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RHIC Spin Collaboration Meetings XV & XVI

February 21, 2003
March 18, 2003

Organizer:

Brendan Fox

RIKEN BNL Research Center

Building 510A, Brookhaven National Laboratory, Upton, NY 11973-5000, USA

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Preface to the Series

The RIKEN BNL Research Center (RBRC) was established in April 1997 at Brookhaven National Laboratory. It is funded by the "Rikagaku Kenkyusho" (RIKEN, The Institute of Physical and Chemical Research) of Japan. The Center is dedicated to the study of strong interactions, including spin physics, lattice QCD, and RHIC physics through the nurturing of a new generation of young physicists.

During the first year, the Center had only a Theory Group. In the second year, an Experimental Group was also established at the Center. At present, there are seven Fellows and seven Research Associates in these two groups. During the third year, we started a new Tenure Track Strong Interaction Theory RHIC Physics Fellow Program, with six positions in the first academic year, 1999-2000. This program had increased to include ten theorists and one experimentalist in academic year, 2001-2002. With recent graduations, the program presently has eight theorists and two experimentalists. Beginning last year a new RIKEN Spin Program (RSP) category was implemented at RBRC, presently comprising four RSP Researchers and five RSP Research Associates. In addition, RBRC has four RBRC Young Researchers.

The Center also has an active workshop program on strong interaction physics with each workshop focused on a specific physics problem. Each workshop speaker is encouraged to select a few of the most important transparencies from his or her presentation, accompanied by a page of explanation. This material is collected at the end of the workshop by the organizer to form proceedings, which can therefore be available within a short time. To date there are fifty-one proceeding volumes available.

The construction of a 0.6 teraflops parallel processor, dedicated to lattice QCD, begun at the Center on February 19, 1998, was completed on August 28, 1998. A 10 teraflops QCDOC computer in under development and expected to be completed in JFY 2003.

T. D. Lee
November 22, 2002

*Work performed under the auspices of U.S.D.O.E. Contract No. DE-AC02-98CH10886.

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STATUS REPORT ON THE AGS

L. Ahrens, BNL

February 21, 2003

for

RHIC Spin Collaboration Meeting XV

RIKEN BNL Research Center

learning to exist, and make progress behind d-Au RHIC – need long stores, and already adequate d and Au injector setups. We may be close now.

-sprint last weekend in January to provide CNI group protons.

-another sprint last week (lest the run be gone with nothing further to show), again to provide both polarimeters with beam and some running time.

present status:

AGS has a "User" setup with a standard high Bdot Siemens Magnet cycle.

The partial snake is setup for this cycle.

Longitudinal emittance reduction in Booster chopping the Linac beam into existing buckets has been exercised. (Linac optimization still needs some time.)

The ac dipole, with a new hardware location and RHIC style low level is nearly complete, already usable. Magnet sharing between tune meter and ac dipole seems ok.

The magnet cycle is designed to allow accumulation of 6 Booster bunches, and so has an injection porch immediately available for polarization measurement.

plan part 1:

optimize the setup using diagnostics other than polarization – emittance, tune measurement.

check that the Booster setup is not deteriorating polarization – this uses polarization measurement in AGS – possibly using the CNI on the injection porch.

measure polarization at the AGS extraction porch.

plan part 2:

search for points of polarization loss. Scan parameters (e.g. snake strength) using the fast feedback from the CNI measuring on the extraction porch.

Use the CNI throughout the cycle to see just where steps in asymmetry occur.

STATUS REPORT ON RHIC RUNNING WITH THE TUNE LOCK (PLL)

P. Cameron, BNL

February 21, 2003

for

RHIC Spin Collaboration Meeting XV

RIKEN BNL Research Center

Tune Feedback for Polarized Protons

Status of Tune Feedback at RHIC

Peter Cameron

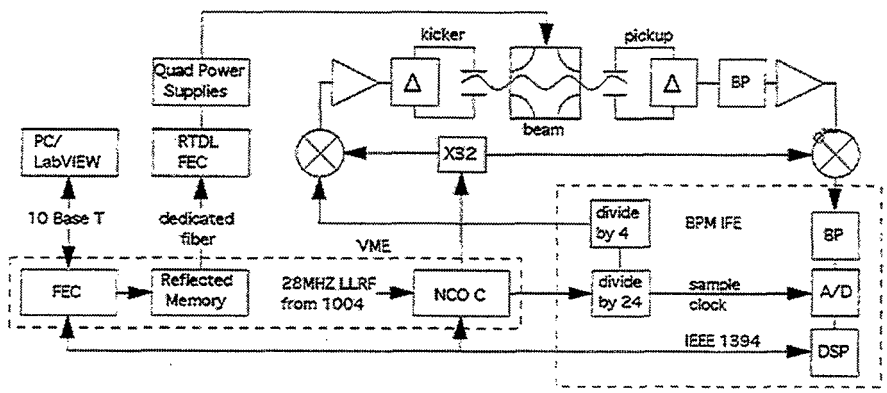
Ramp Control Requirements

- Tune measurement and feedback
  - Avoid resonances - betatron and spin
- Chromaticity measurement and feedback/feedforward
  - Avoid tails on resonance
  - Stability (right sign)
- Coupling measurement and feedback/feedforward
  - Control tune
  - Minimize higher order resonance strength
- Accomplish this without excessive emittance growth/halo formation

Tune Feedback Block Diagram

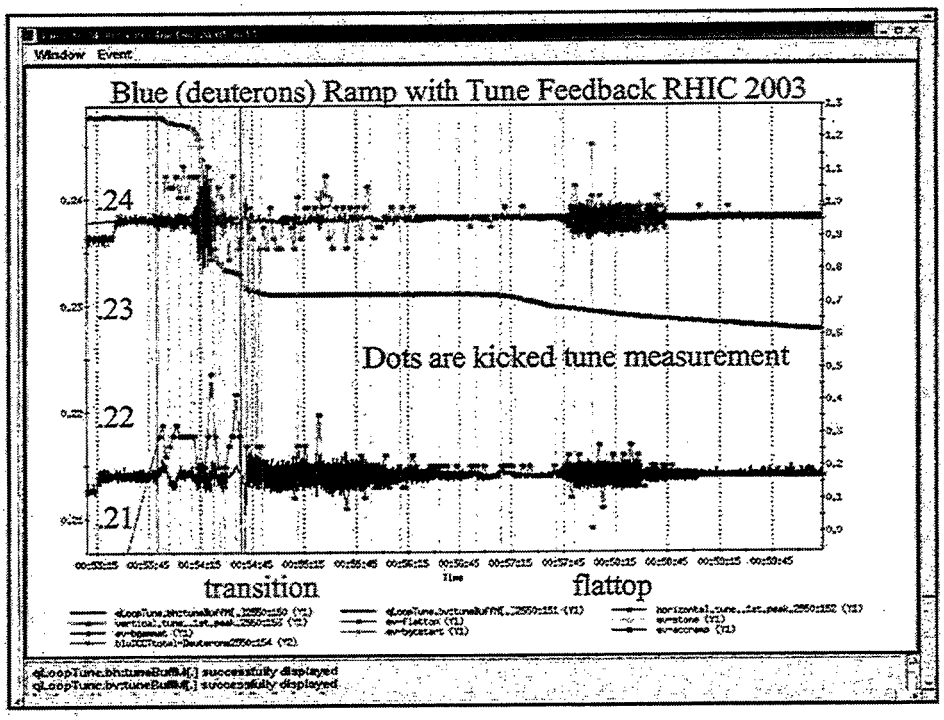
Acceleration RF 28MHz

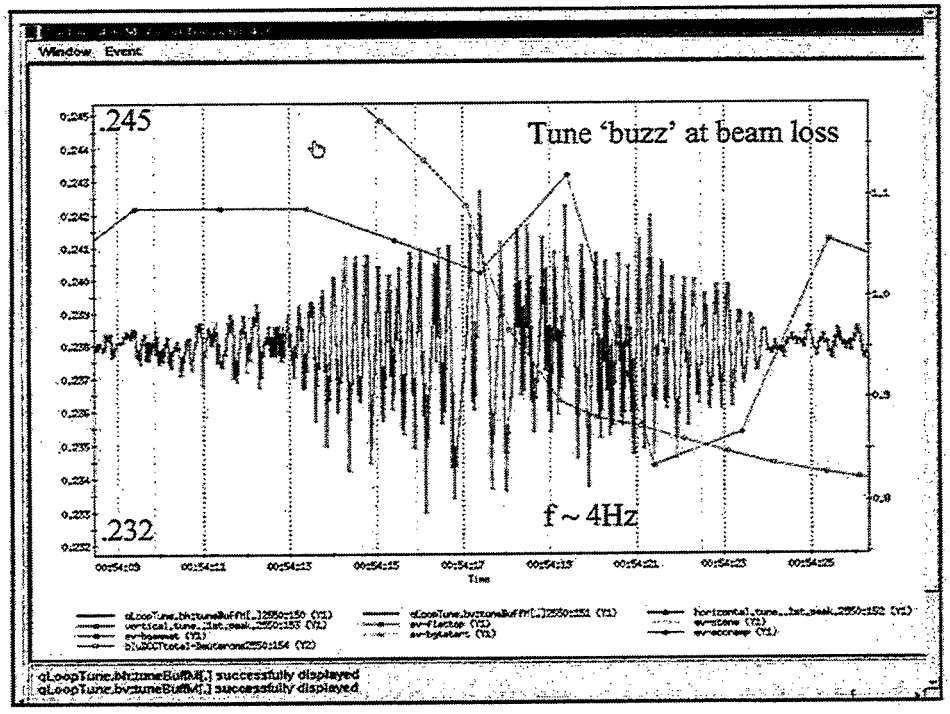
$P_{kick} < 1W$ $f \sim 245MHz$



Tune Feedback in early RHIC 2003

- Seven ramps attempted, all 'successful', but deuteron beam survival worse with TF on!
  - Resonance between TF and power supplies? Radial loop? Beam-beam? Too much loop gain in PLL? Bad chrom?
- This problem was not observed with gold beam
- This problem has not been understood
- There have been no tune feedback ramps since the change to equal frequencies


Window Event
Blue (deuterons) Ramp with Tune Feedback RHIC 2003
.24
.23
.22
.21
Dots are kicked tune measurement
transition
flattop
Time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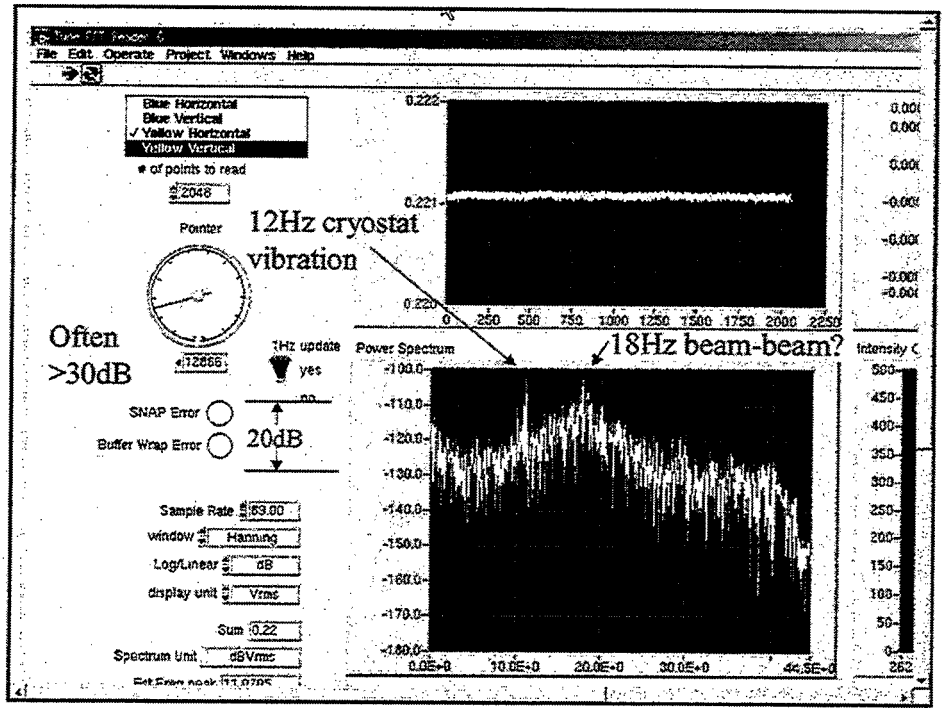
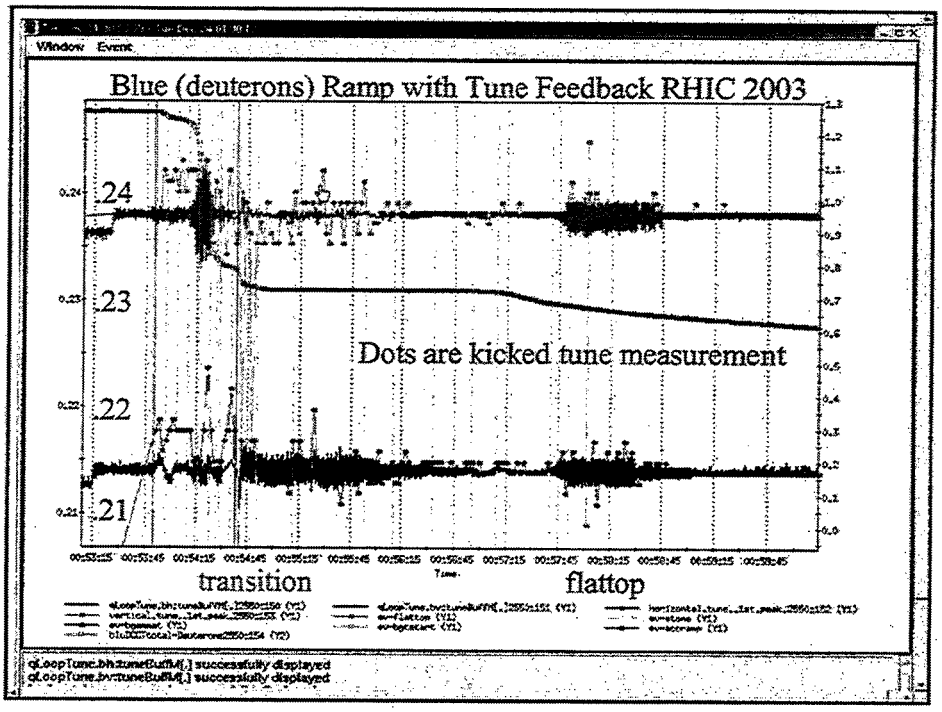
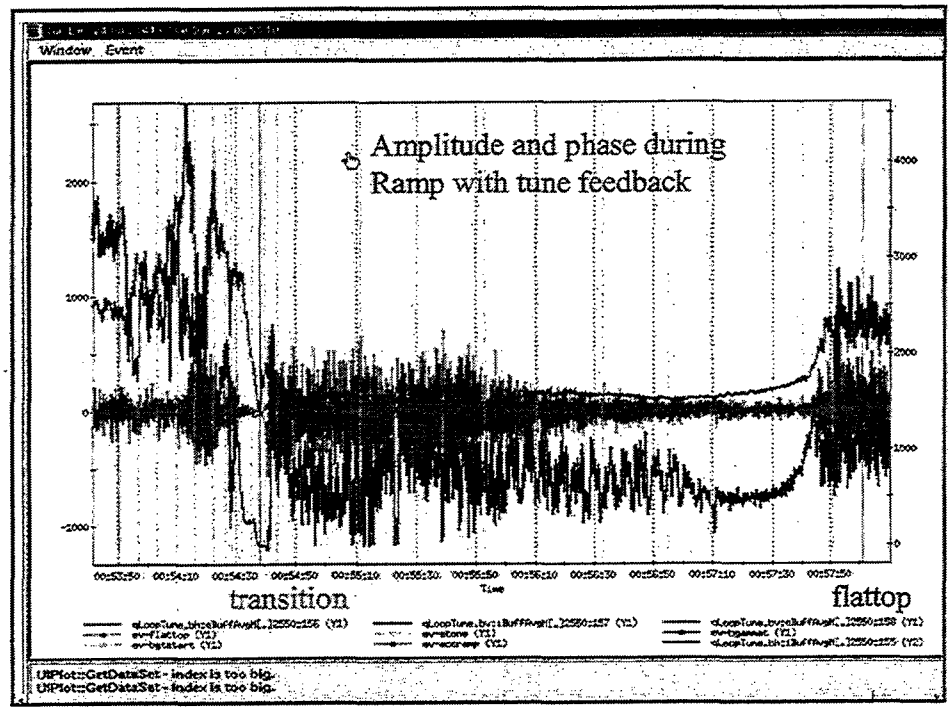
.245
.232
Tune 'buzz' at beam loss
f ~ 4Hz
Time


File Edit Operate Project Windows Help
Blue Horizontal
Blue Vertical
✓ Yellow Horizontal
Yellow Vertical
# of points to read
2048
Pointer
12Hz cryostat vibration
Often >30dB
12666
1Hz update
yes
SNAP Error
Buffer Wrap Error
20dB
Sample Rate 69.00
Window Hanning
Log/Linear dB
display unit Vrms
Sum 0.22
Spectrum Unit dBVrms
Power Spectrum
18Hz beam-beam?
Intensity


Window Event
Blue (deuterons) Ramp with Tune Feedback RHIC 2003
24
23
22
21
Dots are kicked tune measurement
transition
flattop



Transition Crossing

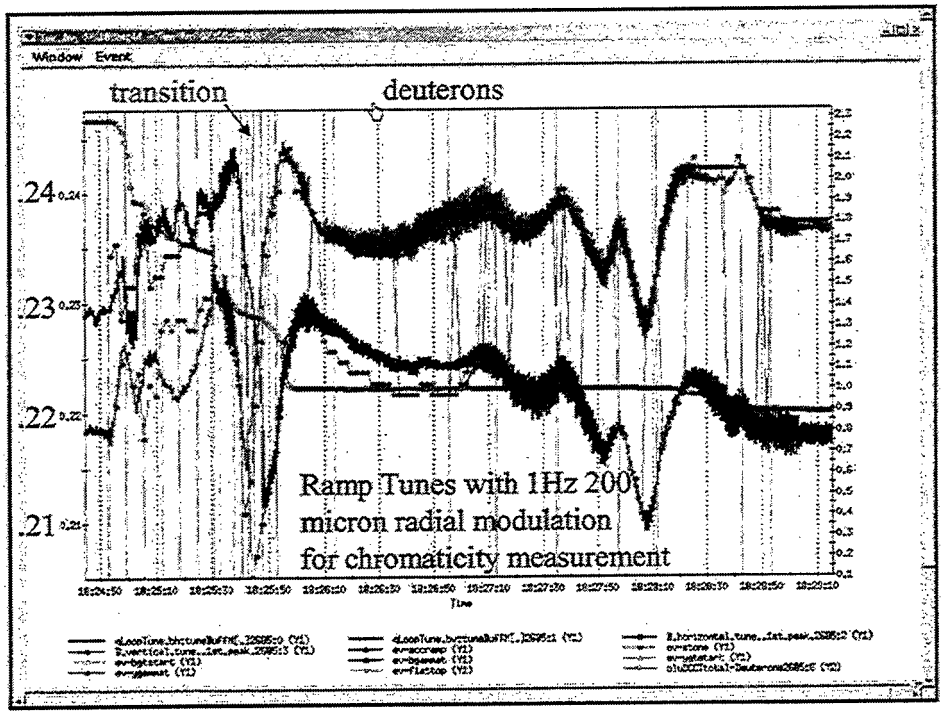
- Key to successful tune feedback is locking to a very small (~femptowatt) excitation signal in the presence of watts of coherent power
- Fundamental weak link is saturation of the first amplifier
  - Resonate pickup difference mode for sensitivity and rejection of sum mode
  - Above the nominal coherent spectrum
  - Moveable BPM with position feedback to center pickup on the beam
  - High Q cavity filters
- Transition defeats two of these
  - Short bunch length puts pickup in the coherent spectrum
  - Orbit shifts drive the pickup at the revolution line
- More kick required to stay above rising noise floor (due to saturation) creates emittance growth
- In addition, there are large tune jumps at transition

