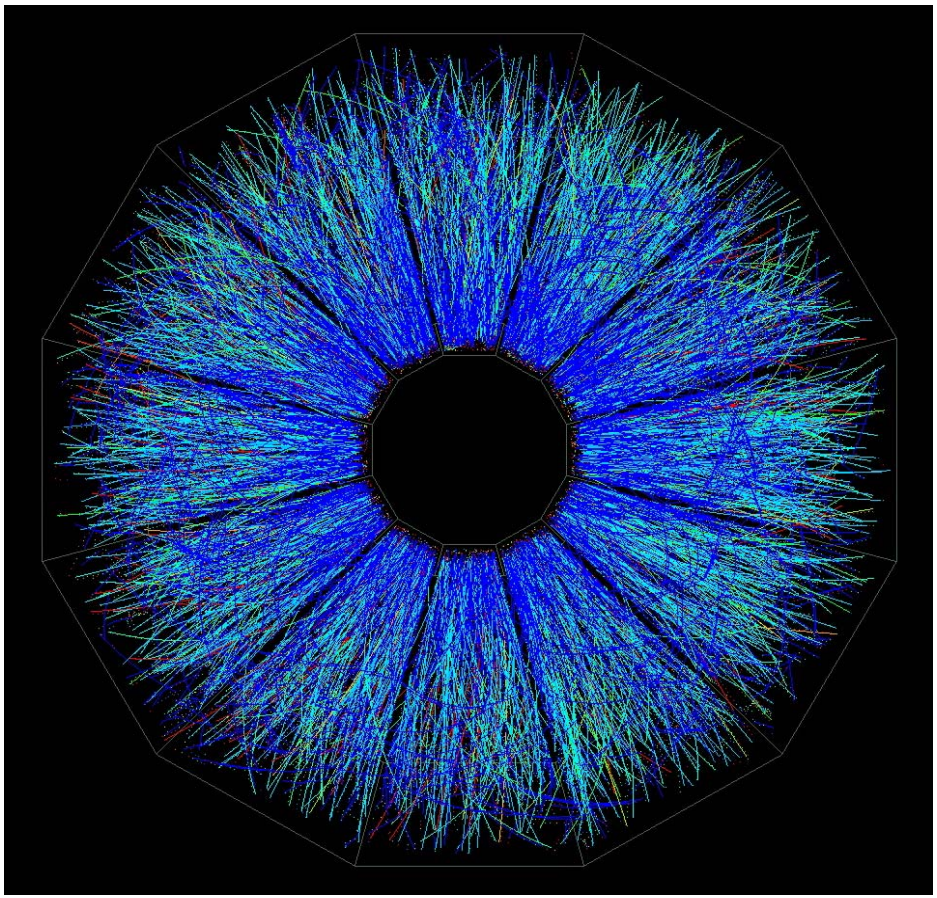
Status of the STAR Experiment



Tim Hallman for the STAR Collaboration
DOE S&T Review
July 24, 2006
Jamie Dunlop presenting

Status of the STAR Experiment

Outline of this Talk:

Status of the STAR Collaboration

Report on Run 6

Recent and “expected soon” physics results

Future Plans

Concerns

Conclusions

Status of The STAR Collaboration: 47 Institutions, 12 countries, ~ 500 Scientists and Engineers

U.S. Labs:
Argonne, Lawrence Berkeley, and Brookhaven National Labs

U.S. Universities:
UC Berkeley, UC Davis, UCLA, Carnegie Mellon, Creighton, CCNY, Indiana, Kent State, MSU, Ohio State, Penn State, Purdue, Rice, Texas A&M, UT Austin, Washington, Wayne State, Valparaiso, Yale, MIT

Brazil:
Universidade de Sao Paolo

China:
IHEP - Beijing, IPP - Wuhan, USTC, Tsinghua, SINR, IMP Lanzhou

Croatia:
Zagreb University

Czech Republic:
Institute of Nuclear Physics

England:
University of Birmingham

France:
Institut de Recherches Subatomiques Strasbourg, SUBATECH – Nantes

Poland:
Warsaw University of Technology

Russia:
MEPHI – Moscow, LPP/LHE JINR – Dubna, IHEP – Protvino

South Korea:
Pusan National University

STAR is a vital, dynamic international collaboration

Some impact of LHC startup projected in the out-years which will be addressed later in the talk

Status of STAR: a growing list of degree recipients

83 advanced degrees to students at 24 institutions awarded on STAR research

Max-Planck-Institut
2005 Frank Simon, PhD
2004 Joern Putschke, PhD
2003 Maierbeck Peter, Dipl.
2002 Markus Oldenburg, PhD
2000 Holm Huemmler, PhD
2000 Tobias Eggert, Dipl.
1998 Rainer Marstaller, Dipl.
1997 Michael Konrad, PhD
1997 Xaver Bittl, Dipl.

Michigan State University
2002 Marguerite Tonjes, PhD

Ohio State University
2004 Selemon Bekele, PhD
2004 M. Lopez-Noriega, PhD
2003 Randy Wells, PhD
2002 Robert Willson, PhD

Purdue University
2003 Timothy Herston, M.S.
2002 Alex Cardenas, PhD
2006 Levente Molnar, PhD

Rice University
2001 Martin DeMello, M.S.

USTC China
2005 Xin Dong, PhD
2004 Shengli Huang, PhD
2004 Lijuan Ruan, PhD

SUBATECH
2005 Magali Estienne, PhD
2004 Gael Renault, PhD
2003 Ludovic Gaudichet, PhD
2002 Javier Castillo, PhD
2000 Fabrice Retiere, PhD
2000 Walter Pinganaud, PhD

University of Texas - Austin
2004 Aya Ishihara, PhD
2004 Yiqun Wang, PhD
2003 Bum Choi, PhD
2002 Curtis Lansdell, PhD

Warsaw University of Technology
2004 Adam Kisiel, PhD
2004 Zbigniew Chajecki, M.S.

University of Washington
2002 Jeff Reid, PhD

Institute of Particle Physics
2005 Zhixu Liu, PhD
2002 Jinghua Fu, PhD

Yale University
2006 Sevil Salur, PhD
2004 Jon Gans, PhD
2003 Haibin Zhang, PhD
2003 Michael Miller, PhD
2002 Matthew Horsley, PhD
2001 Manuel Calderon, PhD

University of Bern
2005 Mark Heinz, PhD

University of Birmingham
2005 John Adams, PhD
2002 Matthew Lamont, PhD

UC – Los Angeles
2006 Jingguo Ma, PhD
2006 Johan Gonzalez, PhD
2006 Weijiang Dong, PhD
2005 Dylan Thein, PhD
2005 Jeff Wood, PhD
2005 Hai Jiang, PhD
2003 Yu Chen, PhD
2003 Paul Sorensen, PhD
2002 Hui Long, PhD
2001 Eugene Yamamoto, PhD

Carnegie Mellon University
2003 Christopher Kunz, PhD

Creighton University
2003 Steve Gronstal, M.S.
2003 Nil Warnasooriya, M.S.
2003 Sarah Parks, M.S.
1999 Jie Lin, M.S.
1998 Quinn Jones, M.S.
1996 John Meier, M.S.
1995 Jeffrey Gross, M.S.

Wayne State University
2005 Ying Guo, PhD
2005 Alexander Stolpovsky, PhD

Nucl. Physics Inst., Prague
2002 Petr Chaloupka, M.S.

UC - Davis
2002 Ian Johnson, PhD

University of Frankfurt
2006 Thorsten Kollegger, PhD
2003 Dominik Flierl, PhD
2003 Jens Berger, PhD
2003 Clemens Adler, PhD
2003 Christof Struck, PhD
1998 Jens Berger, Dipl.
1998 Clemens Adler, Dipl.

Reserches Sub. Strasbourg
2004 Julien Faivre, PhD
2002 Boris Hippolyte, PhD
2001 Christophe Suire, PhD

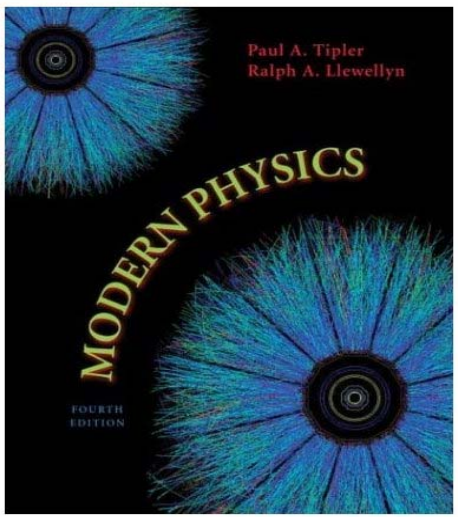
Kent State University
2005 Camelia Mironov, PhD
2005 Gang Wang, PhD
2003 Ben Norman, PhD
2002 Wensheng Deng, PhD
2002 Aihong Tang, PhD

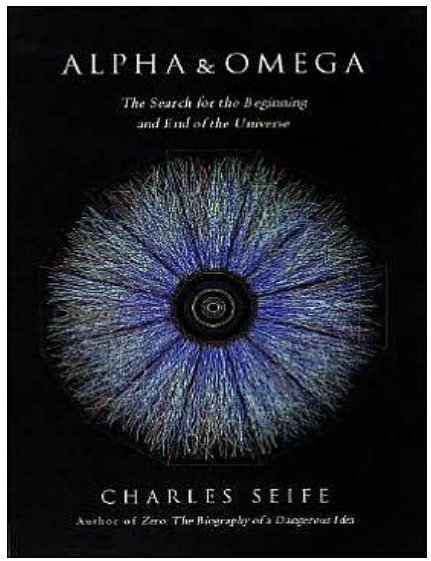
LBNL
2003 Vladimir Morozov, PhD

Blue = awarded since last review

Status of STAR: a growing publication record

- **31** Physical Review Letters
- 19 Physical Review C
- 8 Physics Letters B / J. Physics G / Nuclear Physics A
- 3,740 Citations, not including white paper
- 13 Papers with 100+ citations





Visibility which is impacting the popular image of modern physics

Status of the STAR Collaboration: Scientific Productivity Since the Last DOE Review

Scaling properties of hyperon production in Au+Au collisions at sqrt(sNN) = 200 GeV
Submitted June 8, 2006

Identified baryon and meson distributions at large transverse momenta from Au+Au collisions at sqrt(sNN) = 200 GeV
Submitted June 1, 2006

Strange baryon resonance production in sqrt(sNN) = 200 GeV p+p and Au+Au collisions
Submitted April 28, 2006

Direct observation of dijets in central Au+Au collisions at sqrt(sNN) = 200 GeV
Submitted April 28, 2006

