System size dependence of strange particle correlations in Cu+Cu and Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV at RHIC

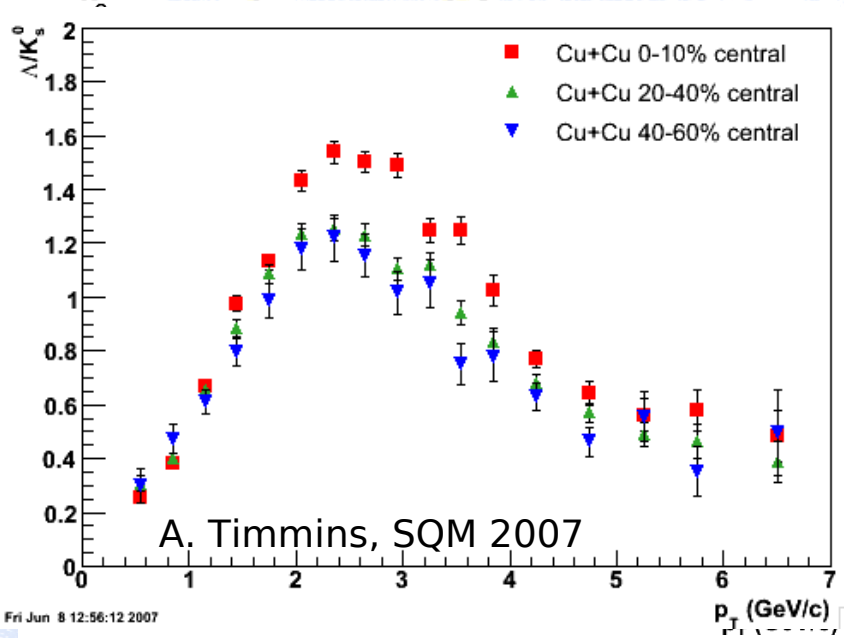
Christine Nattrass (Yale University)
STAR Collaboration

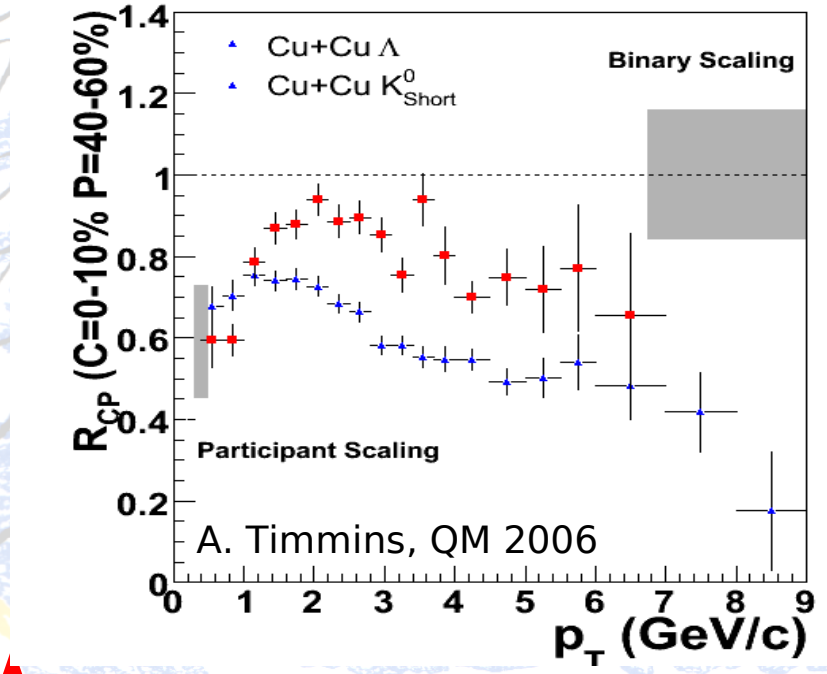
SQM 2007, Levoča, Slovakia

Outline

- Motivation
- Analysis technique
- Results
- Conclusions

Intermediate p_T baryon/meson enhancement

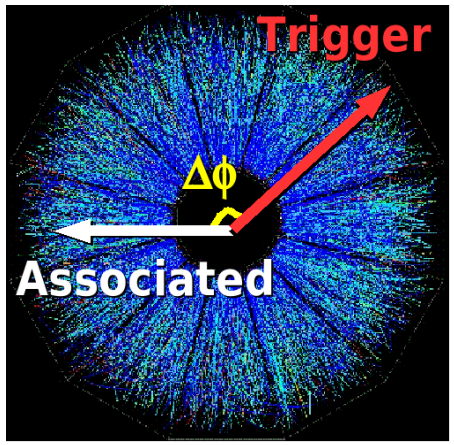


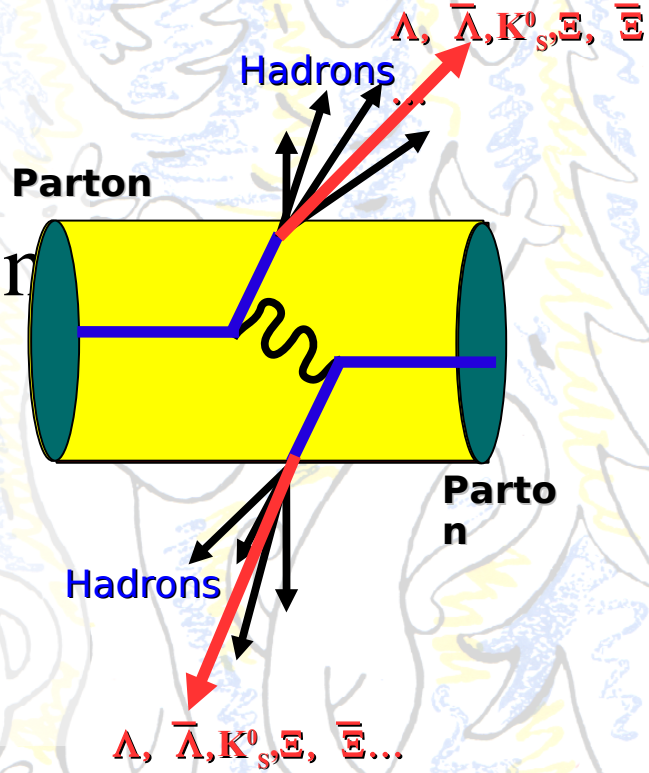


- Large enhancement of baryon/meson ratio in central collisions relative to p+p
  - in both Au+Au and Cu+Cu
  - reaches maximum at p_T ~ 2-3 GeV/c
  - not unmodified jet fragmentation
- Baryon/meson splitting of R_{cp}
  - strange and non-strange particles show similar suppression

Motivation – particle identification in jets

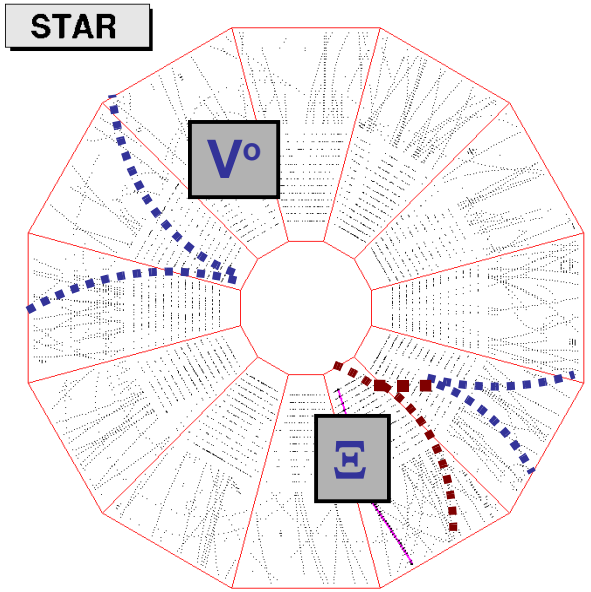
- Particle/antiparticle differences
  - Quark vs gluon jets
- Meson/baryon differences
  - Coalescence/ recombination mechanisms
    - Consistent with particle ratios
    - Testable with identified particle correlations?



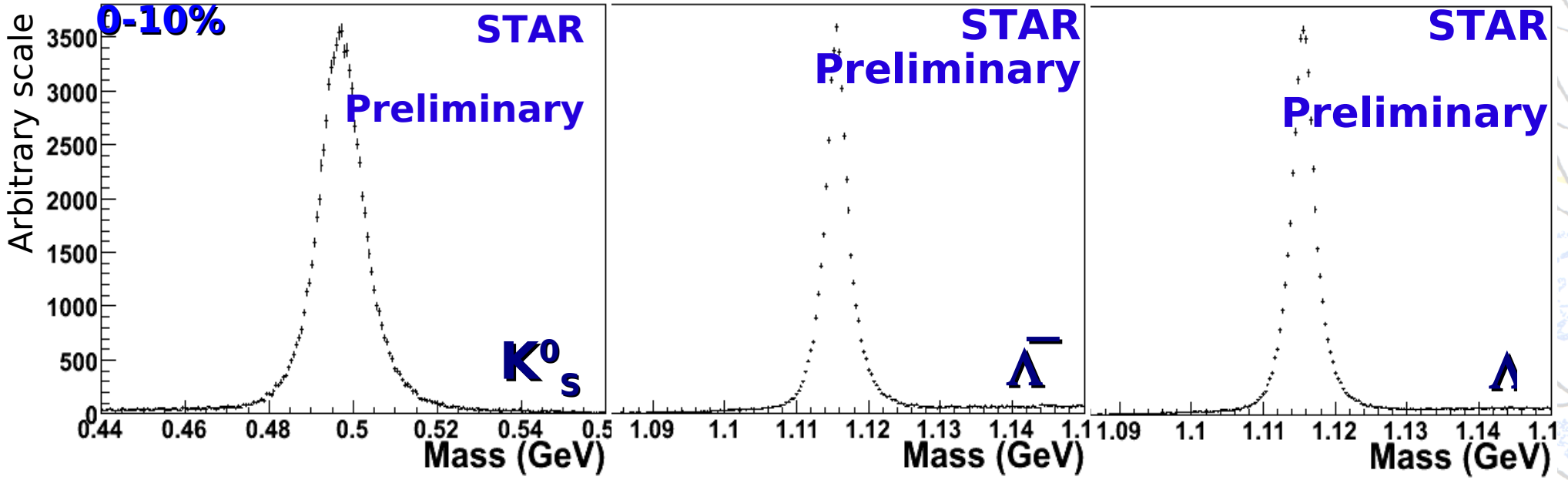


Strange particle identification

- Full azimuthal acceptance
  - Reconstruction of decay vertices possible
  - ~95% purity in Cu+Cu high p_T