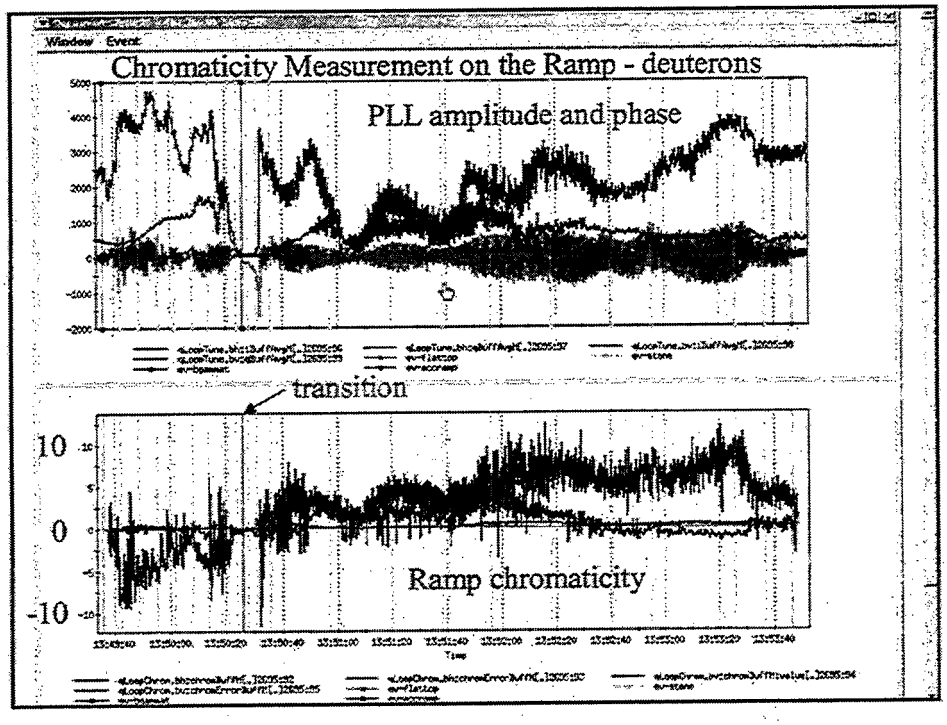
Summary of TF in early RHIC 2003

- Tune control has not been a problem at a level that has been judged sufficient to warrant the additional complexity (and the associated learning curve) involved in making tune feedback operational - operations efficiency has been dominated by other issues
- Transition crossing presents problems that will probably be properly addressed only with a new pickup
- Feedforward has not yet been implemented - impeded use of tune feedback in ramp development
- Sufficient study time was not given to emittance growth

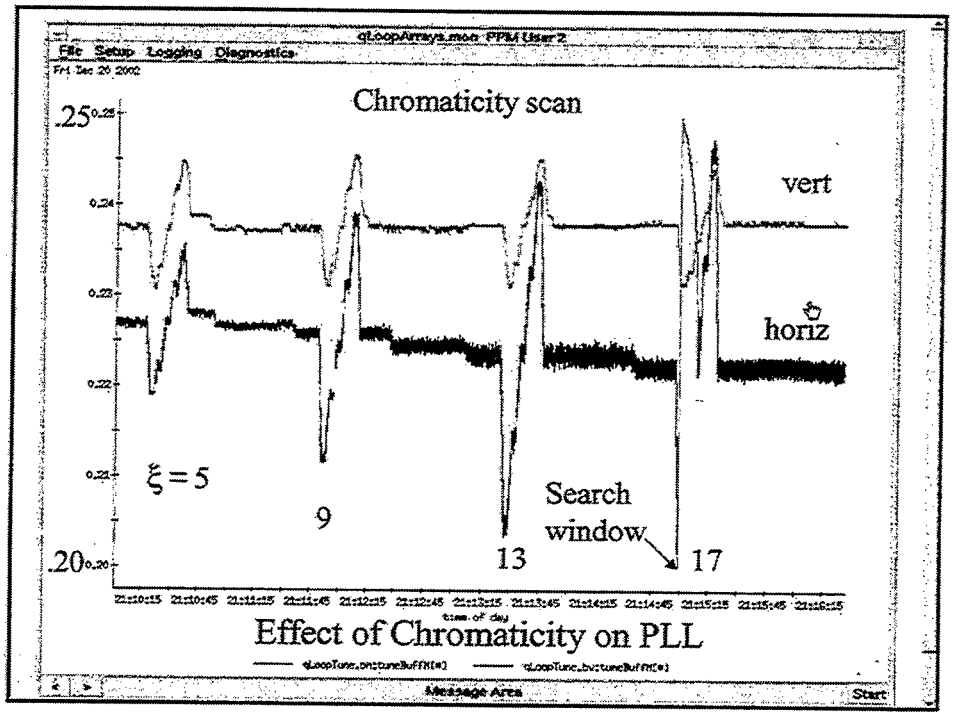
Ramp Control Requirements

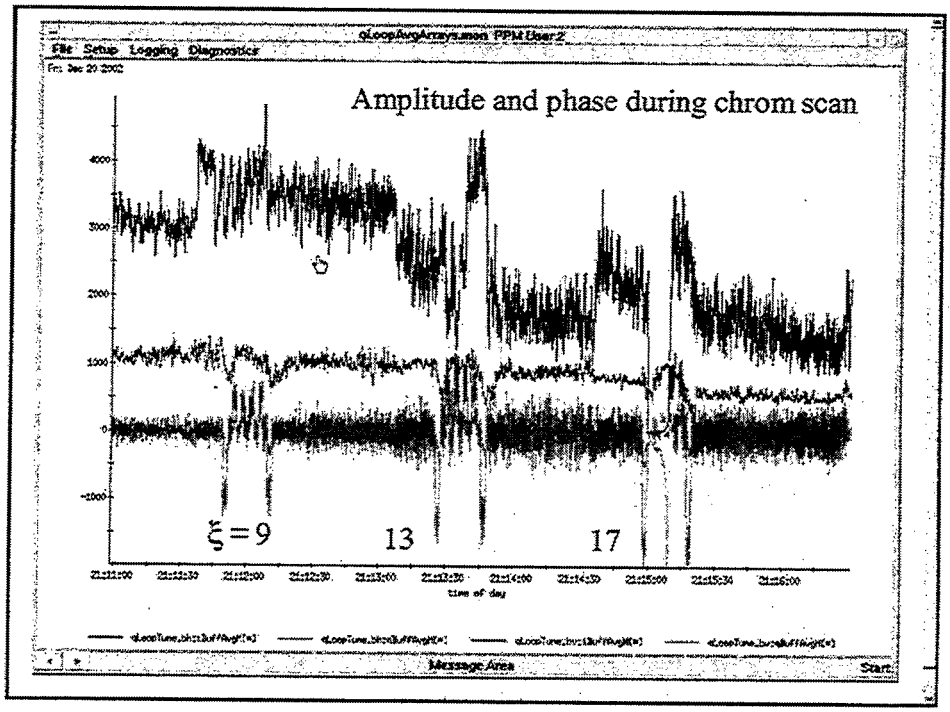
- Tune measurement and feedback
  - Avoid resonances - betatron and spin
- Chromaticity measurement and feedback/feedforward
  - Avoid tails on resonance
  - Stability (right sign)
- Coupling measurement and feedback/feedforward
  - Control tune
  - Minimize higher order resonance strength
- Accomplish this without excessive emittance growth/halo formation


transition
deuterons
.24
.23
.22
.21
Ramp Tunes with 1Hz 200
micron radial modulation
for chromaticity measurement


Chromaticity Measurement on the Ramp - deuterons
PLL amplitude and phase
transition
10
0
-10
Ramp chromaticity

7


Chromaticity scan
.25
.20
vert
horiz
ξ = 5
9
13
17
Search window
Effect of Chromaticity on PLL


Amplitude and phase during chrom scan
ξ = 9
13
17

Ramp Control Requirements

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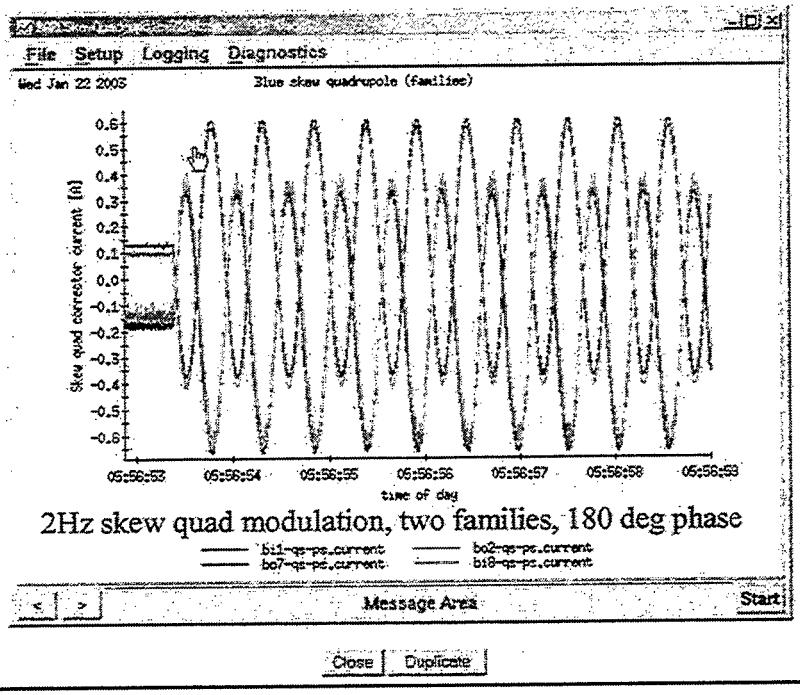
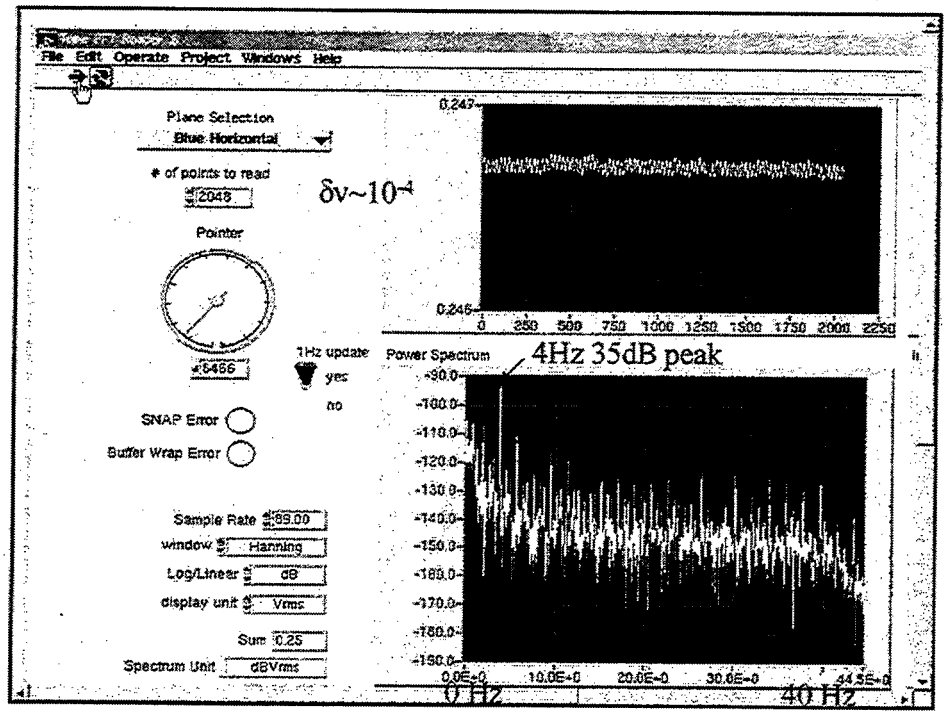
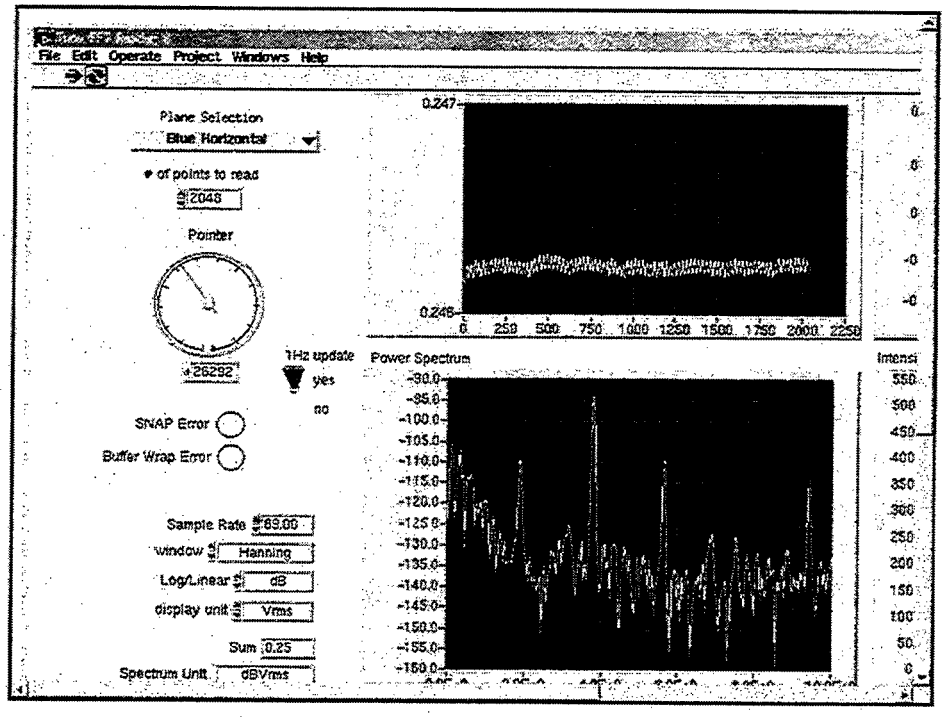


2Hz skew quad modulation, two families, 180 deg phase


File Edit Operate Project Windows Help
Plane Selection
Blue Horizontal
# of points to read
2048
δv~10⁻⁴
Pointer
6466
1Hz update
yes
no
Power Spectrum
4Hz 35dB peak
SNAP Error
Buffer Wrap Error
Sample Rate 89.00
window Hanning
Log/Linear dB
display unit Vrms
Sum 0.25
Spectrum Unit dBVrms
0 Hz
40 Hz


File Edit Operate Project Windows Help
Plane Selection
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# of points to read
2048
Pointer
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1Hz update
yes
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Power Spectrum
Intensi
SNAP Error
Buffer Wrap Error
Sample Rate 89.00
window Hanning
Log/Linear dB
display unit Vrms
Sum 0.25
Spectrum Unit dBVrms

Ramp Control Requirements

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  - Control tune
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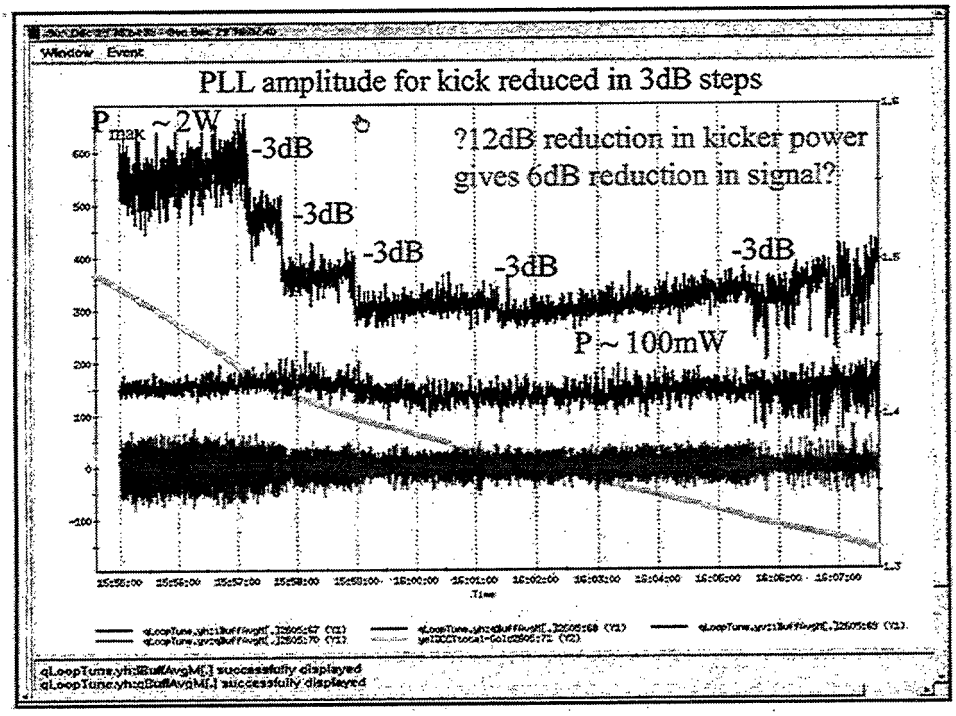


What We've Learned this year

- PLL is greatly improved from last year
- PLL functions well over a large chromaticity range (but what are relevant parameters? – need good beam/PLL/magnet model)
- Chromaticity measurement on the ramp via radial modulation is viable
- Coupling correction is an issue - measurement via skew quad modulation is being actively investigated
- Preamp saturation is an issue, particularly at transition
- Emittance growth is an issue – optimization of kick amplitude and loop gain in progress

Plan and Perspective for Polarized Proton Run

- Plan (what we want to complete before polarized beam)
  - Additional ramps with TF during dAu run
  - Add feedback to loop gain and amplifier power (in progress)
  - Add image rejection hardware
  - Simplified operator interface
  - Feedforward of magnet corrections implemented
  - Additional coupling studies
  - Additional studies of moveable BPM control
- Perspective - Without transition crossing, and with smaller orbit and tune jumps, polarized protons look easy in comparison with dAu. Biggest issue seems to be smooth integration with operations

