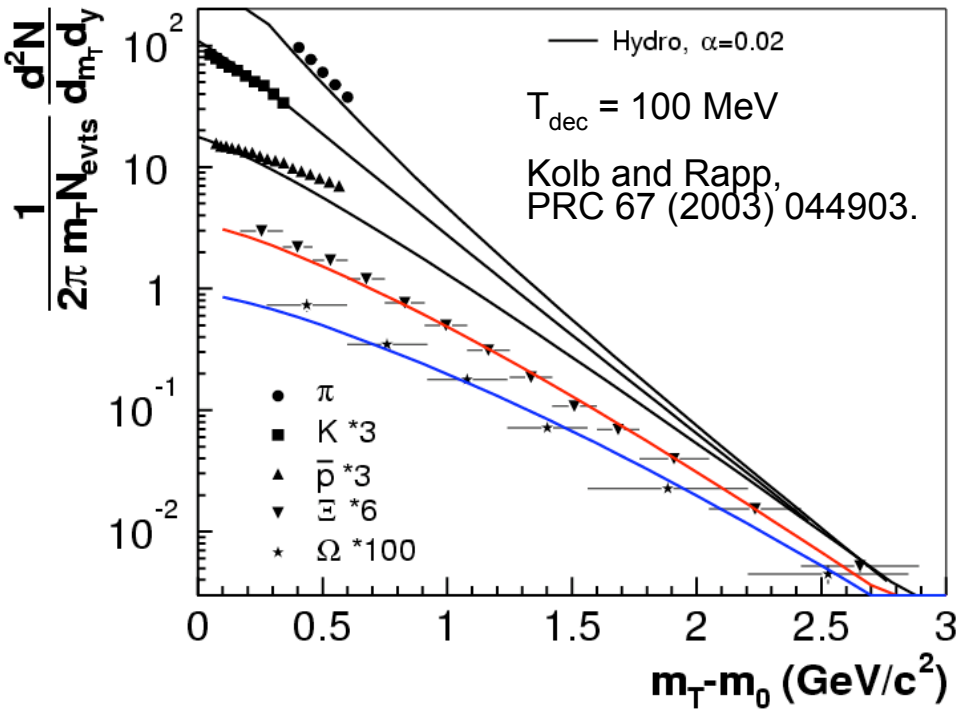
- Sudden Single Freeze-out ?*

See talk by A. Kisiel, P3 Thu, poster by O. Barannikova Spec25.

*A. Baran et al.; nucl-th/0305075.

Kinetic Freeze-out





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- Study □-□ space-time emission