2.0 GeV<p_T<2.5 GeV, 0-10%



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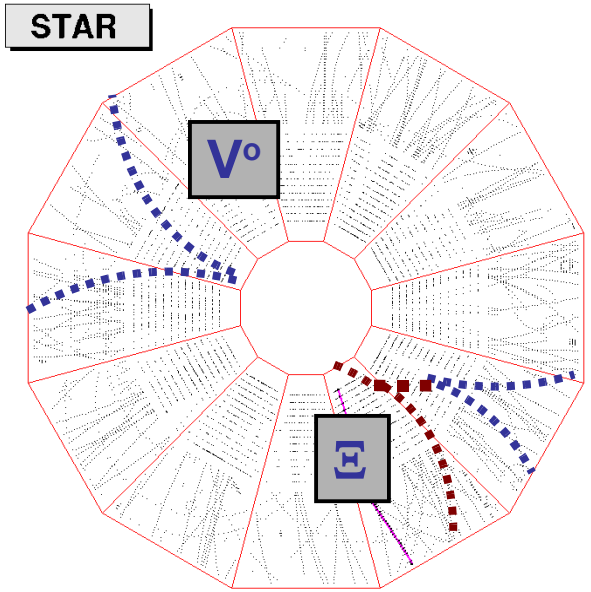
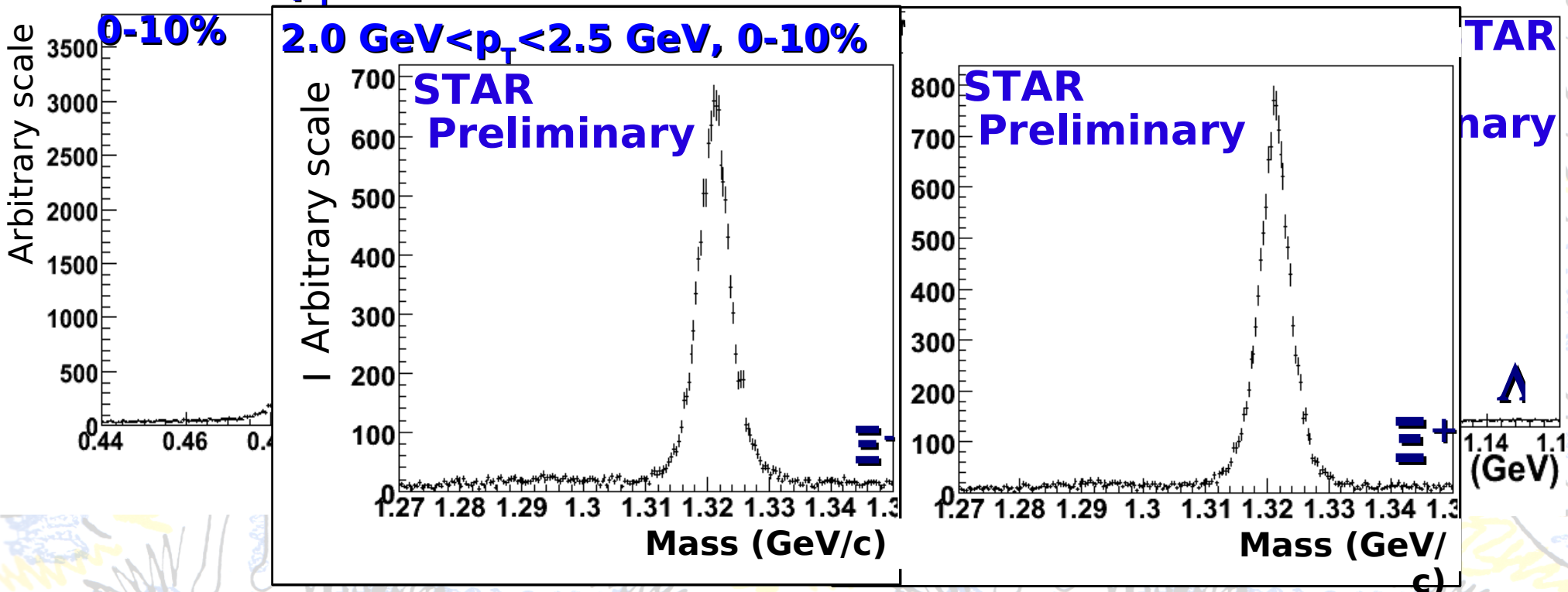
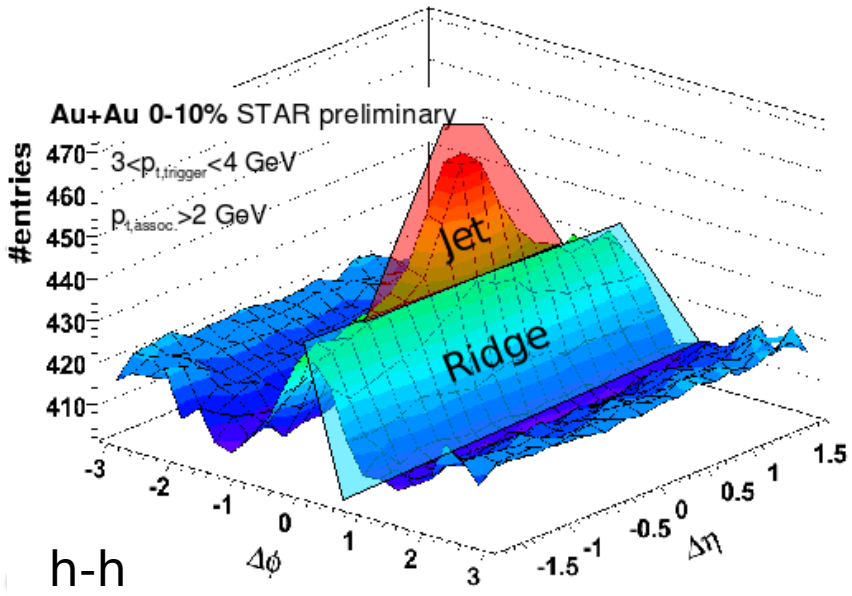




Motivation - Long-range pseudorapidity correlations

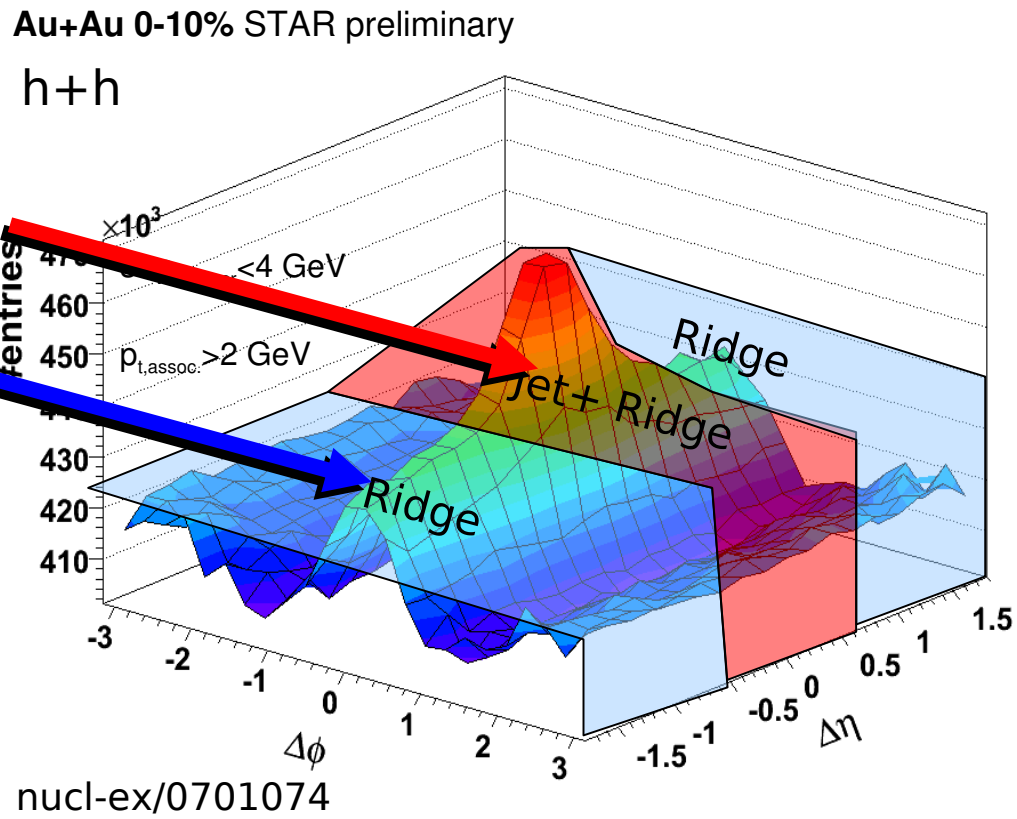
nucl-ex/0701074



- Long-range pseudorapidity ($\Delta\eta$) correlations observed by STAR in Au+Au at intermediate p_T
- Near side jet peak sits on plateau (Ridge)
  - Significant contribution to the near-side yield in central Au+Au
- Look for particle and system size dependencies which might reveal information about production mechanism