STATUS REPORT ON RHIC RUNNING WITH 110 BUNCHES IN dA

T. Roser for W. Fischer, BNL

February 21, 2003

for

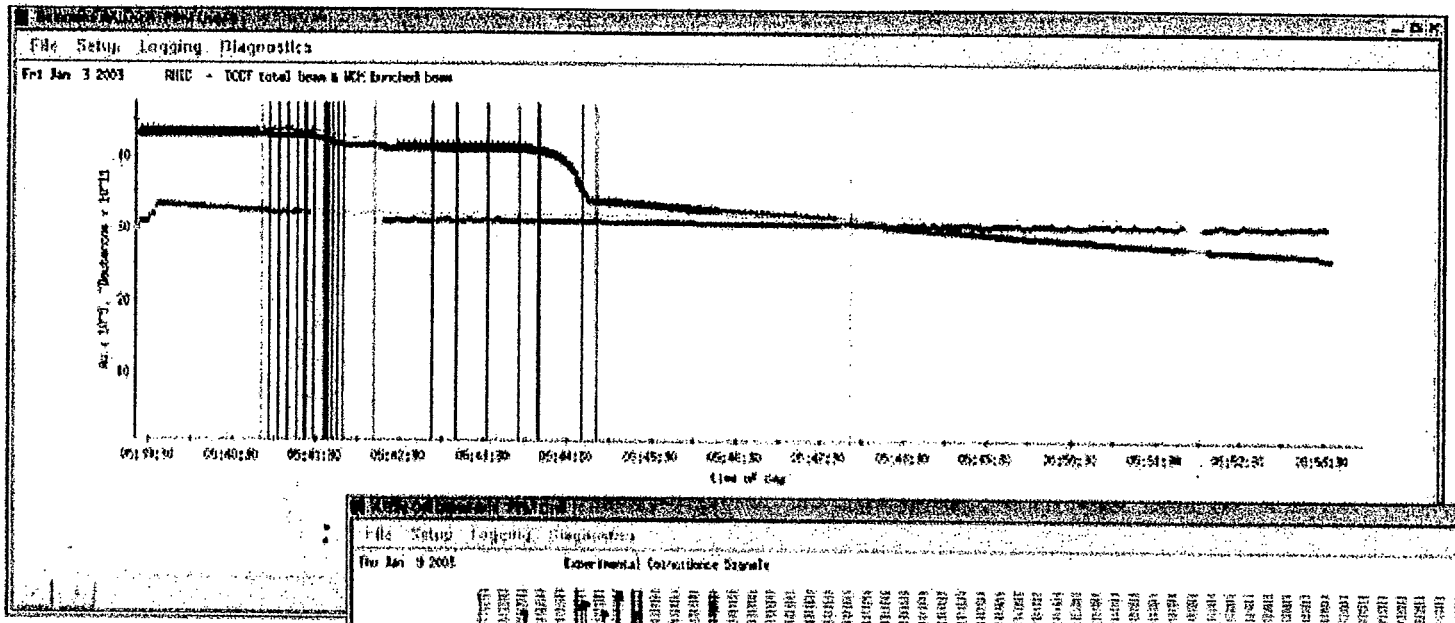
RHIC Spin Collaboration Meeting XV

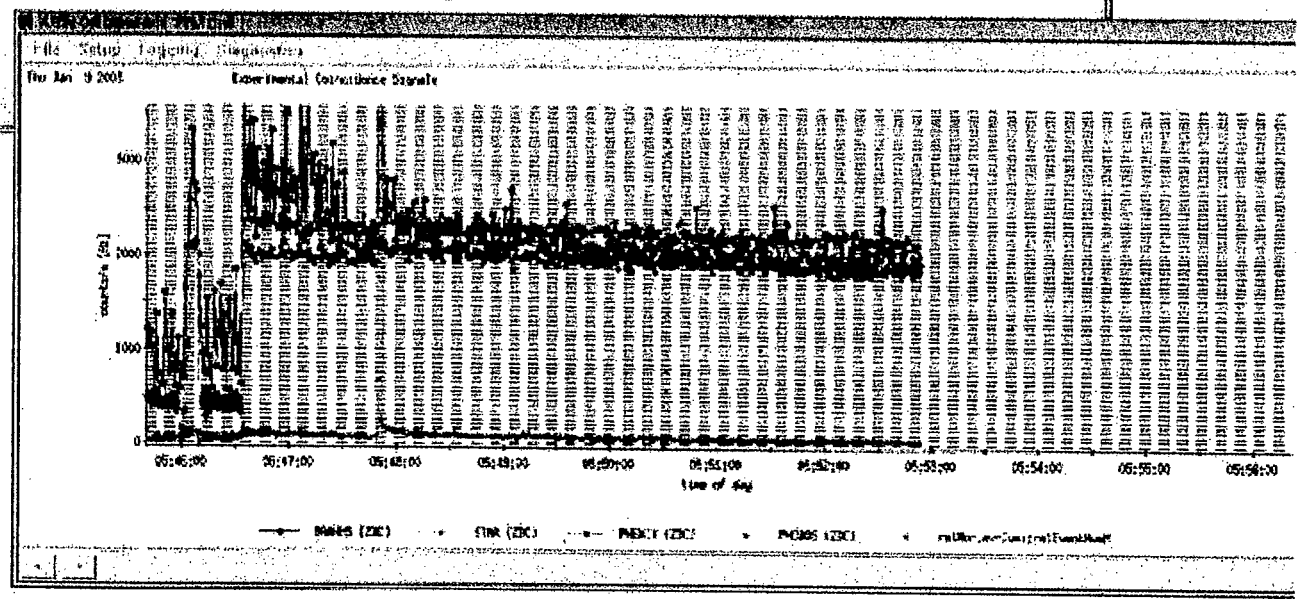
RIKEN BNL Research Center

110 bunch operation

- History:
  - 1st 110 bunch ramp on 10/17/2001
  - 1st 112 bunch store on 01/10/2003
  - 1st 110 bunch physics store on 01/12/2003
- Since then routine operation for dAu
  - About 40 production stores so far
- Usable for pp operation

1st 112 bunch store – 01/10/2003





Improvements made

- Injection kicker hardware (H. Hahn et al.)
  - Decrease in injection kicker risetime
  - Reduction of
    - timing jitter (during filling)
    - and timing drift (from fill to fill)
- Diagnostic Hard and Software
  - More timing diagnostics (AGS and RHIC)
  - Easy drift correction
- People involved:

  J. Addessi, M. Brennan, W. Fischer, H. Hahn, K. Hartman, T. Hayes, T. Le, R. Lee, J. Morris, B. Oerter, F. Severino, R. Spitz, K. Unger, B. Venegas, D. Warburton

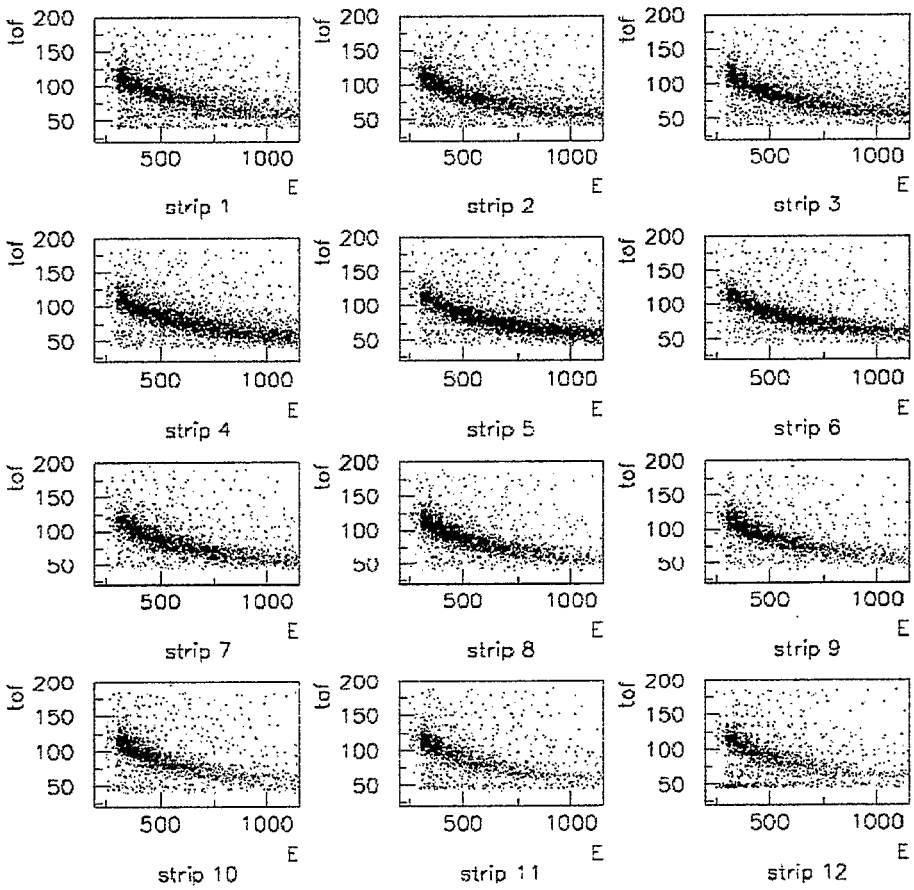
Open issues

- Experimental backgrounds
- Aborted ramps due to beam loss
  - Halo scraping sufficient in some places
  - Increased beam-beam interaction during ramp
- Pressure rise with intense beams
  - No problem so far
  - Observed pressure rises indicate problems with design intensities
- Instabilities
  - Intensities are at levels when instabilities became an issue during last run

CNI Polarimeter Status Report

- A look at the data
2. Problem with timing algorithm
3. Plans

Jeff Wood, UCLA


tof
200
150
100
50
500
1000
E
strip 1
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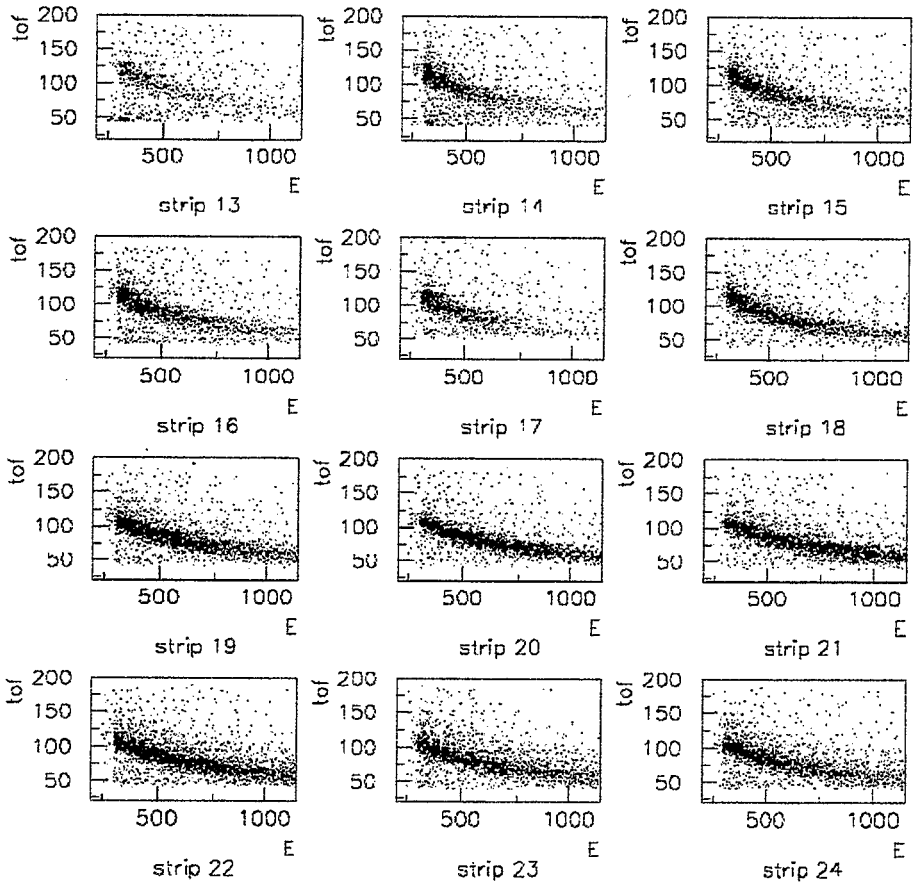
strip 3
strip 4
strip 5
strip 6
strip 7
strip 8
strip 9
strip 10
strip 11
strip 12


tof
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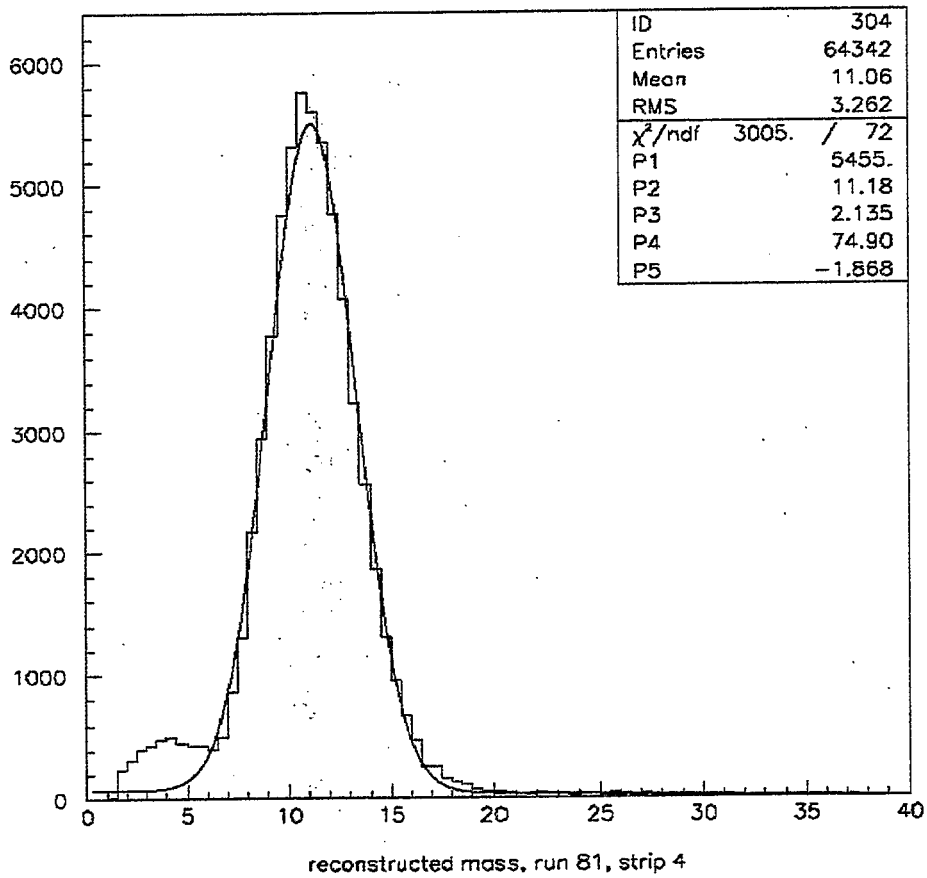
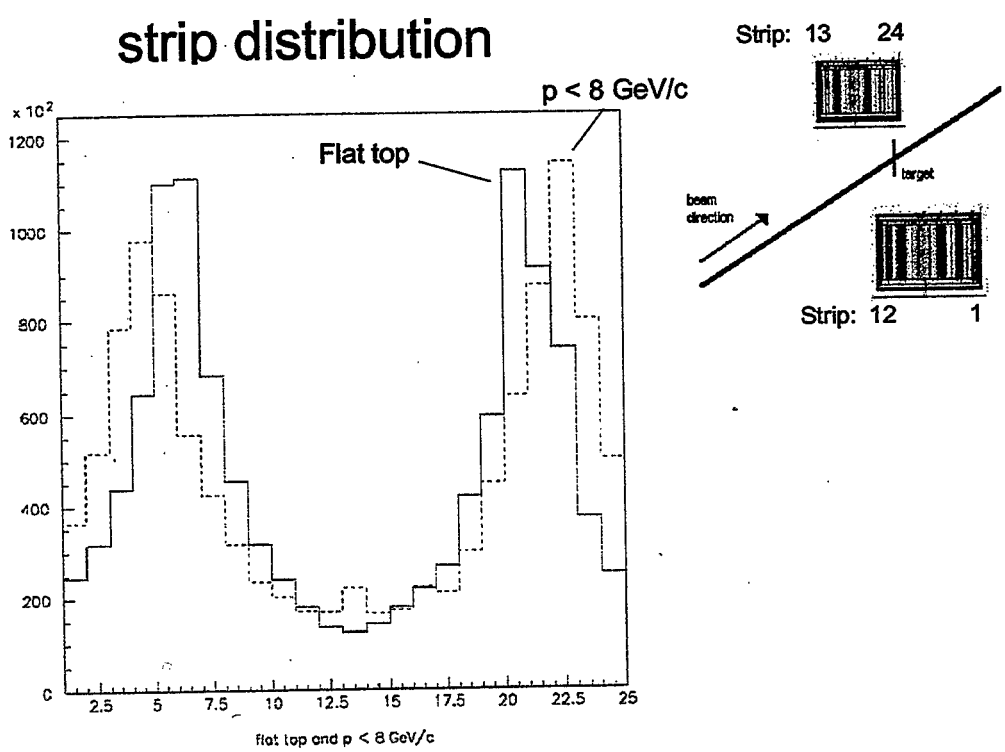
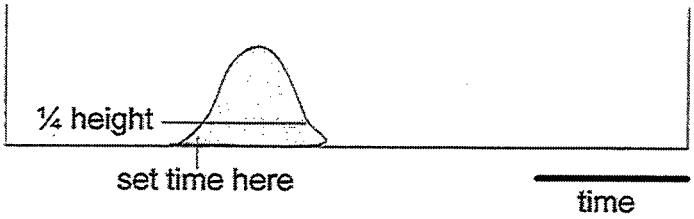
strip 23
strip 24


ID 304
Entries 64342
Mean 11.06
RMS 3.262
χ²/ndf 3005. / 72
P1 5455.
P2 11.18
P3 2.135
P4 74.90
P5 −1.868
reconstructed mass, run 81, strip 4

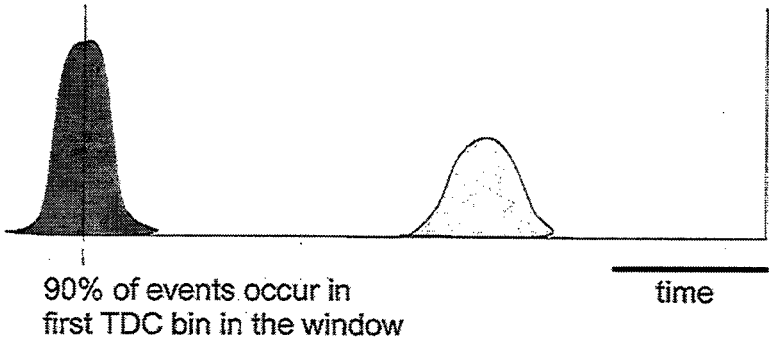

strip distribution
p < 8 GeV/c
Flat top
x 10²
Strip: 13 24
target
beam direction
Strip: 12 1
flat top and p < 8 GeV/c

