

STAR BNL Group

Research & Experiment Operations:
productivity, accomplishments, and issues.

Annual DOE/Nuclear Physics Review of RHIC Science and Technology

July 19, 2007.

W.B. Christie

Outline

- Overview of BNL group staff
 - 1 slide
- Detector Operations responsibilities and accomplishments
 - 5 slides
- Computing/Software responsibilities and accomplishments
 - 5 slides
- Research interests and accomplishments
 - 5 slides
- Issues
 - 3 slides



The STAR Group at BNL

- Responsibilities generally divided between Detector Operations, Computing and Software, and Research.

- Detector Operations: 17.1 FTE (Scientists (6.6), Technical (9.5), Admin. (1)) & Support

- Software & Computing: 9.5 FTE (Scientists (1), Technical (8.5))

- Research: 6.95 FTE (Scientists (5.95), Admin. (1))

Total: 33.55 FTE (FY07)

Historical

FY Year	FY01	FY02	FY03	FY04	FY05	FY06	FY07
Research (FTE)	10.7	9.83	8.63	8.03	7.78	7.7	6.95
Operations & Computing (FTE)	24.17	26.97	25.57	27.75	26.7	26	26.6
Total (FTE)	34.87	36.8	34.2	35.78	34.48	33.7	33.55

Detector Operations Responsibilities

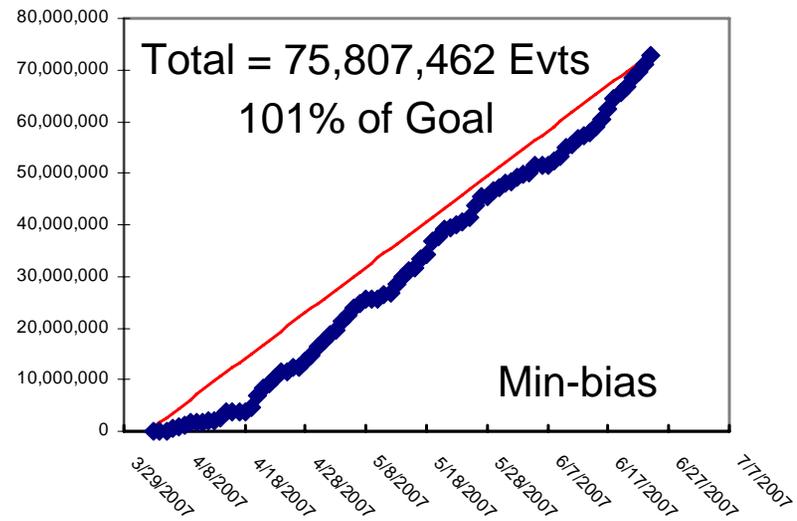
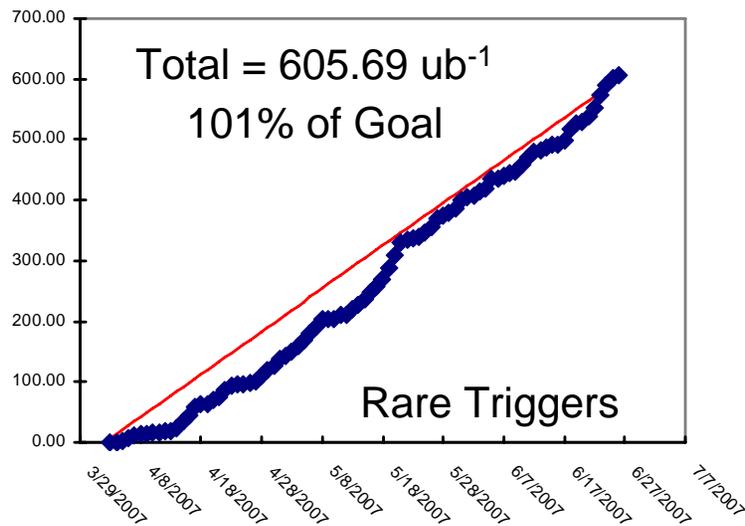
Responsibilities:

- Maintenance and Operation of the STAR Experimental Facility in accordance with all applicable rules, policies, etc.
- Coordination of Detector operations to accomplish the year by year Physics Data set goals of the STAR Collaboration.
- Management of Collaboration (Spokesperson)
- Maintenance, repairs, and ongoing support of electronics for:
TPC, FTPC, SVT, BEMC, BSMD, EEMC, ESMD, Trigger, DAQ
- Sub system management for:
DAQ, Online QA, Run Time system, Magnet, FTPC, SVT, ZDC, Global Interlock system.
- Integration, Design, and maintenance of STAR drawings archives.
- Support integration and installation of new sub systems.
- Coordination of Safety reviews, Work Planning.

Detector Operations Accomplishments

Brief Summary of the STAR Collaboration Data set goals for FY07 Run:

- Accumulate 60 Mevts of “useable” (collision vertex at center of Silicon detectors) min-bias data. (N.B. with estimated yield of .8, goal = 75 Mevts)
- Sample 600 ub^{-1} of luminosity with collection of rare triggers
 - High Pt Photons, 3 particle analysis, Upsilon, B-tag evts, UPC evts, UPC-J/psi, muons, etc.