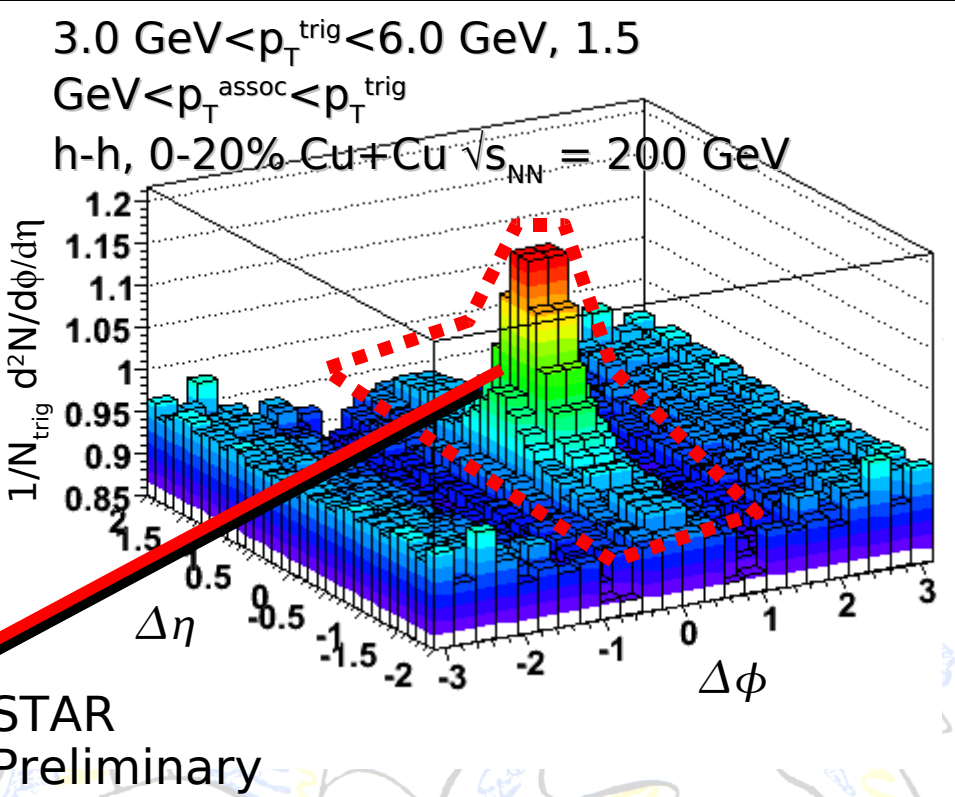
ΔΦ-Δη Correlations - Method

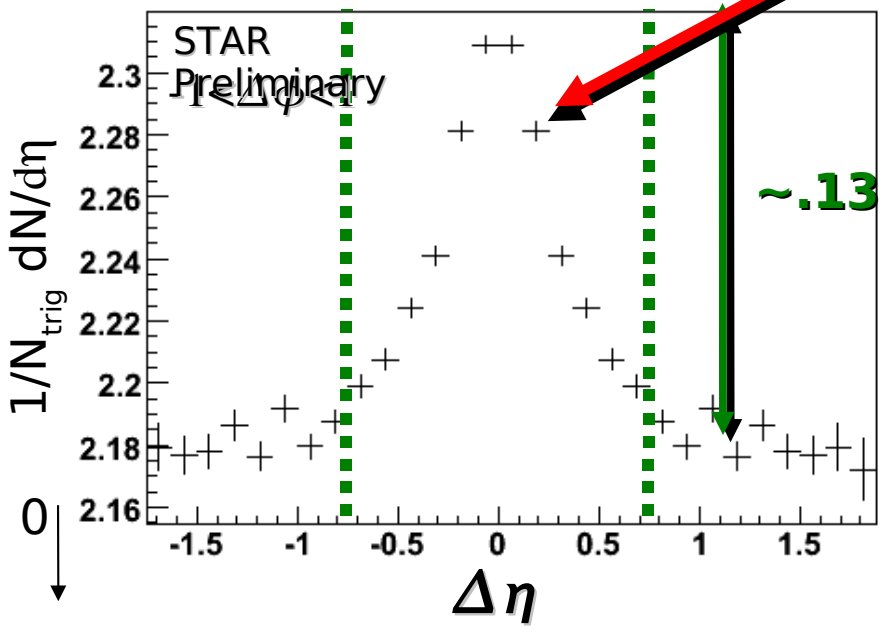
- Ridge previously observed to be flat in Δη
- To determine relative contributions, find yields for near-side, take Δϕ projections in
  - -0.75<Δη<0.75 **Jet + Ridge**
  - 0.75<|Δη|<1.75 **Ridge**
  - Jet = (Jet+Ridge) – Ridge*.75/1.75
  - Ridge = yield from -1.75<Δη<1.75 – jet yield
- Flow contributions to jet cancel
  - v_2 roughly flat with η



The Ridge in Cu+Cu

- Is there a Ridge in Cu+Cu?
- Δη projection flat at large Δη
- Small and large Δη regions match on away side
- Small yield above background in large Δη region
- Jet yield in Δη consistent with Jet in Δη subtracting (Jet+Ridge)-Ridge





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- Small yield above background in large region
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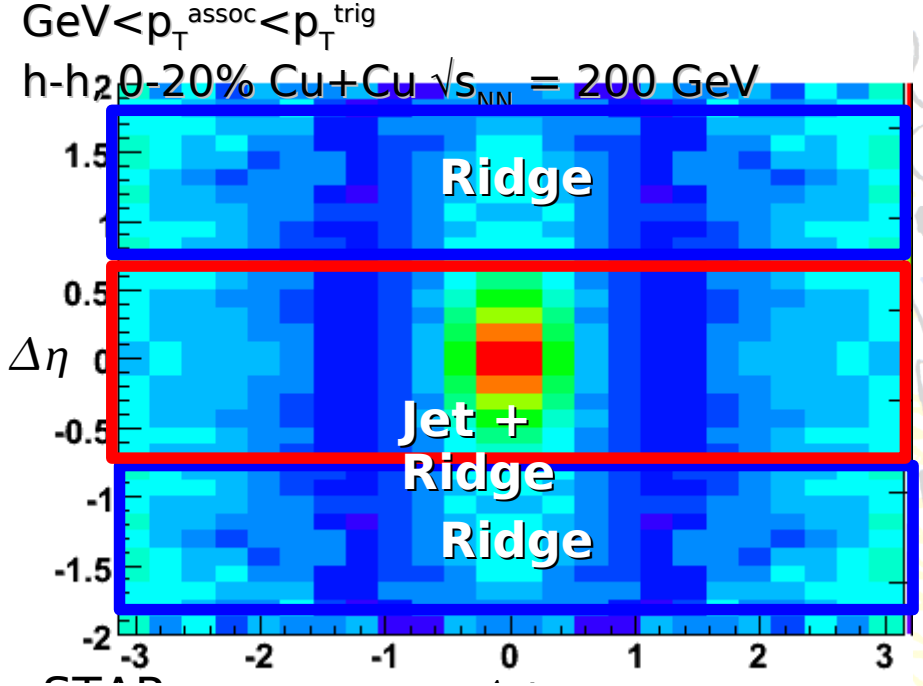