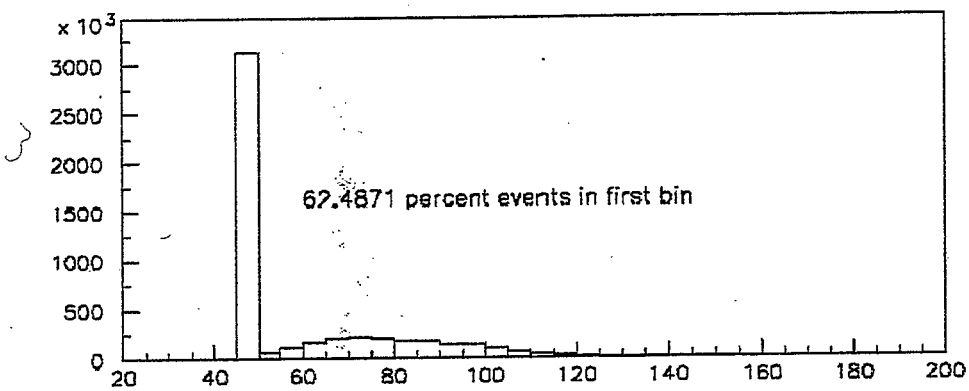
timing algorithm

- find peak in sensitive time window
- look for ¼ peak at an earlier time

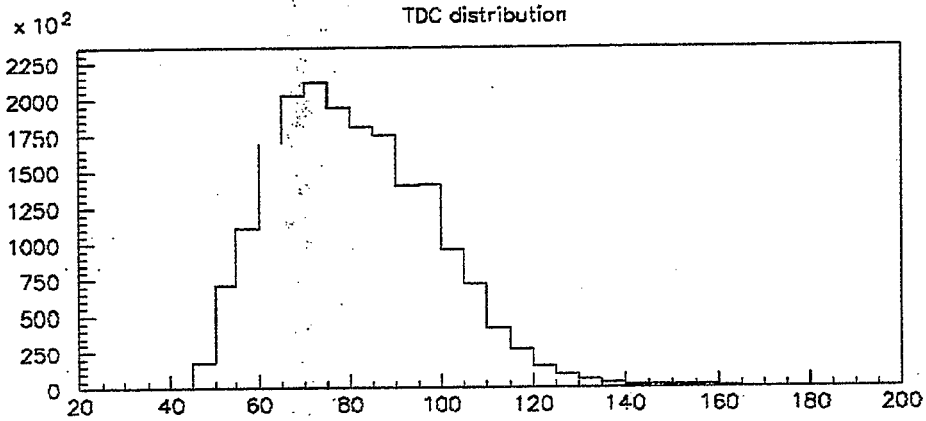


- Problem: pick up prompt background signal





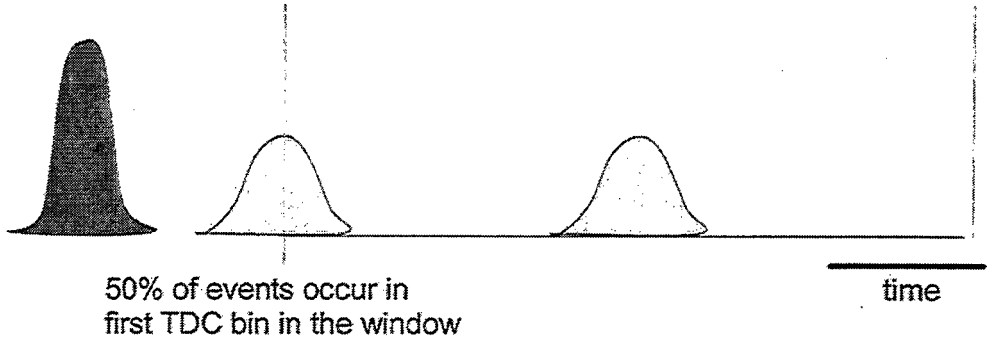
TDC distribution



TDC distribution, cut TDC > 48

Temporary solution

- shift time window
- but still find wrong time for half events



- throw away half events that we record
- need to reprogram algorithm in WFDs

Plan for near future

- Need to change timing algorithm
  - Dima and Igor's next visit
- Would like to try a flat top asymmetry measurement
  - Keep in contact with MCR for available beam

PHENIX
STATUS REPORT

M. Grosse Perdekamp, BNL/RBRC
February 21, 2003

for
RHIC Spin Collaboration Meeting XV
RIKEN BNL Research Center

PHENIX Status Report

- Expected schedule and goals for the pp-run
- PHENIX subsystem readiness
  - o spin related issues
  - o luminosity related issues

Schedule and Goals

- o 5 weeks of spin commissioning:
  - o PHENIX requires 3 days of access including the first maintenance Wednesday (shielding, MVD, muon trigger upgrade test setup)
  - o need detector commissioning beam over night at high luminosity for the last 10 days to tune up trigger and DAQ.
  - o contribute to spin rotator commissioning through feedback from a ZDC/SMD based local polarimeter.
- o 3 weeks of physics with longitudinal polarization
  - o longitudinal double spin asymmetries in inclusive hadron production
  - o comparison running for HI

Expected Running Conditions

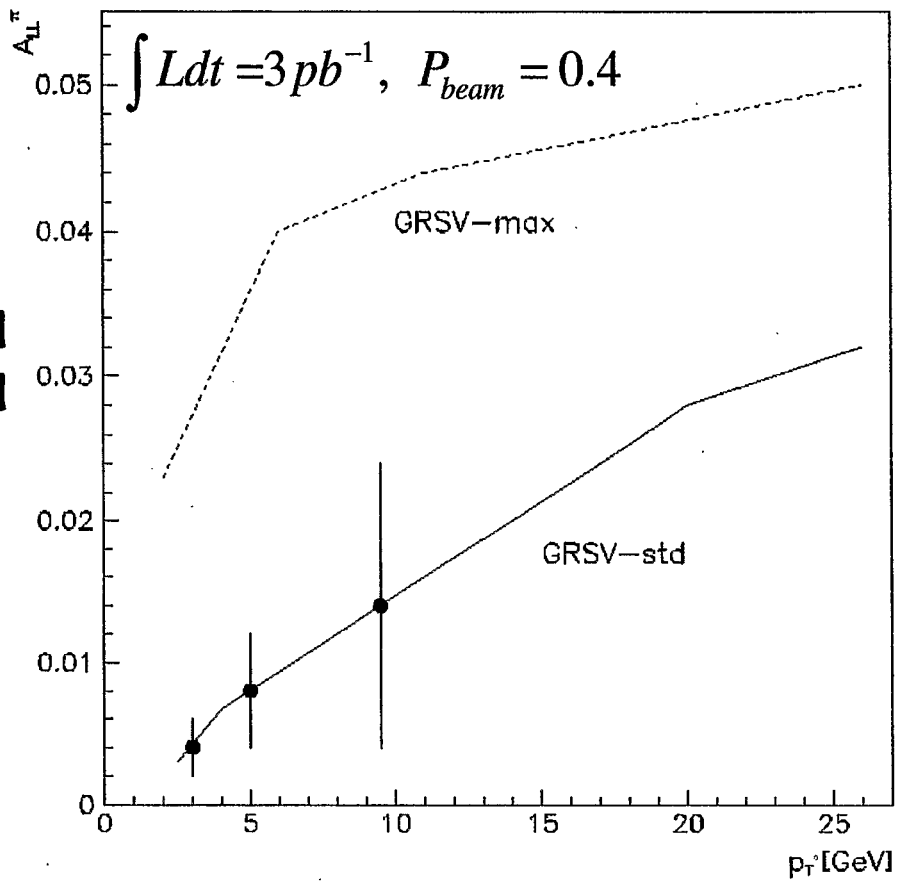
o Beam Polarization > 40%

o Rates

$L_{average}$ = 1.0 x 10^31 $cm^{-2}s^{-1}$ = 0.42MH
L_{peak} = 1.6 x 10^31 $cm^{-2}s^{-1}$ = 0.67MH

o RHIC up-time >40%

W. Vogelsang and M. Stratmann



PHENIX Readiness

Central Arm Tracking
- Drift Chamber
- Pad Chambers
- Time Expansion Chamber

Muon Arm Tracking
- Muon Tracker (new north spectrometer)

Calorimetry
- PbGl and PbSc
- Forward Calorimeters

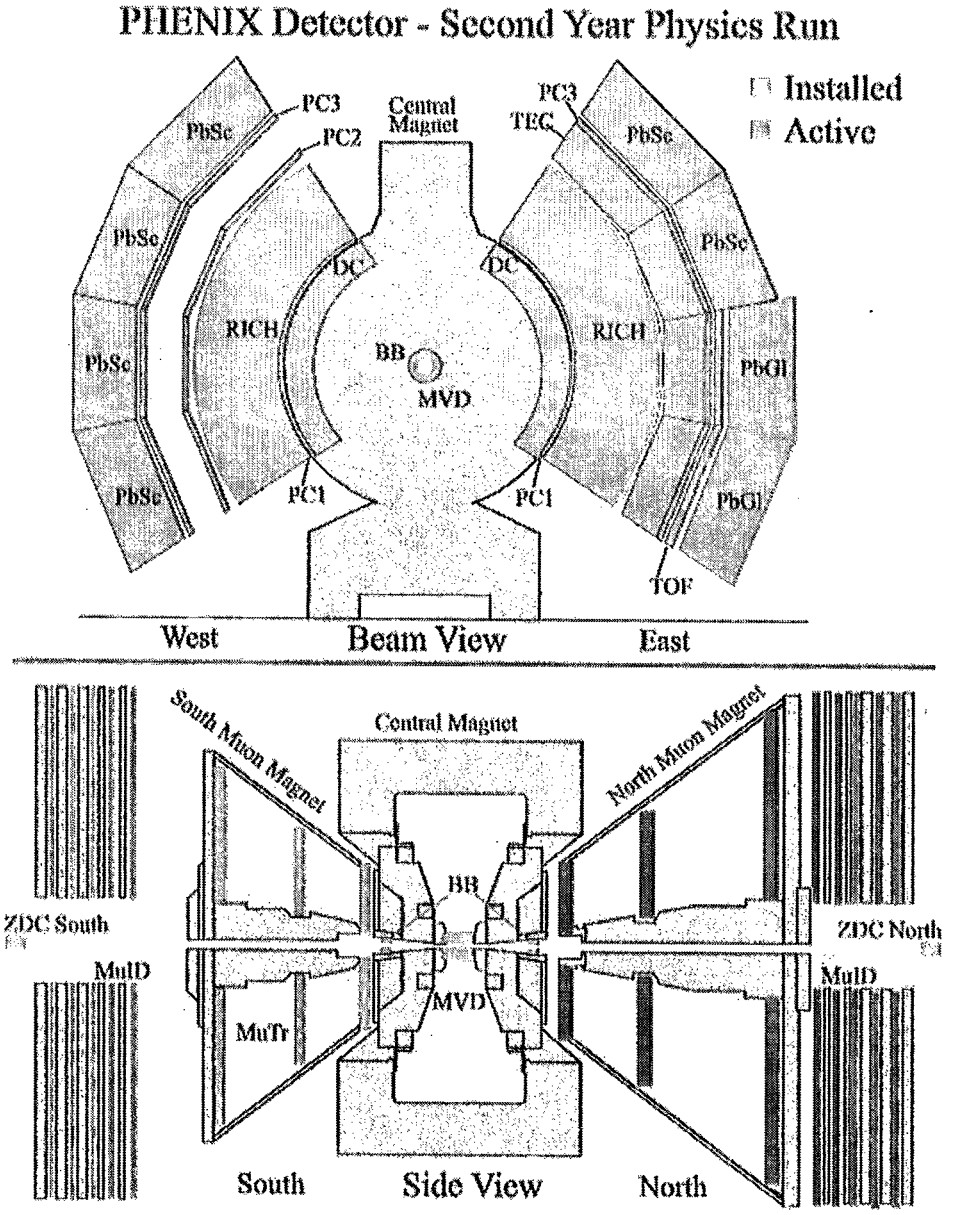
Particle Id
- Muon Identifier
- RICH
- TOF
- TEC

Luminosity Counters/Vertex Detectors
- BBC
- ZDC/SMD
- NTC
- MVD

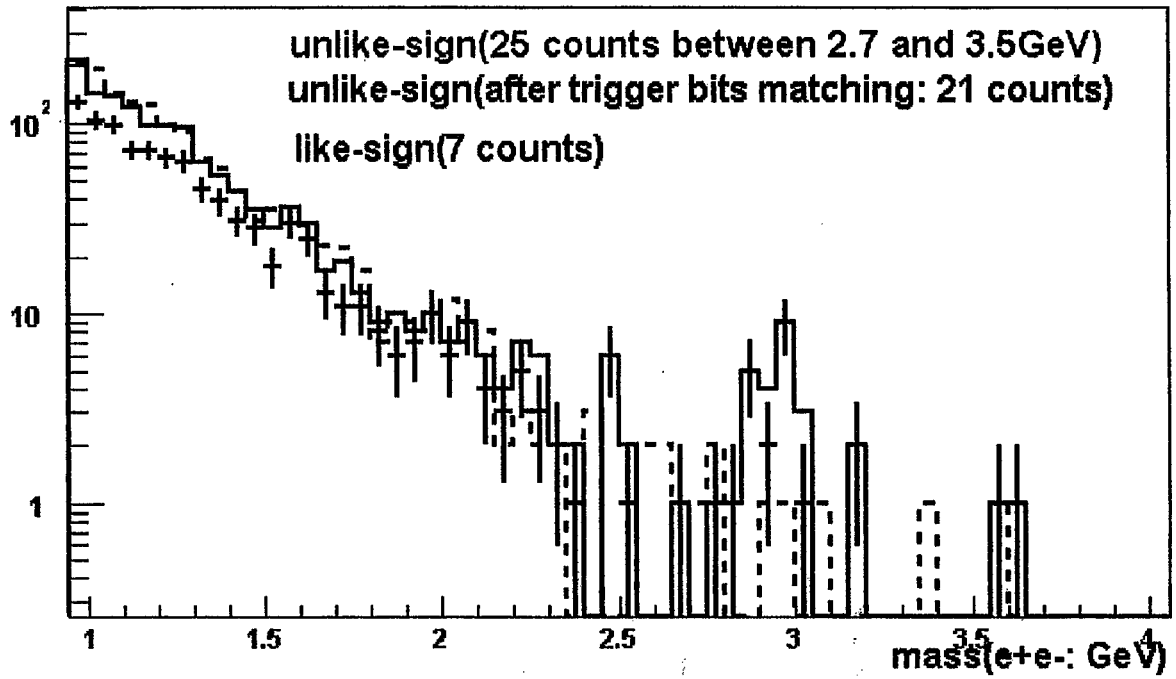
DAQ
- Bandwidth upgrade

Trigger
- Level 2
- Level 1 (trigger processors)
- Relative luminosity measurement

Local Polarimeter



Di-lepton invariant mass spectrum from a electron trigger evaluator running in the new online production frame work



Trigger and DAQ

Present level 1 trigger mix (85-90% life time):

4 photon (different EMC thresholds)
1 electron trigger (EMC cluster-RICH ring coincidence)
1 di-electron trigger (2 RICH rings)
2 single muon
2 di-muon
4 minimum bias (BBC, ZDC, NTC, clock)
2 pulser

=> improve EMC threshold behavior
=> fix beam related background problems
=> back this up with level 2 triggers

Increase Bandwidth from 1.1 to 3.0 kHz

o improve zero suppression
o multi event buffering
o Gigabit ethernet switch in eventbuilder

Spin specific issues

local polarimetry: ZDC/SMD work fine -> see Abhay's talk for details

relative luminosity

spin specific monitoring

pp evaluators in OnCal

export new production frame work to CCJ

muon trigger upgrade test stand

Summary

- o PHENIX is presently running in it's design configuration - MVD
- o Trigger and DAQ are optimized for dAu occupancies and raw rates up to 50kHz
- o Need to configure for 10 times higher collision rates
- o Spin specific work ongoing

PHENIX Status Report

- Expected schedule and goals for the pp-run
- PHENIX subsystem readiness
  - o spin related issues
  - o luminosity related issues

Schedule and Goals

- o 5 weeks of spin commissioning:
  - o PHENIX requires 3 days of access including the first maintenance Wednesday (shielding, MVD, muon trigger upgrade test setup)
  - o need detector commissioning beam over night at high luminosity for the last 10 days to tune up trigger and DAQ.
  - o contribute to spin rotator commissioning through feedback from a ZDC/SMD based local polarimeter.
- o 3 weeks of physics with longitudinal polarization
  - o longitudinal double spin asymmetries in inclusive hadron production
  - o comparison running for HI

Expected Running Conditions

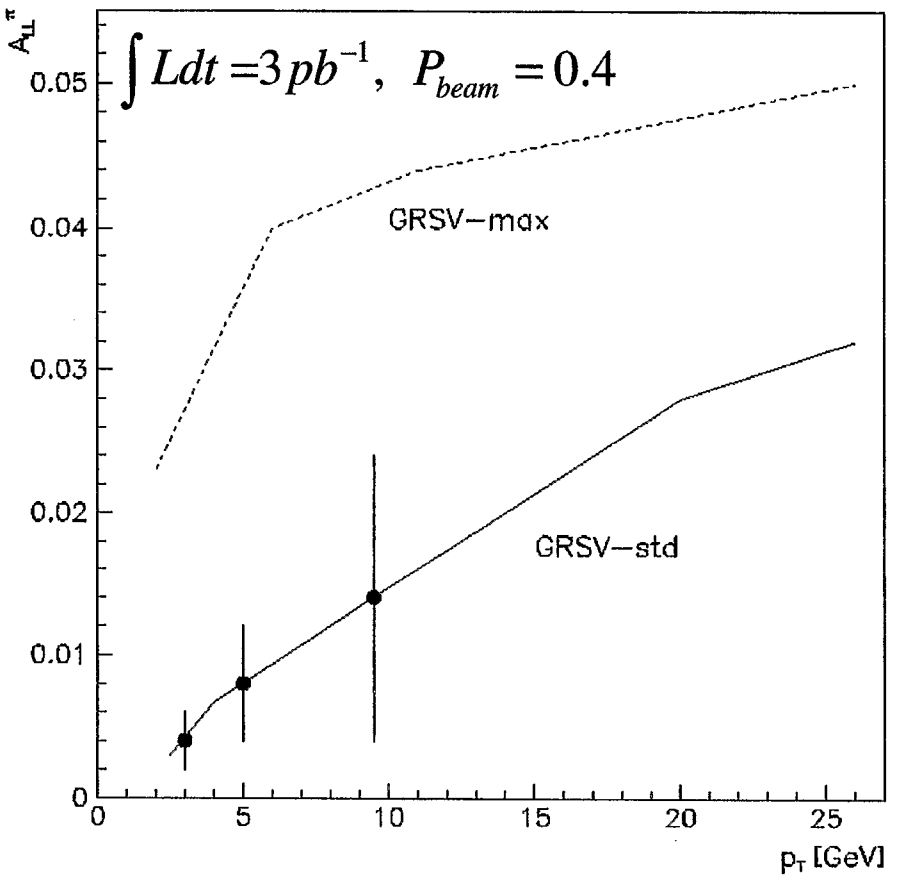
- Beam Polarization > 40%

- Rates

$L_{average}$ = 1.0 x 10^31 $cm^{-2}s^{-1}$ = 0.42MH
L_{peak} = 1.6 x 10^31 $cm^{-2}s^{-1}$ = 0.67MH