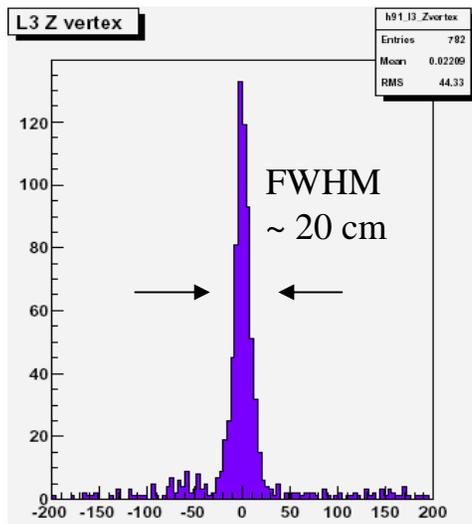


Key contributions to this success from local BNL group:

Operations management & coordination (B. Christie), Trigger defn. & setup (J. Landgraf (Chair), B. Christie, Z. Xu, J. Dunlop (Trigger Board), VPD commissioning/setup (B. Christie & L. Ruan), DAQ & Run Control setup/support (T. Ljubicic & J. Landgraf), Online QA (F. Laue & P. Sorensen), BEMC Expert support (O. Tsai), Period Coordinators (Z. Xu, L. Ruan), Online Computing (J. Lauret, L. Hajdu, W. Betts, M. DePhillips)

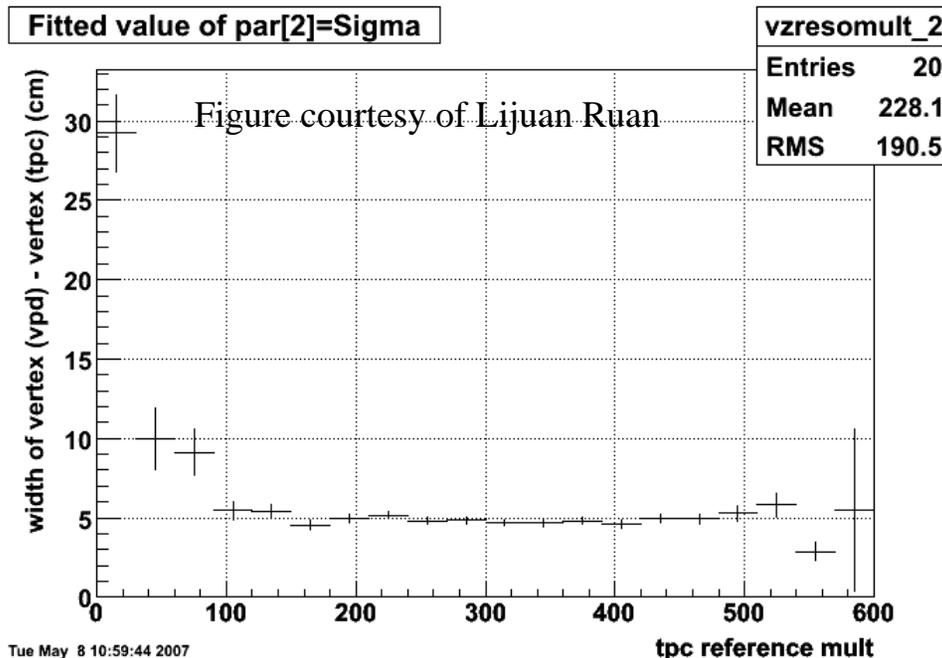
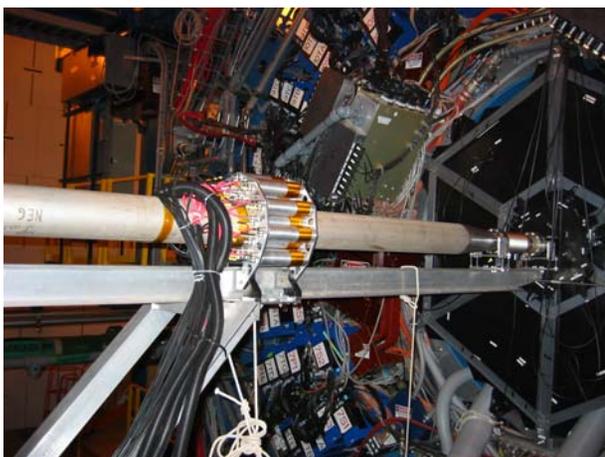
Detector Operations Accomplishments

- Design, prototype, install, & commission new LV supplies for BEMC PMTs.
 - O. Tsai, D. Padrazo & STAR Technical group
- Move SVT RDO boxes and install new cabling.
 - D. Lynn, I. Kotov, D. Padrazo & STSG



- Debug and commission new Vertex Position Detector (VPD)
 - B. Christie, L. Ruan, Z. Xu

A Major goal of the run was to accumulate “60 Mevts of useable min-bias”. This was estimated to be 75 Mevts of mb-vpd.