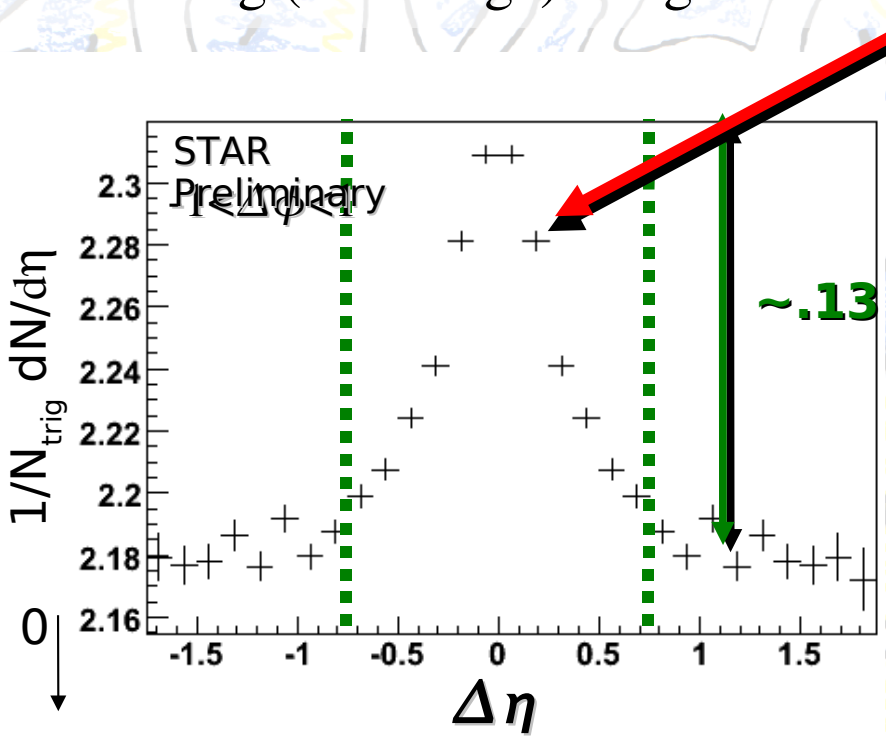

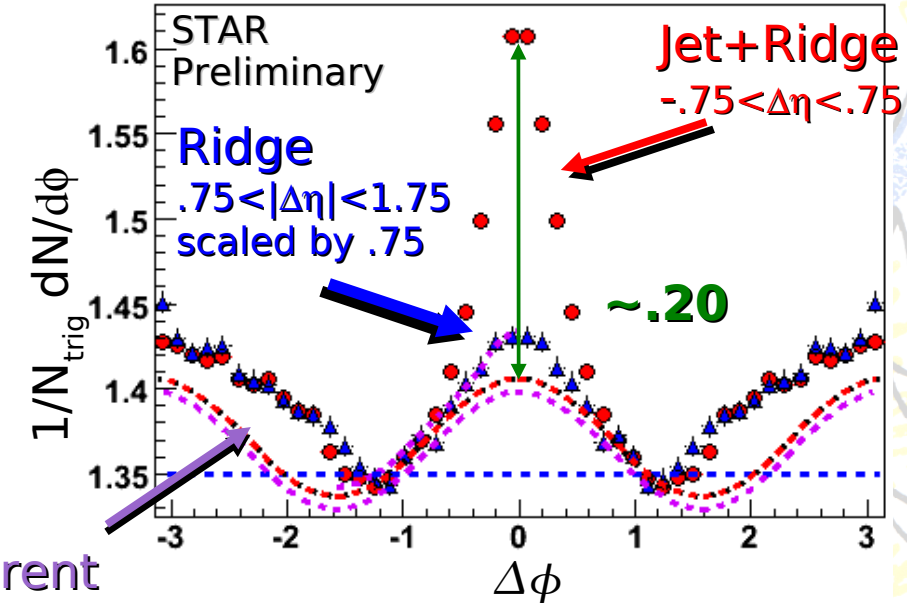

Different flow background parameters

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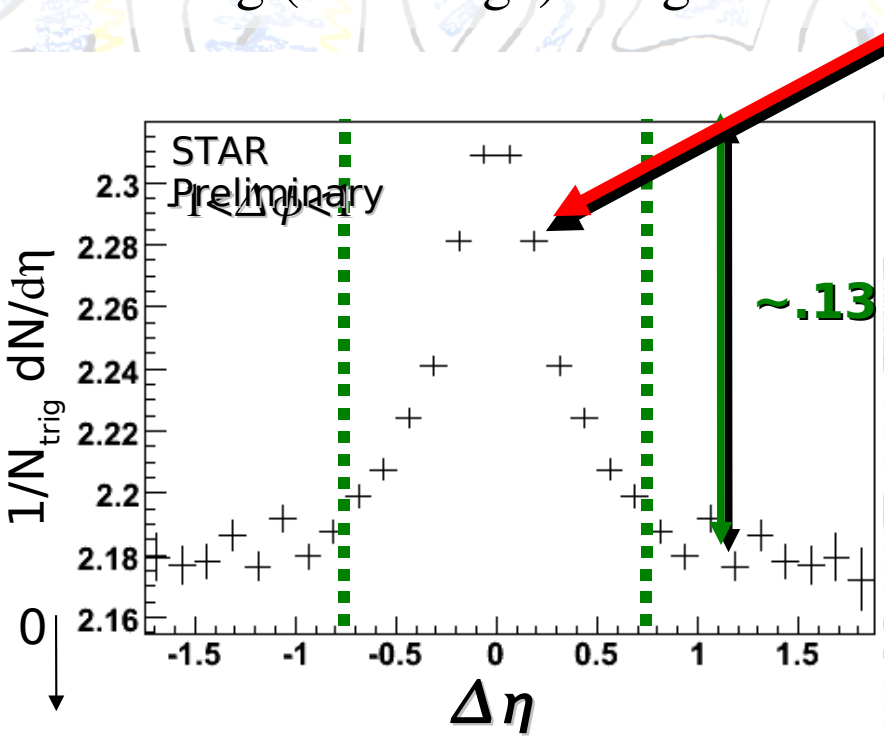
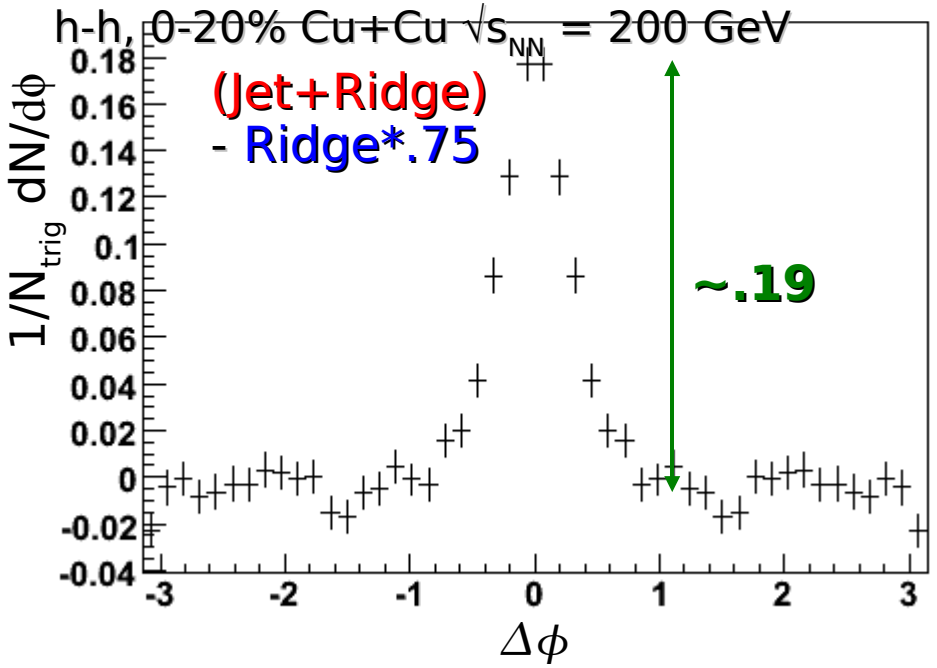
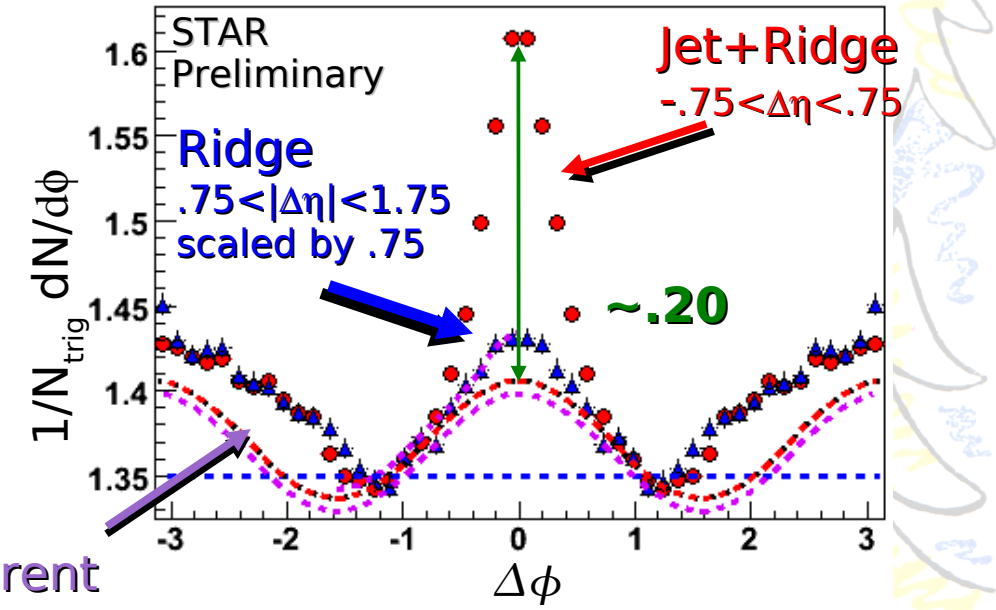
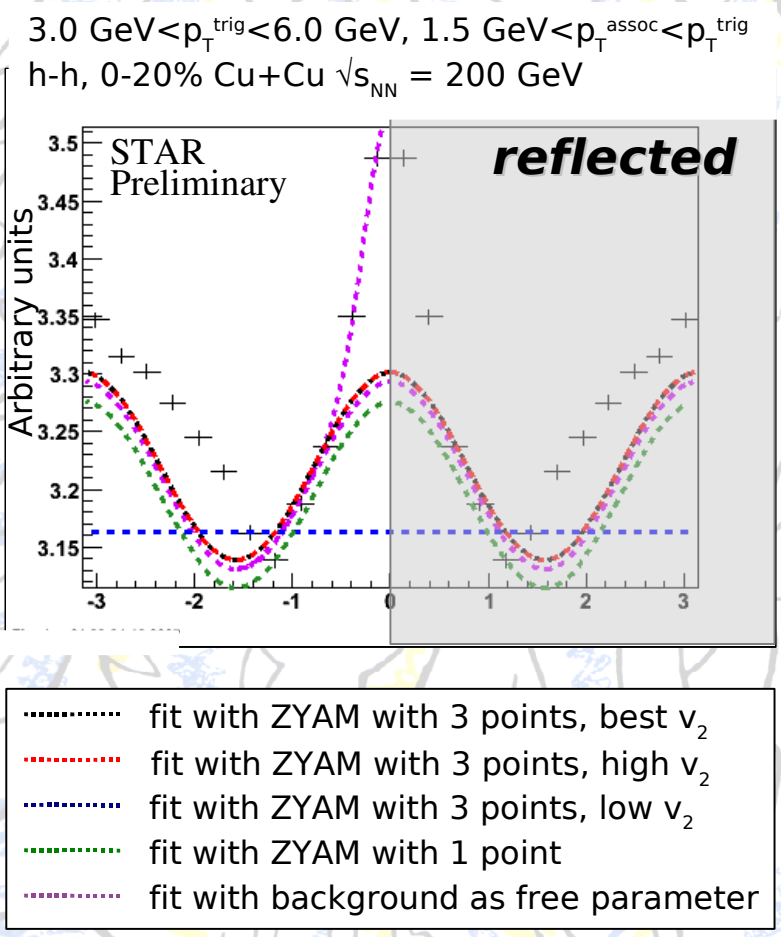






