

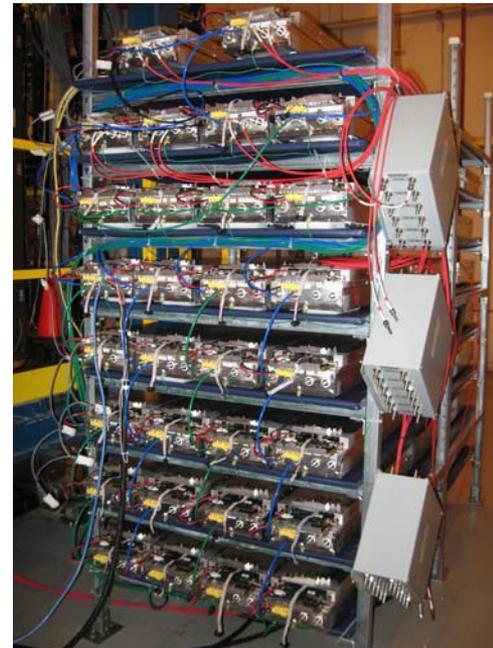
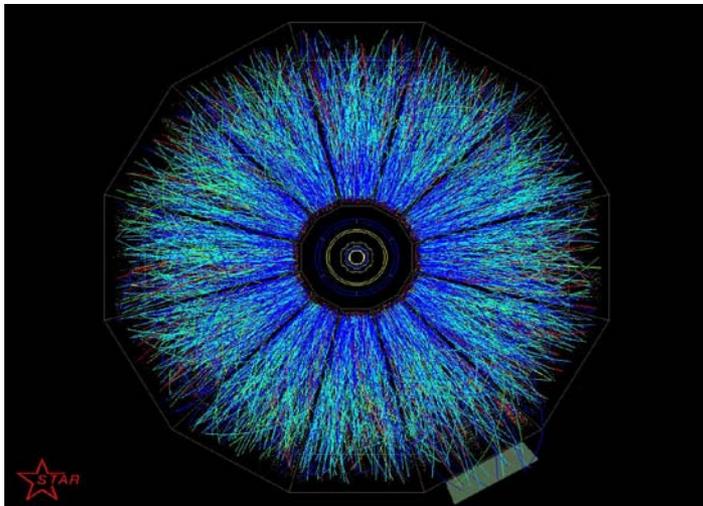
W.B. Christie, BNL

RHIC Retreat

July 15, 2009.

Outline

- Summary of STAR Goals for RHIC Run 9
- Brief Summary of STAR Changes for Run 9
- STAR Performance in 500 GeV pp run
- STAR Performance in ongoing 200 GeV pp run
- Comments



Testing TOF trays



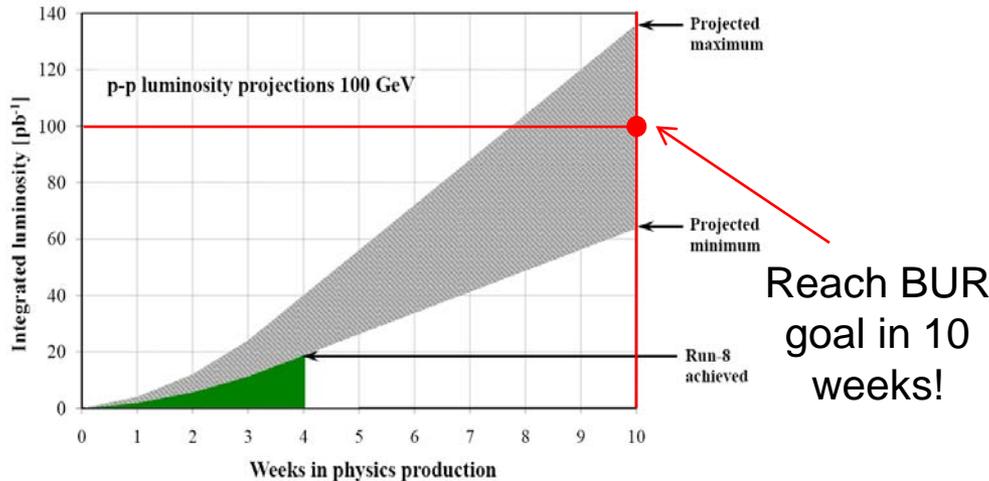
New TPC Electronics

- Commission major detector upgrades (TPC, TOF, Trigger)
- Physics and preparation for the future at 500 GeV
 - Establish local polarimetry of transverse components
 - W cross-section
 - W A_L : 10 pb⁻¹ sampled with Longitudinal polarization 50%
- pp2pp @ 200 GeV: ½ week for complete transverse program
- If the run is extended: highest priority 200 GeV p+p
 - BUR: 50 pb⁻¹ sampled, 60% Polarization, FOM P⁴L = 6.5 pb⁻¹

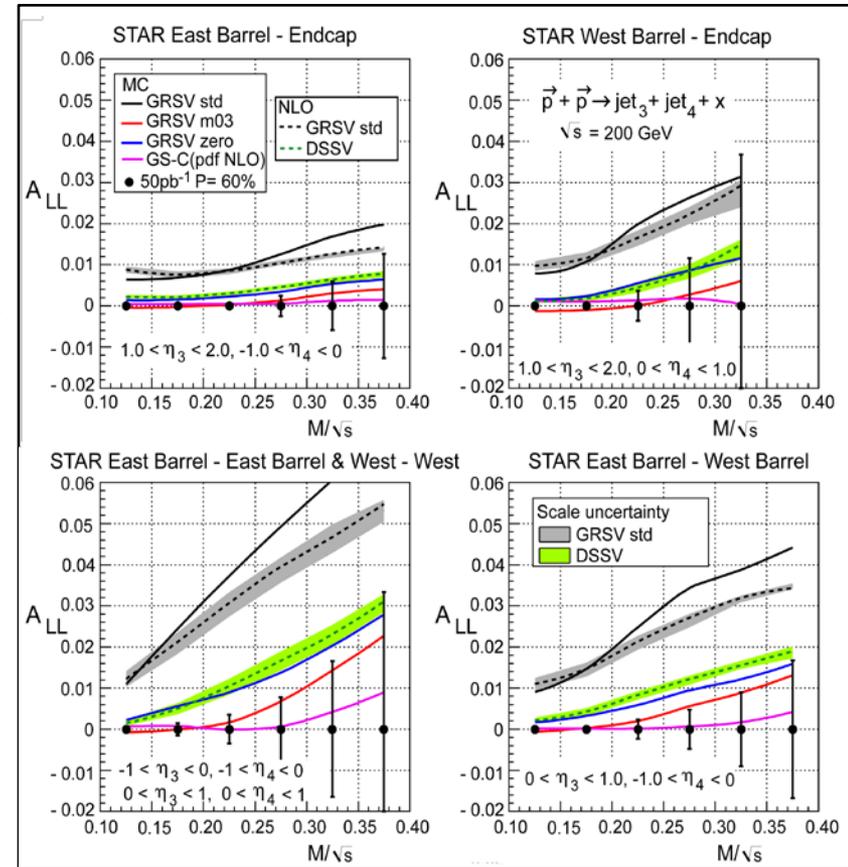
STAR Run 9 200GeV program (Gluon polarization)