- Sudden Single Freeze-out ?*

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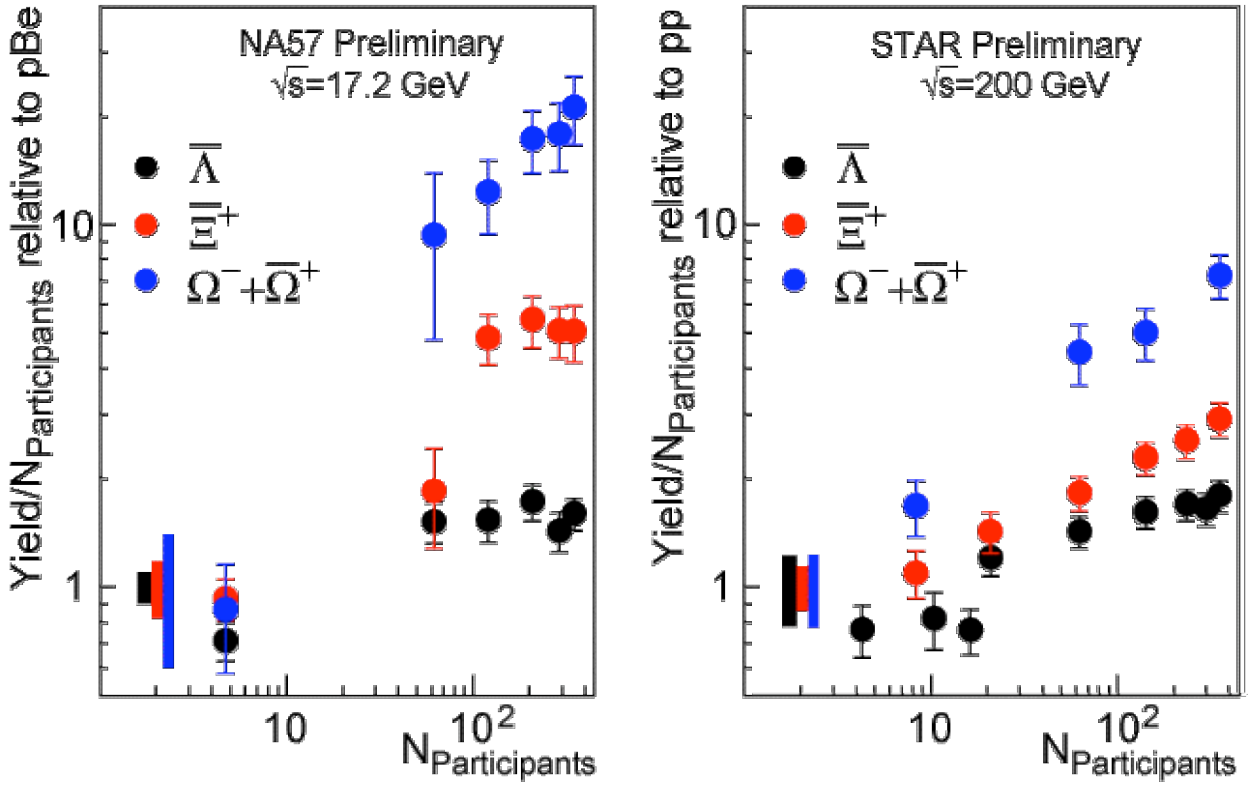
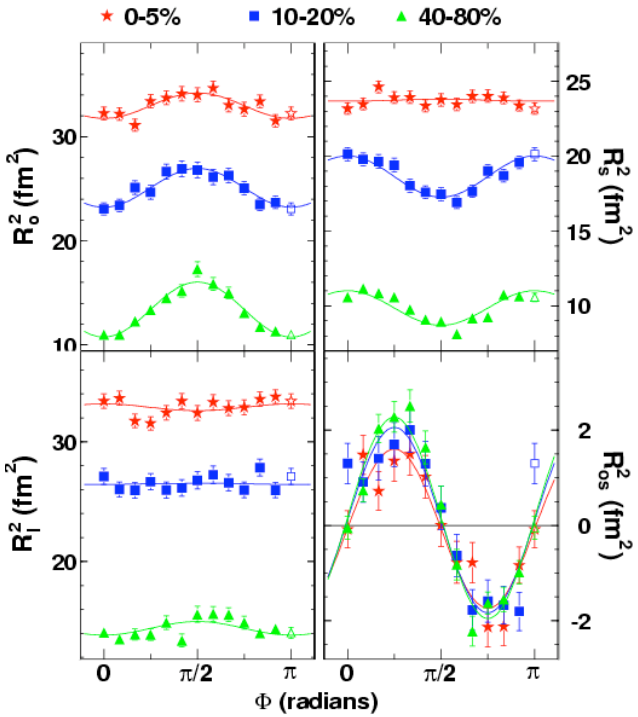
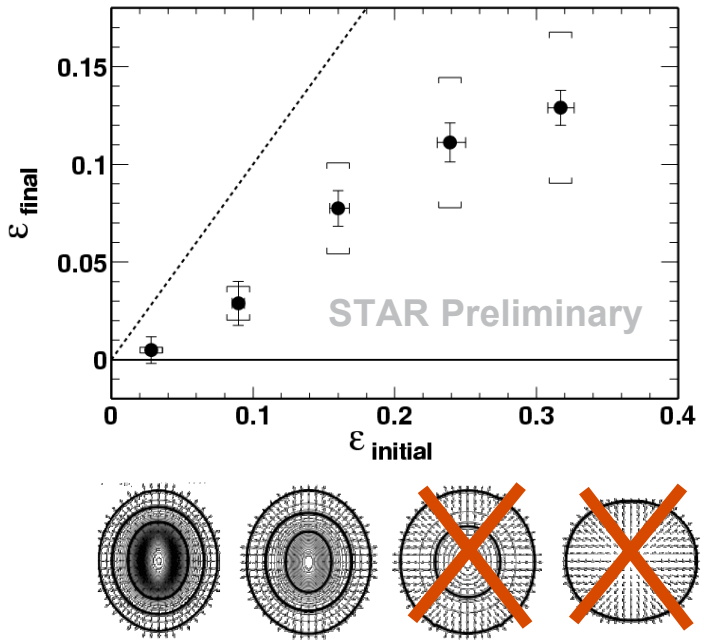
Strangeness Production