Forward Neutral Pion Production in p+p and d+Au Collisions at sqrt(sNN)=200 GeV
Submitted February 10, 2006

Identified hadron spectra at large transverse momentum in p+p and d+Au collisions at sqrt(sNN) = 200 GeV
published April 27, 2006, Phys. Lett. B 637 (2006) 161

Strangelet Search at RHIC
Submitted November 27, 2005

Multiplicity and Pseudorapidity Distributions of Charged Particles and Photons at Forward Pseudorapidity in Au + Au Collisions at sqrt(sNN) = 62.4 GeV
published March 13, 2006 Phys. Rev. C 73 (2006) 034906

Directed flow in Au+Au collisions at sqrt(sNN) = 62 GeV
published March 8, 2006, Phys. Rev. C 73 (2006) 034903

Status of the STAR Collaboration: Scientific Productivity

Transverse-momentum pT correlations on (eta,phi) from mean-pT fluctuations in Au-Au collisions at sqrt(sNN)=200 GeV
published May 5, 2006, J. Phys. G 32 (2006) L37

Incident Energy Dependence of pt Correlations at RHIC
published October 19, 2005, Phys. Rev. C 72 (2005) 044902

Multi-strange baryon elliptic flow in Au+Au collisions at sqrt(sNN)= 200 GeV
published September 13, 2005, Phys. Rev. Lett. 95 (2005) 122301

Multiplicity and Pseudorapidity Distributions of Photons in Au + Au Collisions at sqrt(sNN) = 62.4 GeV
published August 5, 2005, Phys. Rev. Lett. 95 (2005) 062301

Distributions of Charged Hadrons Associated with High Transverse Momentum Particles in pp and Au+Au Collisions at sqrt(sNN) = 200 GeV
published October 6, 2005, Phys. Rev. Lett. 95 (2005) 152301

K(892)* Resonance Production in Au+Au and p+p Collisions at sqrt(sNN) = 200 GeV at STAR
published June 6, 2005, Phys. Rev. C 71 (2005) 064902

Minijet deformation and charge-independent angular correlations on momentum subspace (eta,phi) in Au-Au collisions at sqrt(sNN) = 130 GeV
published June 29, 2006, Phys. Rev. C 73 (2006) 064907

Azimuthal Anisotropy in Au+Au Collisions at sqrt(sNN) = 200 GeV
published July 14, 2005, Phys. Rev. C 72 (2005) 014904

17 papers published or submitted since last review

Abstracts Submitted to Spin06

- Longitudinal spin results (all based on Run 5 results):
  - Inclusive Jets A_{LL} (Relyea)
  - Inclusive π^0 A_{LL} and cross section at $-1 < \eta < 1$ (Simon)
  - Inclusive π^0 A_{LL} at $1 < \eta < 2$ (Webb)
  - Inclusive charged hadron A_{LL} (Kocoloski)
  - Longitudinal spin transfer in Λ production (Xu)

- Transverse spin results (both based on Run 6 results):
  - Mid-rapidity Sivers asymmetry for di-jets (Balewski)
  - A_N for forward π^0 and jet-like events (Nogach)

33 abstracts in final preparation for submission to QM06

Status of STAR Collaboration

Long term (≥ 2-3 weeks) visitors hosted at BNL for work on STAR

Ahammed	VECC
Arkhipkin	PPL, Dubna
Bai	NIKHEF
Baudot	Subatech
Bhardwaj	Rajasthan
Bhati	Panjab
Bonnet	IReS
Brandine	MEPhI
Bystersky	NPI, Czech Rep.
Chattopadhyay	VECC
Caines	Yale
Chen	USTC
Choi	Pusan
Consentino	Sao Paulo
Crawford	SSL
DeMoura	Sao Paulo
Dietel	Frankfurt
Engelage	SSL
Estienne	IReS
Fedorisin	NIKHEF
Filip	PPL, Dubna
Filippov	NPI, Czech Rep.
Gangaharan	UCLA
Guimaraes	Sao Paulo
Grebenyuk	NIKHEF
Grube	Pusan
Gupta	Jammu
Heinz	Yale
Hippolyte	IReS
Jakl	NPI, Czech Rep.
Jia	Lanzhou
Kapitan	NPI, Czech Rep.
Kechechyan	LHE, Dubna
Kim	Pusan
Kiryluk	MIT
Kisiel	Warsam
Kopytine	Kent State
Kotchenda	MEPhI
Kravstov	MEPhI
Kurnadi	UCLA
Little	IRES
Liu	Wuhan
Ma	UCLA
Margetis	Kent State
Markert	Kent State
Martin	Subatech
Matulenko	IHEP, Protvino
Mironov	Kent State
Mohanty	VECC
Morozov	IHEP, Protvino
Munhoz	Sao Paulo
Nandi	Mumbai
Nelson	Birmingham
Netrakanti	VECC
Nogach	IHEP, Protvino
Okorokov	MEPhI
Pachr	NPI, Czech Rep.
Panebratsev	LHE, Dubna
Perkins	SSL
Poljak	Zagreb

Status of STAR Collaboration

Long term (≥ 2-3 weeks) visitors hosted at BNL for work on STAR

Raniwala	Rajasthan	Thomas	LBNL
Ridiger	MEPhI	Tokarev	LHE, Dubna
Rogatchevski	LHE, Dubna	Trentalange	UCLA
Sahoo	Bhubaneswar	UCLA	UCLA
Seyboth, J.	MPI	van Niuwenhuizen	MIT
Seyboth, P.	MPI	Vernet	IReS
Shao	USTC	Vokal	LHE, Dubna
Sharma	Panjab	Waggoner	Creighton
Speltz	IReS	Wang	Tsinghua
Stringfellow	Purdue	Wieman	LBNL
Suaide	Sao Paulo	Witt	Yale
Sumbera	NPI, Czech Rep.	Zawisza	Warsaw
Sun	Lanzhou	Zhang	USTC
Surrow	MIT	Zhong	SI
Takahashi	Sao Paulo	Zulkarneeva	PPL, Dubna

~ 90 STAR visitors hosted in 2006 for data taking, operations, etc.

Report on Run 6: summary of STAR data sets

Species	S $^{1/2}$ (GeV)	Goal	Achieved
pp (long.)	200	$L_{sampled}$ = 10 pb^{-1} @ 50% P FOM = LP^4 = 625 nb^{-1}	2.1 pb^{-1} (prior to transverse P) 6.39 pb^{-1} (after transverse P) $L_{sampled}$ = 8.49 pb-1 FOM ~ 828 nb^{-1}
pp (trans.)	200	~3 pb^{-1*}	3.34 pb^{-1}
pp	200	3 Mevts of L2 J/Psi	3.17 Mevts

All STAR Run 6 data taking goals met or exceeded

STAR's Scientific Plan (Subject to PAC Approval)

Measurements in Runs 6-9 that will provide qualitatively new insights into the properties of

the nucleon
the nucleus
dense QCD matter

Specifically:

Run 6 Place a world-class constraint on gluon polarization in the proton, Δg

Delineate the roles of parton orbital motion/transversity in creating the transverse single spin asymmetry (A_N) observed for inclusive forward π° production

First significant measurement of Sivers effect asymmetry in di-jet production

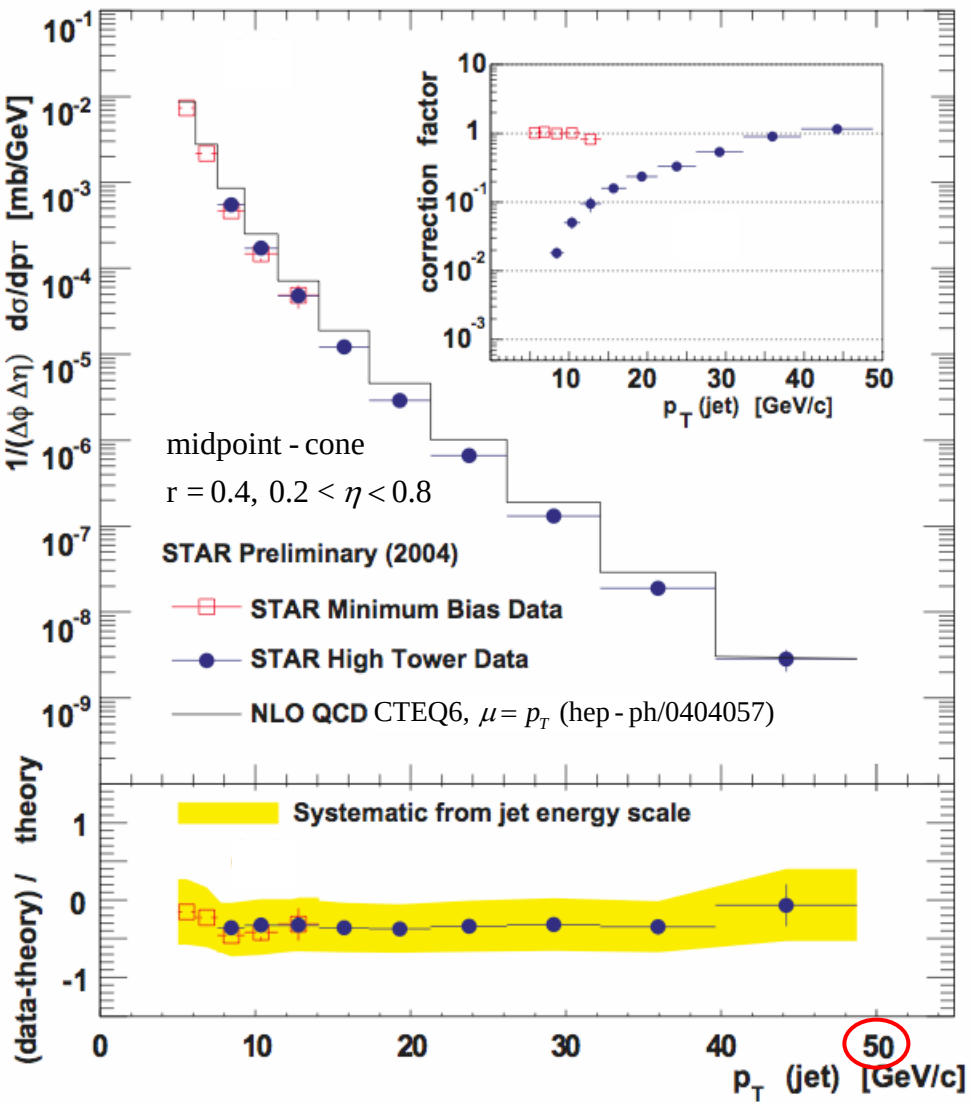
Run 7 Decisive test of existence of the Color Glass Condensate in relativistic heavy nuclei