Projected performance / assumptions - STAR 200GeV program



- Precision inclusive measurements, in particular inclusive jet production
- Di-Jet production - Probe x dependence of $\Delta g(x)$
- Substantial improvement of gluon polarization reflected in highest PAC recommendation!



Assumption: FOM = $P^4 L \sim 6.5 \text{ pb}^{-1}$
 $P \sim 0.6$, $L_{\text{delivered}} \sim 100 \text{ pb}^{-1}$
 $L_{\text{recorded}} \sim 50 \text{ pb}^{-1}$
Need: 10 weeks

Goals from p+p 200 GeV for heavy ion physics



Goal in the BUR: $\mathcal{L} = 50 \text{ pb}^{-1}$

- Reference for Au in RHIC II era: last chance for a few years

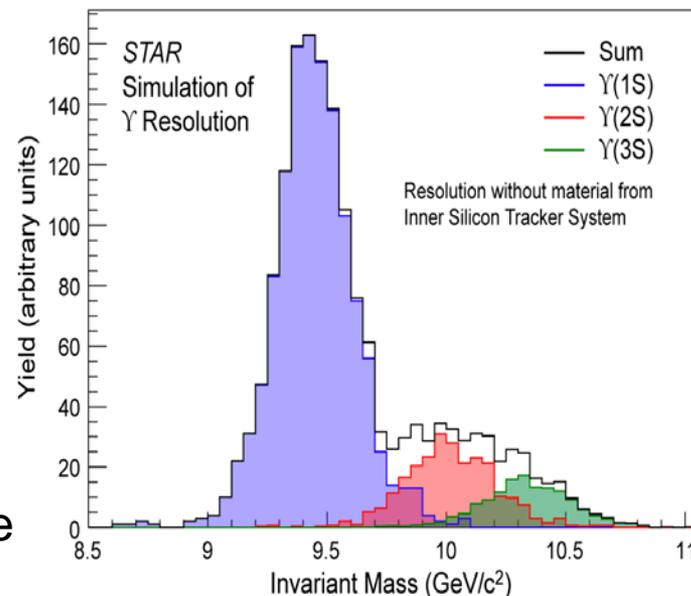
Factor 5x increase in \mathcal{L} for rare probes vs. run 6

- Non-photonics electrons: extend correlation signatures for B vs. D
- J/ Ψ : use TOF and EMC for precision
- Upsilon: 1st attempt to separate higher states
- γ -hadron: currently p+p is limit on I_{AA}

Large minbias dataset with DAQ1000: 300 M

Has not been possible in previous years, due to DAQ limitations

Fundamental baseline for untriggerable probes: D, dileptons, hadrons



- DAQ1000 allows STAR to take these data sets in parallel with Spin program
- Particle ID from TOF adds significant improvement in Signal/Background for many of these topics
- Low mass in center of STAR for this data set, relative to Run 6

DAQ1000 Completed for Run 9



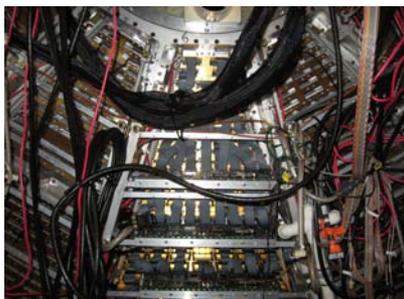
FEE Board



RDO Board

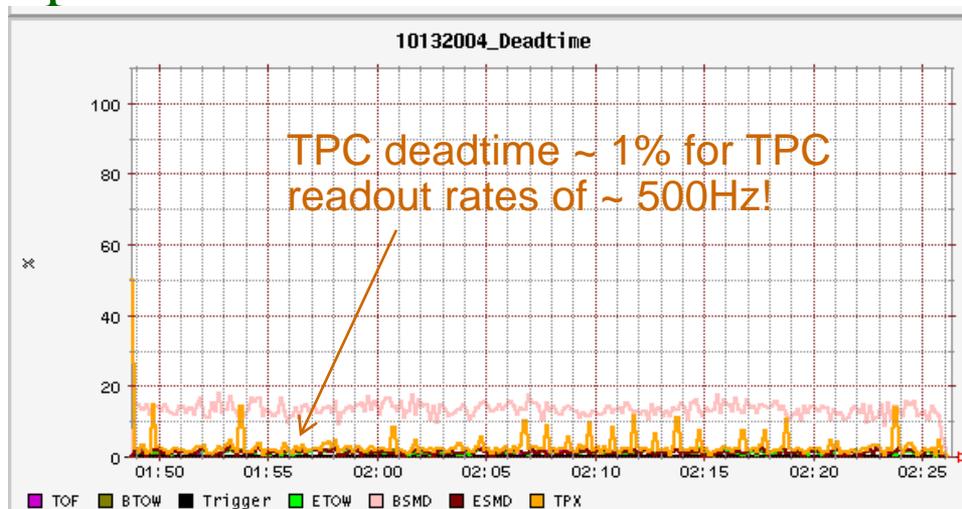


FEE Testing



First sector installed & Tested

- All new Readout Boards (RDO, ~ 200) were received, tested, and installed.
- All FEE boards (~5000) were received, tested, and installed. Completed on schedule.
- All LV power supplies were removed, modified, reinstalled, and tested.
- The new TPC (aka TPX) electronics was fully installed, commissioned and operational in Run 9!