- d-Au shows same suppression for as p-p
- and do not show N_{part}-scaling in Au-Au

HBT versus Reaction Plane



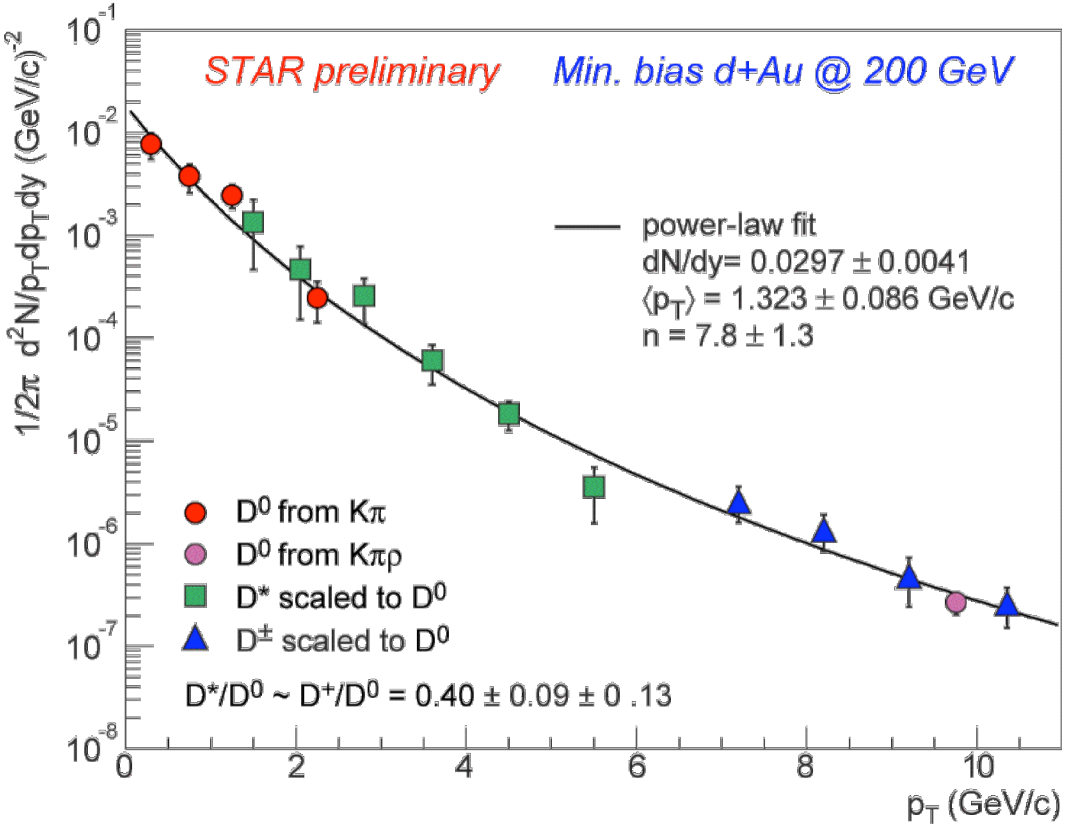


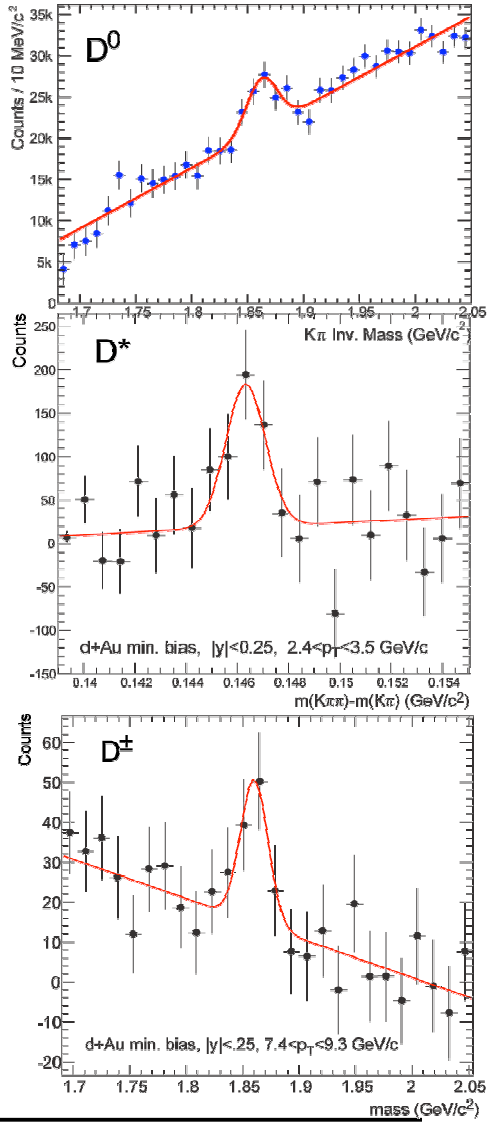
- HBT versus reaction-plane
  - geometrical analog of v_2
  - R(Φ) reveals anisotropic source
  - probe of dynamical evolution