Progress in understanding the suppression of NPE's from semi-leptonic decays of charm and bottom in $\sqrt{s_{NN}}$ = 200 GeV Au+Au

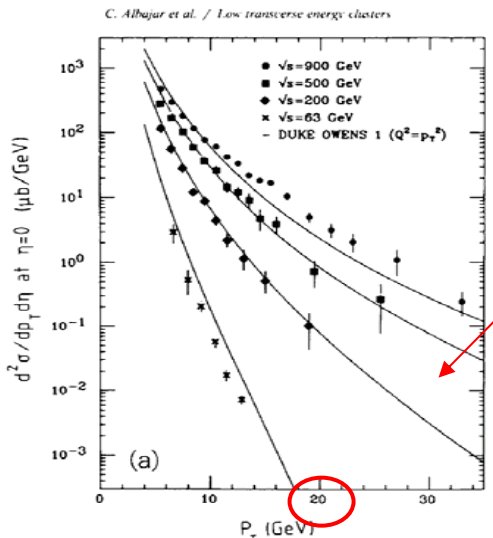
Run 8 Detailed mapping of the x dependence of gluon polarization in the proton, $\Delta g(x)$

Run 9 Precision tests of the properties of quark-gluon matter with upgraded PID/DAQ capability
Search for QCD Critical Point

Recent and "expected soon" p+p results: corrected cross section data

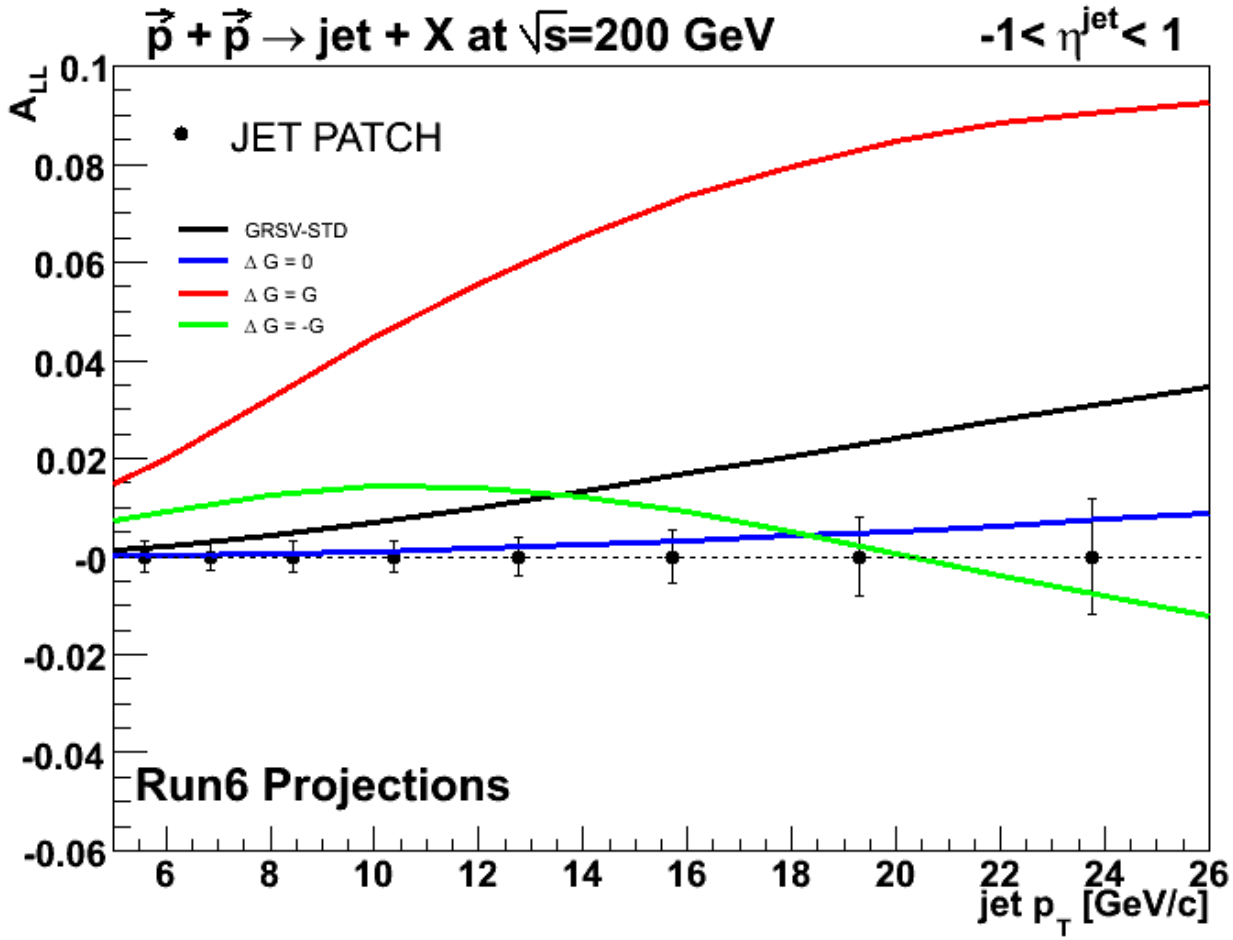


- Good agreement between MB and HT data
- Good agreement with NLO over 7 orders of magnitude
- Error bars
  - statistical uncertainty from data
- Error band
  - leading systematic uncertainty
  - 10% E-scale uncertainty →50% uncertainty on yield
  - Need di-jet, photon-jet to reduce sys. error
- Agree with NLO calculation within systematic uncertainty



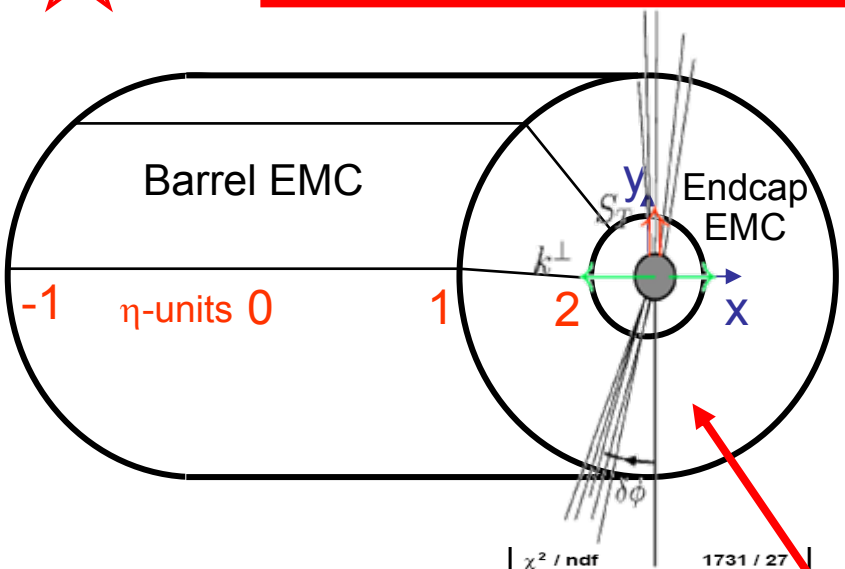
UA1 at 200 GeV

Projected inclusive jet A_{LL} sensitivity from run 6

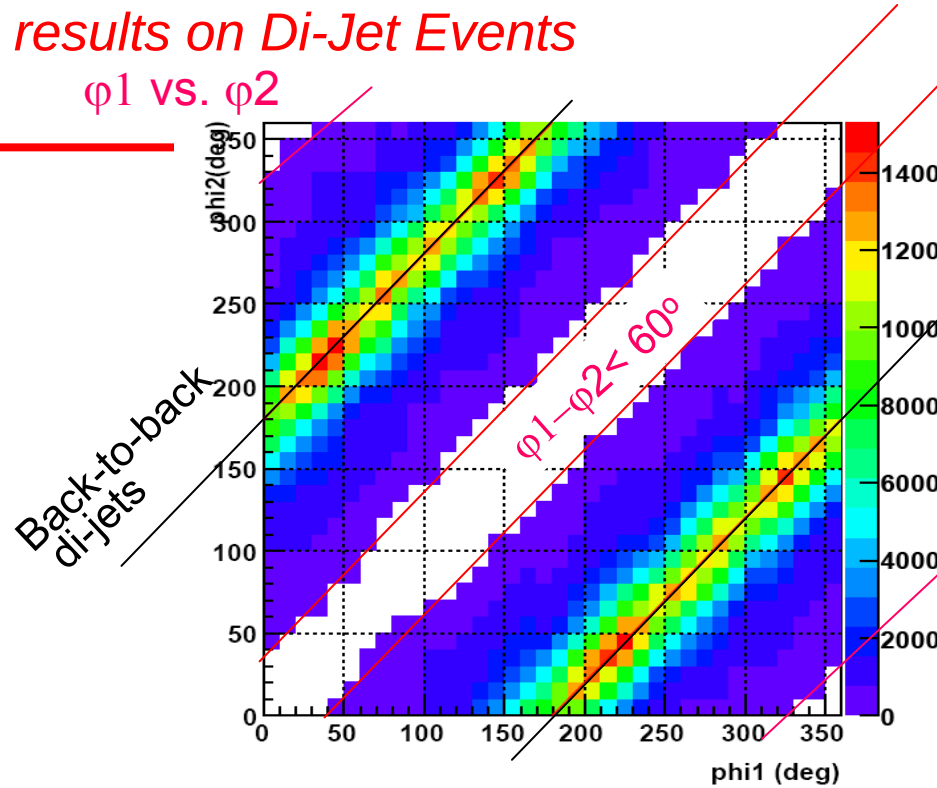


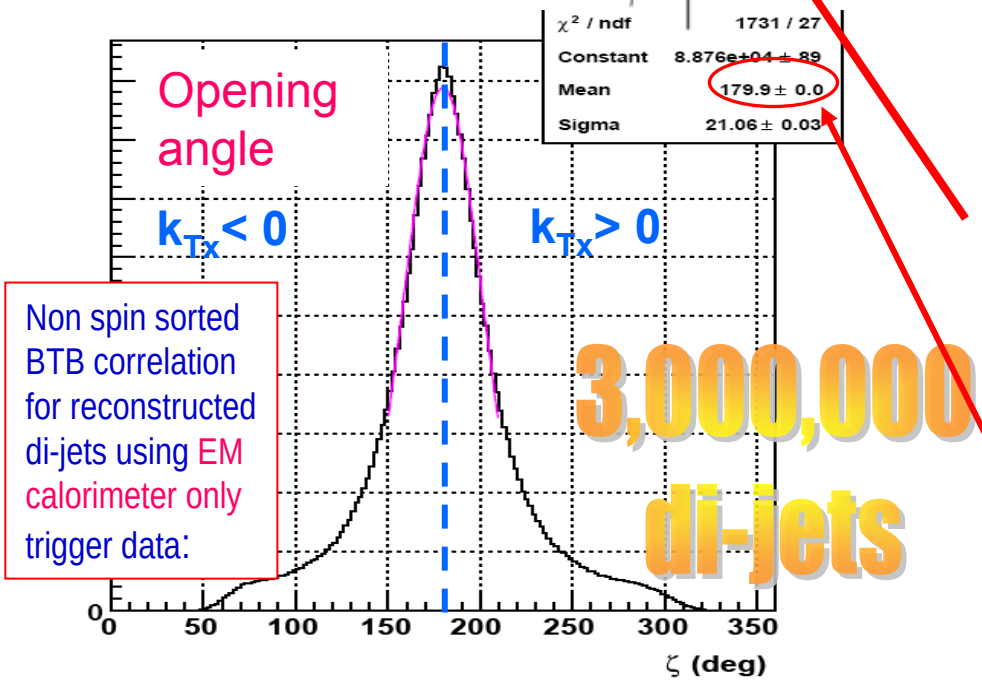
Next quantum step forward for STAR Spin: mapping out the gluon polarization (ΔG(x)) as a function of Bjorken x using q + g → direct γ + jet and jet+jet channels in p+p collisions at √s = 200 GeV