Modifying LV Supplies



Installing FEES/RDOs



Boards Arriving

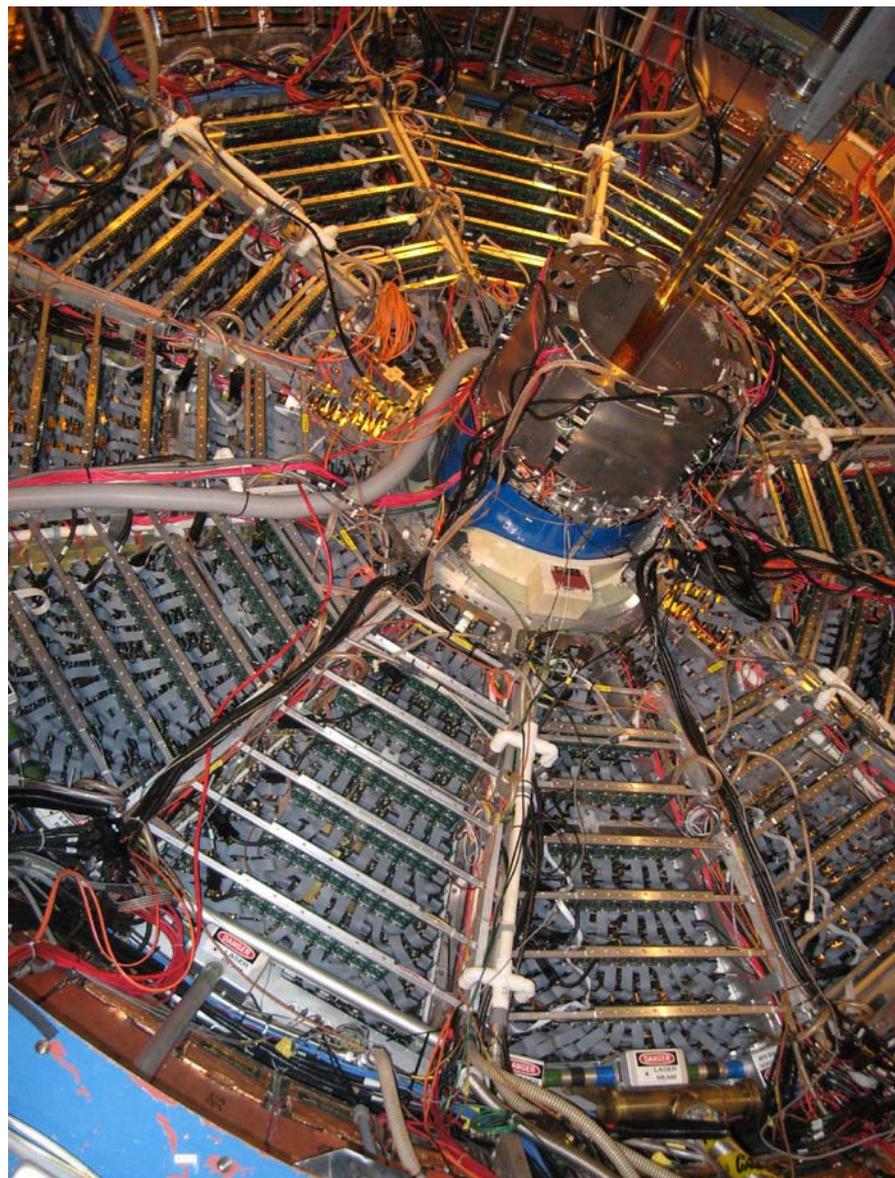
DAQ1000 TPC Electronics Upgrade Complete



New TPC Low Voltage supplies installed



New TPC readout computers installed



New TPC FEEs, RDOs, cables, and fibers installed

TOF Test Stand and one of two Gas Manifolds



- Goal for FY08 Shutdown was to get somewhere between $\frac{1}{2}$ (i.e. 60) and $\frac{3}{4}$ (i.e. 90) TOF trays installed for Run 9.
- We ended up slightly better than the high end goal, with 94 (out of 120) TOF trays installed.
- Plan to complete remaining tray installation this summer.

Trigger Changes for Run 9



New Hardware:

All the “standard” trigger detectors converted to new QT Digitizer electronics

- BBC, ZDC, VPD: New Crate
- PXZ, MTD, pp2pp: New Crate
 - ⇒ both crates get new PECL -> ECL for TAC boards
- FPDE, FPDSMD: New crate

TOF: 5 new TDSMI boards (built by TOF/BNL)

⇒ Data path uses DRORC to L2

TCU: Planned for new board with new interface board (Still being commissioned)

Recabling of BEMC DSM tree to close Jet Trigger hole at $\eta = 0$.

Miscellaneous fiber routing changes and additions.