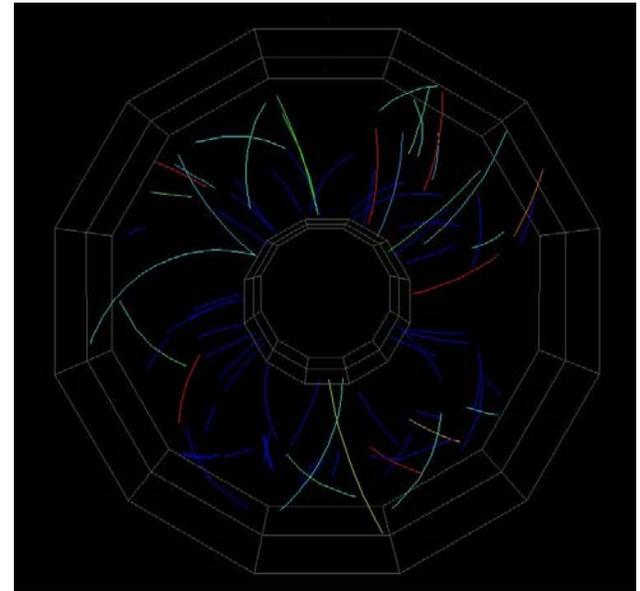
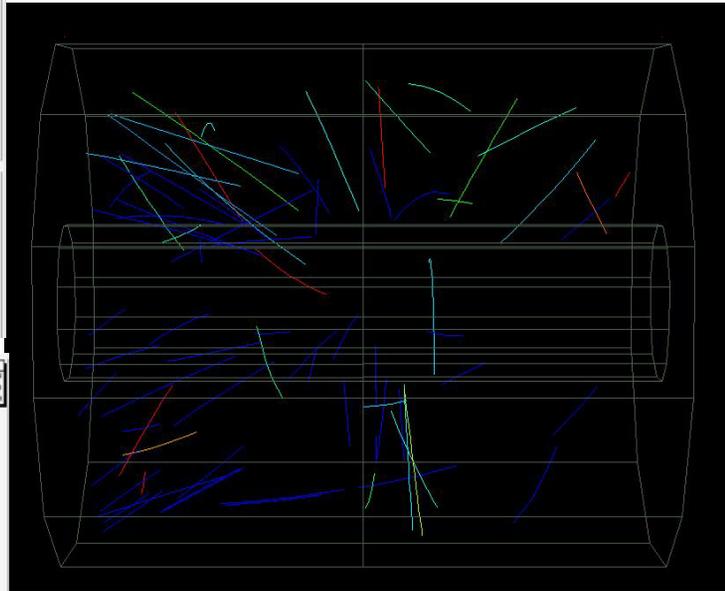
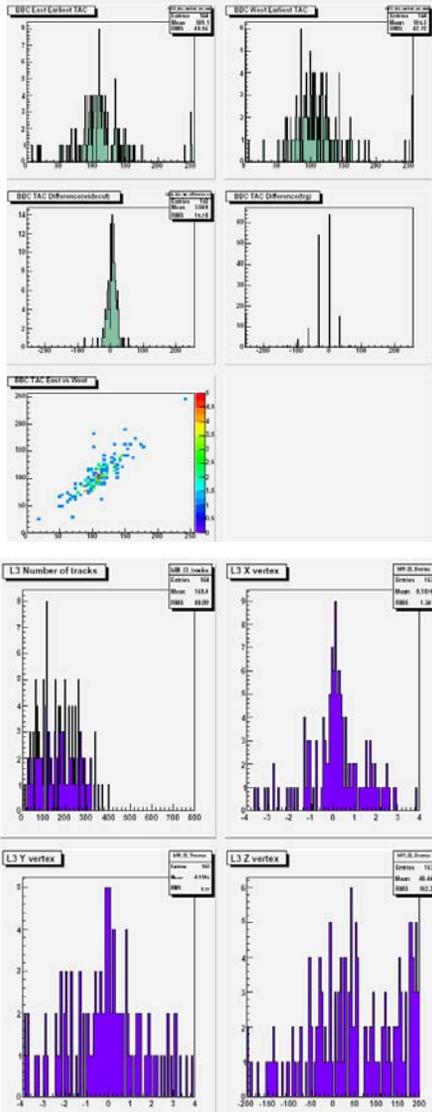
Detector Operations Accomplishments

We timed in STAR, set up a collision trigger, and managed to take a small number of events during the Low Energy Test run.

- B. Christie, J. Ruan.

STAR TPC image of $\sqrt{s} = 9.1$ GeV AuAu Collision

Taken June 7, 2007.



Run 8158119, Evt 44

Good news: Able to trigger on collisions with the BBC. Currents in the TPC negligible.

Other efforts worked on throughout the FY07 Physics Run

DAQ1000 (aka TPX on DAQ Monitor page): T. Ljubicic, J. Langraf, STSG

- 1 Readout Board and 29 FEES of new TPC electronics.
- Debugged/tuned early in the run, and included in all data runs at the end of the run.

Forward Meson Spectrometer (FMS): L. Bland, A. Ogawa, STSG

- Detector itself was characterized/debugged using a rack of CAMAC electronics.
- New “QT” Electronics was installed and debugged through the run. Setup, debugging, and tuning of this electronics is continuing.

Time of Flight (TOF): STSG

- Installed a number of Electronics boxes, fibers, cables, etc. in preparation for tray installation for FY08 run.

Heavy Flavor Tracker (HFT): T. Ljubicic, STSG

- Installed PC, electronics box, and small multi plane test detector.
- Took data just under Beam pipe outside of STAR magnet.
- Finally installed between FTPC and beam pipe, took some data.

Muon Test Detector (MTD): Z. Xu, L. Ruan, P. Fachini, STSG

- Uses large readout pad MRPC chambers.
- Trigger setup a bit lengthy, but took data for last ~ 1.5 months.