- Strong radial flow*
  - HBT R(m_T): flow-induced **x-p** correlations
    - extensive systematics
  - non-identical particle correlations: shift in emission points

See talk by A. Kisiel, P3 Thu and posters by S. Bekele HBT9, J. Cramer Cor19, T. Gutierrez HBT6.

First D Measurement at RHIC

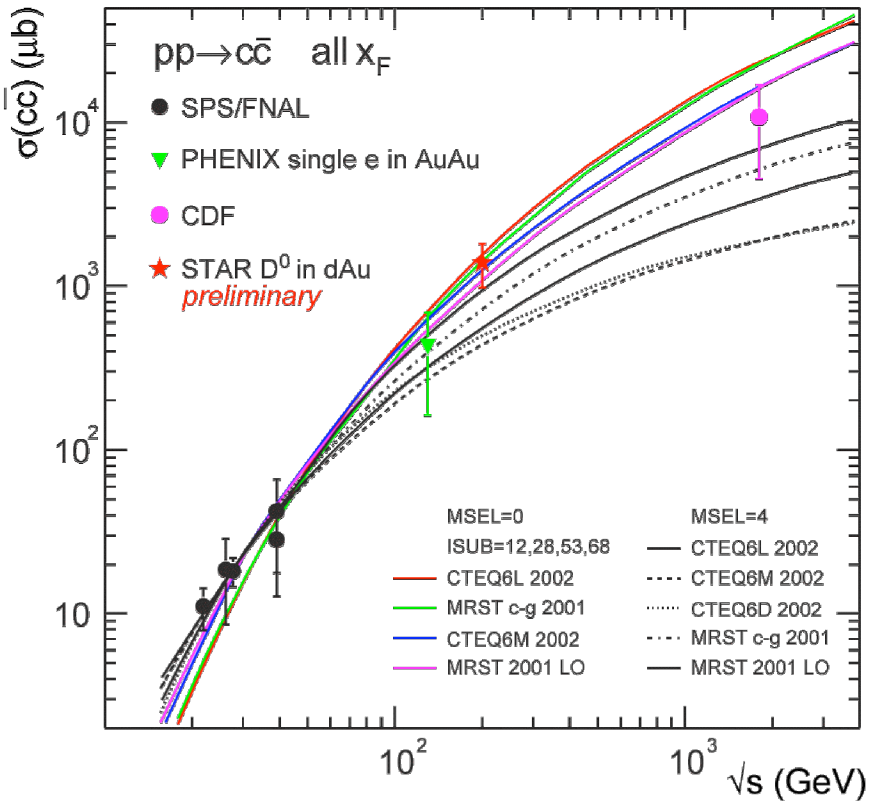


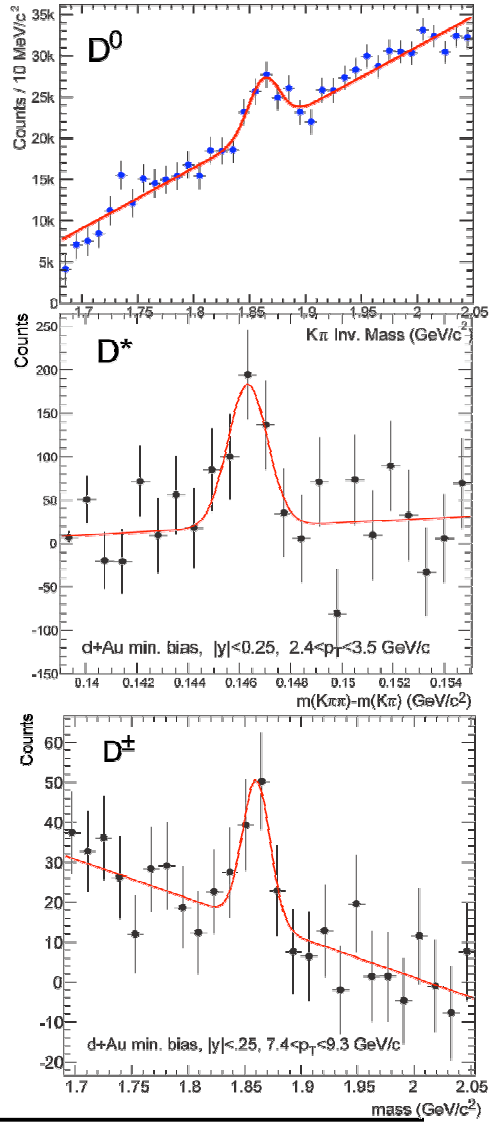


- D^0, $D^{\pm}$, D^* spectra from d+Au
- Cover range $0.2 < p_T < 11$ GeV/c

See talk by A. Tai, Plenary Wed 12:20.