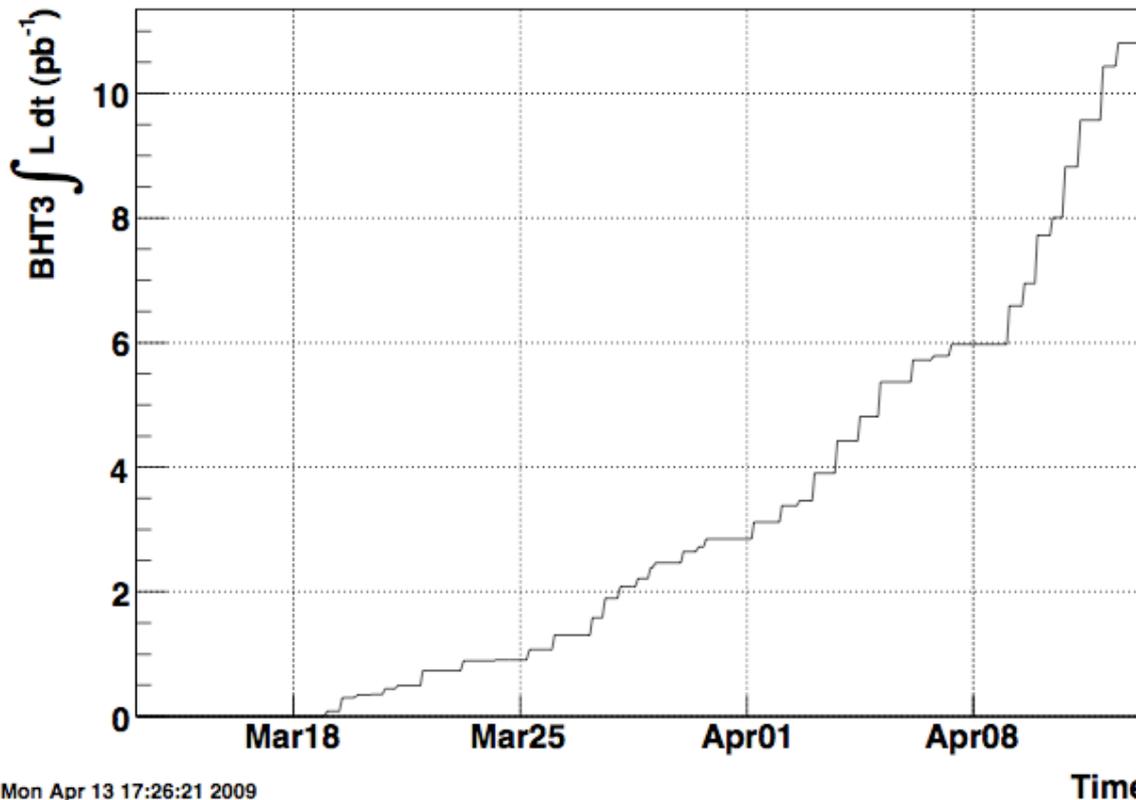
N.B. It was expected that commissioning and tuning the new Trigger electronics would take several weeks. This indeed turned out to be the case.

The screenshot displays the STAR DAQ monitoring interface. The top section shows the system is 'RUNNING [to RCF]' with ID '10100077' and 'production2009_500GeV_c [physics]'. It indicates 'In progress...' and provides start/end times and duration. Below this, a table lists various triggers and their performance metrics.

Trigger	DAQ Evts.	DAQ Rate (Hz)	L0 Evts.	L0 Rate (Hz)	Scaler Rate (Hz)	Scaler Deadtime	Built	Express	Alt	Err
L2_W	3008	5	18101	25	37.2	9.1%	3992	25	14801	6
BMT0	18097	27	18101	25	37.2	9.1%	18077	0	0	20
BBCMB	6049	11	6051	9	10.4	9.1%	6044	0	0	5
BBCMB-Cat0	6560	12	6571	9	10.4	9.1%	6564	0	0	5
BBCMB-Cat2	6204	12	6206	9	10.4	9.1%	6199	0	0	5
BBCMB-Cat3	6049	11	6051	9	10.4	9.1%	6044	0	0	5
EMStest	197583	298	197640	294	1844.0	9.8%	197600	0	0	43
JP1	6180	8	11878	17	914.3	9.9%	6175	0	5696	5
zero_bias	634	0	634	1	1	9%	634	20	0	0
L2_Bgamma	12544	10	12600	15	99	9.6%	12531	0	140	13
L2_Egamma	3500	3	2614	11	11.0	9.7%	2549	0	62	3
L2_LW	783	0	3919	77	116.9	9.2%	782	25	38130	1
JP2	49230	70	50919	77	116.9	9.2%	45195	0	13605	43
A10	13764	18	58610	77	116.9	9.2%	13756	0	45146	8
EMStest-FPE	89311	129	89245	133	329.9	9.6%	89280	0	0	31

The bottom section of the screenshot shows a detailed view of the 'RUNNING' status for '10100077', listing various system components and their operational status (e.g., 'L2', 'Trigger', 'FPDE', 'FPDSMD', 'TPX').

2009 STAR 500 GeV pp LongPol BHT3 Recorded Luminosity



Goal
10 pb⁻¹

FOM goal (2.5pb⁻¹)
not met due to low
Beam polarizations

Achieved FOM ~ 1.5 pb⁻¹

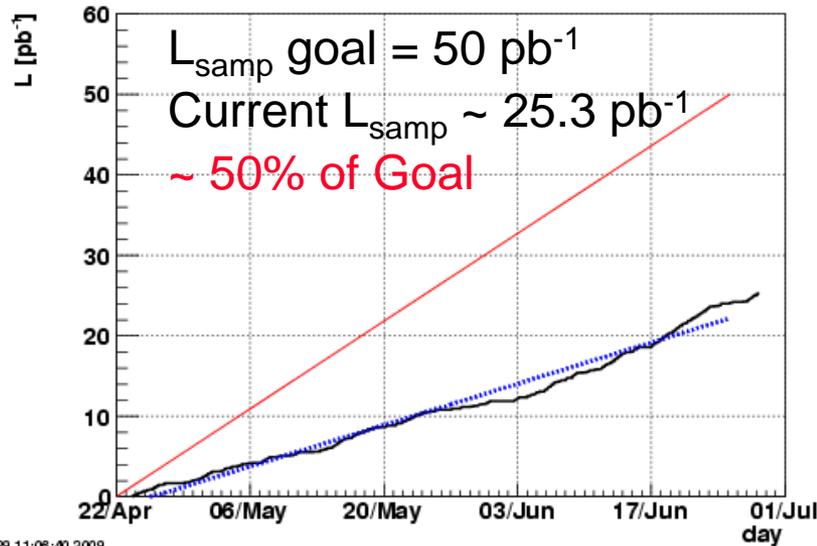
Mon Apr 13 17:26:21 2009

Total sampled luminosity ~ 10.7 pb⁻¹, goal achieved.