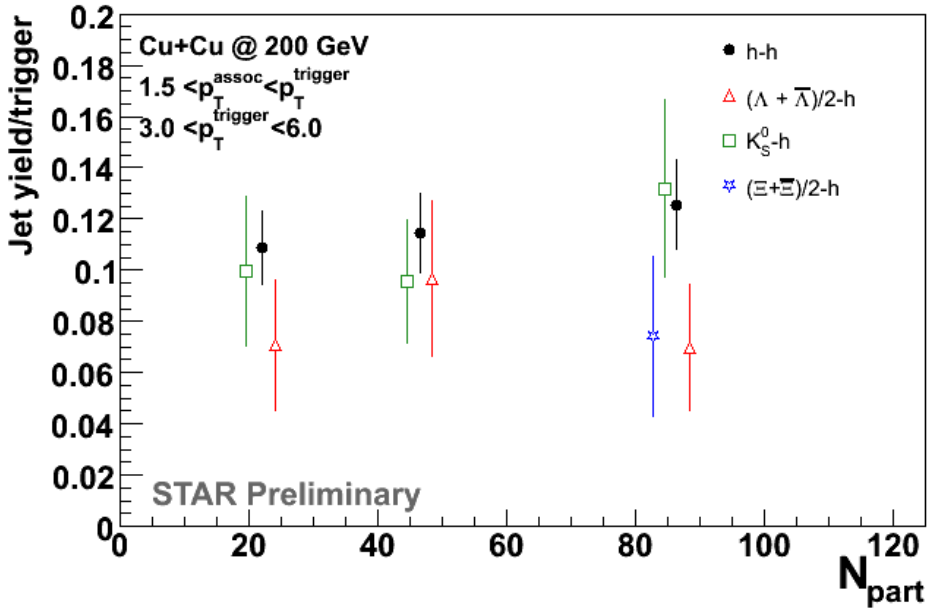
Different flow background parameters

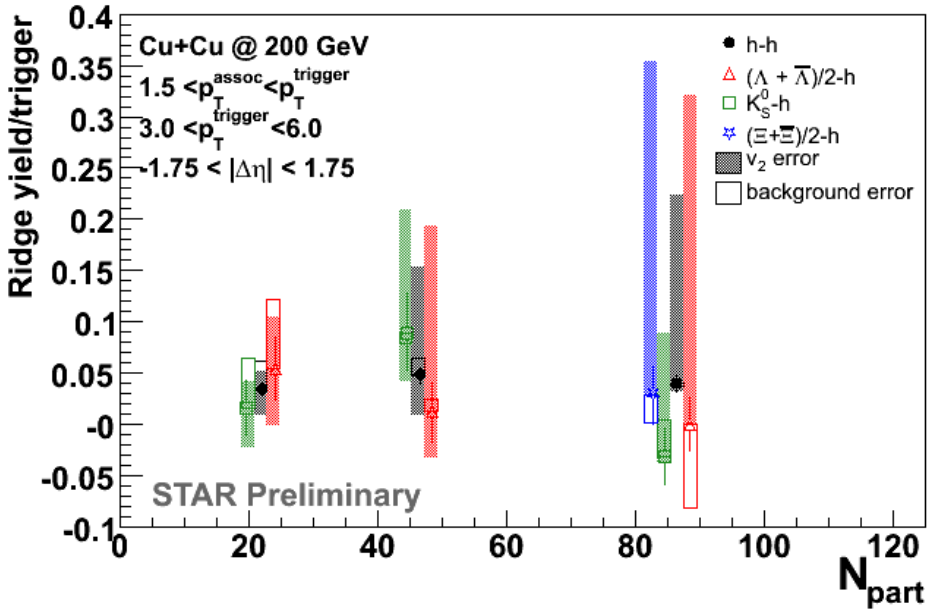
Determination of yields and errors



- Background:
  $B(1+2\, v_2^{trig}\, v_2^{assoc} \cos(2\Delta\Phi))$
- Different fit methods for determination of B
  - *Z*ero *Y*ield *A*t *M*inimum (ZYAM)
  - 1 point, 3 points
  - B as Free parameter (used as best guess)
- v_2 error
  - v_2 measurements in progress
    - upper bound for v_2 measured
      - $v_2 \approx$ 10-15% depending on p_T, centrality
    - estimate for lower bound, near 0
  - Λ, $\bar{\Lambda}$,K^0_S,Ξ^-,Ξ^+ v_2 not measured
    - Assume quark scaling of h v_2 in Cu+Cu

Near-side Yield vs N_{part}





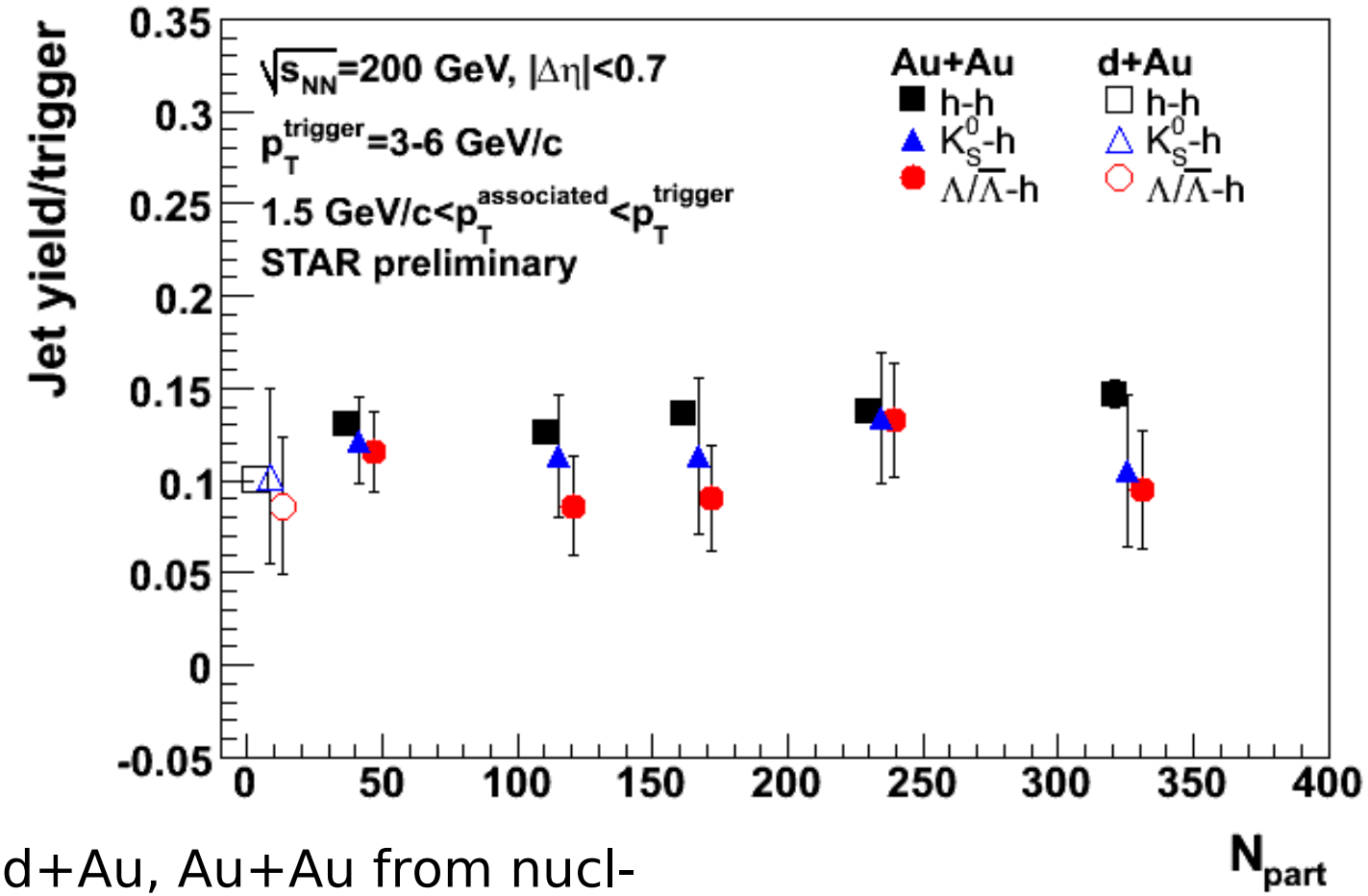
- Jet yield flat with N_{part} within errors
  - no v_2 or background error due to method
- Ridge yield
  - very small
  - flat with N_{part} within errors
- No trigger particle type dependence

Data points at same N_{part} offset for visibility

Jet yields: 10% error added to V^0 and h triggers to account for track merging, 15% to Ξ triggers

Near-side Yield vs N_{part} Cu+Cu vs Au+Au

- Jet yield comparable in Cu+Cu and Au+Au
- Ridge yield consistent with N_{part} in Cu+Cu and Au+Au