- RHIC up-time >40%

W. Vogelsang and M. Stratmann



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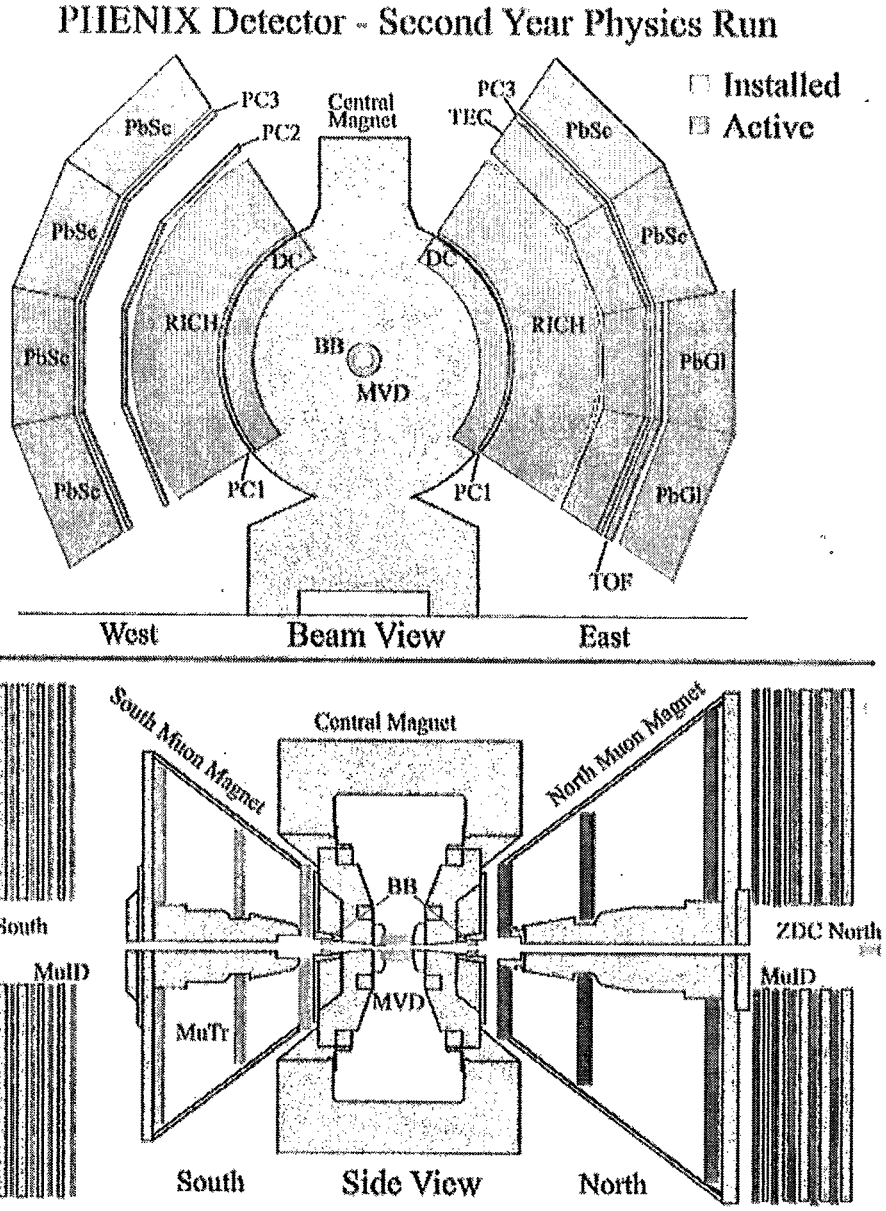

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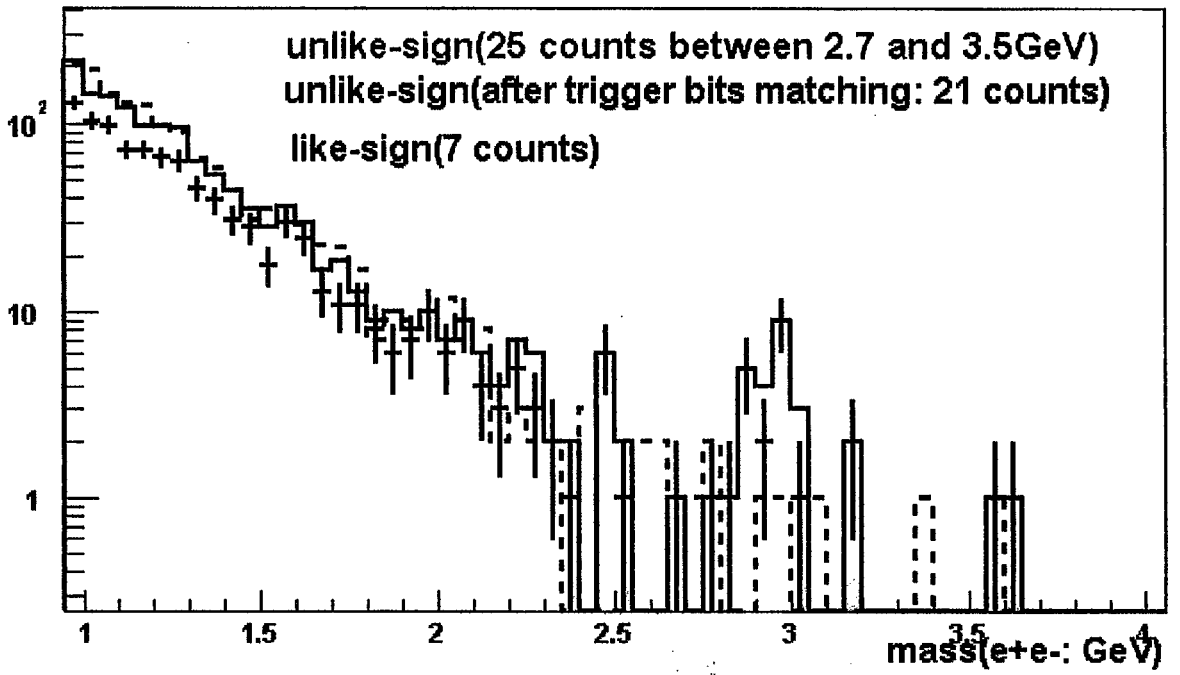

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STAR
STATUS REPORT

B. Surrow, BNL
February 21, 2003

for
RHIC Spin Collaboration Meeting XV
RIKEN BNL Research Center

STAR spin

Status report on the readiness of the STAR experiment for the polarized pp run

Bernd Surrow
BNL

For the
STAR Spin group

Outline

STAR spin

- STAR SPIN goals (STAR SPIN BUR)
- Overview of STAR shutdown work
- Status of STAR subcomponents
- Summary and outlook

STAR SPIN goals (STAR SPIN BUR)

STAR spin

- Physics objectives: Transverse polarization

  - Transverse polarization running: $\int Ldt = 1\ pb^{-1}$ and $P > 35\%$ at $\sqrt{s} = 200$ GeV

    ⇨ First measurement of A_N for forward π^0 production at large Feynman x and moderate p_T in RUN II using the STAR FPD prototype system (G. Rakness at SPIN 2002) revealed large asymmetries which persist from E704 energies ($\sqrt{s}$ = 20GeV) to RHIC energies ($\sqrt{s}$ = 200GeV)

    ⇨ Strong theoretical interest in those measurements

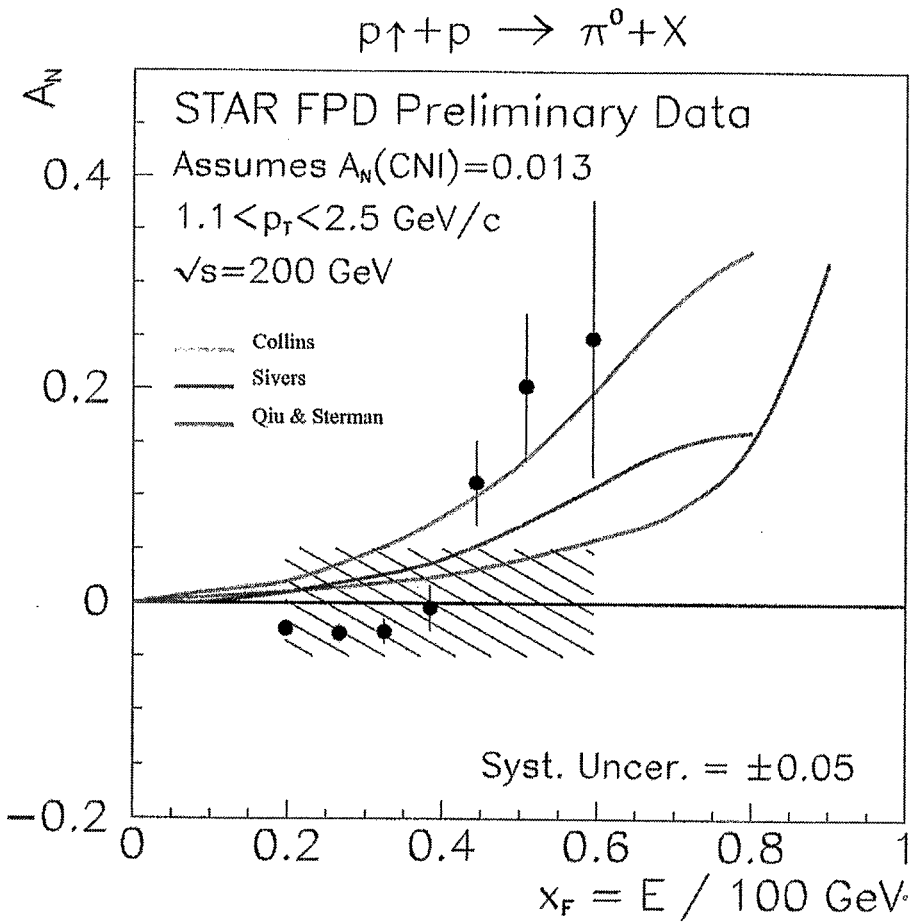
    ⇨ Complementary experimental efforts at other spin programs (e.g. HERMES: Measurement of azimuthal single spin asymmetries in semi-inclusive DIS)

    ⇨ Goal for RUN III:

    - Complete measurement of A_N at forward rapidity over larger kinematic range ($3 < \eta < 4$ and $1 < p_T < 4$ GeV) with higher precision using a completely
    - new FPD detection system (A. Ogawa at SPIN 2002) which will be used to
    - commission the STAR spin rotator magnets by minimizing left/right and up/down spin-dependent asymmetries

STAR SPIN goals (STAR SPIN BUR)

- First measurement of A_N for forward π^0 production at RHIC in RUNII



- Several approaches beyond the basic "naive QCD calculations" yield non-zero A_N values at RHIC energies
- A_N is found to increase with energy similar to E704 result
- This behavior is also seen by several models which predict non-zero A_N values

STAR SPIN goals (STAR SPIN BUR)

STAR spin

- Physics objectives: Longitudinal polarization

  - Longitudinal polarization running: $\int Ldt = 3\ pb^{-1}$ and $P > 35\%$ at $\sqrt{s} = 200$ GeV

    ⇨ Goal for RUN III:

    - First measurement of the double longitudinal spin asymmetry A_{LL} in inclusive jet production at mid-rapidity
    - Precise measurement (at the level of ± 0.001) of the relative luminosity is crucial (J. Kirlyuk at SPIN 2002 conference)
    - Jet-trigger on the STAR Barrel Electromagnetic Calorimeter BEMC is favorable
    - Yields for anticipated running conditions:

      ⇨ Trigger requirement: $\Sigma E_T > 6$ GeV over BEMC/EEMC jet patches

      ⇨ Rate: 40 Hz

      ⇨ Yield for 10 days at 33% efficiency (~$3pb^{-1}$):

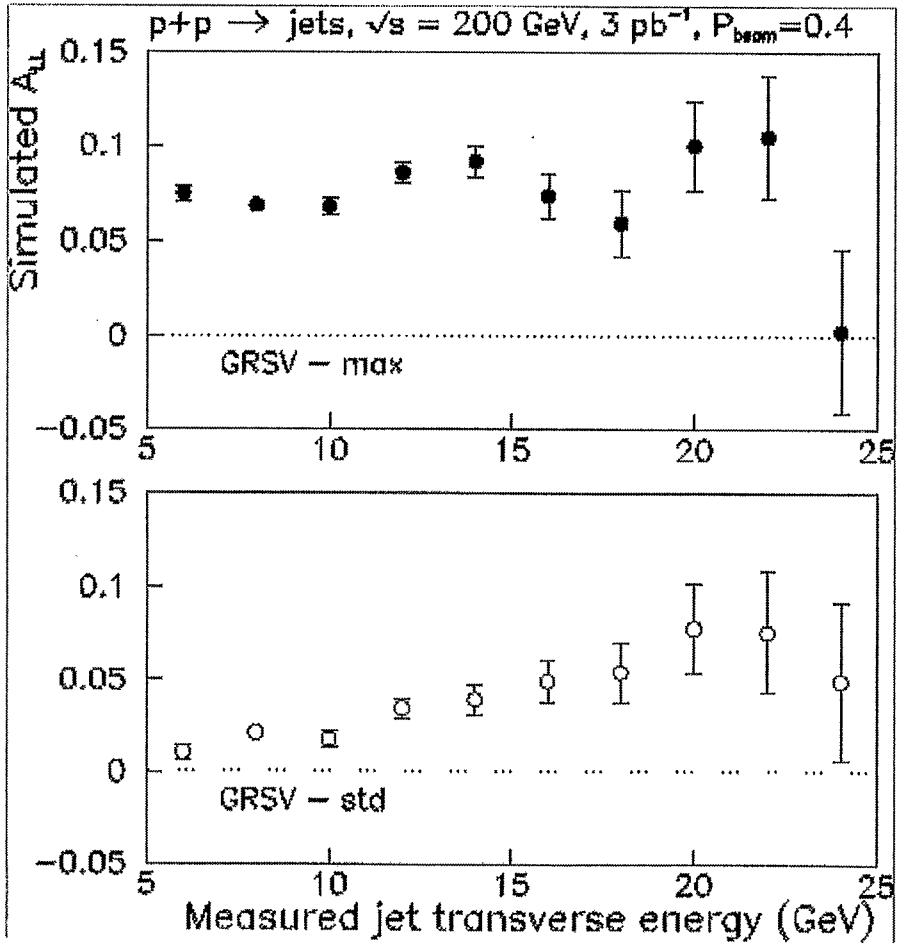
      ⇨ ~ 1×10^6 jets for p_T = 5 - 10 GeV

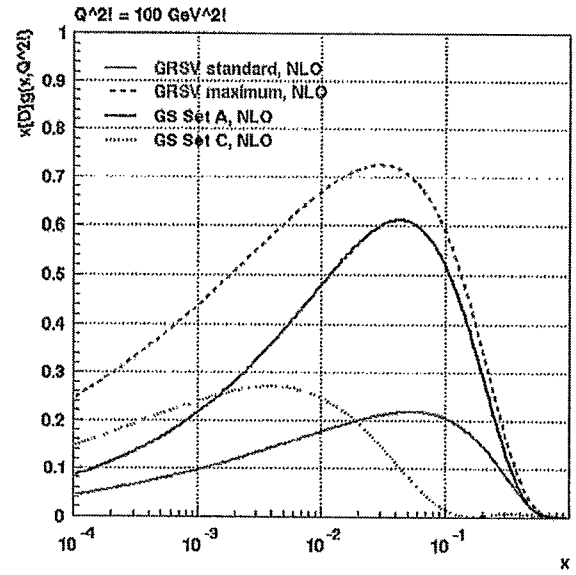
      ⇨ ~ 9×10^4 jets for p_T = 15 - 20 GeV

      ⇨ ~ 1×10^3 jets for p_T = 30 - 35 GeV

STAR SPIN goals (STAR SPIN BUR)

- Prospects on constraining ΔG from inclusive jet production in RUN III





- Simulation based on Pythia including trigger and and jet reconstruction efficiencies
- Assume: Coverage of EMC (barrel)
  ⇨ $0 < \Phi < 2\pi$ and $0 < \eta < 1$
- Jet Trigger: $E_T > 5$ GeV over at least one "patch" $(\Delta\eta = 1) \times (\Delta\Phi = 1)$
- Jet reconstruction: Cone algorithm (seed = 1GeV, R = 0.7)

(B.S. at SPIN 2002)

STAR SPIN goals (STAR SPIN BUR)

STAR spin

- Requests on machine operation

  - Total amount of time requested: 8 weeks (incl. setup, commissioning and data collection)

    ⇨ AGS polarization at injection energy into RHIC: at least 40%

    ⇨ 2 weeks: setup of RHIC complex for polarized proton collisions

    ⇨ 3 weeks: RHIC spin commissioning tasks (essential to STAR SPIN program):

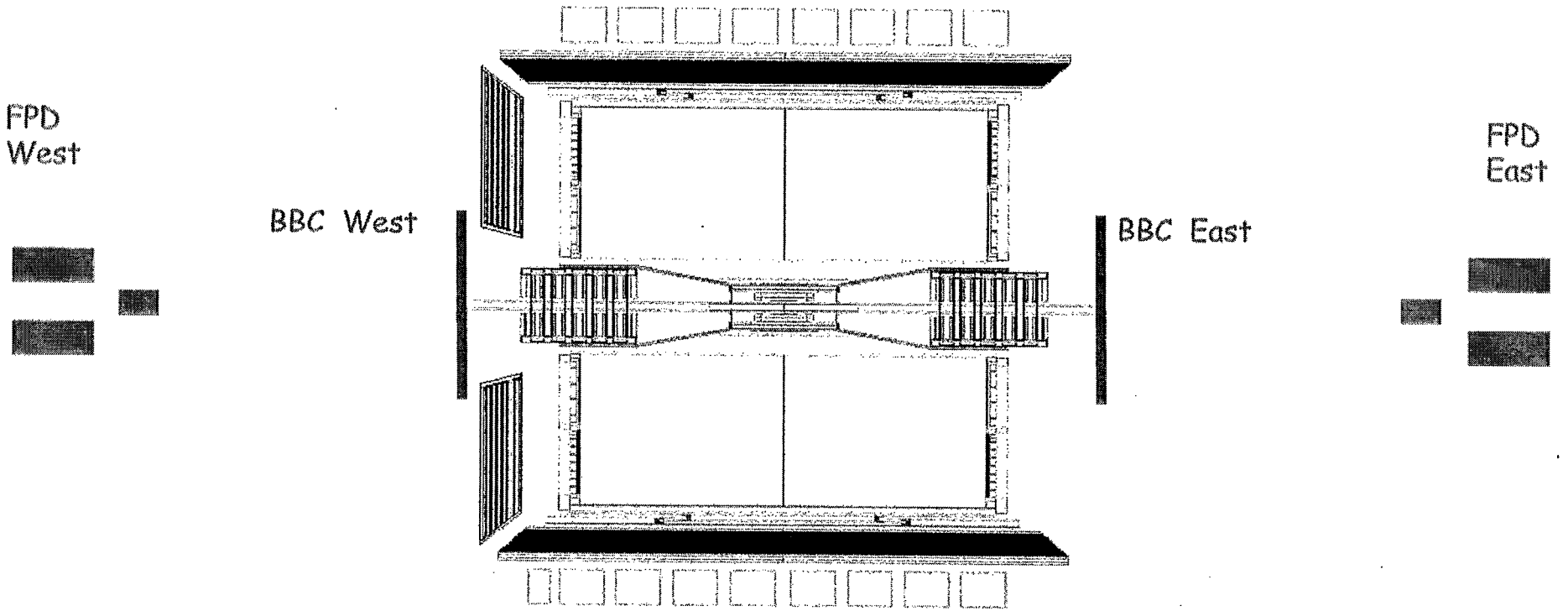
    - Commissioning of the STAR spin rotator magnets
    - Commissioning of RHIC AC dipole magnets
    - Down-ramping development
    - Luminosity optimization to achieve $1 \cdot 10^{31}$ $cm^{-2}s^{-1}$