~ 10 pb⁻¹ of additional delivered luminosity used for ZDC Polarimetry studies
(Not necessary in future years, will get ZDC polarimeter into scalers)

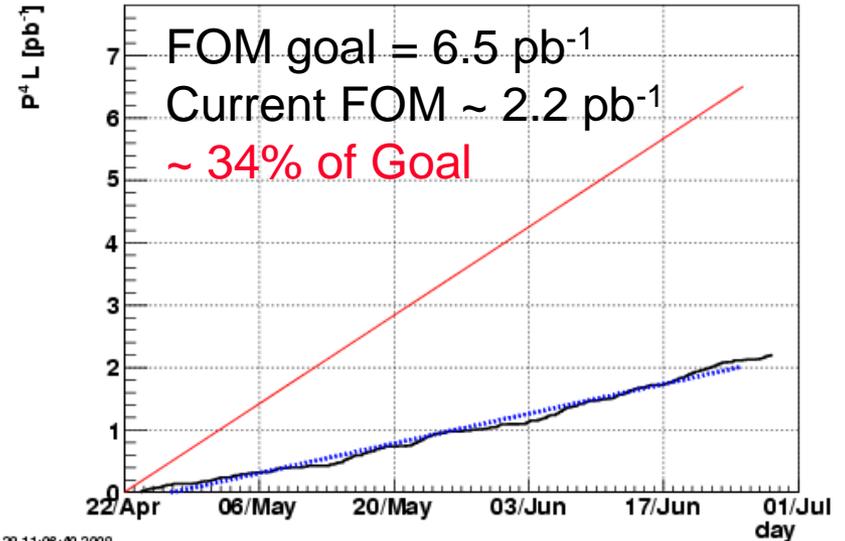


L2JetHigh



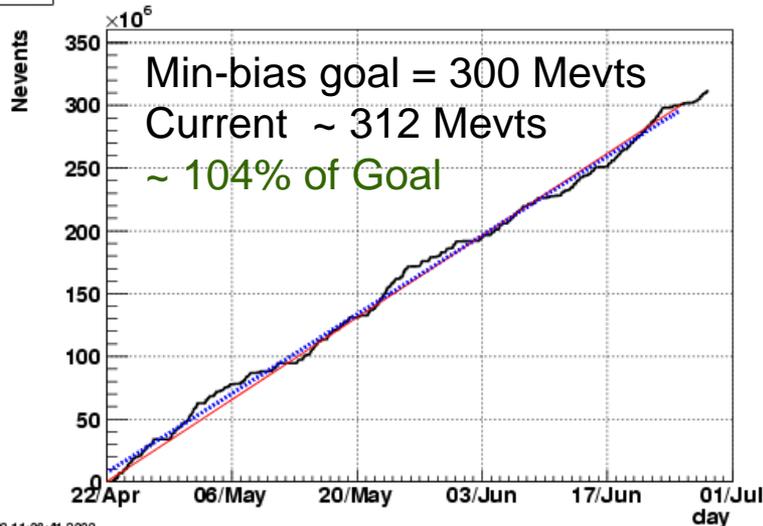
Mon Jun 29 11:06:40 2009

L2JetHigh



Mon Jun 29 11:06:40 2009

VPDMB



Mon Jun 29 11:06:41 2009

STAR efficiency for sampling the delivered luminosity was the best its ever been (primarily due to DAQ1000).

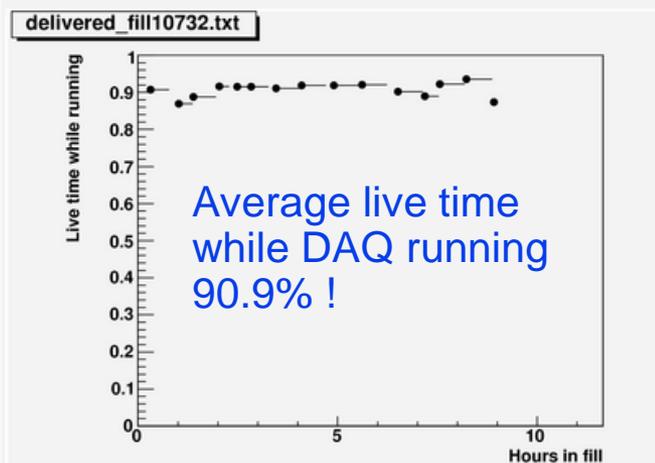
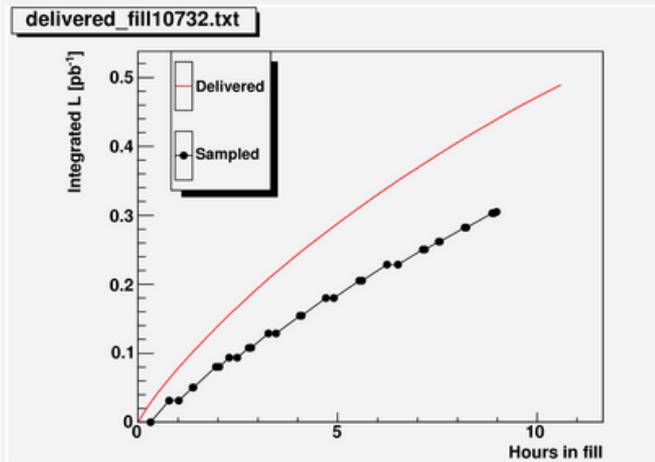
Appears that missing the pre-run goals may lead to further inquiry by DOE.

Retreat Input: Very important that Collider estimate performance as accurately as possible, and that Experiments achieve projected physics goals.

Example of STAR's "efficiency" for a RHIC Store



Fill 10732
Started Mon May 11 20:12:00 2009
Ended Tue May 12 06:48:00 2009
10.6 Hours
Total delivered: 0.489 pb⁻¹
Sampled Fraction: 0.624
Fraction of L delivered while taking data: 0.686
Fraction of hours delivered while taking data: 0.675
Hours lost before first run: 0.3 Frac: 0.030
Hours lost after last run: 1.6 Frac: 0.152
Luminosity fraction lost before first run: 0.058
Luminosity fraction lost after last run: 0.102
Average Live Time while taking data: 0.909



A few of the values listed/calculated:

- Total L delivered 0.489 pb⁻¹
- Sampled % = 62.4%
- % delivered while DAQ running = 68.6%
- % of hours while DAQ running = 67.5%
- Hours "lost" before first physics run = 0.30 (3%)
- Lum % lost before 1st run 5.8%
- Hours lost after last run 1.6 hrs (15% of store)!
- Lum % lost after last run 10.2%!

These efficiency statistics were calculated for all Stores after April 24th. Thanks to Peter Ingrassia for supplying Store data from RHIC.

Input for Retreat: Important that Collider efficiently end stores!