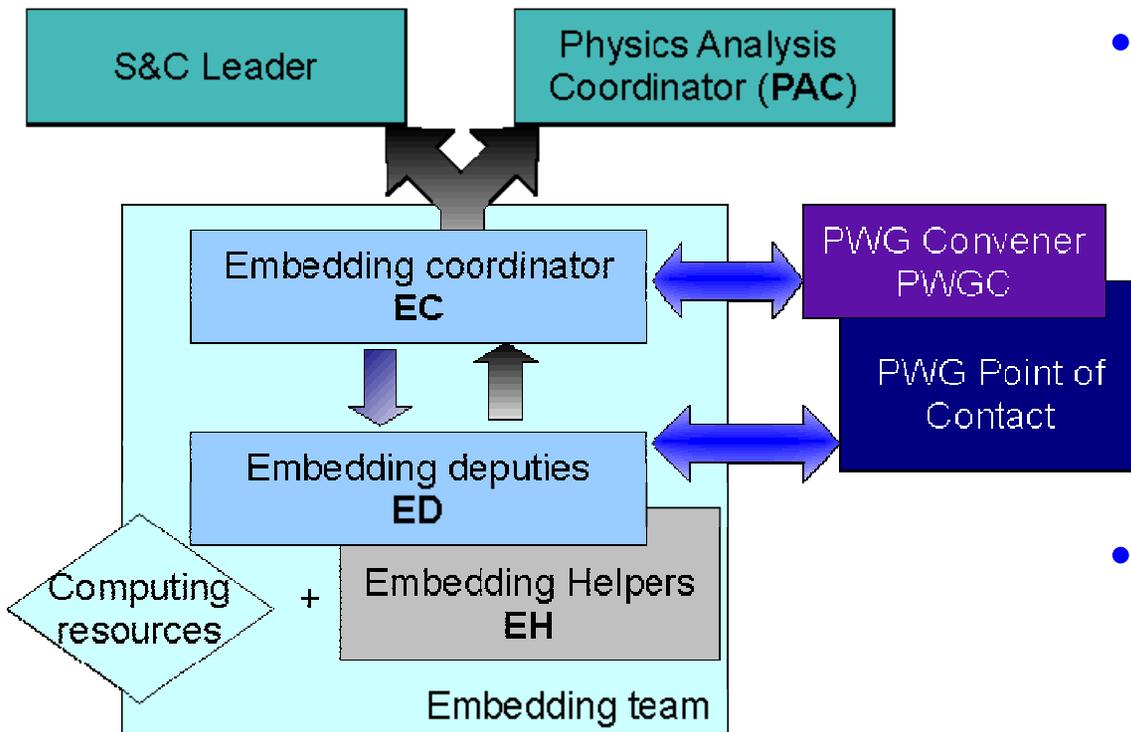
Software & Computing Responsibilities

- Provide structure and help for end-user's analysis
- Lead the reconstruction efforts
 - Global tracking, particle identification, vertex-ing,
 - Make it all work at the end: take the 20% left of Pareto's principle (which we know takes 80% of the time) for any software related project
- Lead the simulation efforts
 - Geometry definitions, handshake with reconstruction, event generators, framework design.
- Lead the Grid efforts
- From coordinate (to lead) the calibration efforts
- Produce the data / datasets (real data or simulated)
- Provide infrastructure/framework support
 - Database access and support
 - Event visualization, framework support (including some user support), database, Quality assurance
 - Run support: online computing, online tools for bookkeeping and accounting, data safety (archiving and backups) and online QA
 - Web access and Web tools/toy support
 - Cyber-security, patching and maintenance
- Sub-system's software coordination

BNL Group Software & Computing Responsibilities

- The BNL group is involved in the S&C leadership
 - 10 of 12 roles in the project's core structure (full time)
 - 2 of 7 deputy roles
 - 3 of 12 sub-system software coordination roles
- Areas covered
 - Project management (**Jerome Lauret**)
 - Detector simulation (**Maxim Potekin, Victor Perevoztchikov, Ron Longacre**), data reconstruction (**Yuri Fisyak**), database (**Micheal DePhillips**), infrastructure (**Jerome Lauret, Valeri Fine, Wayne Betts**)
 - Calibration (**Gene Van Buren**)
 - Data production (**Lidia Didenko, Levente Hajdu**) and Distributed computing aka Grid computing (**Jerome Lauret, Levente Hajdu, Lidia Didenko, Wayne Betts, Valeri Fine**)
 - Online computing (**Jerome Lauret, Wayne Betts, Micheal DePhillips, Jeff Landgraf**), general user support (**Wayne Betts**), cyber-security (**Jerome Lauret, Wayne Betts**)
 - DAQ (**Jeff Landgraf, Victor Perevoztchikov**) , Trigger detectors and FMS software coordination (**Akio Ogawa**)
 - QA,online and offline (**Jerome Lauret, Gene Van Buren, Paul Sorensen, Frank Laue**)
- Achievements
 - Many – selecting top 3
 - + kept all data production, run and general support going smoothly, user services and computer services, off-BNL software stack deployment and support

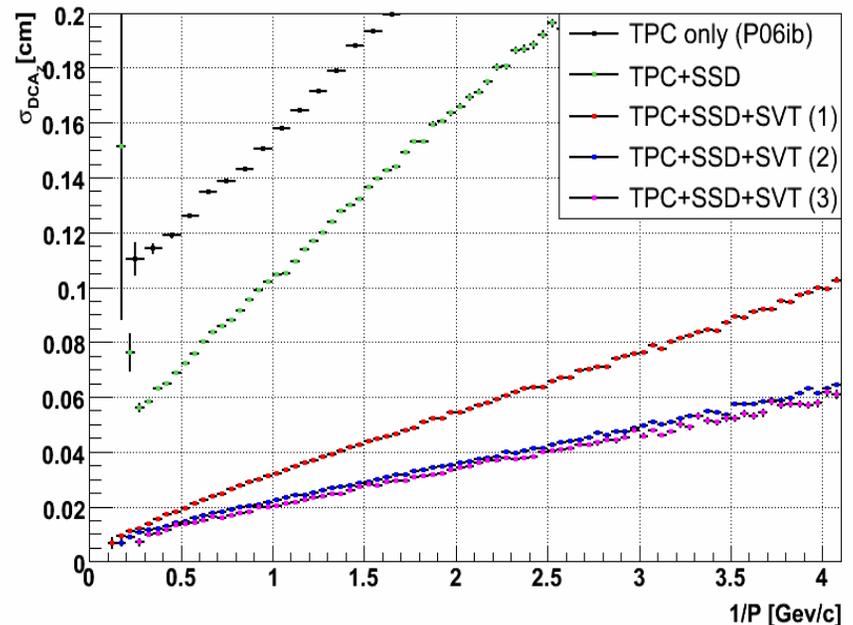
Software & Computing achievements



- Re-organization of the embedding team and effort
 - Supported and lead by off BNL resources, this structure had collapsed (infrastructure & production)
 - Use a distributed model with a multi-site “team”
- Team Building from grass-root
 - Software coordinators meetings
 - Calibration coordination meetings