    ⇨ 1 week: transverse polarization running

    ⇨ 2 weeks: longitudinal polarization running

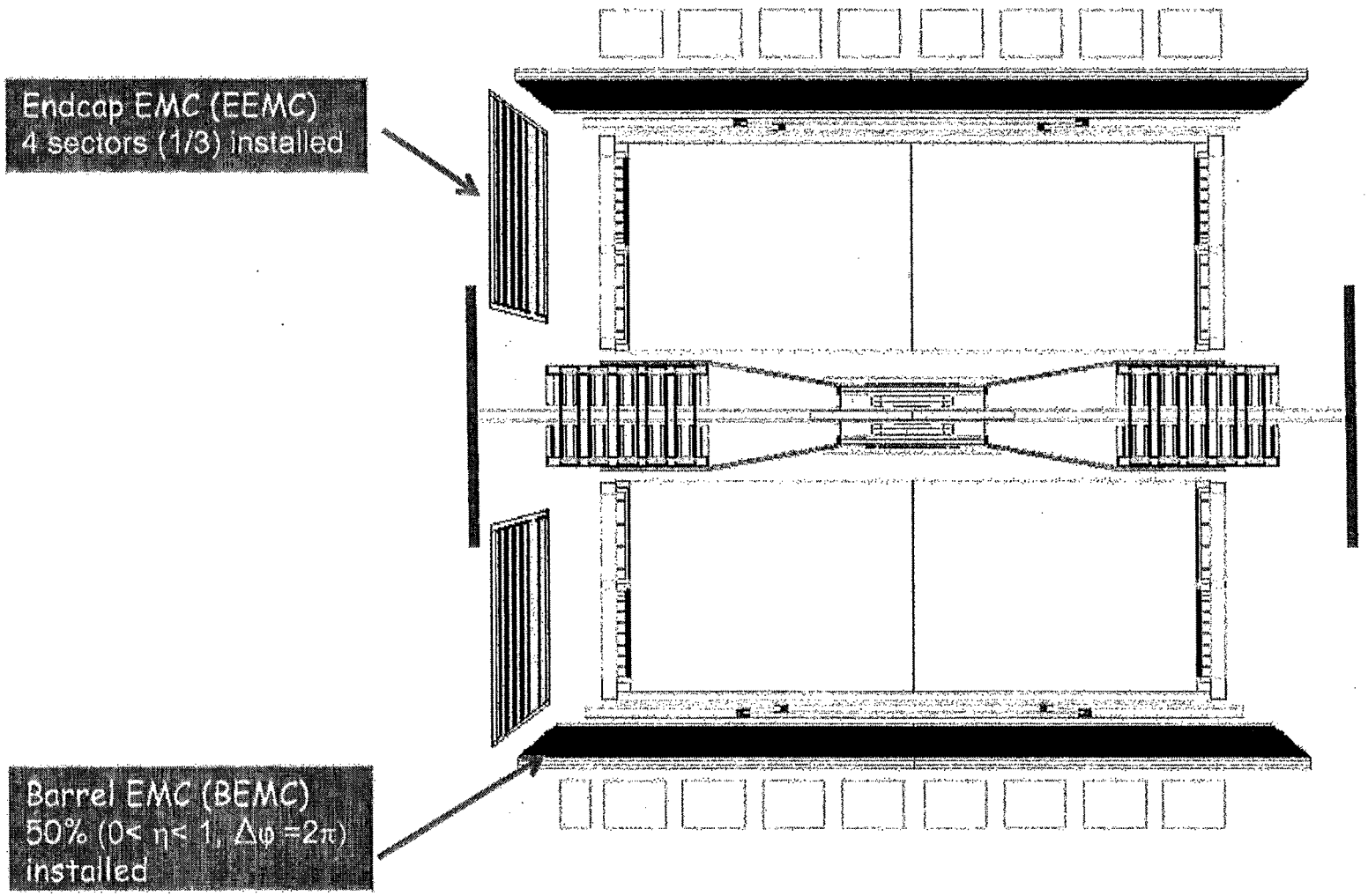
Overview of STAR shutdown work

- STAR BBC and FPD



Overview of STAR shutdown work

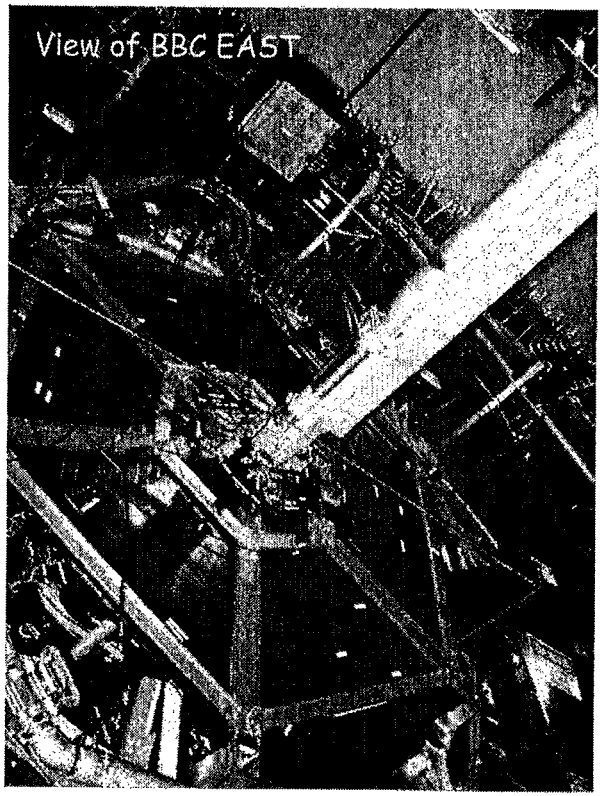
- STAR BEMC and EEMC

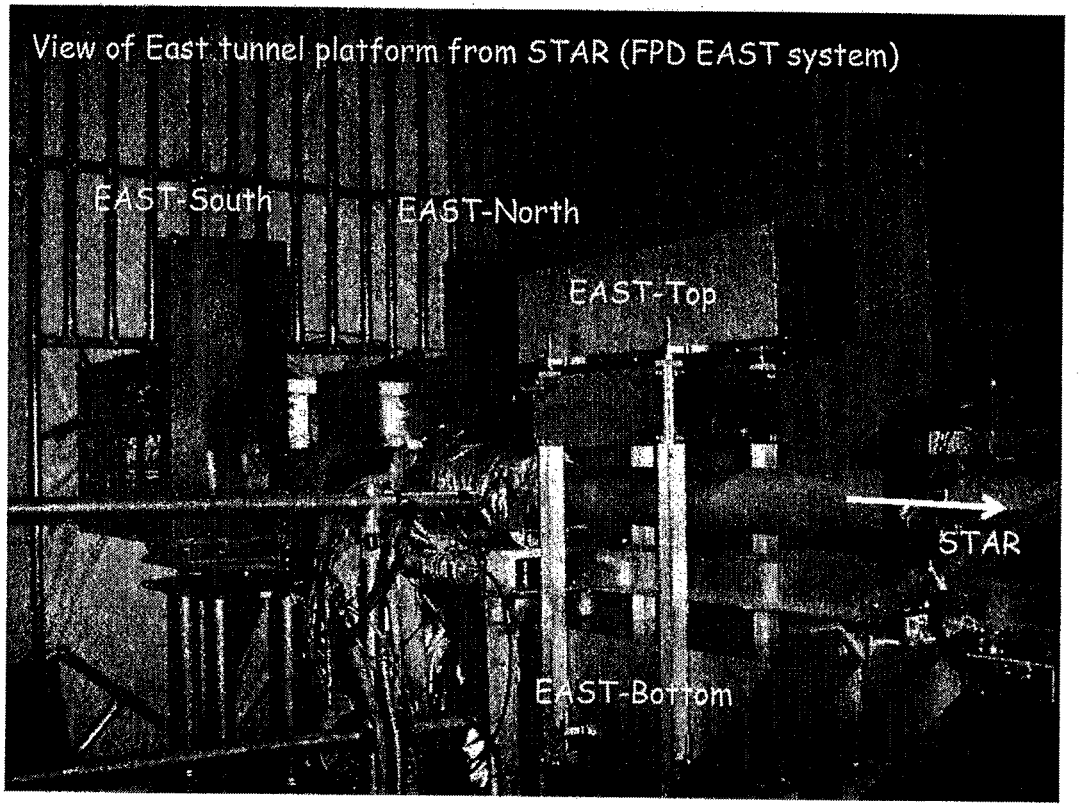


Status of STAR subcomponents: BBC / FPD

STAR spin

- Upgrade of the STAR BBC, FPD and scaler system

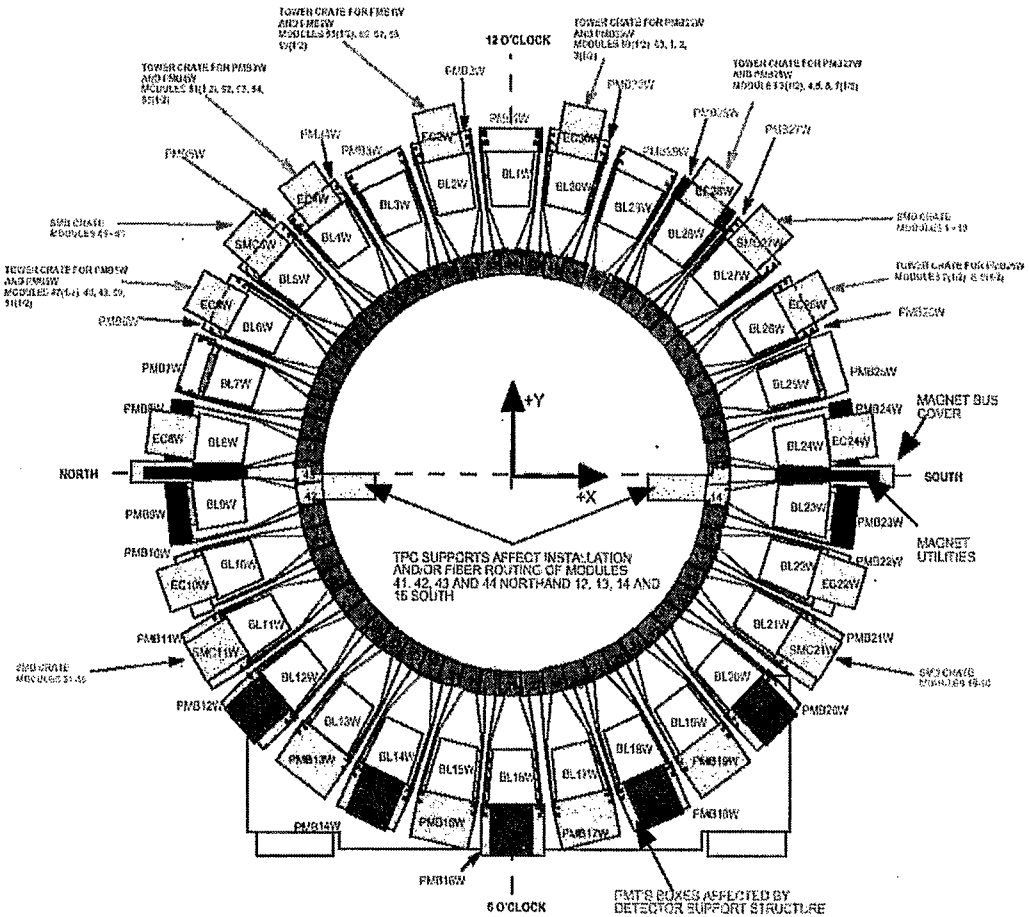




⇨ More details on the STAR BBC, FPD and scaler system will be given by: A. Ogawa

Status of STAR subcomponents: BEMC

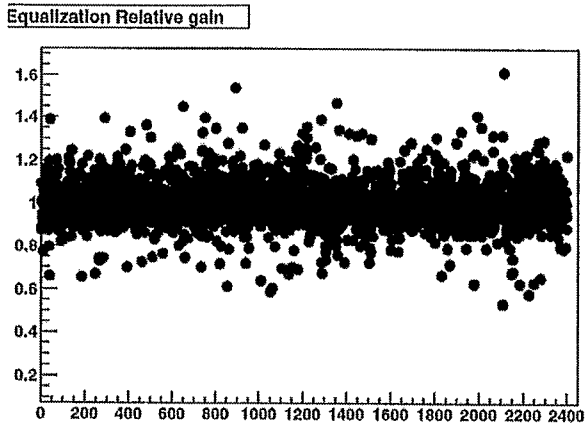
- BEMC module installation
  - BEMC: 50% installed ($0<\eta<1$, $\Delta\varphi=2\pi$)
  - This amounts to 60 BEMC modules:
    - ⇨ $(\Delta\eta, \Delta\varphi)_{module} \sim (1.0, 0.1)$
    - ⇨ 40 towers/module
    - ⇨ $21X_0$
    - ⇨ $(\Delta\eta, \Delta\varphi)_{tower} \sim (0.05, 0.05)$
    - ⇨ All PMT Boxes installed
    - ⇨ All Electronics installed
  - 60 SMD Modules Installed
    - ⇨ Positioned at $5X_0$
    - ⇨ $(\Delta\eta, \Delta\varphi) \sim (0.007, 0.007)$
    - ⇨ All Electronics installed
  - Level Zero Trigger Installed
    - ⇨ High Tower
    - ⇨ Jet Patch

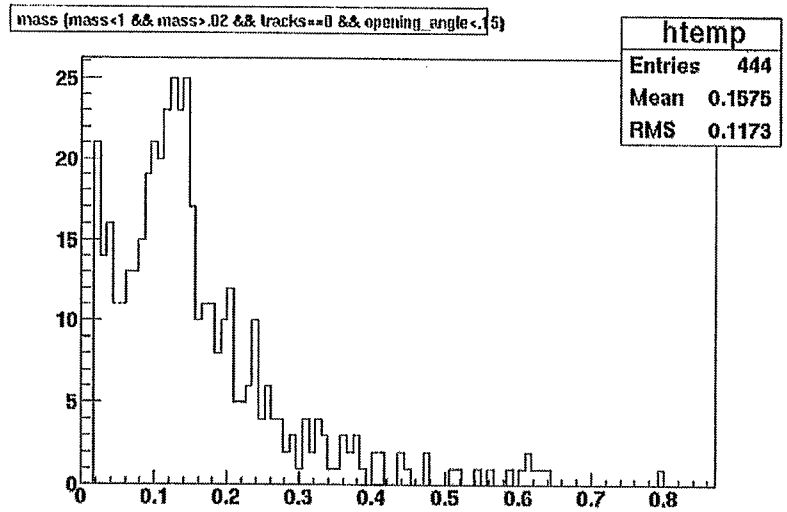


EMC FACE OF THE STAR BARREL AS SEEN FROM +Z (WEST FACE) SHOWING THE CONFIGURATION OF MODULES, PMT'S BOXES AND ELECTRONICS CRATES.

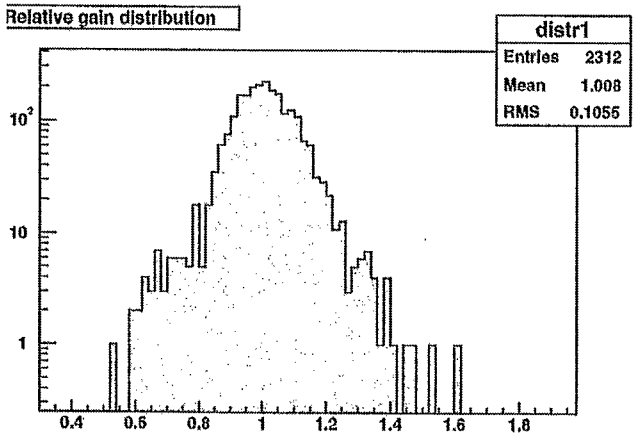
Status of STAR subcomponents: BEMC

- Calibration (started during d-Au running)

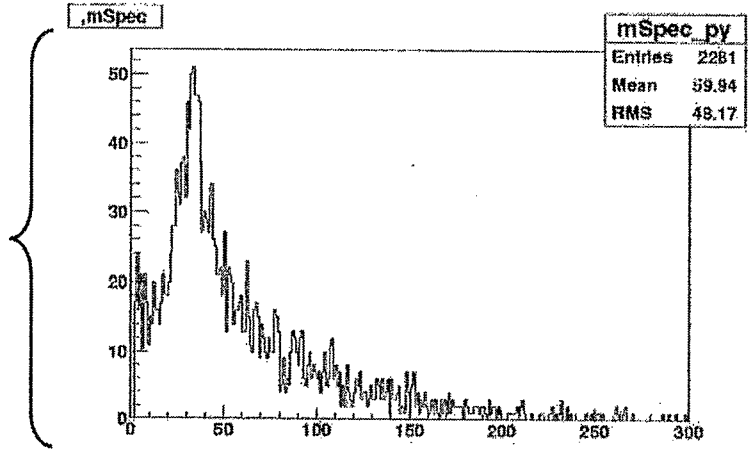




⇨ Reconstructed π^0 mass-peak!

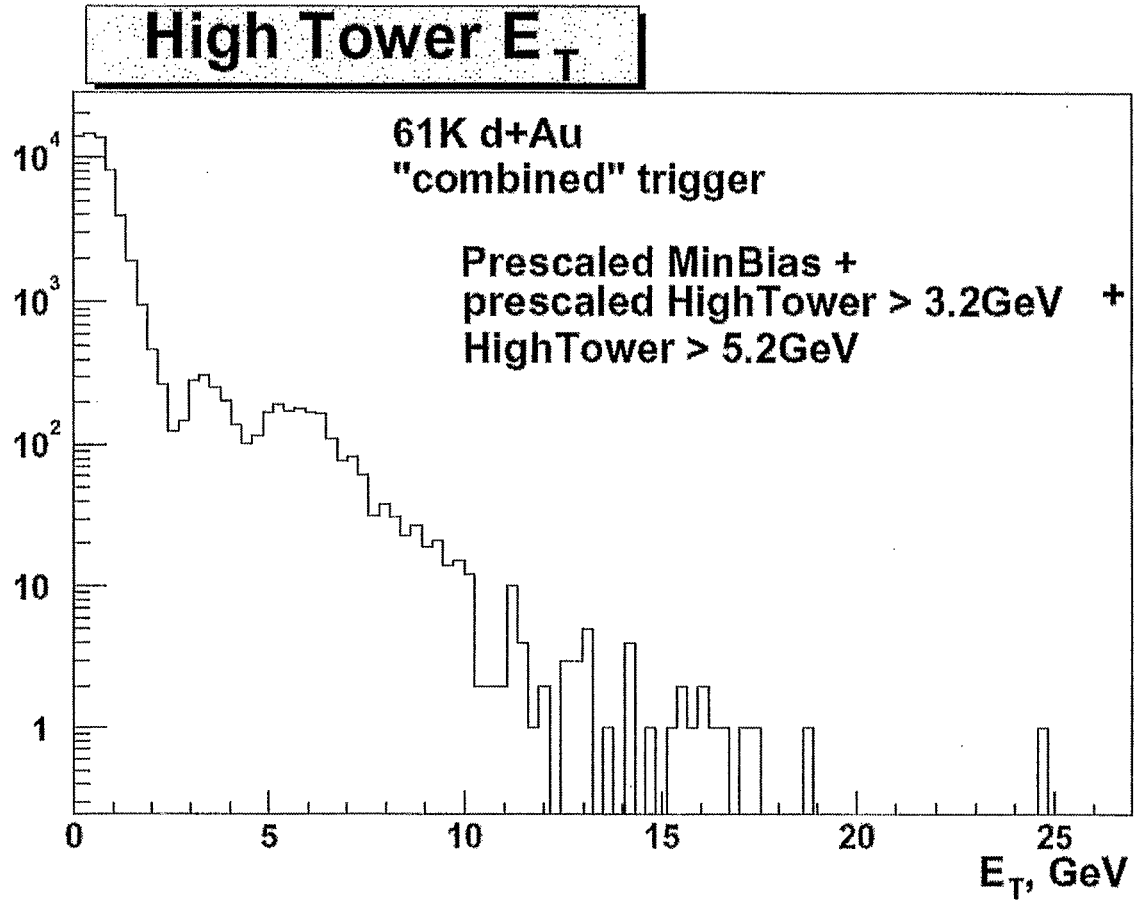


⇨ Relative calibration set by MIP response!