"Expected soon" 2006 STAR results on Di-Jet Events



φ1 vs. φ2





Non spin sorted BTB correlation for reconstructed di-jets using EM calorimeter only trigger data:

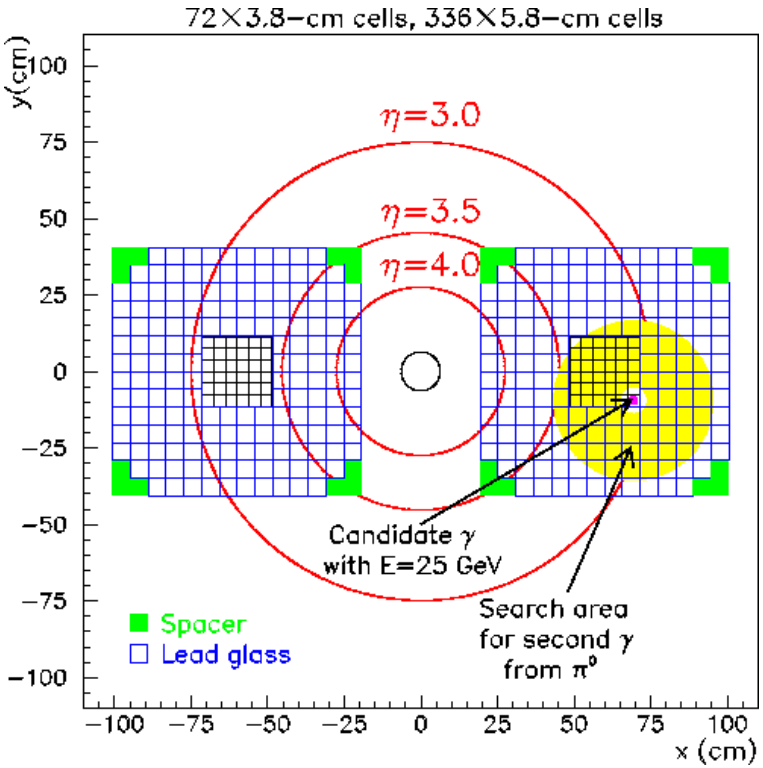
3,000,000 di-jets

Proposal by Vogelsang et al: use (transverse) spin dependent a-coplanarity of back-to-back jets to determine if initial state spin / k_T correlation is significant for quarks & gluons.

Collected sample gives sensitivity to quark & gluon Sivers functions ~ an order of magnitude less than those anticipated by Vogelsang and Yuan based on interpretation of SIDIS Sivers asymmetries measured in HERMES

Result will be presented at Spin06

New Detection Capability in Run 6 for Transverse Studies

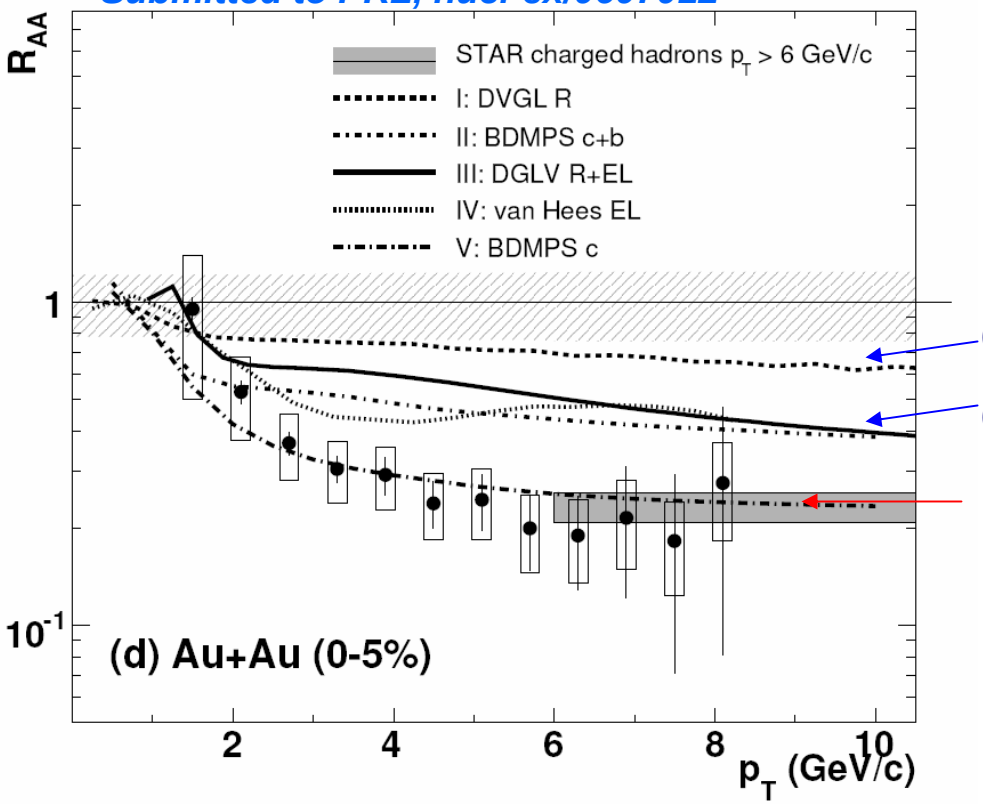


Larger acceptance of FPD++ brings:

- Direct Photon capability
  - *No fragmentation ⇒ if asym. observed it must come from Sivers modulo higher twist effects*
- Multi particle correlations
  - *If Jet asymmetry observed then strong evidence for a Sivers contribution*
  - *Ability to look inside Jet for signatures of Collins fragmentation*
- Increased phase space in X_F and p_t
  - *Study p_t dependence to confirm whether or not this is a pQCD process (i.e. A_N drops as $1/p_t$)*

Recent Heavy Ion Submission: Suppression on Non-Photonic Electrons

Submitted to PRL, nucl-ex/0607012



BDMPS: N. Armesto et al, nucl-ex/0511257

DGLV: Wicks et al, nucl-ex/0512076

c+b, radiative only

c+b, collisional+radiative

c only, collisional+radiative

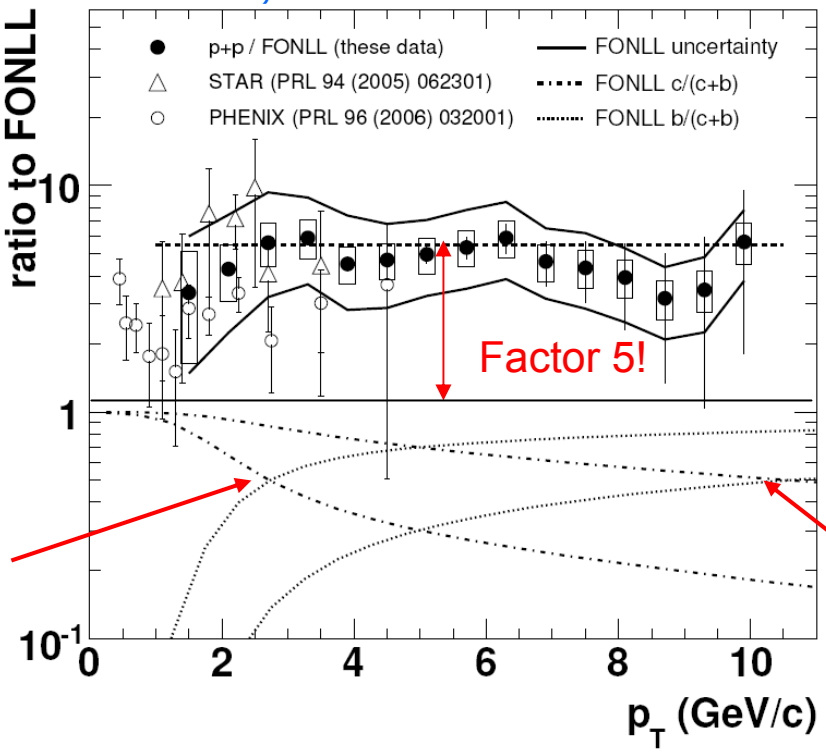
Stronger suppression seen in data than was predicted

Has led to a revisiting of mechanism of energy loss

- Requires extreme densities ("violating entropy") or
- Addition of ignored components such as elastic energy loss

The difficulty in interpreting of the unexpectedly large suppresion of non of non-photonic electrons from semi-leptonic charm and bottom decays