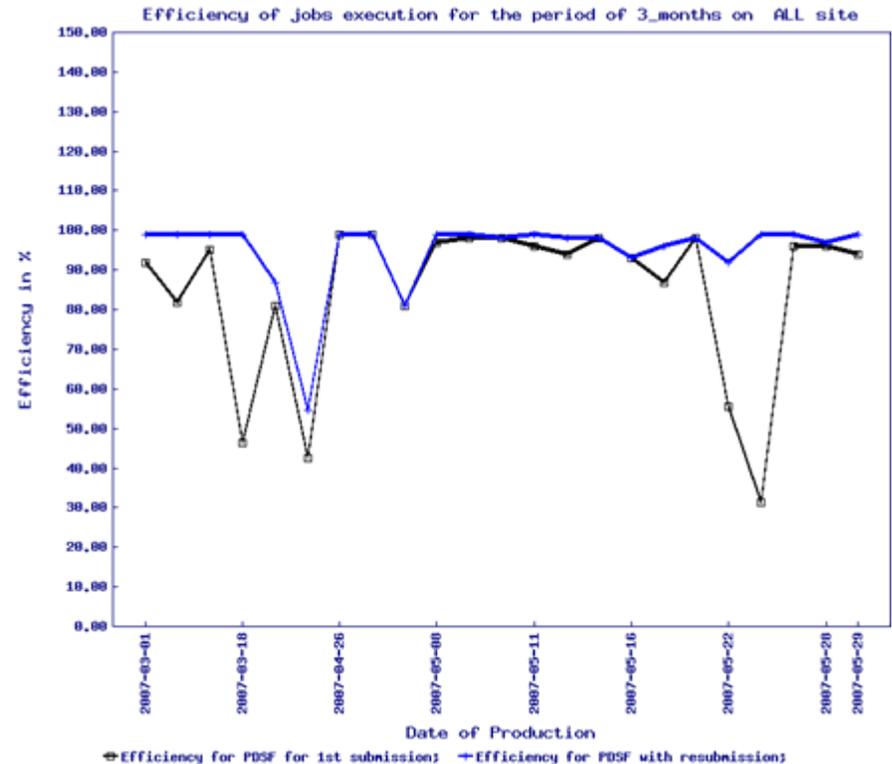
Software & Computing achievements

- Silicon tracking and calibrations
 - Alignment procedure revisited
 - Calibration procedures for SVT & SSD redone
 - T0, drift, Lorentz effect, rotations
 - Hit error propagation revisited
 - Self-alignment procedure developed
- Current results
 - SVT: 50 μm (rPhi), 30 μm (z) ;
SSD: 30 μm (rPhi), 740 μm (z)
 - Encouraging (30% increase on Xi with loose vertex cut)



Software & Computing achievements

- **Distributed data access**
 - Data sets access entirely Xrootd based (economics)
- **Grid**
 - Ramping up grid based production – simulation run on the Grid exclusively for the past 1.5 month
 - Efficiency 97%+ with one re-submission
 - Sites used are not necessarily STAR dedicated (FermiGrid, ...)



Research Group (2006/2007)

- Patricia Fachini, Paul Sorensen, Aihong Tang, Thomas Ullrich, Zhangbu Xu, Ron Longacre,
- **New:** Matt Lamont (STAR/eRHIC), Lijuan Ruan
- **Left:** Frank Laue (industry), Haibin Zhang (industry)

- **Main Topics:** Heavy Flavor, Identified High- p_T Hadrons, Flow, Resonances
- **Students supervised:** V. Ames (summer HS student), J. Chen, M. Cosentino. H. Liu (graduated), J. Mlynarz, N. K. Pruthi, Z. Tang, G. Wang (graduated), Y. Xu, Y. Zhang (graduated), J. Zuo

- **Goldhaber Distinguished Fellows:** Lijuan Ruan, Paul Sorensen

- **Invited talks at major conferences & meetings:**
 - HP06 (2), QM06 (2), SQM06 (2), SQM07 (2), Rutgers Town Meeting (2), C2CR07 (1), BNL 421st Lecture: Z. Xu

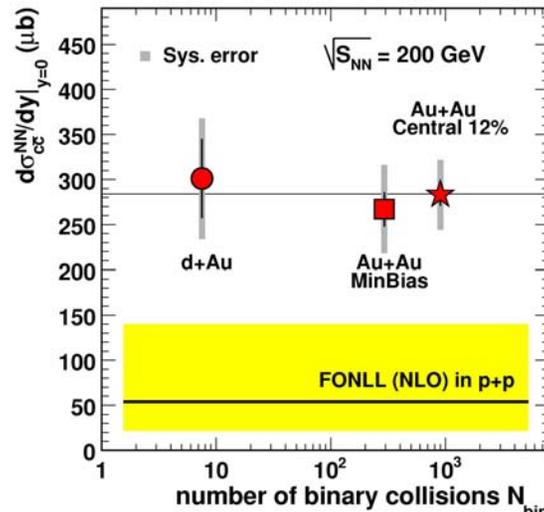
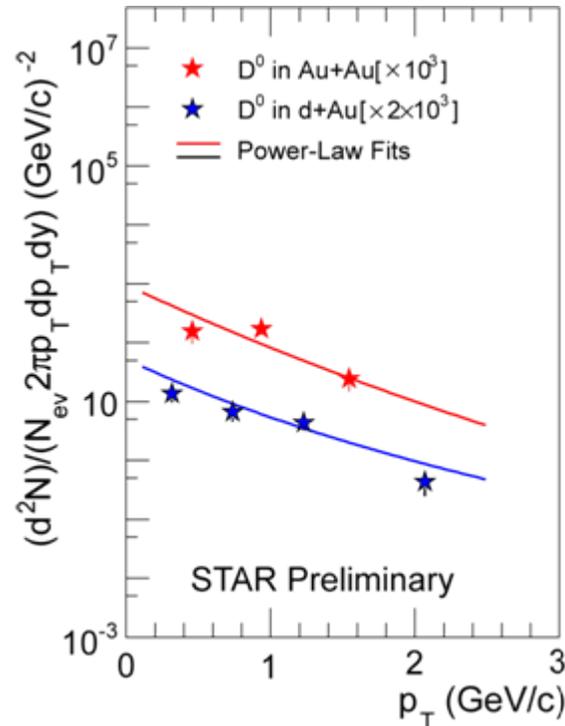
- **Publications (refereed journals only):** PRL (2), PRC (5), JPG (2), PLB (3), EPJC (1)
- **STAR Analysis Coordinator:** J. Dunlop
- **STAR Physics Working Group Conveners:** M. Lamont, A. Tang, T. Ullrich (2006)
- **RHIC-II Working Group Conveners:** T. Ullrich, Z. Xu