Status of STAR subcomponents: BEMC

- Commissioning of High-Tower (HT) Trigger (started during d-Au running)



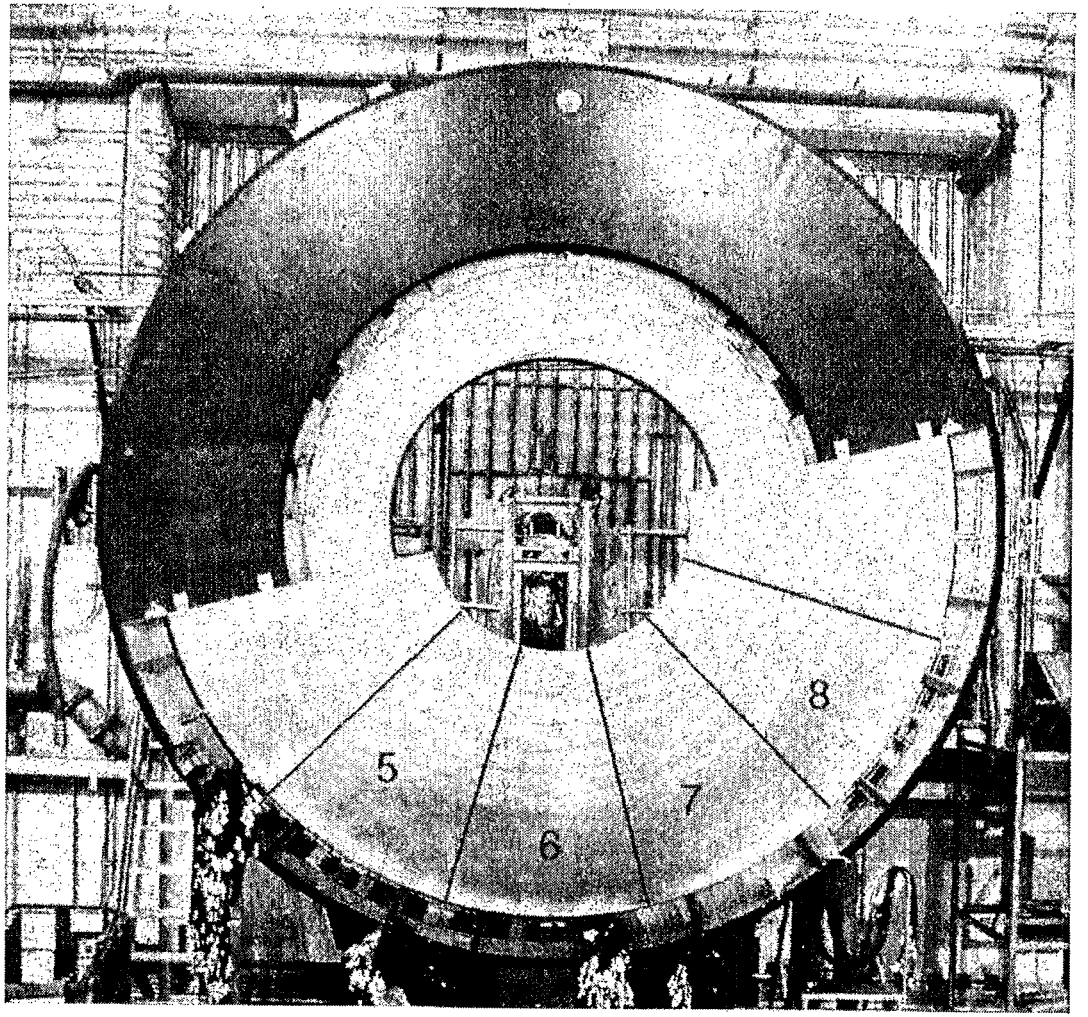
⇨ Commissioning of High-Tower (HT) Trigger has started during d-Au running

⇨ Commissioning of Jet-Trigger still to be done!

Status of STAR subcomponents: EEMC

STAR spin

- EEMC sector installation: started during last shutdown



⇨ All detectors in sectors 5-8 (except pre-shower layers in sect. 8)

⇨ All tower readout electronics installed

⇨ Plan to install one sector SMD and pre/post-shower readout

Status of STAR subcomponents: EEMC

STAR spin

- Installed EEMC sectors: Status and commissioning plans
  - Status:
    - ⇨ Rudimentary slow control is functioning
    - ⇨ From source, LED and laser tests: 95% of installed towers are working
    - ⇨ Commissioning of DAQ (e.g. adjust timing to STAR triggers) and trigger is on-going
  - Commissioning plans:
    - ⇨ End of d-Au running: establish connection to STAR DAQ and acquire test runs with EEMC contributing to STAR triggers (high-towers triggers)
    - ⇨ Identification of π^0 in EEMC
    - ⇨ Preliminary extension of jet trigger patch coverage from 6 (BEMC) to 8 (including EEMC sectors)

Summary and Outlook

STAR spin

- Transverse polarization: 1 week
  - Goal: Measure A_N with the newly installed FPD system
  - Tune STAR spin rotator magnets
- Longitudinal polarization: 2 weeks
  - Goal: Measure A_{LL} for inclusive jet production (50% of BEMC modules are now installed!)
- Commissioning tasks:
  - High-Tower trigger commissioning has started
  - Jet-Patch Trigger commissioning still to be done

Brahms Status for RUN-3 pp. 3/21/2003 RSC meeting

F.Videbœk

BNL

Brahms pp goals

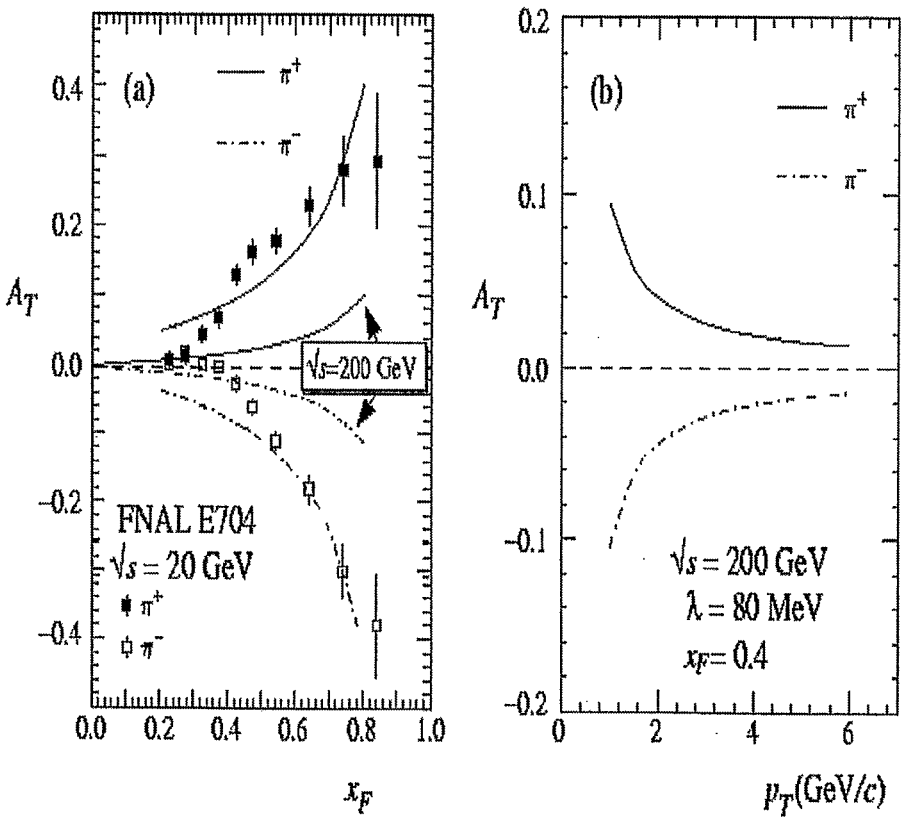
1. Reference data for HI collisions
2. Reference data for dA and gluon saturation description for high pt (.5-4 GeV/c) at large rapidities (3-3.5).
3. Transverse spin asymmetry at moderately high X_f for charged π.

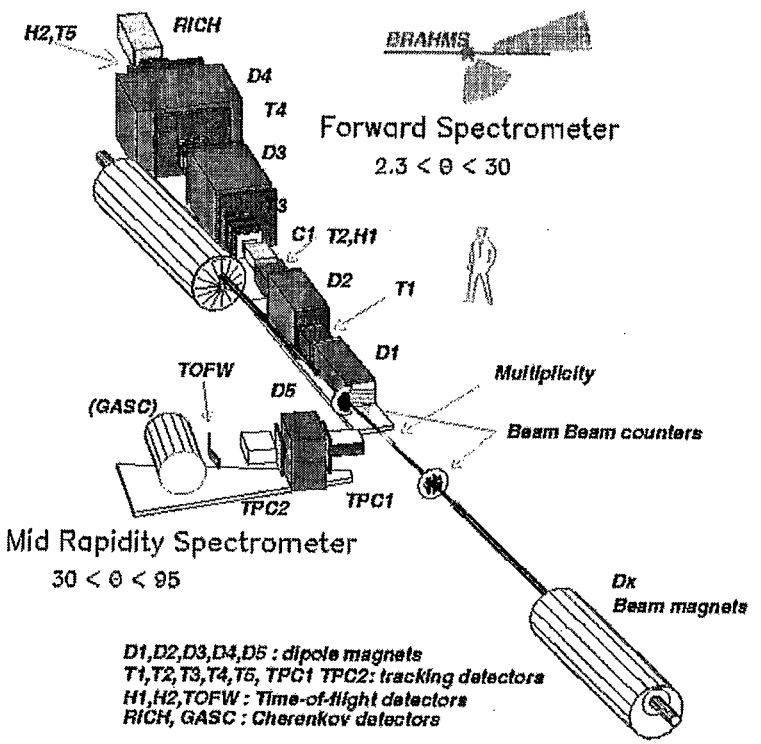
From Saito's talk at "future transversity measurements 9/18-20,2000

Single Transverse Spin Asymmetry

- Several Models

BRAHMS fits best!





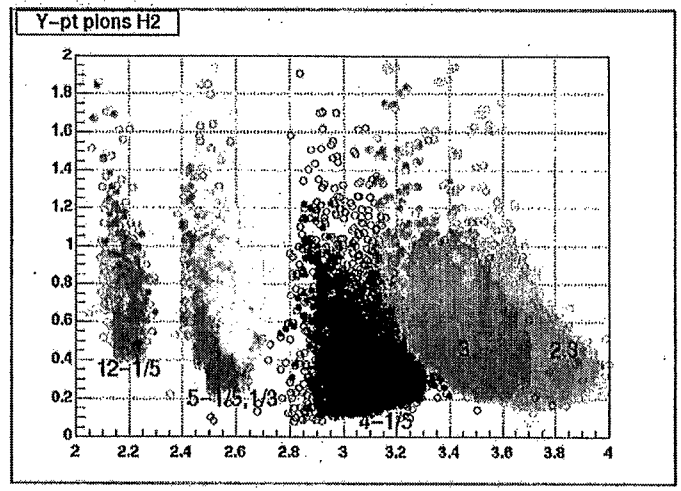
Requirements for spin program

- A pi- measurements will complement the STAR π^0 measurement. Thus π^0 and π^- asymmetries can be mapped for range of xF, pt. not a single shot measurement.
- Due to small acceptance requires high luminosity and good polarization.
- First measurements will be made for moderate Xf (0.2-0.3) [rates] to understand setup and systematic.

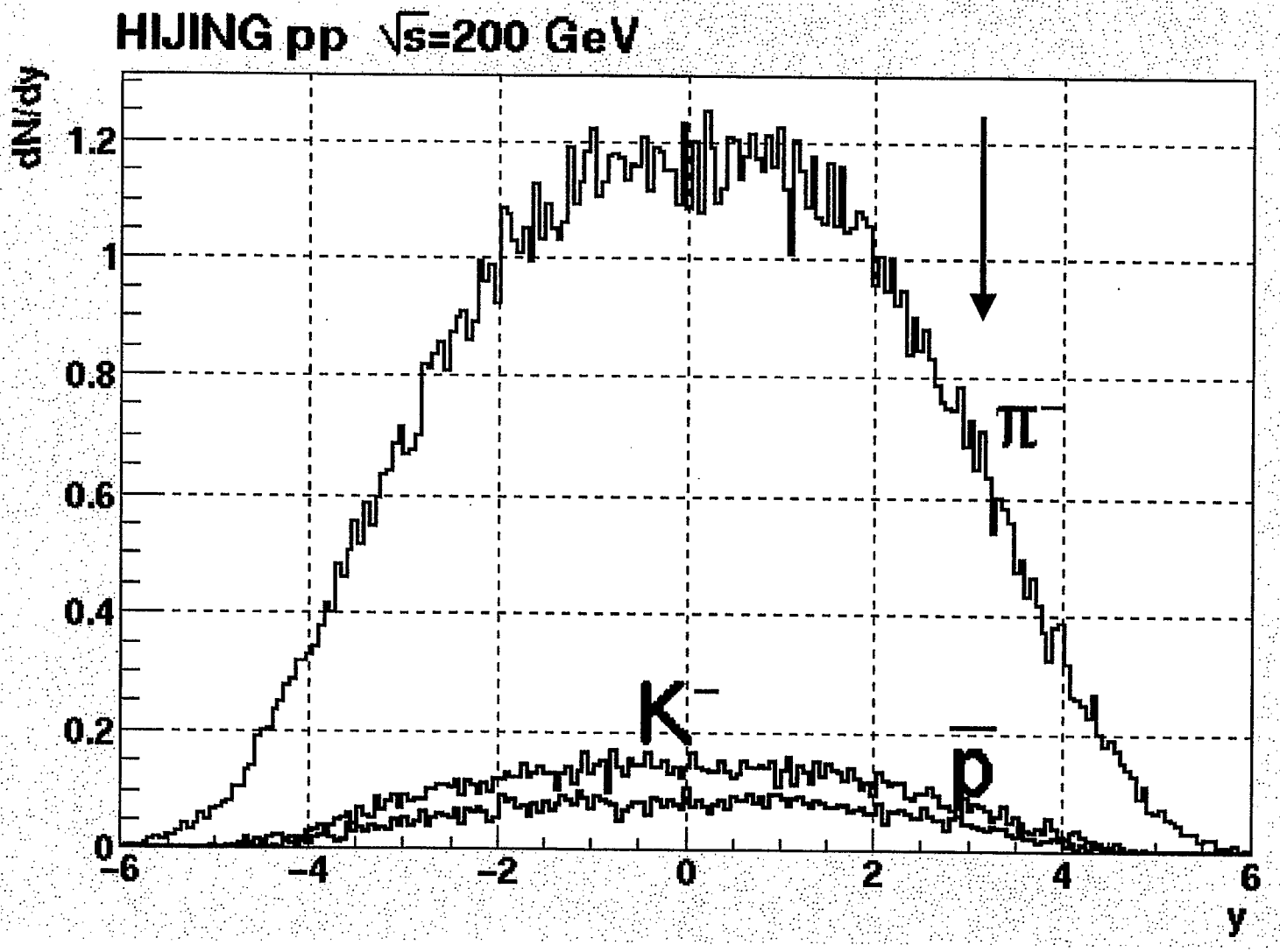
Status.

- Run-2
  - The short run did not allow for a complete measurement of reference data. Not complete coverage in angle and momentum.
  - No time was really left for checking the polarization setup/program.

Experimental issues for spin part.



- Solid angle
  - BFS ~ .6 msr; P-theta acceptance.
  - At Xf~.25 pt~1 (3 deg setting).
- DAQ is event driven
  - Effective data-rate is achieved with trigger setup using 3 hodoscopes (Td1,H1,H2) in FS.
  - Trigger system implemented last year, and re-designed for Run-3. System is operational for dA; has high efficiency and ~.3-.6 tracks/trigger (depending on background & angles.)
  - The Min Bias required for all triggers is generated from the pp2pp INEL stations (2*4). Being used presently for dA.
- PID
  - Present PID separates π/K up to ~20 GeV/c
  - To go higher has to change pressure in RICH; For this year will likely interfere with other pp part of pp program.
  - Contamination from p-bar and k-though not too large.


HIJING pp √s=200 GeV
dN/dy
1.2
1
0.8
0.6
0.4
0.2
0
−6
−4
−2
0
2
4
6
y
π⁻
K⁻
p̄

Experimental issues

- Background
  - Data taking only useful with collimators in , and no pol measurements in progress.
  - Expect otherwise triggers and DAQ to be in good shape.
- Polarization measurements.
  - Brahms have received two spin scalers (STAR design).
  - Have yet to be implemented with DAQ/Run-control. Likely to be done during setup phase of pp run.

Word on running priorities.