First D Measurement at RHIC

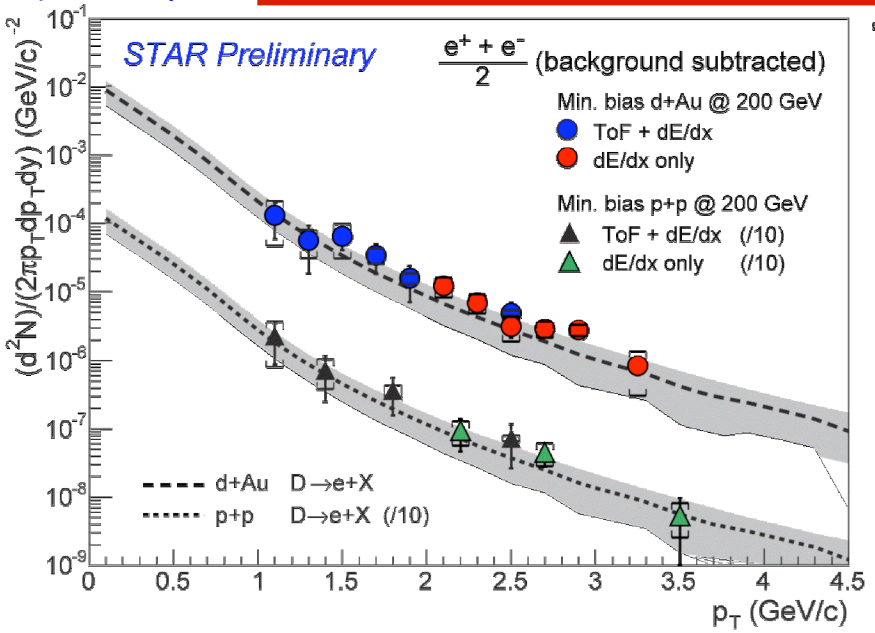


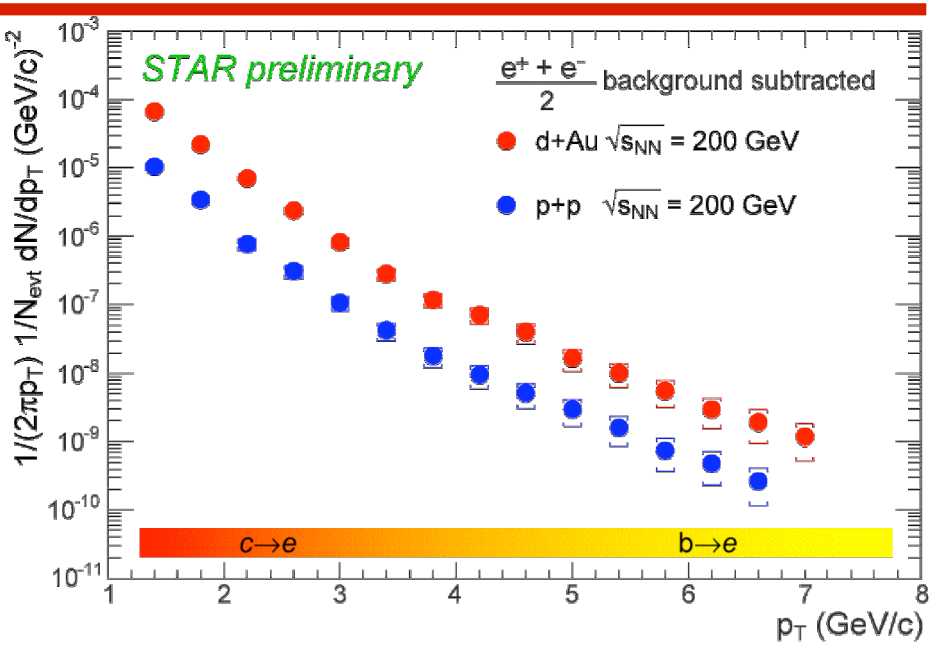


- D^0, $D^\pm$, D^* spectra from d+Au
- Cover range $0.2 < p_T < 11$ GeV/c

See talk by A. Tai, Plenary Wed 12:20.

Heavy Flavor D,B → e + X





- $(e^+ + e^-)/2$ spectrum, background subtracted
- e-PID by TOF, dE/dx and EMC, measurements consistent
- Consistent with measured D meson yield
- PYTHIA: c → e, dominates at p_T ~ 2-4 GeV/c
  b → e, dominates at p_T > 4-5 GeV/c

See talks by L. Ruan P2 Thu, A. Suaide P2 Thu, and poster by X. Dong Instr28.

Summary

- High p_t → consistent with jet quenching scenario
- v_2, R_{AB} → quark coalescence seems to work
  → partonic collectivity ?
- Bulk properties → hadronic re-scatterings
  → evidence of collectivity

- R_{AA} of particles carrying heavy flavor (c,b)
- Measure centrality dependence of spectra and v_2 of d, π^0, η, ω, ϕ, …, D^0, D_s, χ_c, J/ψ
- quantify partonic collectivity
- probe partonic eos

Talks:

A. Tai	*STAR measurements of open charm production in dAu collisions at 200 GeV*	Plenary, Wed 12:20
L. Barnby	*Production of f, K^0_s and L and R_{dAu} from d+Au*	P1 Hadron Spectra Thu
J. Castillo	*Elliptic flow of multi-strange baryons X and W in Au+Au*	P3 Collective Flow Thu
T.W. Henry	*Jet Distributions in d+Au and p+p Collisions at STAR*	P1 High Pt Jets Frii