d+Au, Au+Au from nucl-ex/0701047

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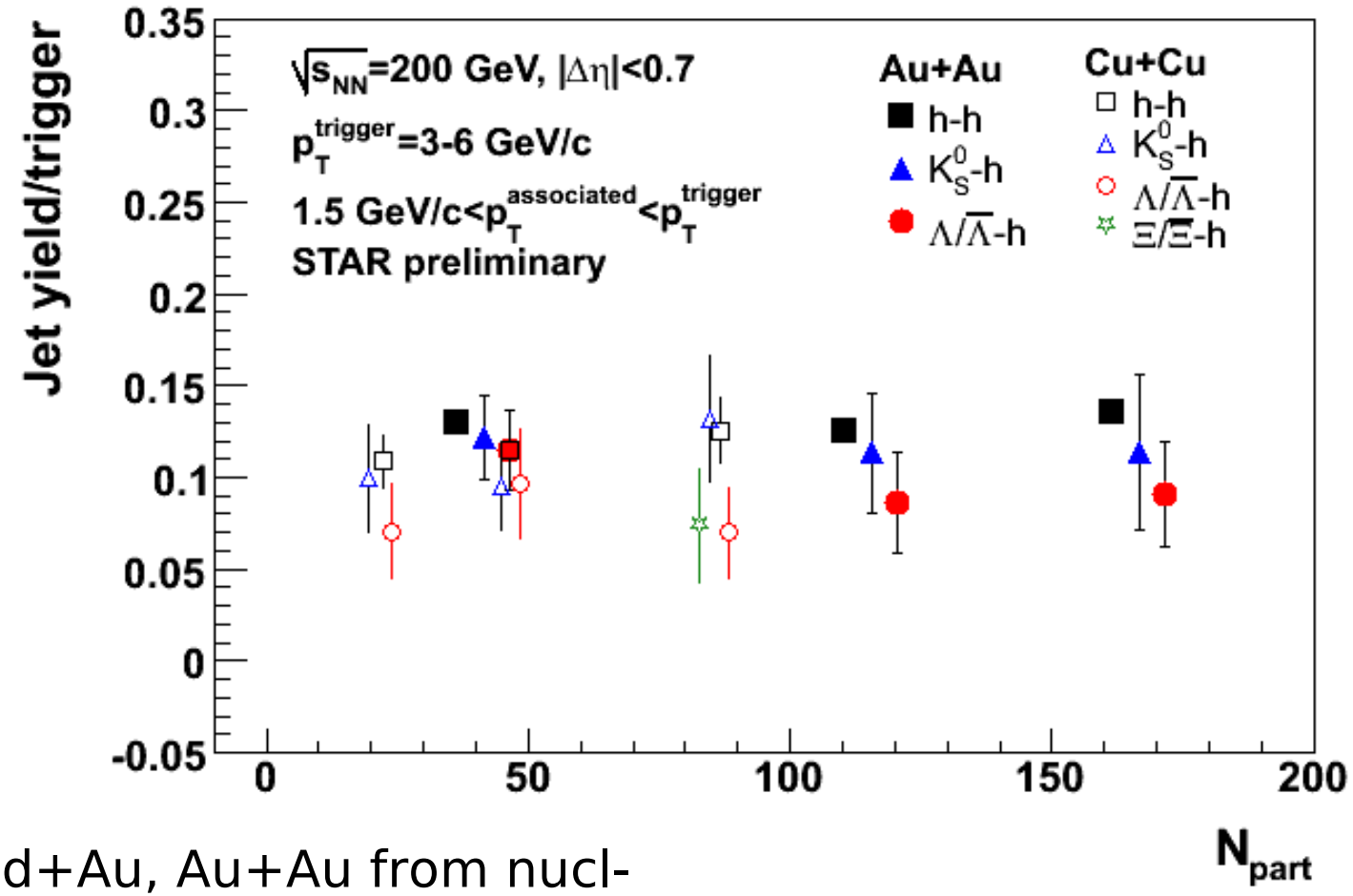

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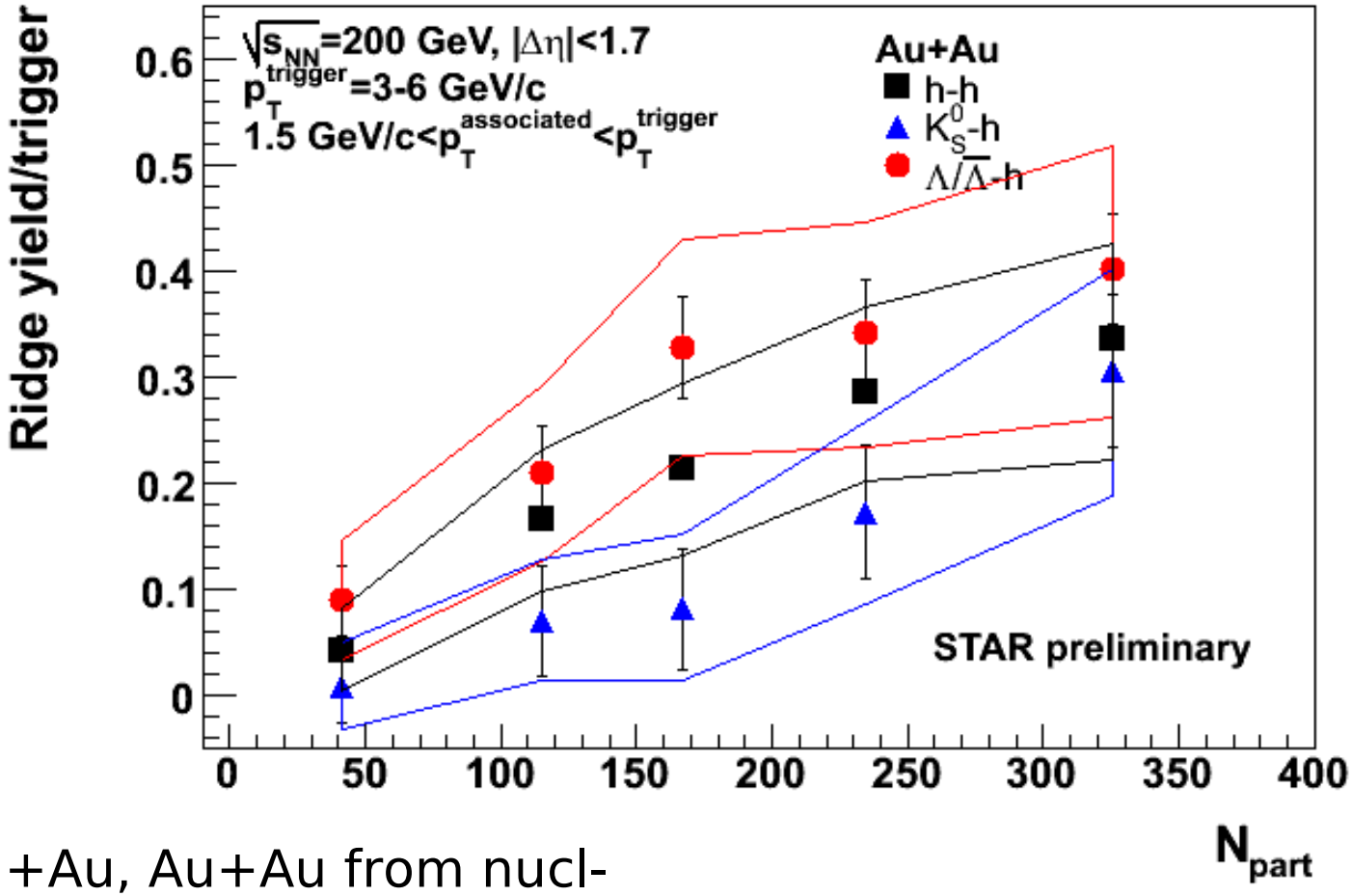

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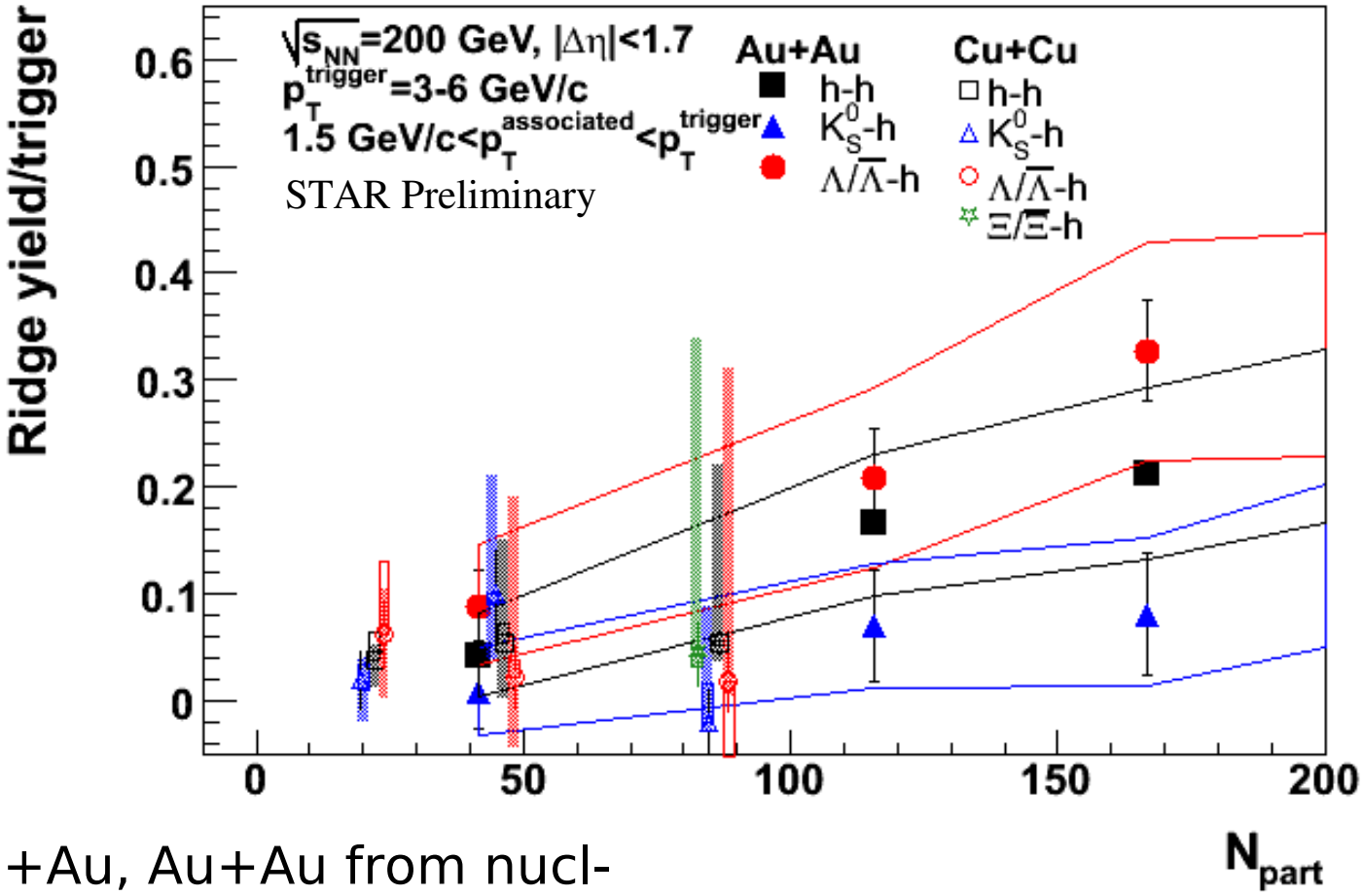