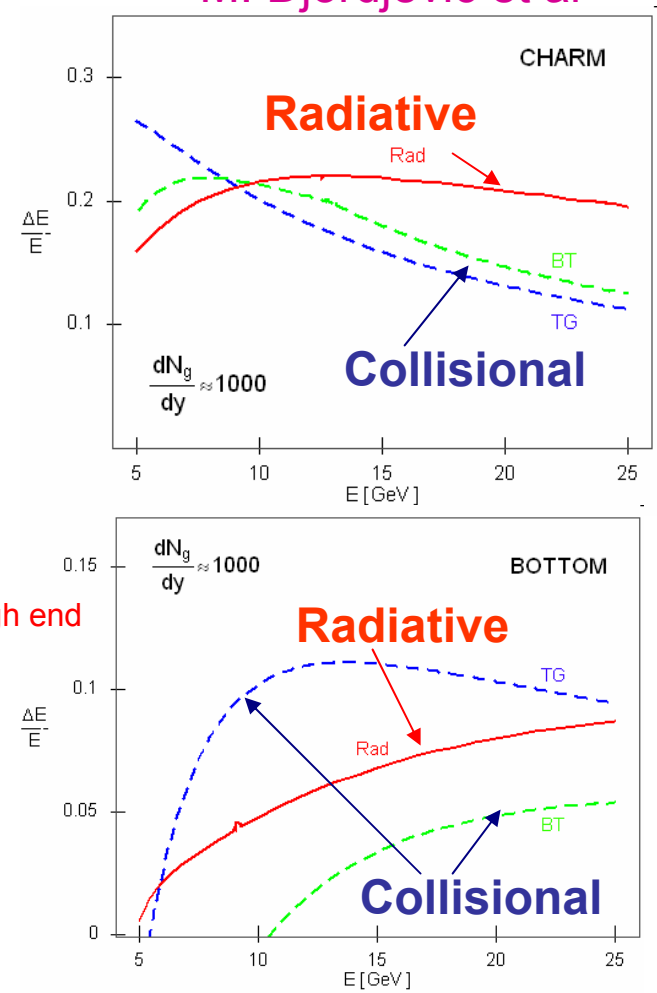
Submitted to PRL, nucl-ex/0607012



The low end

The high end

M. Djordjevic et al



Theory: Relative yield of charm and bottom not well constrained (and overall factor 5)

The collisional and radiative energy loss for the two is predicted to be different

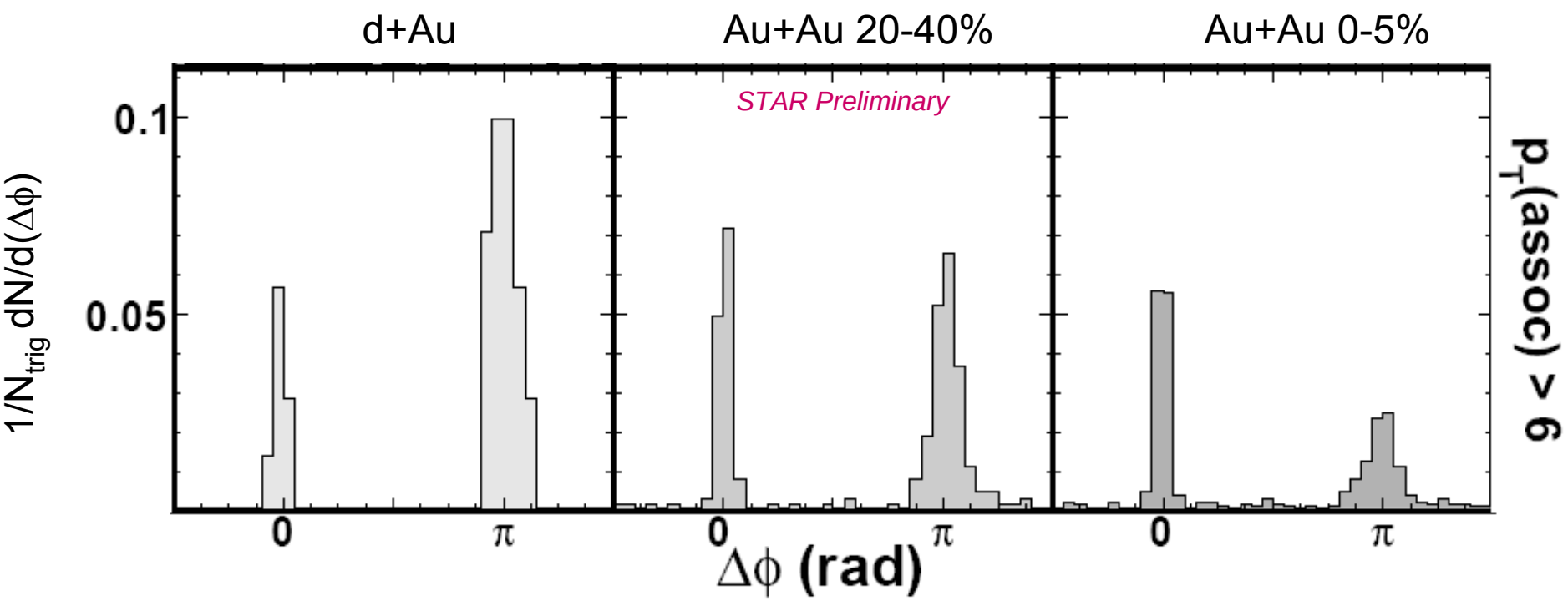
NEED eventually to disentangle relative yield from C and B mesons

Note: this plot from 0.1 pb^{-1}; we have 12 pb^{-1} with 2x acceptance from run 6 (factor 200x stats)

Recent heavy Ion submission: Dijets from dihadrons

$8 < p_T(\text{trig}) < 15$ GeV/c

$p_T(\text{assoc}) > 6$ GeV



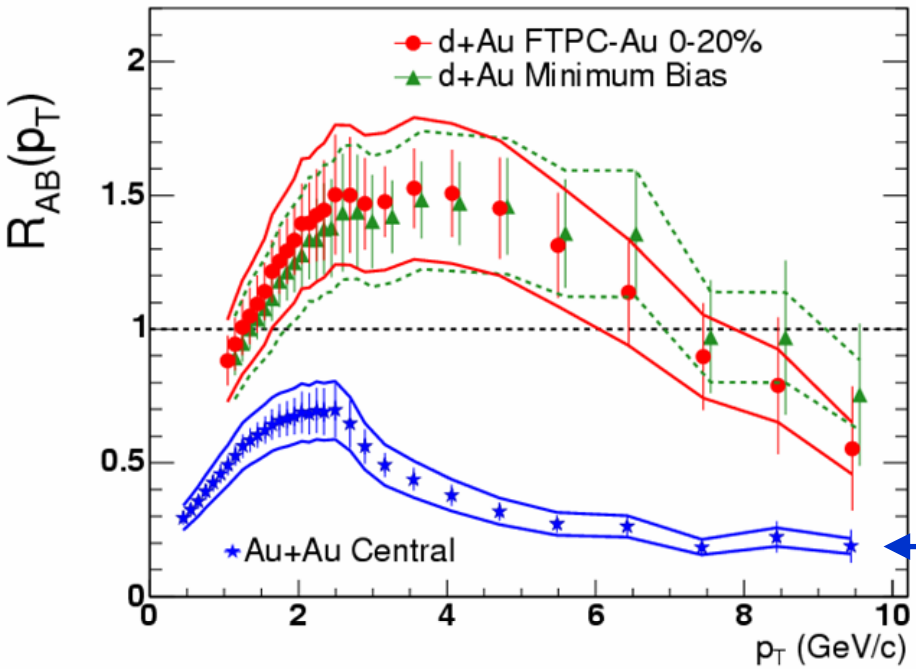
At high trigger p_T, high associated p_T:

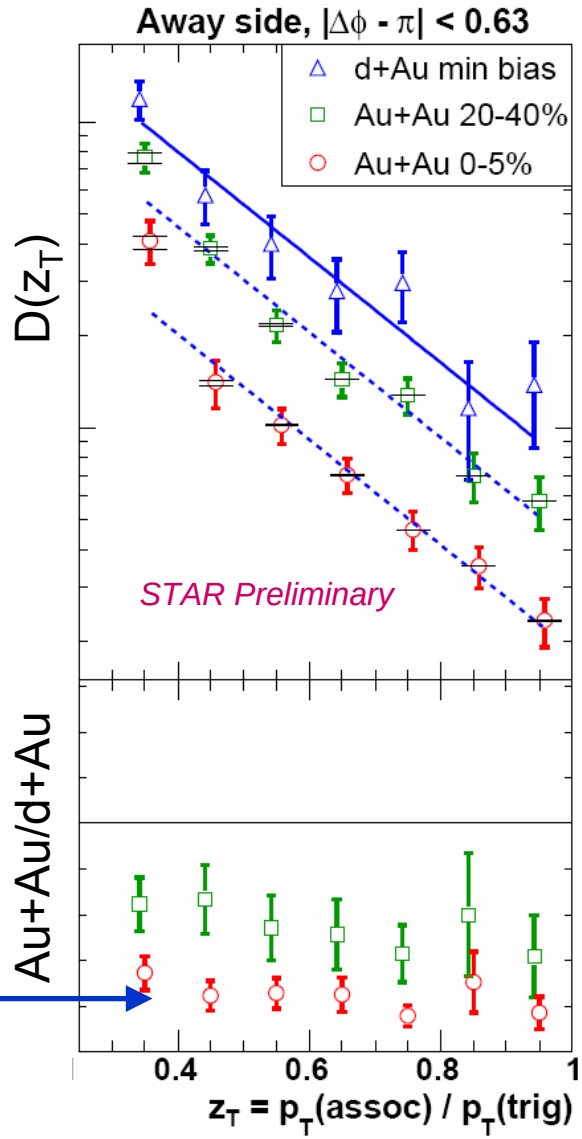
clear jet-like peaks seen on near and away side in central Au+Au

STAR, nucl-ex/0604018, submitted to PRL

Yields of away-side peaks

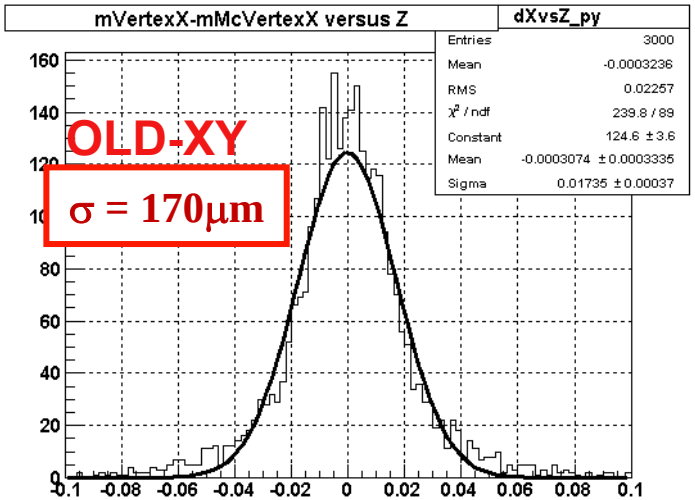
- Away-side yield strongly suppressed to level of R_{AA}
- No modification of shape in the longitudinal (z_T) or transverse ($\Delta\phi$ width) directions
- Strong set of additional constraints on E-loss models