- **eRHIC (EIC):** J. Dunlop, M. Lamont, T. Ullrich, Z. Xu

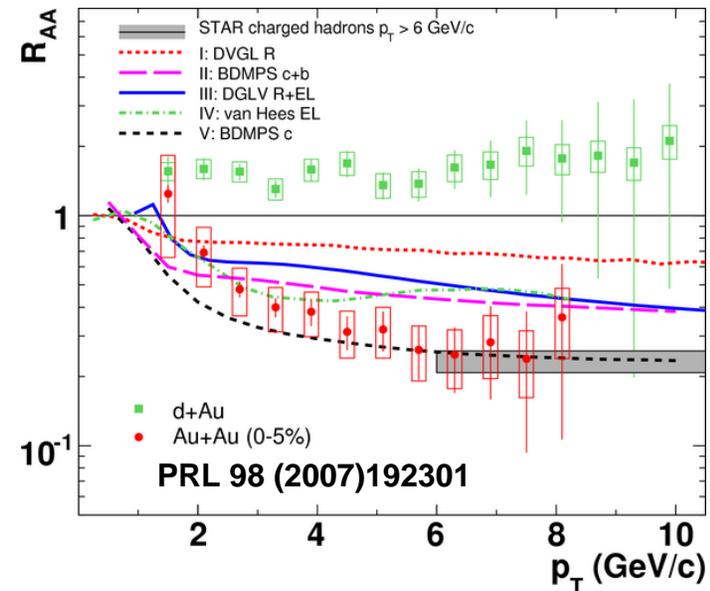
Research Group Accomplishments

Open Heavy Flavor

- First measurement of D meson in heavy-ions collisions ever (H. Zhang)
- D and low- p_T e and μ from charm decays: Charm production scales with the number of binary collisions (H. Zhang, Z. Xu)
- Charm through decay electrons: Large suppression of high- p_T charm partons in central Au+Au (F. Laue, T. Ullrich)



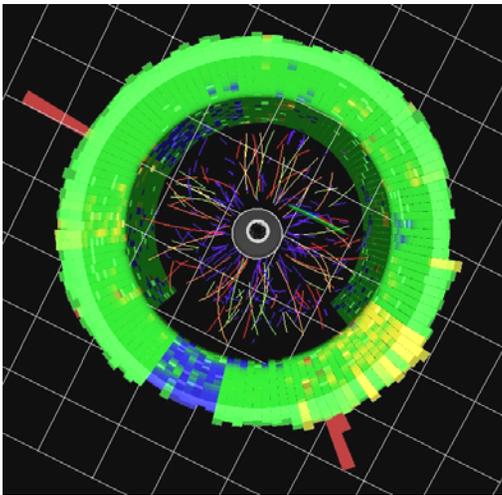
D & binary scaling
paper in preparation



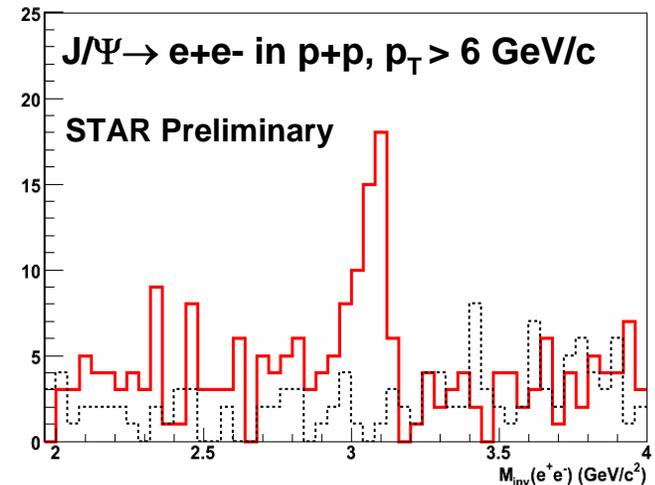
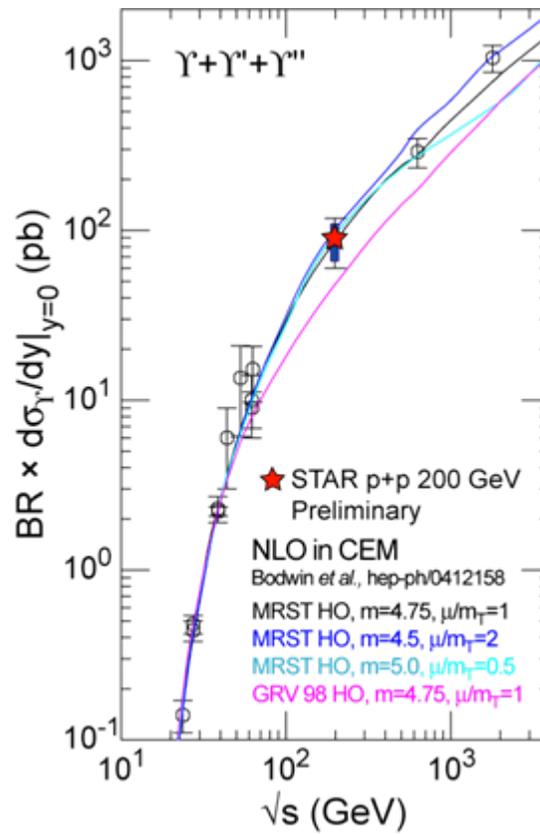
Research Group Accomplishments