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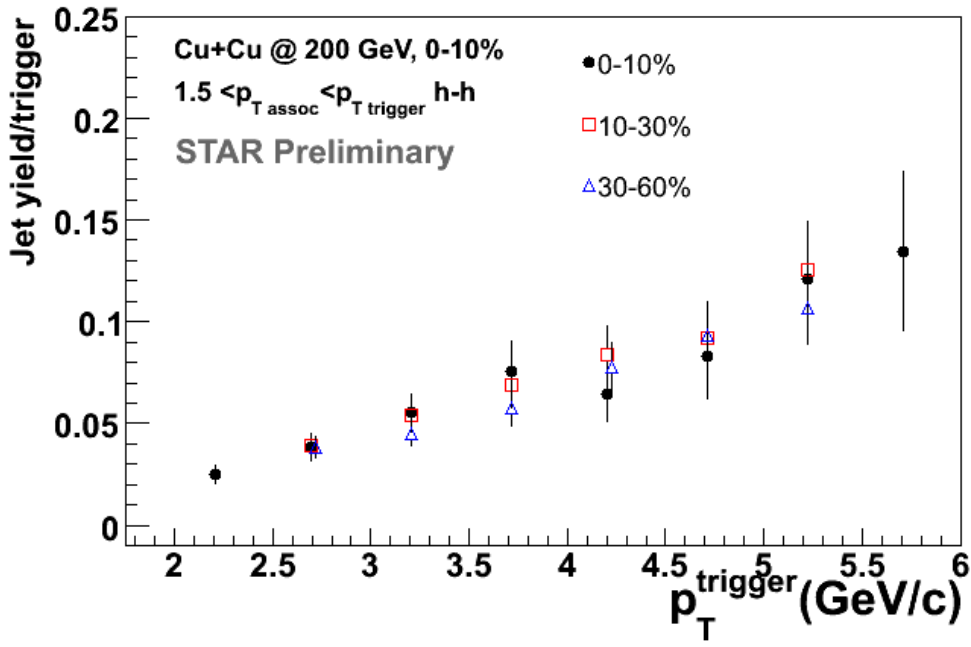
Near-side yield vs $p_T^{trigger}$

- Jet yield rises with $p_T^{trigger}$ in h-h
  - Yield roughly constant with centrality
- No particle type dependence within error bars
- Central Au+Au and 0-60% Cu+Cu jet yields comparable



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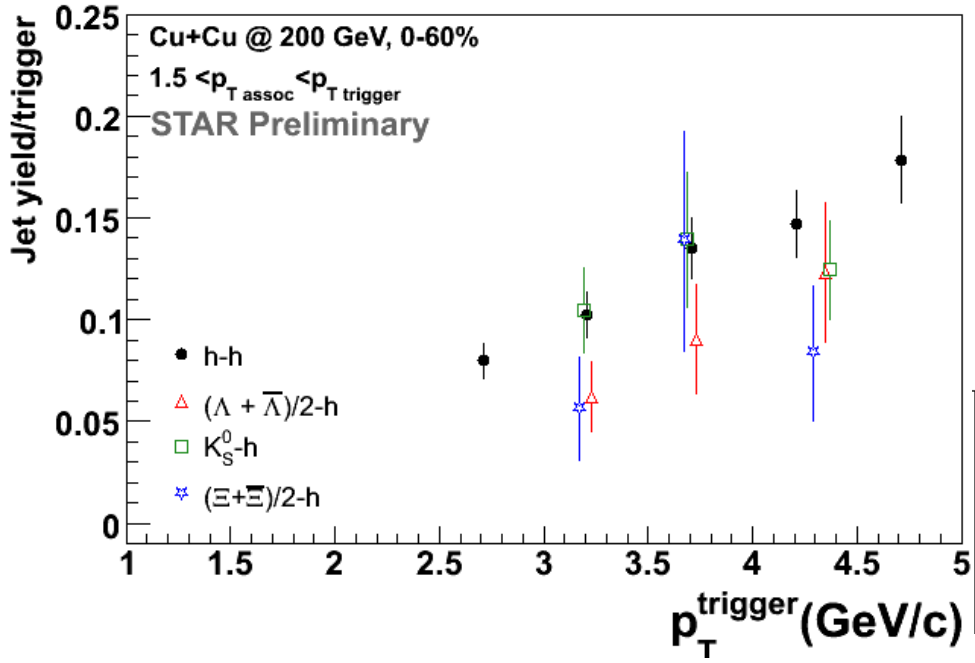
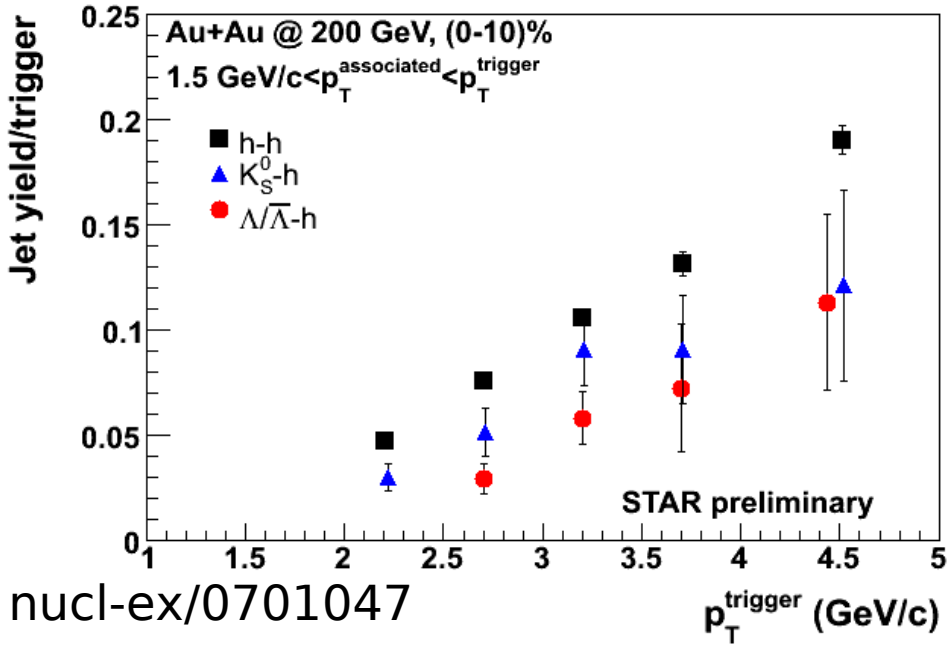
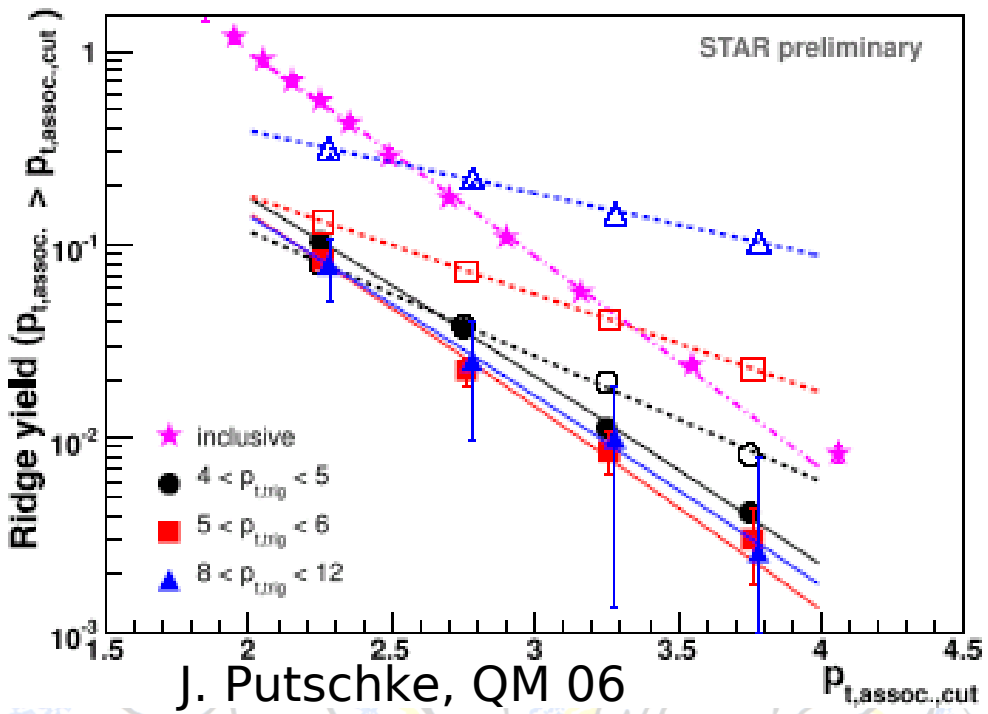




nucl-ex/0701047

p_T-distribution of associated particles

- Ridge spectra similar to the bulk
  - Cu+Cu measurements probably not possible
- Jet spectra are slightly harder
  - Cu+Cu T within error of Au+Au
  - Cu+Cu fit only to h-h



J. Putschke, QM 06

Fit to A exp(-p_T/T)