Summary efficiency statistics



For the Entire 200 GeV run:

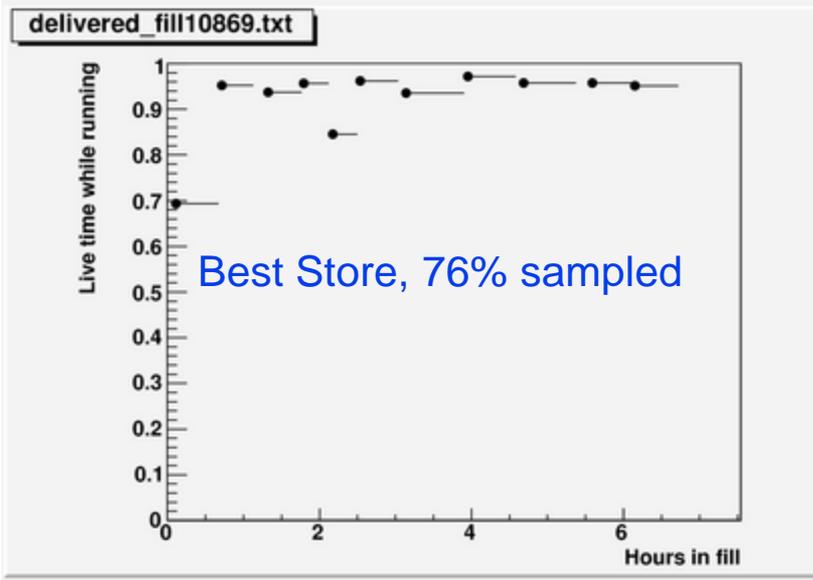
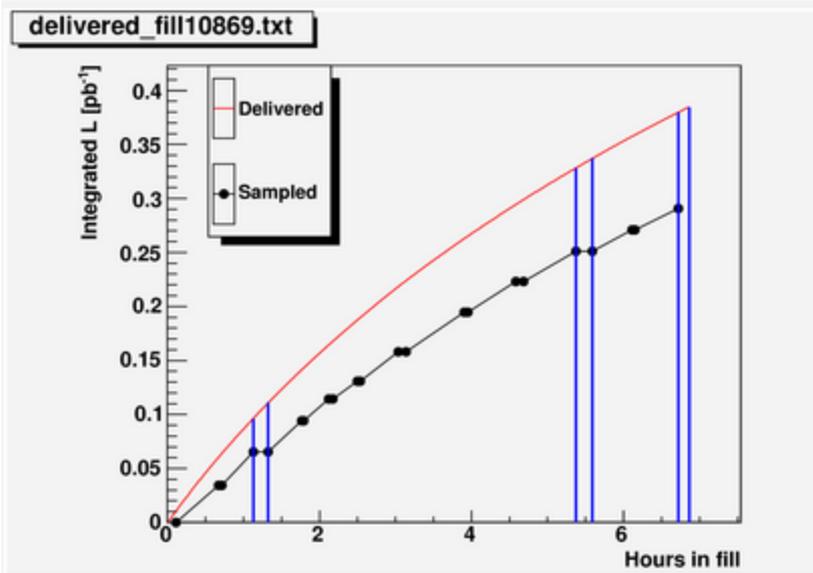
51.3 pb⁻¹ delivered (C-AD 53.5)

	Lum.(pb ⁻¹)	Ratio/delivered
Sampled	25.3	47%
Before first run	8.4	16%
After last run	3.6	7%
Lasers	5.4	10%
Deadtime	3.7	7%
Rest	7.1	13%

Retreat Input:

Important that Shift crews get trained (i.e. Physics all day on Tuesdays).

Important that physics running gets going before midnight!



First 500 GeV Run a success:

- Established and calibrated local polarimetry for 500 GeV beams with the ZDC SMD
 - Achieved BUR goal of 10pb^{-1} sampled luminosity. Expect first RHIC W measurement
 - First chance to determine environment STAR will have to deal with for 500 GeV program. Collider backgrounds essentially non-existent. Charge loading in TPC significant. W triggers commissioned.
- Low polarization, and hence missed FOM goal, makes W A_L extraction problematic
- Collider has more work to do to increase polarization

200 GeV Run a mixed bag:

- Portions of this data set, relevant as Heavy Ion references, will far surpass all earlier STAR pp data sets
- Due (primarily) to luminosity lifetime issues we fell short of our Spin sampled luminosity and FOM goals by factors of a few. Will need to complete in future run.

The first STAR pp2pp run was very successful.

Expanded STAR Capabilities:

- New, fast TPC electronics an unqualified success!
 - New capability allows STAR to simultaneously run multiple physics programs and sample majority of delivered luminosity.
- New TOF system (94/120 in Run 9, rest this summer) adds significant PID capability for STAR data sets. Large increase in Signal/Background for many analyses.

Some specific Retreat items I collected during the Run



Date 2/25/09

Issue about early overnights for Experiments. For both of the first two nights it appeared that the collider tried to deliver stores with intensities/# of bunches beyond what was reliably operational. Suggest that this is not the best way to go.

Date 3/25/09

Have a Monday Scheduling mtg. Implied that nothing but physics until 6 am Wednesday APEX. I miss Tuesday 9 am mtg for Collab mtg talk, and find 4 hours of Beam Dev. scheduled. This should be discussed and scheduled at the Monday mtg once one reaches "stable" operations. Impacted Shift crew training.

Date 3/25/09

Endless debates on such basic items as emittance vs intensity, polarization vs intensity, value of CNI, etc. Should give topics enough discussion to reach consensus, and then move on.

Date 4/2/09

Again the idea that plans are "hatched" at the 9 am mtg to do beam dev. starting immediately. As discussed at last year's Retreat, plans made and executed in this manner are by definition not well thought through. This is a bad practice, especially this late in a run.

I'd pressed for C-AD to block out time for Beam Dev. and then develop a plan before the dev starts at the Monday Scheduling mtg. I think the idea "We can take whatever, whenever, until we're stable" is a bad excuse for a bad practice.

Some specific Retreat items I collected during the Run (2)



Date 5/10/09

It appeared that there was a long delay in getting back to beam operations due to significant time spent waiting for experts to come. This sort of downtime should be avoided in the future.

Date 5/12/09.

Tuesday May 12th. Wanted beam for Shift training. No beam from 7 am to 5:30 pm and still waiting. This hurts our ability to maintain Shift Crew efficiency. Going to APEX at 7 pm.