Heavy Flavor

- First measurement of Υ cross-section $d\sigma/dy|_{y=0}$ in pp at $\sqrt{s} = 200$ GeV (F. Laue, T. Ullrich)
 - Highly efficient trigger in place, next step: Υ in Au+Au from run 7
- Study of J/ψ production at high- p_T (Z. Xu, L. Ruan)



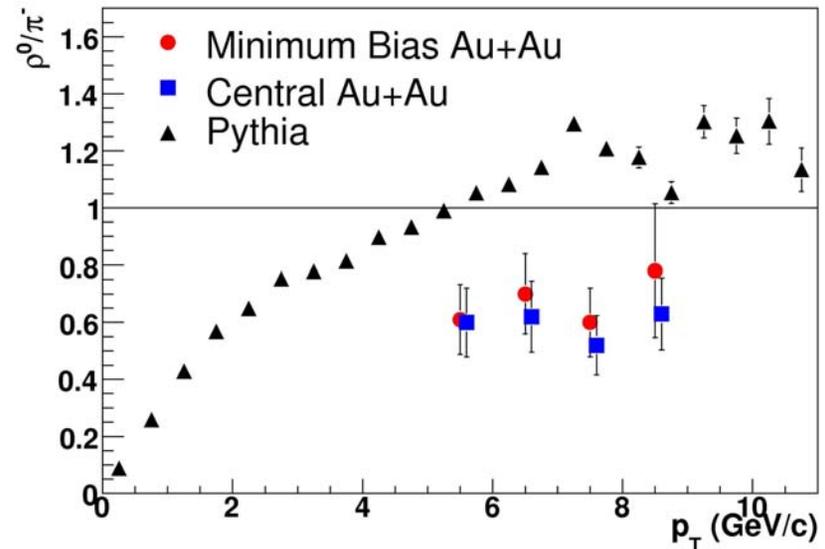
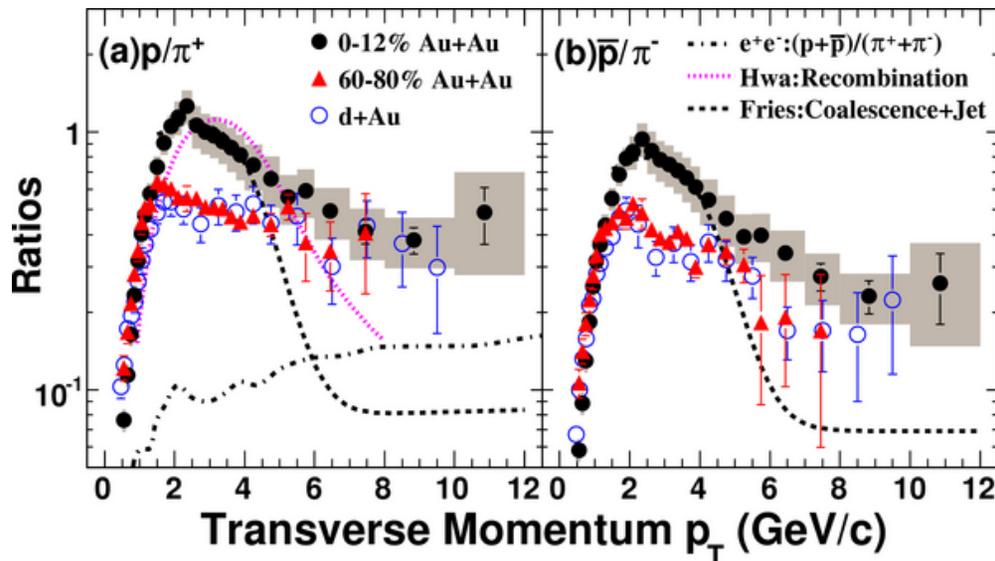
Υ paper in preparation



Research Group Accomplishments

Identified Hadrons & Resonances at High- p_T

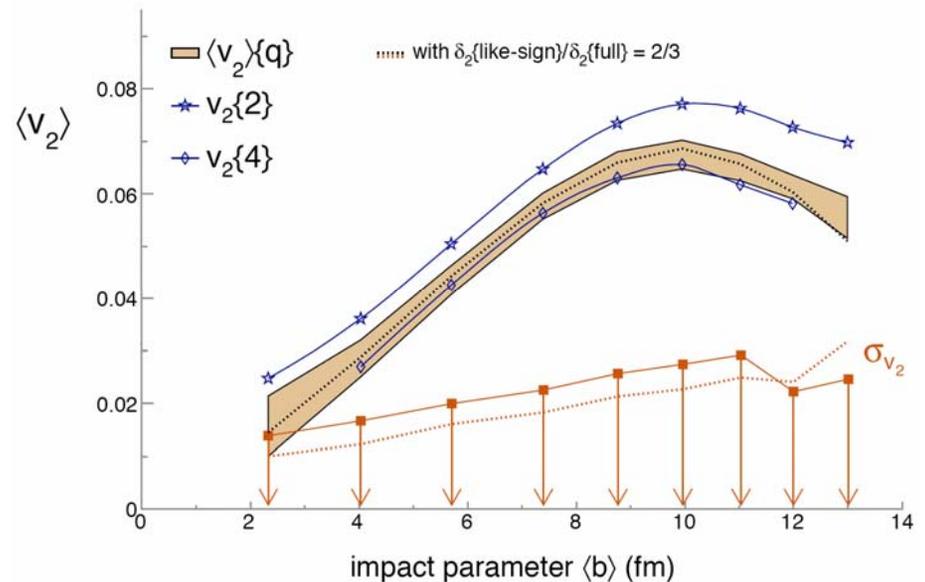
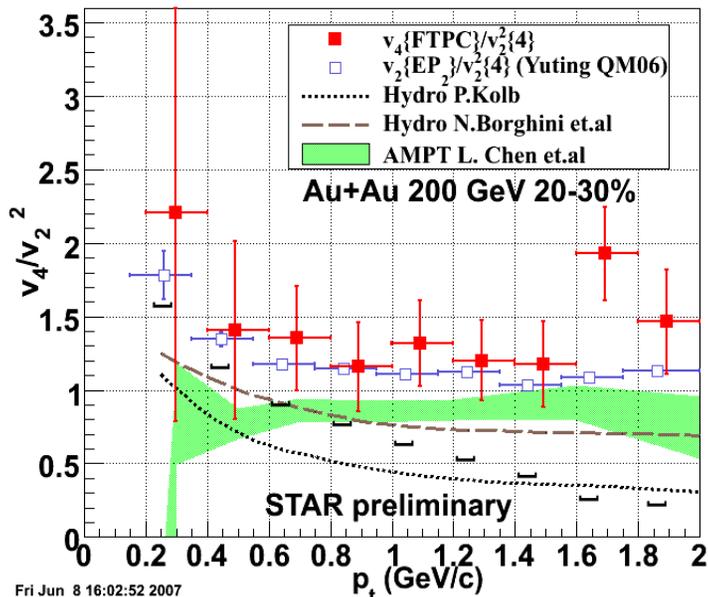
- Identified p and π at high- p_T (L. Ruan, Z. Xu)
 - **Expected:** Larger energy loss of g-jets than q-jets ($\sim 9/4$)
g-jet contribution to p significantly larger than to π at high p_T
 - **Found:** at high- p_T : p/π (Au+Au) $\sim p/\pi$ (d+Au, p+p)
No evidence of color charge factor difference
- Probing dense matter with short-lived resonances (P. Fachini, R. Longacre)