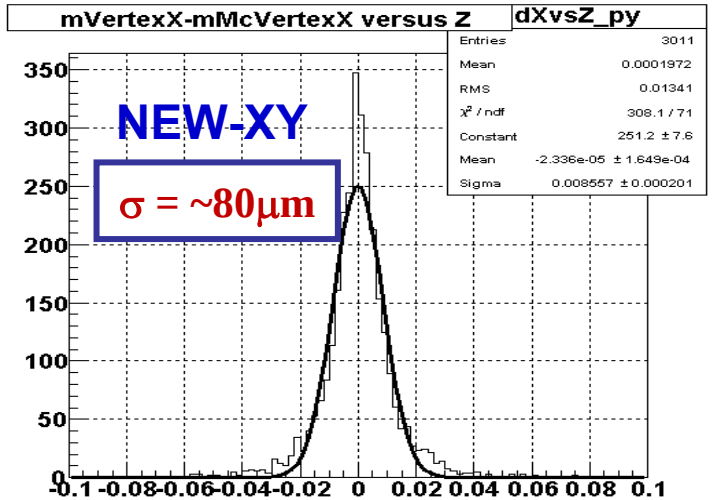


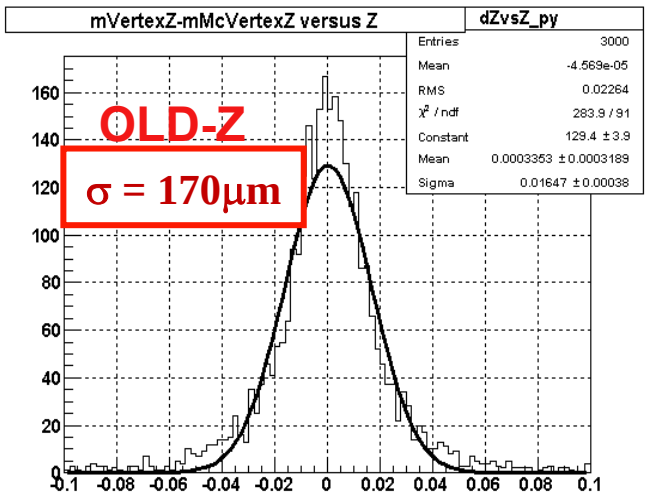


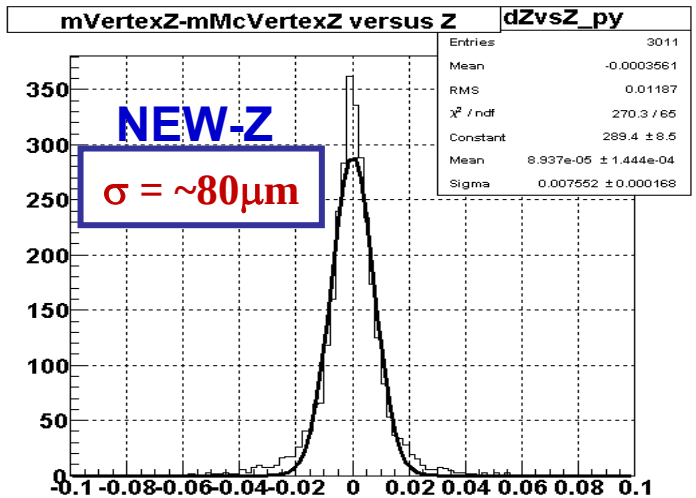
STAR, nucl-ex/0604018, submitted to PRL

A Recent Technical Accomplishment:
Progress in optimizing event vertex resolution using SVT (Cu+Cu, 62 GeV)
(Calibration effort led by Lauret, Margetis, Fisyak, and Perevotchikov)







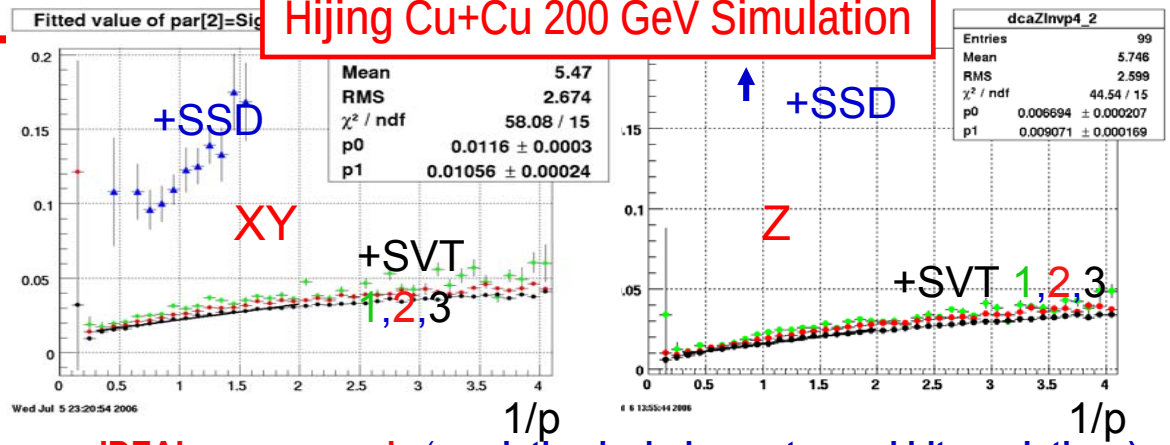


Factor of ~3 in event vertex resolution gained relative to previous SVT; ~7 relative to TPC

→ event vertex resolution not a limiting factor for μVertex-ing in STAR

Progress in optimizing DCA Resolution using SVT

Hijing Cu+Cu 200 GeV Simulation

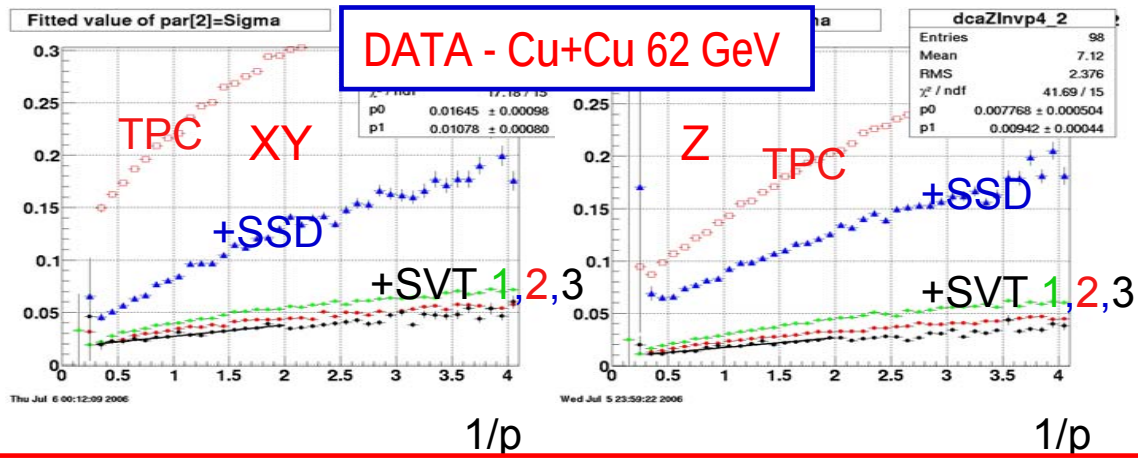


IDEAL case scenario (**resolution includes vertex and hit resolutions**)

At infinite momentum limit, dca resolution is ~120um in XY and 70um in Z

At 1 GeV/c it is 200um in XY and 150 in Z

DATA - Cu+Cu 62 GeV



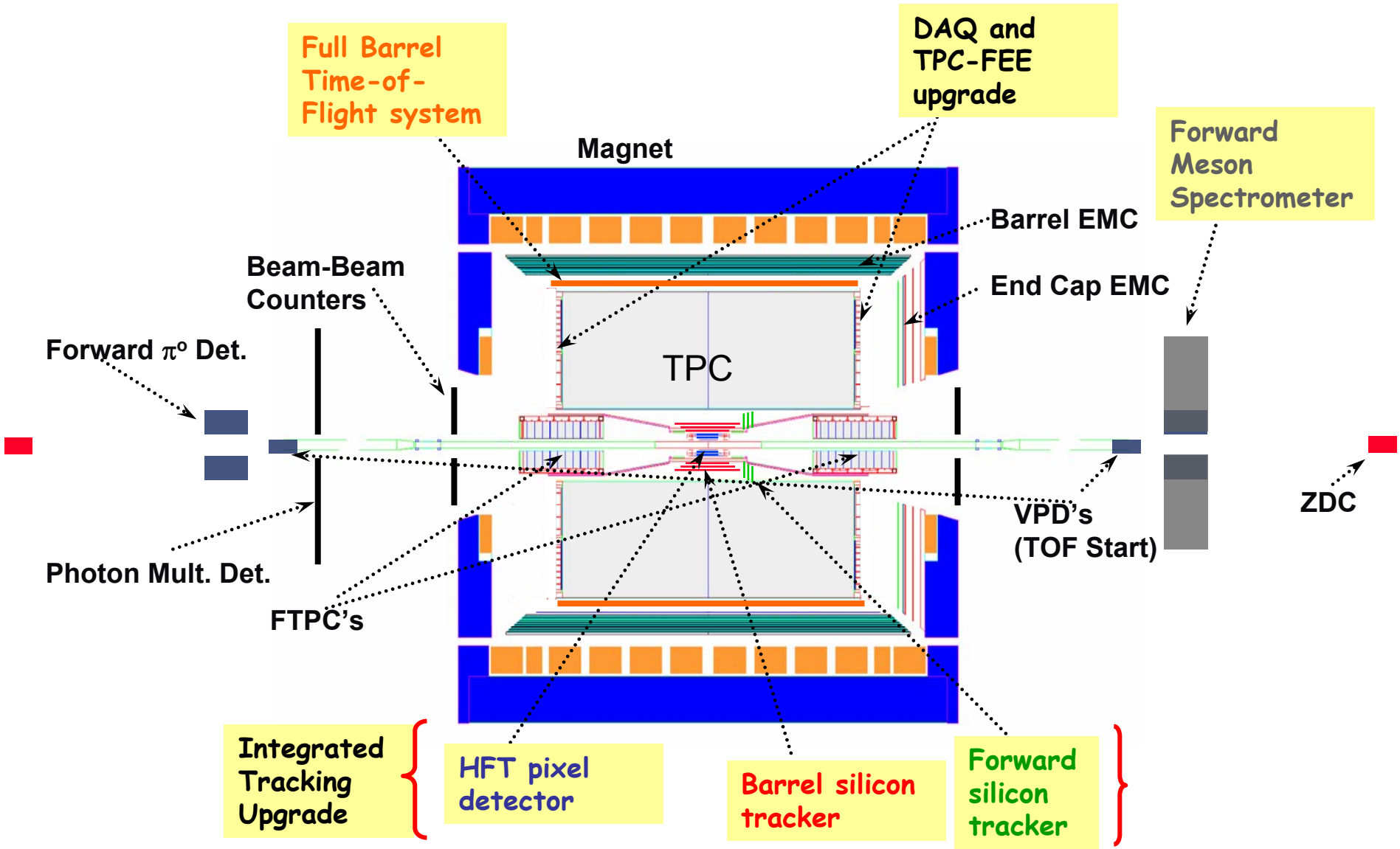
Conclusion: SVT now performing close to design

projected resolutions for Au+Au at $\sqrt{s_{NN}}$ = 200 GeV suggest improved significance for to D → kπ comb subtraction possible