Input received after run in response to request for input to Retreat:

- For Spin running C-AD should use integrated FOM (rather than luminosity) as primary measure of ongoing run status.
- Reliable/clean polarimetry needed.
- Scheduled accesses OK this year. Must continue.
- Some more shielding necessary for STAR.
- Some work on understanding emittance growth (i.e. diff between Blue and Yellow, for pp2pp running).

Summary Retreat Comments on RHIC Run 9.



1.) A key role of the 9 am mtgs during a run are to efficiently gather relevant status information and then effectively plan the strategy/plan to optimize the operation of the Collider and achieve the physics goals for the run.

- When it becomes clear that there is ambiguity about the values of critical collider parameters some mechanism outside of the 9 am mtgs should be set up which studies/deliberates (argues) these issues and then delivers that best input possible to the 9 am mtgs. Time consuming debates in the 9 am mtg that don't lead to consensus on these issues should be avoided as much as possible.

2.) For Spin running FOM should be the standard plot by which progress in the run is measured.

- If polarization is unknown this will stress resolving the issues early.
- It will hopefully avoid C-AD deriving false comfort from the delivered Luminosity.

3.) I'd like to suggest that there be a clear distinction and demarcation during a given physics run when a transition is made between the mode where plans for that day's collider development are made at the 9 am mtg, and when the development plans must be at least scheduled as defined blocks of time at the Monday Scheduling mtg.

- Instances after this point where the Run Commissioner feels that extraordinary circumstances require immediate scheduling of development time would then be clearly announced at the 9 am mtg.

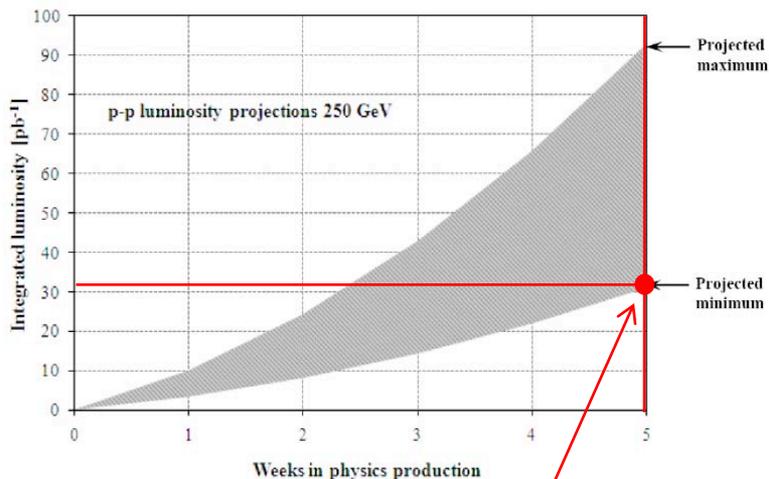
4.) Given this year's experience, it is important that C-ADs pre run estimated collider performance estimates be as accurate as possible.

5.) It seems that the Collider may need to devise more precise plans, pre run, on what level of tuning should/must be done and then maintained on critical collider parameters.

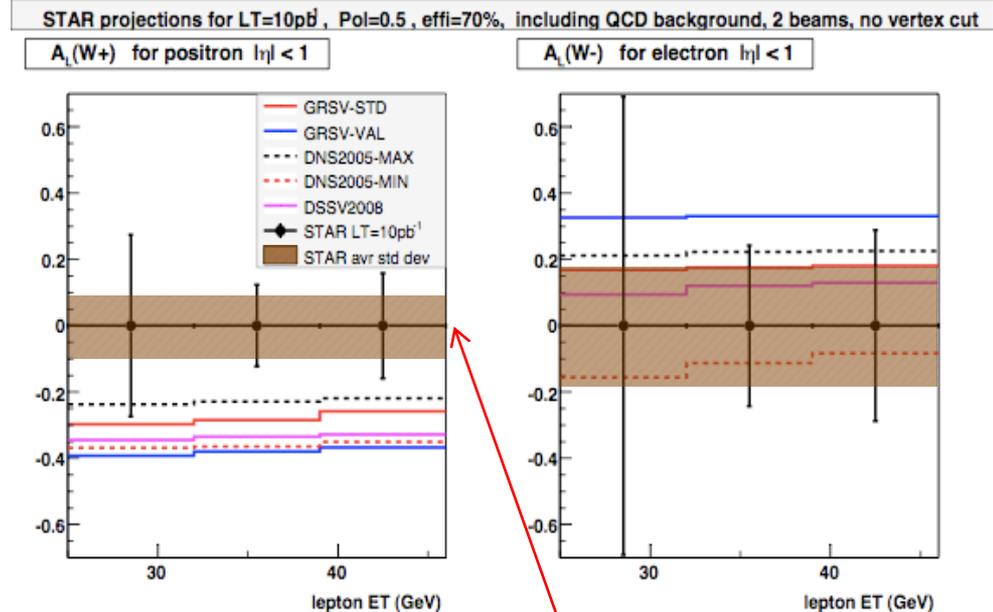
STAR Run 9 500GeV program (W production)



Projected performance / assumptions - STAR 500GeV program



Assumed only minimum projection / Time needed in STAR for commissioning work: $\sim 10 \text{ pb}^{-1}$ (recorded)



- Primary goal: Develop local polarimetry in STAR at 500GeV (ZDC) :

DONE

- Physics Goal 1: First W measurement in STAR at mid-rapidity : Establish signal (Extensive full GEANT simulations completed of W signal and QCD background events - Feasibility demonstrated!)
- Physics Goal 2: First $A_L W$ measurement (W^+)
- Other opportunities: Jets / Di-Jets at low x