Research Group Accomplishments

Collective Flow & Flow Fluctuations

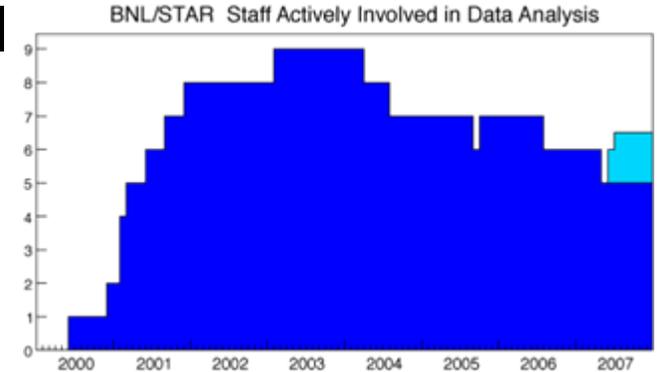
- Novel study of azimuthal particle distributions: (A. Tang)
 - $dN/d\phi \propto 1 + 2v_2 \cos(2\phi) + 2v_4 \cos(4\phi) + \dots$
 - v_4/v_2^2 sensitive to degree of thermalization of the created matter
 - New analysis with significantly reduced systematic uncertainties
- New study: Elliptic Flow (v_2) Fluctuations (P. Sorensen)
 - Upper limit challenges various models for the initial conditions
 - Uncertainties on $\langle v_2 \rangle$ well understood



Research Program Issues

– Problems maintaining manpower level

- Overall decreasing
- Kept up by use of LDRD & Presidential Award Funds



- Increasing load on research personnel due to infrastructure support
- Some research effort devoted to future BNL projects (eRHIC)

Software & Computing Issues/Concerns

- Scalability

- Data has grown up, team remains the same
- Tasks are more complex, resolution (momentum, PID, Energy) required by Physics program increase driving R&D, team remains the same
- Detector R&D draw manpower/expertise from S&C (simulation, tracking), team diverted to more tasks

- Project oversight

- Reported funding issues to remote institutions have cascading effect on BNL S&C (core) team
 - Expected “to make it work”, a dropped project would end to be our responsibility [expectation]
 - Building from the ground-up (grass root) approach may be questionable
- R&D bring new activities and roles ... with the same number of local FTE, seems orthogonal to the previous observation

- TimeLine

- DAQ1000 and bigger data sets demands in our views
 - Out sourcing of computing cycles – Grid
 - Efficient data access, data movement, data placement
 - Efficient Physics analysis tools (resolving needle in a hay stack in human achievable time frame)
- Grid effort is STAR
 - Funding from PPDG is gone, OSG base program provide some support but no NP extensions
 - Efforts require development ; currently out sourcing non-permanent workforce from Europe – is this viable?
 - Can we reach 2009 and have all the tools needed to face the data deluge?

- Additionally

- Cyber-security in general divert significant of FTE hours on already running thin support

- Plan to re-scope this year and drop (or more out-sourcing) some activities

BNL STAR Group Operations Issues/Concerns

- In Key Positions we have minimum staffing:
 - 1 FTE for Operations management & coordination, Shutdown scheduling & Oversight, Run coordination, STSG Supervision, Detector Support grp Leader, Safety
 - 1+ FTE to cover both DAQ and Run Control
 - 1 FTE (non-BNL) for TPC system
 - 1+ FTE for BEMC system
- The BNL Operations group has had to provide support for sub-systems initially provided by Collaborating Institutions
 - FTFC, BEMC, All sub systems Electronics support.
 - Redirection of bulk of T. Ljubicic to DAQ1000 upgrade.
- We've operated ("near the edge") with a small number of key people (myself, Ralph Brown, Jeff Landgraf, Blair Stringfellow)
 - Knowledge lost to STAR with R. Brown leaving is significant. *(moved to other project)*
 - B. Stringfellow also has key broad knowledge of STAR. We will lose his general STAR knowledge, as well as TPC management, in less than one year. *(retirement).*
- **STAR Operations is concerned that to continue the success to date, additional manpower from the Collaboration and within the STAR Operations group is needed.**
 - Efforts underway to quantify key areas of concern and try and obtain/gather/identify additional manpower *(Mou's, August Operations Workshop)*