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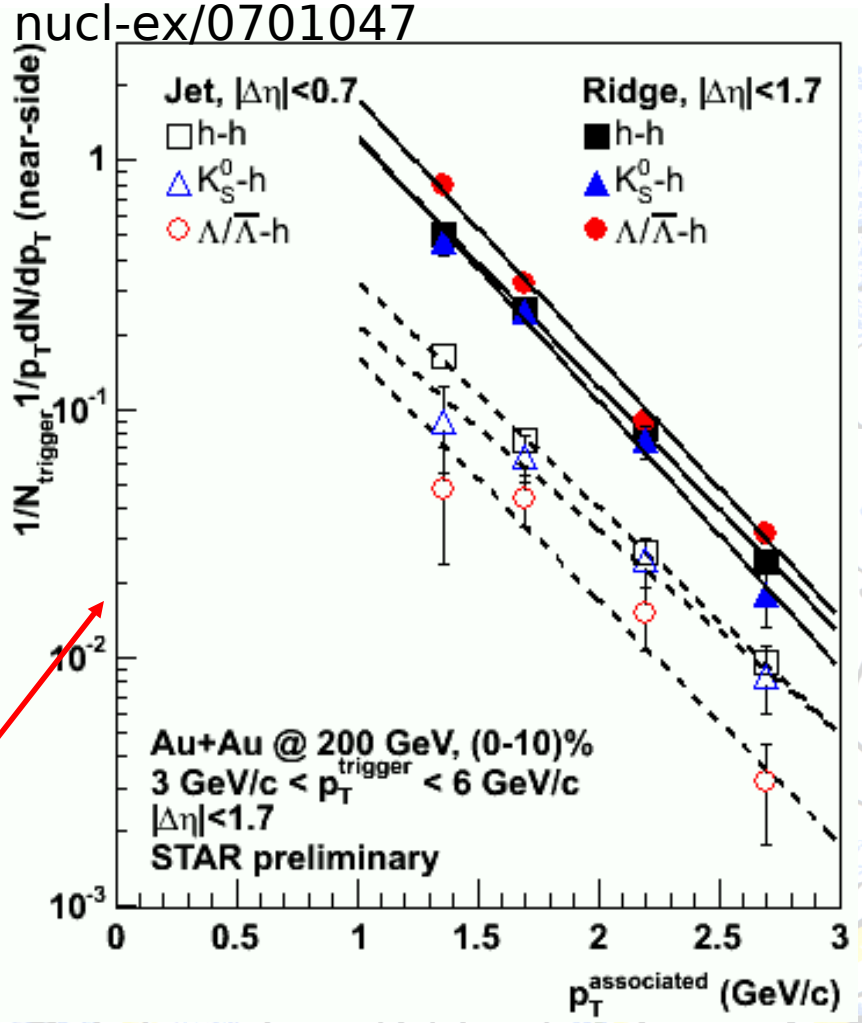

Trigger particle	T(ridge) MeV	T (jet) MeV
$h^{+/-}$	438 ± 4 (stat.)	478 ± 8
K^0_S	406 ± 20 (stat.)	530 ± 61
Λ	416 ± 11 (stat.)	445 ± 49

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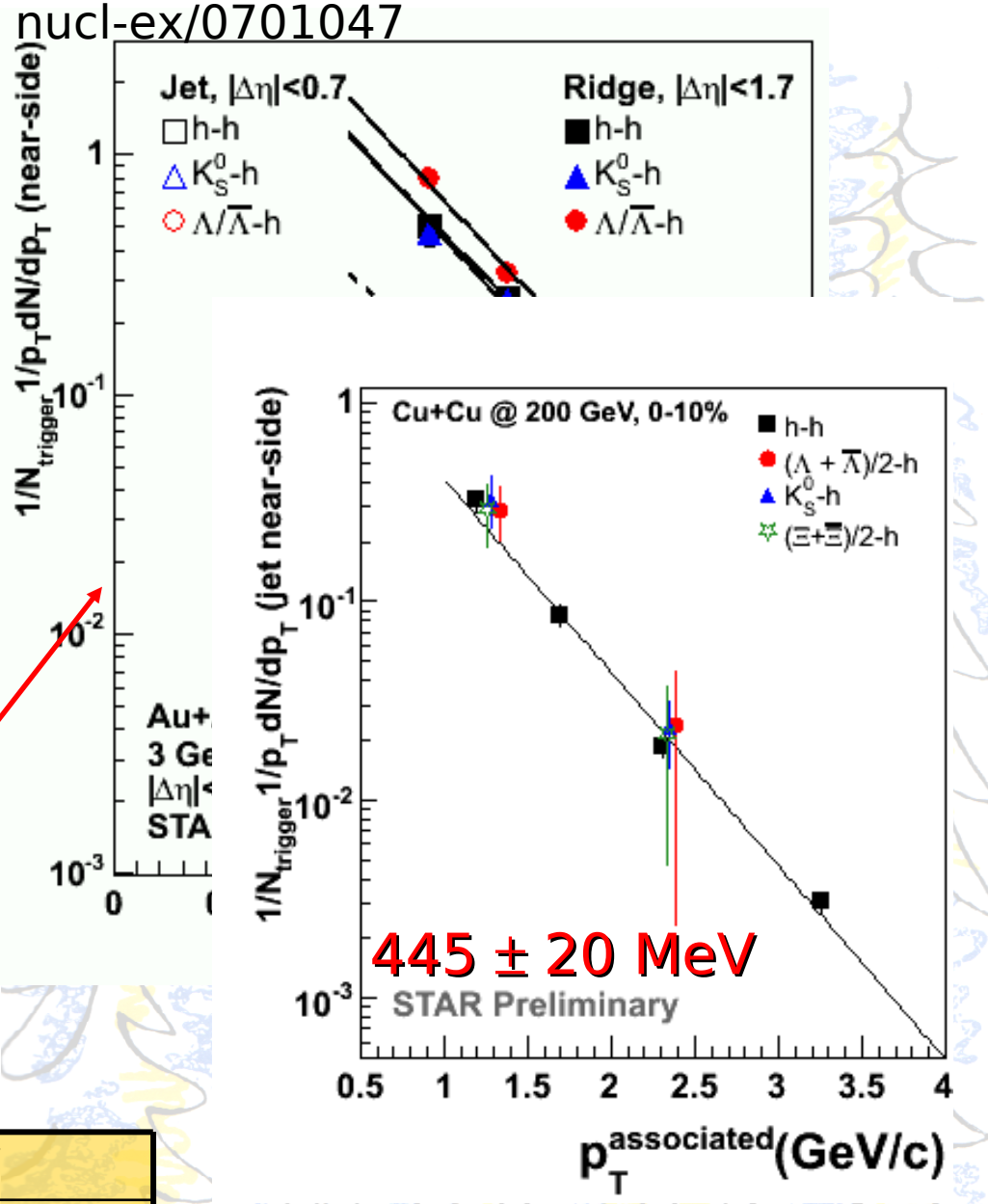

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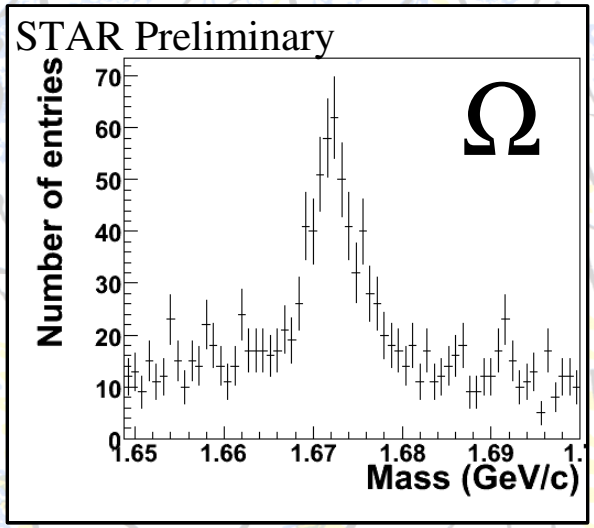
Fit to A exp(-p_T/T)

Conclusions

- Ridge yields
  - Cu+Cu very small
  - Cu+Cu and Au+Au consistent at the same N_{part}
- No trigger particle type dependence within errors
  - including non-strange, and singly and doubly strange triggers
- Jet yields
  - Cu+Cu and Au+Au consistent at the same N_{part}
  - increases with $p_{T\ trigger}$
    - constant with centrality
    - independent of system

Future work

- Systematics
  - Reduce systematic error from v_2
  - Identified particle v_2
- Coming soon
  - Identified associated particles in Cu+Cu
  - Ω triggers
    - Comparisons to Au+Au – See B. Abelev's SQM talk
  - Away-side yields
  - Energy dependence of Jet and Ridge yields



~1000 Ω triggers in central Cu+Cu with p_T>2.5 GeV/c!
~2000 in central Au+Au

STAR Collaboration

- University of Illinois at Chicago - Argonne National Laboratory Institute of High Energy Physics - University of Birmingham Brookhaven National Laboratory - California Institute of Technology - University of California, Berkeley - University of California, Davis - University of California, Los Angeles - Carnegie Mellon University - Creighton University – Nuclear Physics Inst., Academy of Sciences - Laboratory of High Energy Physics - Particle Physics Laboratory - University of Frankfurt - Institute of Physics, Bhubaneswar - Indian Institute of Technology, Mumbai - Indiana University Cyclotron Facility - Institut de Recherches Subatomiques de Strasbourg - University of Jammu - Kent State University - Institute of Modern Physics - Lawrence Berkeley National Laboratory - Massachusetts Institute of Technology - Max-Planck-Institut fuer Physics - Michigan State University - Moscow Engineering Physics Institute - City College of New York - NIKHEF and Utrecht University - Ohio State University - Panjab University - Pennsylvania State University - Institute of High Energy Physics - Purdue University – Pusan National University - University of Rajasthan - Rice University - Instituto de Fisica da Universidade de Sao Paulo - University of Science and Technology of China - Shanghai Institue of Applied Physics - SUBATECH - Texas A&M University - University of Texas, Austin - Tsinghua University - Valparaiso University – Variable Energy Cyclotron Centre, Kolkata - Warsaw University of Technology - University of Washington - Wayne State University - Institute of Particle Physics - Yale University - University of Zagreb

Thank you!

Backup slides

"Large acceptance hadronic detector"