Assumption:

$$\text{FOM} = P^2 L \sim 2.5 \text{ pb}^{-1}$$

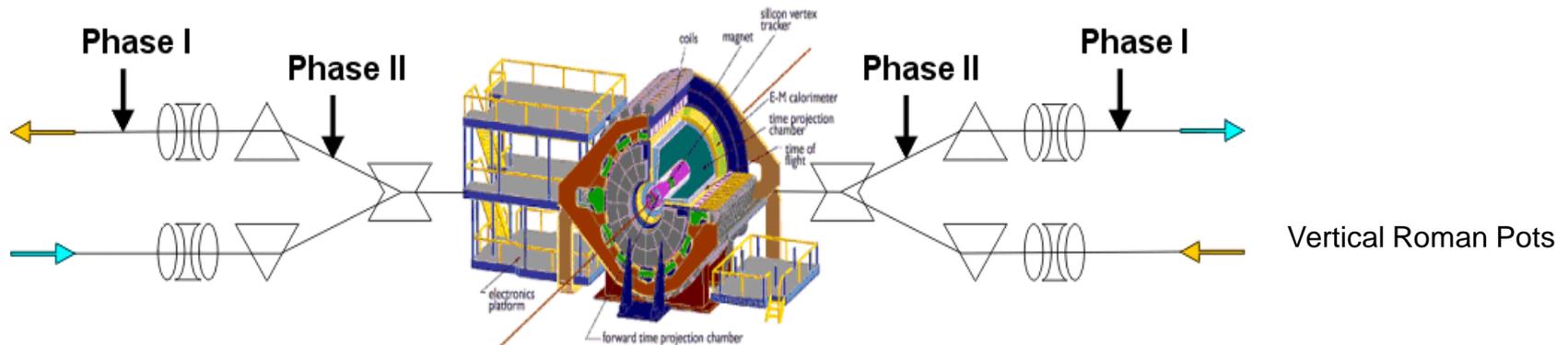
$$P \sim 0.5$$

$$L_{\text{delivered}} \sim 30 \text{ pb}^{-1} L_{\text{recorded}} \sim 10 \text{ pb}^{-1}$$

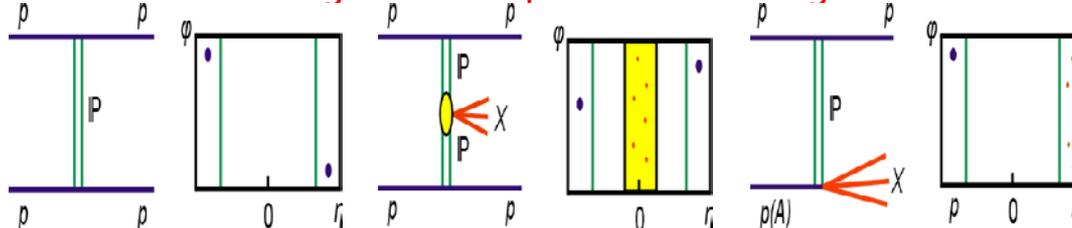
STAR Run 9 200GeV program (pp2pp)



- Unique opportunity of diffractive physics in STAR : pp2pp



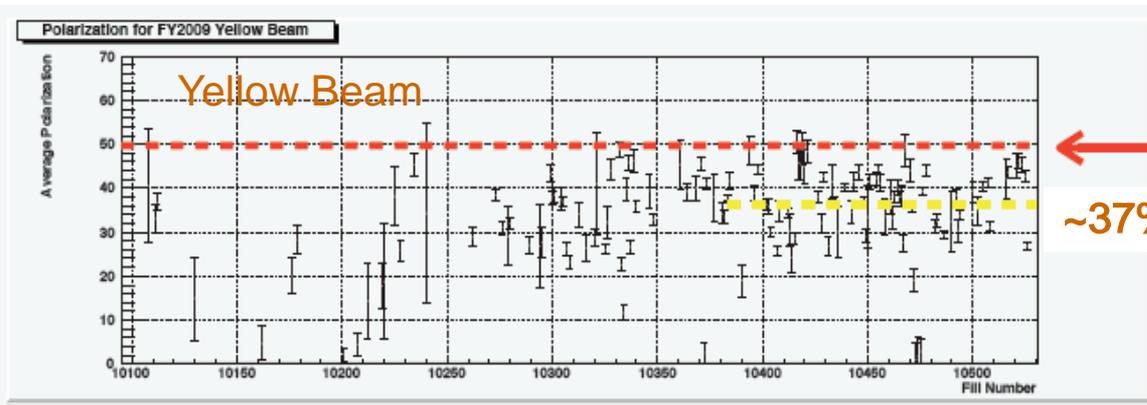
- Physics: Elastic scattering / Central production / Single diffraction dissociation



QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

- Need to reach small t values to measure small masses of interest \Rightarrow large $\beta^* = 20\text{m}$ required, special optics and beam scraping needed
- pp2pp setup moved to STAR and integrated (Run 8) / Commissioning of trigger and Si detectors ongoing / Need: Dedicated run of 4-5 days (incl. 2 days setup)

Run 9 - 500GeV period - Status

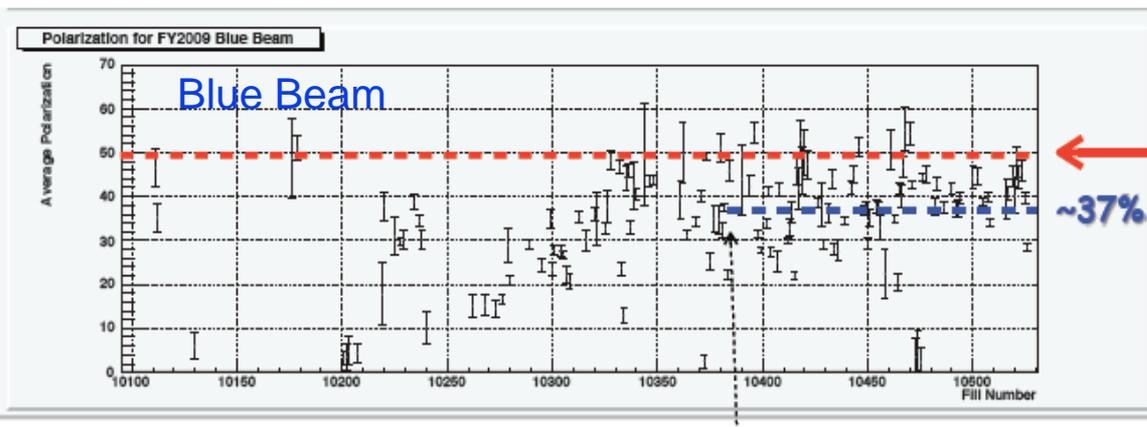


~ 50-55% at injection

~ 35-40% at store

← Polarization goal

~37%



← Polarization goal

~37%

- Spin rotator tuning:
 - Trans. Component reduced to 10%
 - No significant lifetime issue of Y and B beam observed

Need to understand the de-polarization in RHIC. C-AD plans to continue studies this year via APEX