Upgrades planned to carry out the future STAR program

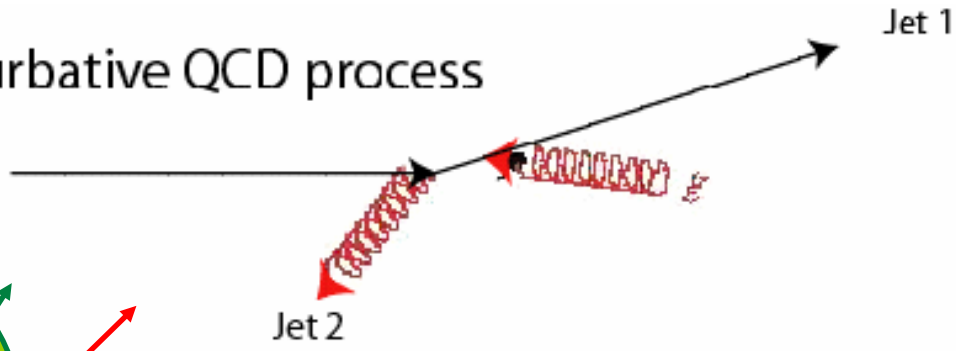
- A Barrel MRPC TOF — PID information for > 95% of kaons and protons in the STAR acceptance; clean $e^{\pm}$ ID down to 0.2 GeV/c extended scientific reach for key observables
- Forward Meson Spectrometer: — Jet reconstruction at high pseudorapidity: CGC monojet search in d(p) + A; isolation of fragmentation effects in large pp $\rightarrow \pi^0$ production single-spin transverse asymmetries
- A DAQ/ TPC FEE Upgrade — New architecture / FEE $\rightarrow$ > 1 khz of events available at L3; effective increase in utilization of luminosity by factor of 10; zero dead time for rare probes
- Heavy Flavor Tracker / Intermediate Silicon Tracker — Precise hit position close to the primary vtx $\rightarrow$ D's ,B's, flavor- tagged jets
- Forward Tracking Upgrade — W charge sign identification (Si and/or GEM technology)

STAR Upgrades

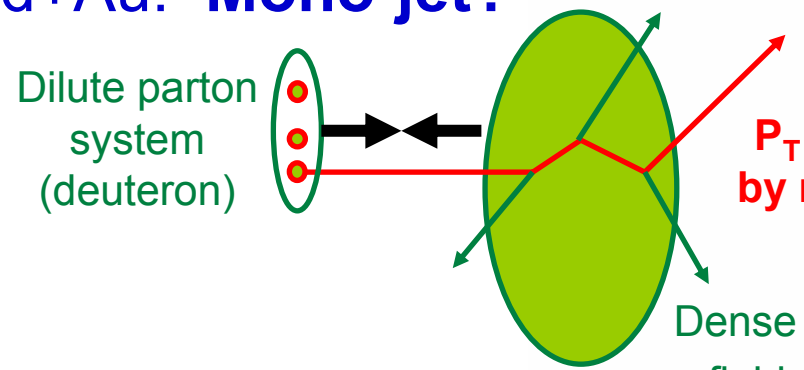


A definitive test of the CGC: search for forward mono-jets in the STAR Forward Meson Spectrometer

p+p: **Di-jet**

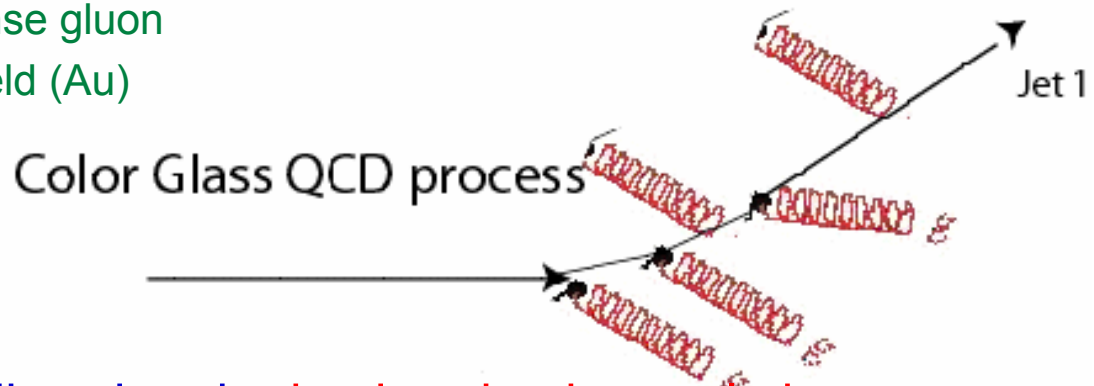


d+Au: **Mono-jet?**



P_T is balanced by many gluons

Kharzeev, Levin, McLerran gives physics picture (NPA748, 627)



Color glass condensate predicts that the back-to-back correlation from p+p should be suppressed

Status of STAR Forward Meson Spectrometer upgrade

Some materials (Pb glass, tubes & bases) not available from IHEP on necessary time scale

Plan for revised configuration in place

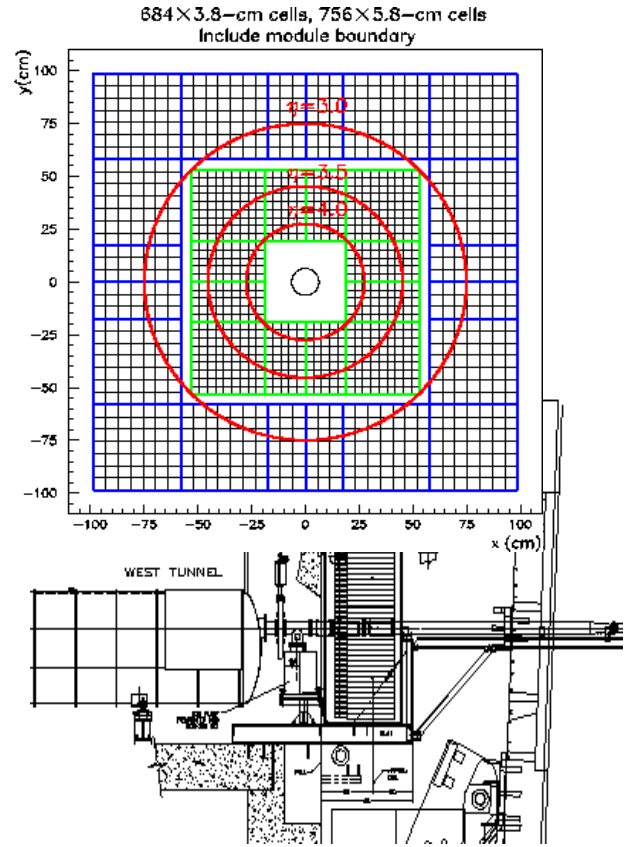
FDP++ array being disassembled; prep for new configuration underway

Materials required being assembled; PMT base prototyping ongoing at Penn State

Sizeable student team (5 graduate, 7 undergraduate) “in harness”

Readout electronics being prototyped at Space Science Lab

Plan is to be ready for Run 7



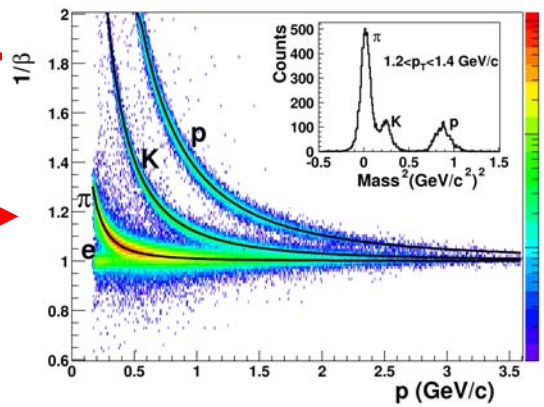
- FMS increases areal coverage of forward EMC from 0.2 m^2 to 4 m^2
- Addition of FMS to STAR provides nearly continuous EMC from $-1<\eta<+4$

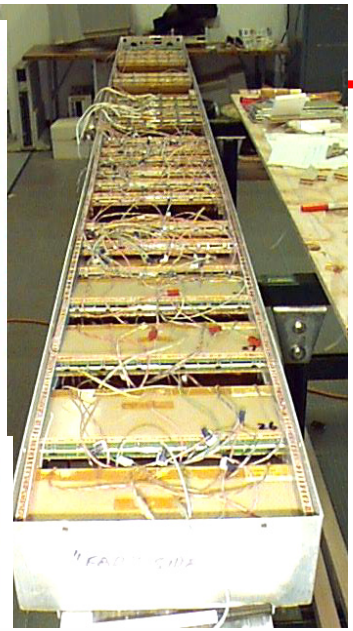
STAR TOF Barrel Status

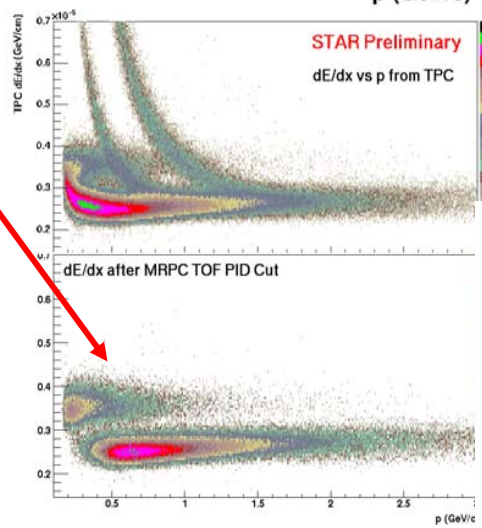
What TOF Provides:

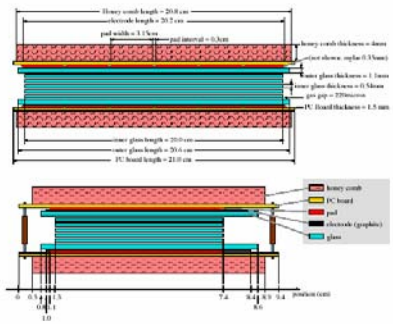
PID information for > 95% of kaons and protons in the STAR acceptance

clean e± ID down to 0.2 GeV/c









Status of Construction Project

- Construction project begun
- First 32 modules off Chinese production lines complete & ready for shipment to U.S.A.
- Mechanical elements (trays, stacking fixtures, etc.) on track
- Project cost and schedule within envelope of DOE construction project
- Significant implementation by Run 8, completion for Run 9
- Budget: $4.7M US, $2.3M in-kind from China

DAQ1000 – TPC Readout Upgrade

- Acquisition of very large data samples for precision and rare process studies: e.g., symmetry restoration /breaking, $\gamma\gamma$ HBT, …
- Triggered data sets benefit - dead time reduced to ~ 0
- Space for end cap tracker for W physics

Goal: Increase data rate for most detectors to ≥ 1kHz

Make use of CERN developments for ALICE/LHC:

PASA (preamp/shaper amp)
ALTRO (digitizer, digital filter, zero suppression, buffer)
SIU (RDO, optical data sender)
D-RORC (PCI receiver board)

Cost *Estimate*: $1.8 M

Status / Schedule:

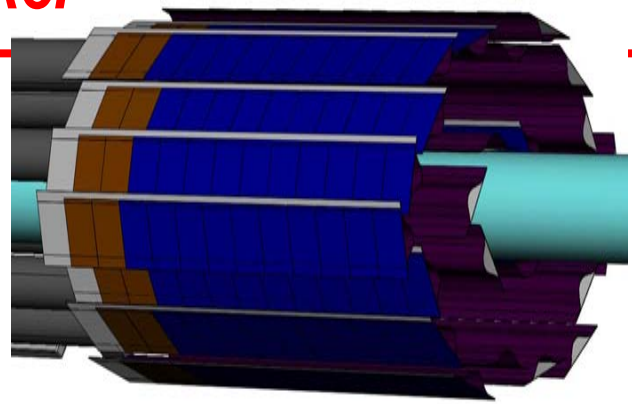
After ~ 1 year delay due to contract difficulties, chip procurement appears in-hand

Prototyping effort ongoing through 2006

Nov. 2006 small prototype (one sector) operational in STAR

Full TPC readout in STAR complete for Run 9

STAR Heavy Flavor Tracker



Physics Focus

- Heavy flavor collectivity
- Charm quark kinetic equilibration
- Heavy flavor (c,b) energy loss
- Vector mesons $\rightarrow e^+e^-$

Proposed Configuration

- Two layers of CMOS pixel detector around a new thin (0.5mm) small radius (20 mm) beam pipe
- 10^8 pixels, $(30\ \mu m)^2$
- 50 μm thick
- 10 μm point resolution

Status: HFT Concept reviewed by BNL Detector Advisory Committee:

Technology endorsed

Significant program of R&D needed through FY08

Prototype operational for Run 8-9

Construction Start FY2009

Significant progress on:

- Physics design and vetting with simulations
- Mechanical design
  - integration and installation
  - support
  - alignment
  - calibration
- Sensor prototype
- Readout design

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STAR Intermediate Silicon and Forward Tracking Upgrades

Intermediate Silicon Tracking (IST) Upgrade:

- Ultimate pointing device for HFT – compatible with DAQ1000
- Replaces SVT – remove SVT infrastructure in $1<\eta<2$ region for $W^{+(-)} \rightarrow e^{+}(e^{-})$ (sea anti-quark contribution to proton spin), and provide part of the $1<\eta<2$ tracking
- Two technologies under investigation: ALICE style pixels, silicon strips

Forward Tracking Upgrade (FTUP):

- High precision Tracking in $1<\eta<2$ to discriminate charge sign in $W^{+(-)} \rightarrow e+(e-)$ - 10's of GeV $e^{\pm}$
- Use of silicon strip disks or barrel GEM detectors being studied

Status: Good progress on simulations; software infrastructure in place

Goals:

Technology choice for IST by STAR in early fall (pixels or silicon strips)
Technology choice for FTUP on similar time scale
Conceptual proposals in time for DAC review later in 2006
R&D program through 2008 to answer key questions
Forward tracker installation – before first long polarized pp run at $\sqrt{s}$ = 500 GeV.

Serious Concerns

- Support (people and resources) for effective operation of the detector ⇒
  - Transfer of responsibility for operation of several detector systems to BNL
  - Resulting inability to meet some critical support needs and increased scope
  - Operations crew stretched thinner; increased response time; less efficient use of beam time
- Realizing the R&D called for in the BNL mid-term plan to maintain steady progress on upgrades
- Support for development of next-generation computing tools to "keep up" in the era of DAQ1000 (c.f. talk by Jerome Lauret, break-out session B, Tuesday morning)
- The FY06 shutdown is very short with a great deal to accomplish; getting everything done in this period will challenge STAR's capabilities

Projections for STAR manpower in the out years (based on ongoing MOU exercise)

Initial observations:

Reminder: numbers shown are a lower limit due to confusion in some cases about whether people or positions should be counted in the out years. This is a real effect, known for some institutions with no plan to participate at the LHC.

Non-negligible decrease in out years related at some level to LHC start-up **BUT** all institutions presently in STAR plan to continue their participation, even in 2010

Absolute number of FTE's remains large in 2010 and is sufficient to build the upgrades and carry out the experiment (NB: the number of FTE's is different from the number of collaborators)

New institutions continue to apply for membership (e.g. University of Seoul most recently)

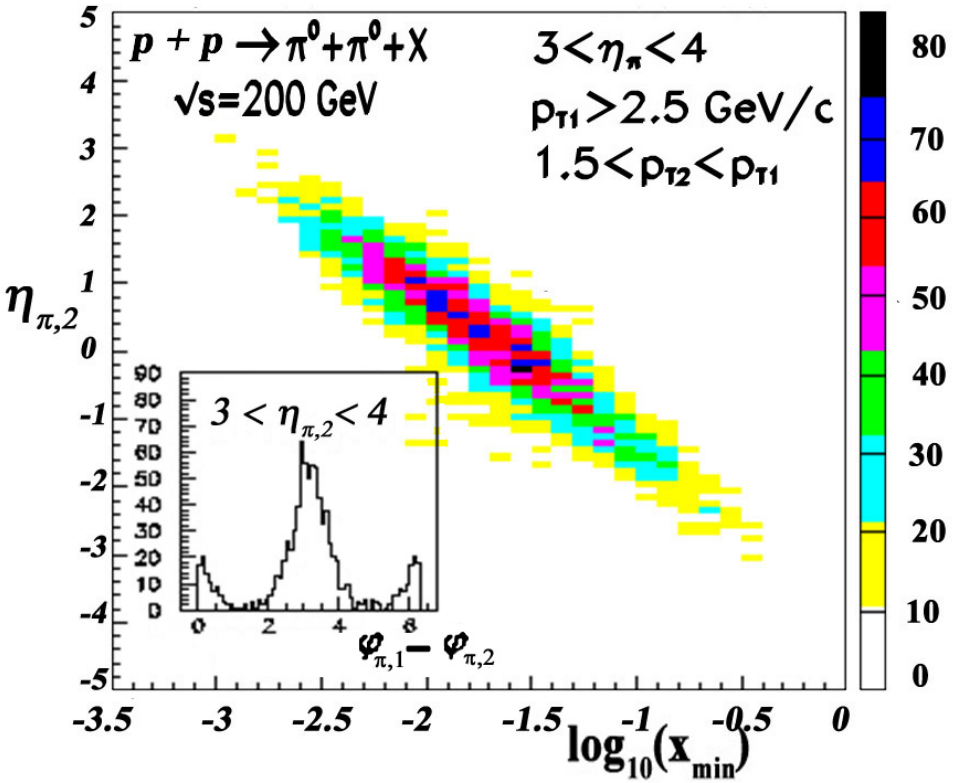
Conclusions

- The STAR program is making outstanding progress:
  - New physics and important scientific discoveries
  - Educating the next generation of nuclear scientists
  - Developing new capabilities
  - Quality operation of the detector with increasing efficiency

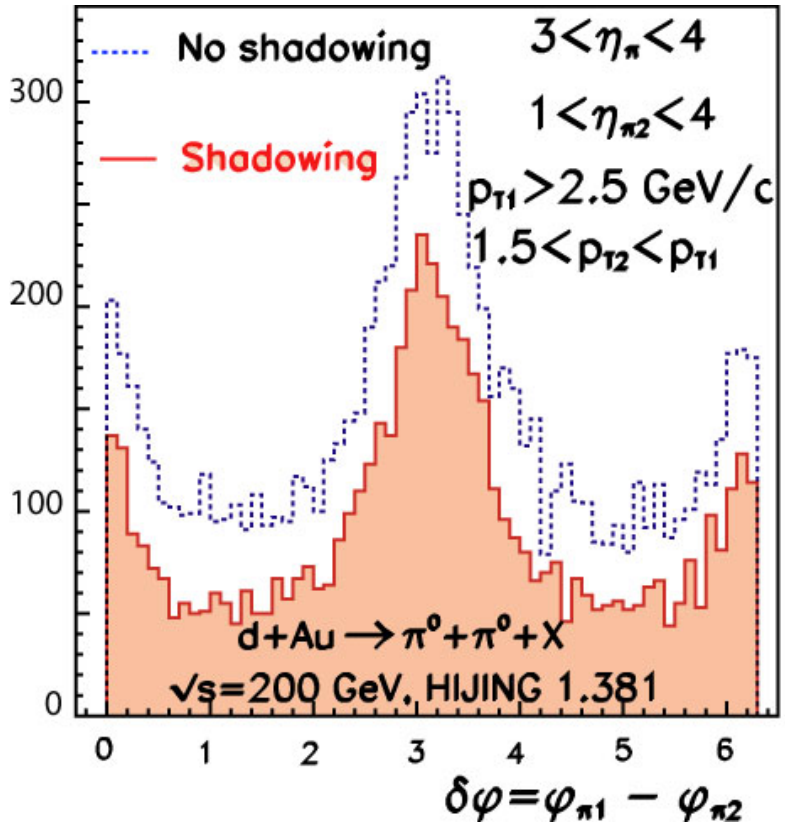
- With continued strong support, the future is very bright for a unique world-leading program of heavy ion and spin physics studies well into the next decade

p+p and d+Au → π^0+π^0+X correlations with forward π^0

p+p in PYTHIA



d+Au in HIJING hep-ex/0502040



Conventional shadowing will **change yield, but not coincidence structure**.

Coherent effects such as CGC evolution will **change the structure**.

Sensitive to x_g **~ 10^{-3} in pQCD** scenario; **few x 10^{-4} in CGC** scenario.