A. Kisiel	*Non-identical particle correlations at 130 and 200 GeV*	P3 HBT Tue
M.A.C. Lamont	*Identified particle ratios at large transverse momentum at 200 GeV*	P1 High Pt Tue
C. Markert	*Strange Baryon Resonance Production in p+p, d+Au and Au+Au*	P2 Strangeness Spectra Fri
A. Poskanzer	*Azimuthal Anisotropy: the higher harmonics*	P3 Collective Flow Thu
L. Ruan	*Open charm product'n and Cronin of leptons and id'ed hadrons in d+Au, p+p*	P2 Heavy Quark Thu
A. Suaide	*Inclusive electron distributions in dAu and pp collisions at RHIC*	P2 Heavy Quark Thu
A.H. Tang	*Directed and Elliptic Flow in Au+Au and azimuthal correlations in p+p and d+Au*	P3 Collective Flow Thu
F. Wang	*Measurement of Jet Fragmentation at RHIC*	P1 High Pt Jets Fri
G. Westfall	*Correlations and Fluctuations in STAR*	P4 Fluctuation and Corr. Fri

Posters:

O. Barannikova, J.E. Gonzalez, S. Huang, J. Ma, C. Mironov, L. Molnar, H. Zhang	Spectra 3,11,25,26,31,35,38
M. Heinz and J. Adams, H. Long, M.G. Munhoz and J. Takahashi, S. Salur, F. Simon, R. Witt	Strange 1 – 4,13,16
S. Bekele, T.D. Gutierrez, S.R. Klein	HBT 6,9,10
S. Chattopadhyay, Y. Guo	High Pt 25,32
J.G. Cramer, M. Kopytine, J. Porter, D. Prindle, C. Pruneau, J. Putschke, R.L. Ray	Corr. 5 – 9,19,22,26
M. Oldenburg, P. Sorensen	Flow 2,13
M. Moura	Electro 1
D. Arkhipkin, X. Dong, M. Oldenburg, A. Rose	Instr.11,24, 25, 28