- As mentioned Brahms has 3 goals for this runs.
  - Completion of the low-pt survey using FS involves angle field settings not relevant for measurement of transverse asymmetries (except for seeing none). Estimated to take ~1-2 weeks (50% uptime, …)
  - The higher pt (y~2 and y~3) pt spectra..
  - The high rapidity (3&4deg) are settings where data will be useful for both the spin program and the high pt spectra for comparing with dA and AuAu (CGC/gulon saturation picture).
- Run-3 will be a first attempt for the A_{nn} measurements, and should be followed up in subsequent runs.

pp2pp
STATUS REPORT

W. Guryn, BNL
February 21, 2003

for
RHIC Spin Collaboration Meeting XV
RIKEN BNL Research Center

RUN-03 pp2pp Readiness

Włodek Guryn

Goals of the RUN-03:

Measure A_N in the $0.003 < -t < 0.02$ $(GeV/c)^2$ with 0.2% error;

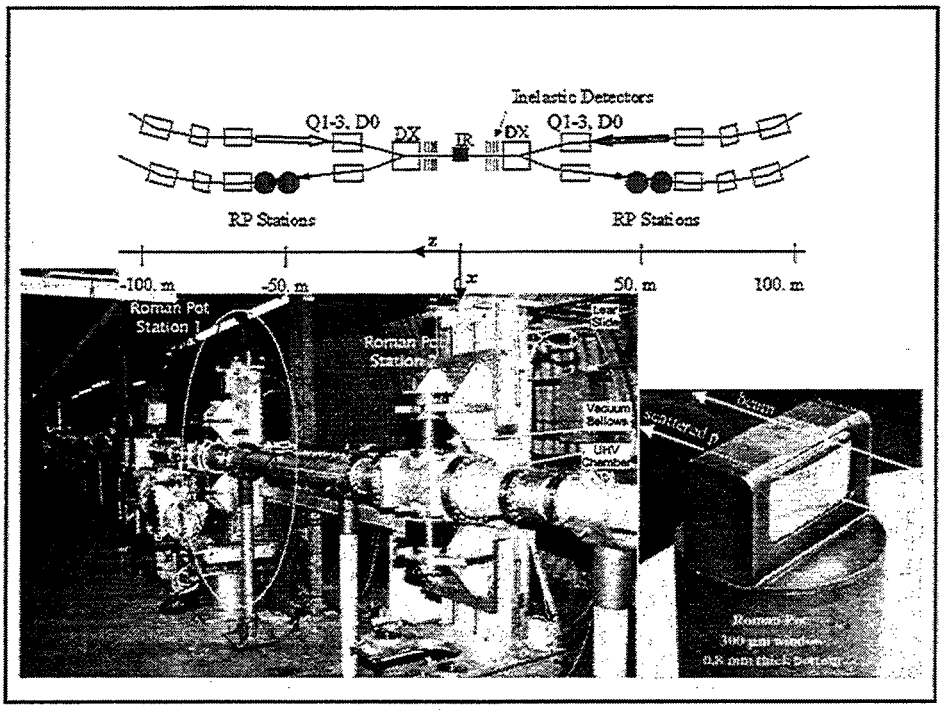
Improve nuclear slope B measurement from current 10% error down to 3%;

Measure σ_{Tot} with 5-10% error, which requires luminosity measurement with 5% error.

The Setup

Improvements of the to the last year's setup:

- The setup is twice "bigger" than last year – it includes two Roman pot stations fully instrumented on each side, allowing measurement of the angle and position of the scattered proton;
- New running conditions have been requested, implementation is in progress, to allow moving the pots down to 6mm from the beam, thus increasing the acceptance for the A_N measurement;
- New Si strip detectors, made by Hamamatsu, will be used – they have been delivered;
- New sequencers for Si readout are being tested at ITEP;
- New DAQ is under construction to improve data rate up to 400 Hz.



Some Transport Issues

Improvement: Measure angle and position at RP to solve for x_0, y_0 and scatt. angles

Design transport: (x_0, y_0) are known, a_{11} or a_{33} small $\Rightarrow$ parallel to point focusing

$$\begin{pmatrix} x_D \\ \Theta_D^x \\ y_D \\ \Theta_D^y \end{pmatrix} = \begin{pmatrix} a_{11} & L_{eff}^x & 0 & 0 \\ a_{12} & a_{22} & 0 & 0 \\ 0 & 0 & a_{33} & L_{eff}^y \\ 0 & 0 & a_{43} & a_{44} \end{pmatrix} \begin{pmatrix} x_0 \\ \Theta_x^* \\ y_0 \\ \Theta_y^* \end{pmatrix}$$

Actual transport is not known and is also coupled (x,y) because of the quad roll

$$\begin{pmatrix} x_D \\ \Theta_D^x \\ y_D \\ \Theta_D^y \end{pmatrix} = \begin{pmatrix} a_{11} & L_{eff}^x & a_{12} & a_{14} \\ a_{12} & a_{22} & a_{23} & a_{24} \\ a_{13} & a_{23} & a_{33} & L_{eff}^y \\ a_{14} & a_{24} & a_{34} & a_{44} \end{pmatrix} \begin{pmatrix} x_0 \\ \Theta_x^* \\ y_0 \\ \Theta_y^* \end{pmatrix}$$

Readiness

Status:

1. Si Detectors, pp2pp setup under control;
2. Need formal approval from ASSC in CAD to take data with higher intensity and at closer distance. Implementation of safety measures is under way;
3. Scheme for 5% error in luminosity measurement needs work and planning;
4. Scheme for accurate tune measurement to reduce systematic error due to the transport uncertainty needs work and planning (CAD).
5. No problem with tune setup since injection and ramp with $\beta^* = 10$ m

Event Rates

1. With 110 bunches at 10^{11}/bunch, after scraping by factor of four the RUN-03 beam intensity would be 3×10^{12}, compared to 5×10^{11} in RUN-02;
2. Roman pot operation at the distance down to 6-8mm from the beam;
3. This would result in the first strip to be at ~ 8-10 mm

- **Running at the above intensity, about 6 times last year's, gives trigger rate 162 Hz at $y_{min} = 15$ mm, RUN-02 useful rate in the t-acceptance for spin was 9 Hz.**
- **At $y_{min} = 10$ mm the above rate increases by 50%.**
- **Use 80 Hz as conservative estimate, in case highest intensity is not achieved for $y_{min} = 15$ mm and 120 Hz for $y_{min} = 10$ mm**

Running time

$$\Delta A_N = \frac{1}{P\cos\phi\sqrt{N_{Tot}}} \longrightarrow N_{Tot} = \left(\frac{\varepsilon}{P\Delta\phi\Delta A_N}\right)^2$$

Where $\Delta\phi$ is the dilution factor, which depends on the acceptance in ϕ

1.FY-02 run, y_{min}= 15 mm $\Rightarrow \Delta\phi/\varepsilon = 0.44$

2.FY-03 run, y_{min}= 10 mm $\Rightarrow \Delta\phi/\varepsilon = 0.53$

One data point with $\Delta A_N = 0.002$, P = 0.40 will require

N_{tot}= 8.1 M events at y_{min}= 15 mm $\Rightarrow$ 2.0 days (14 hr/day)

N_{tot}= 5.6 M events at y_{min}= 10 mm $\Rightarrow$ 1.0 days (14 hr/day)

With the above statistics $\Delta B/B < 3\%$

We need roughly a TWO-DAY run this year.

Summary

- No obvious show stoppers in preparation for the run;
- Tasks to watch, pp2pp:
  - Si assembly and testing,
  - new sequencer (ITEP),
  - Trigger commissioning;
- Requirements for the run:
  - High intensity,
  - Good vertex, since transport depends on z,
  - Accurate luminosity measurement,
  - Will need short periods for commissioning, not a dedicated time.

We can do physics with a short, two day run.

FURTHER COMMENTS ON COMMISSIONING THE SPIN ROTATORS

W. MacKay, BNL
February 21, 2003

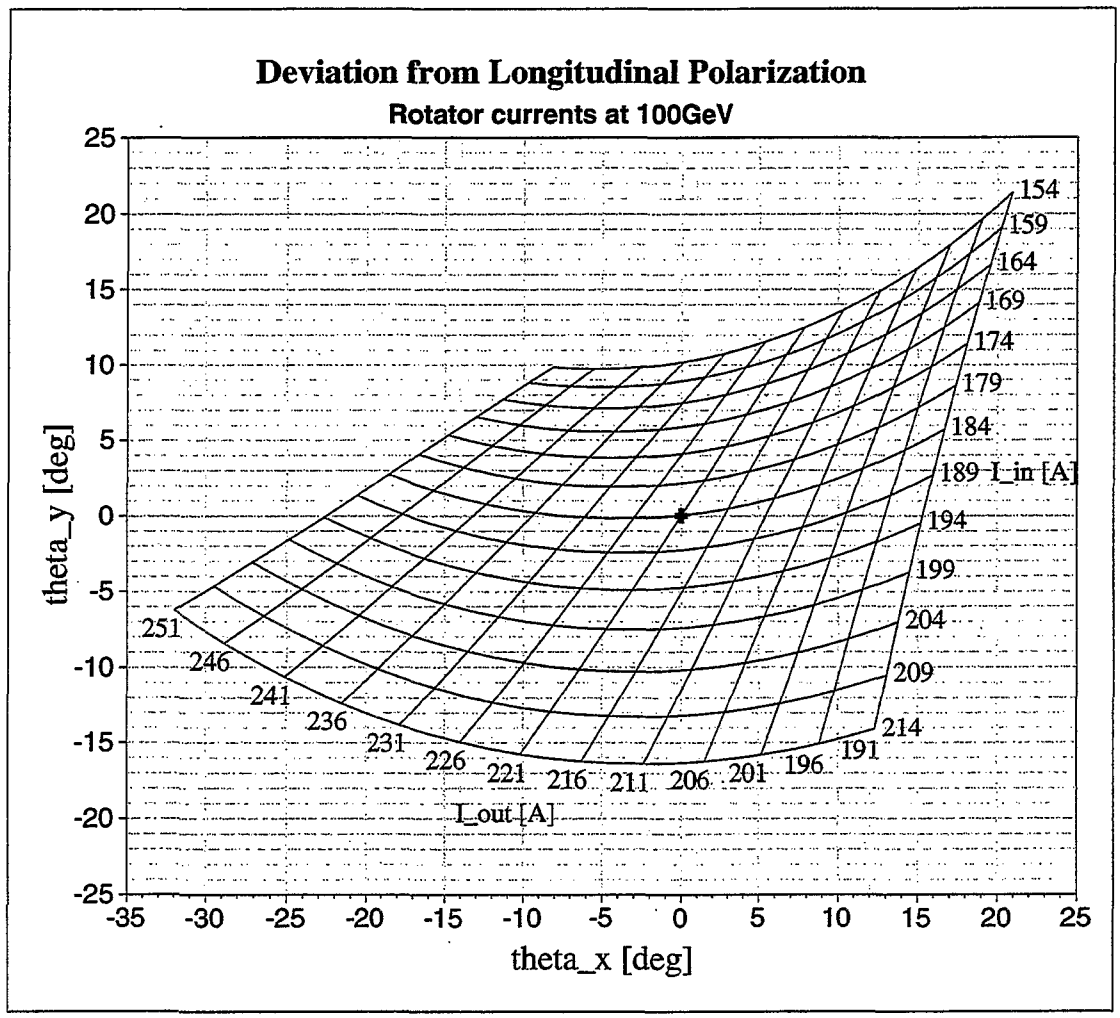
for
RHIC Spin Collaboration Meeting XV
RIKEN BNL Research Center

Calibration of Spin Rotators

Waldo MacKay

For 100 GeV protons with longitudinal polarization the calculated sensitivities to rotator currents are given in the following graph. Each rotator consists of four helical dipoles as described in previous meetings. The angles plotted are relative to the longitudinal direction at the center of either the STAR or PHENIX detector. A 1% error in energy would shift the polarization direction by 0.4° in θ_x. (There is a net spin precession of 40° about the vertical axis after the rotator due to the D0 and DX dipoles.)

The polarization deviation due to steering errors through in IR will be amplified by the factor of $G\gamma = 191.08$; e. g. a 0.5 mrad steering shift would change the polarization direction by about 5.5°. I believe we will want to keep the IR steering angle changes (drifts) down to the 0.1 mrad range at 100 GeV. (At 250 GeV, this effect will be 2.5 times larger.)



PHENIX Local Polarimeter Readiness for RUN03

Abhay Deshpande

For

M. Chiu, A. Denisov, A.D., B. Fox, Y. Fukao, N. Saito, K. Tanida, M. Togawa, & S. White

RHIC Spin Meeting

02/21/03

Local Polarimeter for RHIC Experiments

- The stable direction of the proton spin vector in the RHIC ring is vertical.
- For all A_LL measurements in the PHENIX and STAR spin program the proton spin direction has to be longitudinal → **Use Spin Rotator Magnets (SRMs)**
- Calibration and monitoring of the SRMs is being discussed in the context of PHENIX and STAR "local polarimetry"

Principle of Local Polarimetry for PHENIX

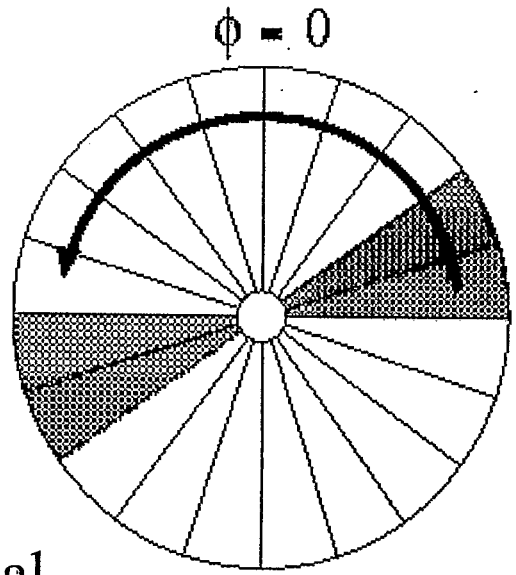
- **Recall:**

  RHIC Run 02, Experiment at IP12

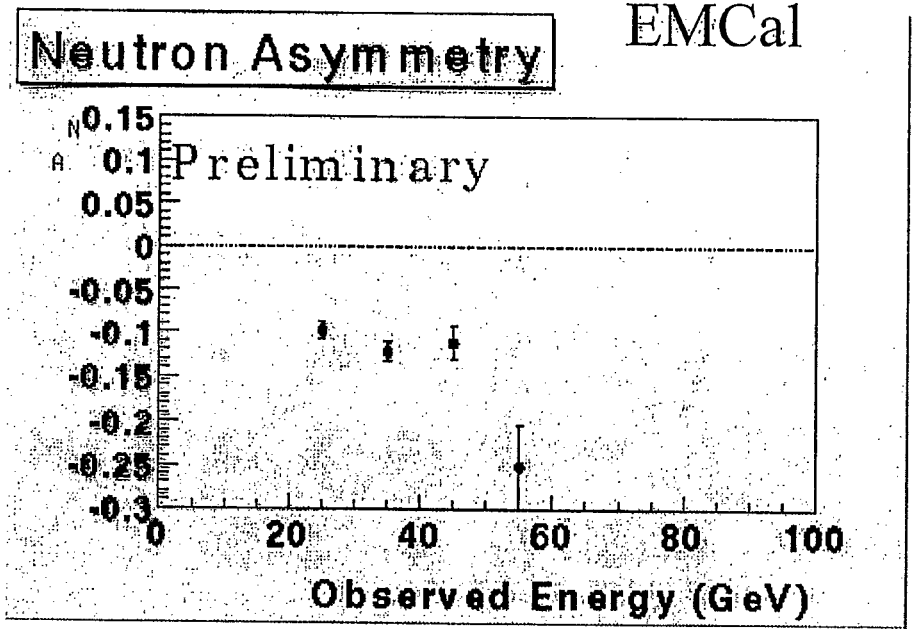
  Search for analyzing power (A_N) in neutral pion and neutrons in transverse pp scattering

  → Observed large analyzing power in neutron production using a lead tungstate electromagnetic calorimeter, confirmed by an independent measurements using ZDC and a pre-shower detector.

Run 2 IP12
Results
Y. Fukao
Spin 2002

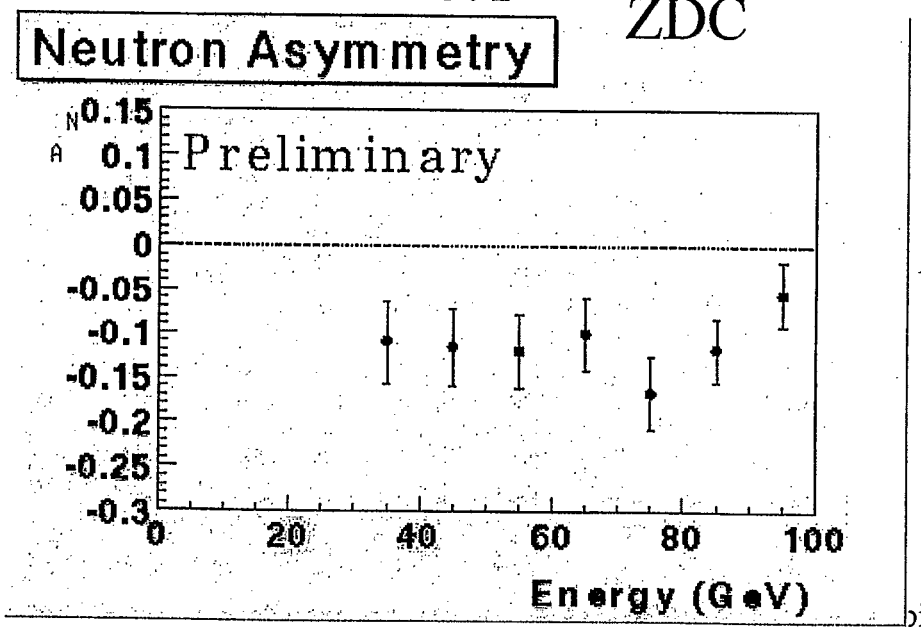


EMCal



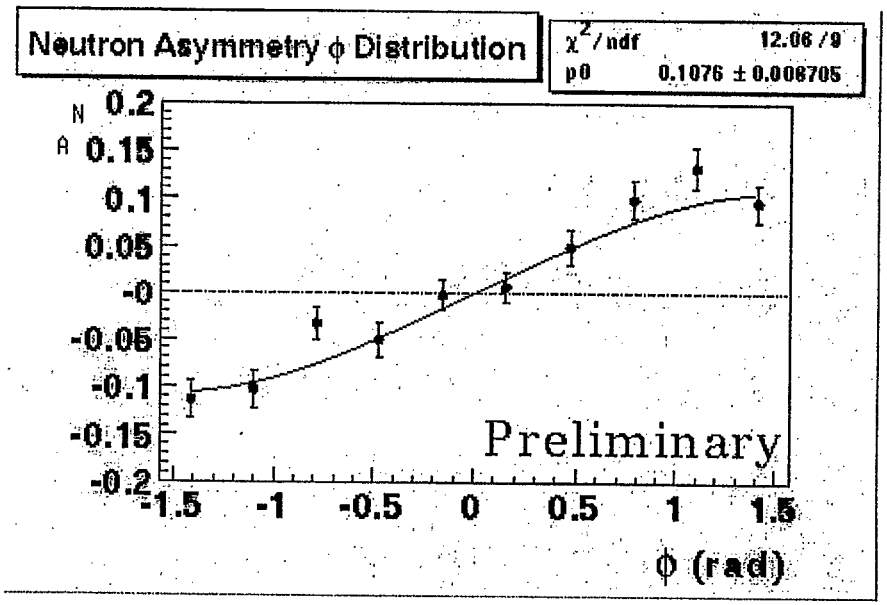
$\langle A_N \rangle = -0.109 \pm 0.0072$

ZDC



$\langle A_N \rangle = -0.110 \pm 0.015$

EMCal



$\langle A_N \rangle = -0.108 \pm 0.0087$

Phenix Local Polarimeter
ZDC Shower Max Detector

- Construction & Design: A. Denisov, S. White
- Commissioning: A.Denisov, W. White, M. Chiu, + 2
- **Polarimetry Issues:** A. D., B. Fox, Y. Fukao, N. Saito, K. Tanida, M. Togawa

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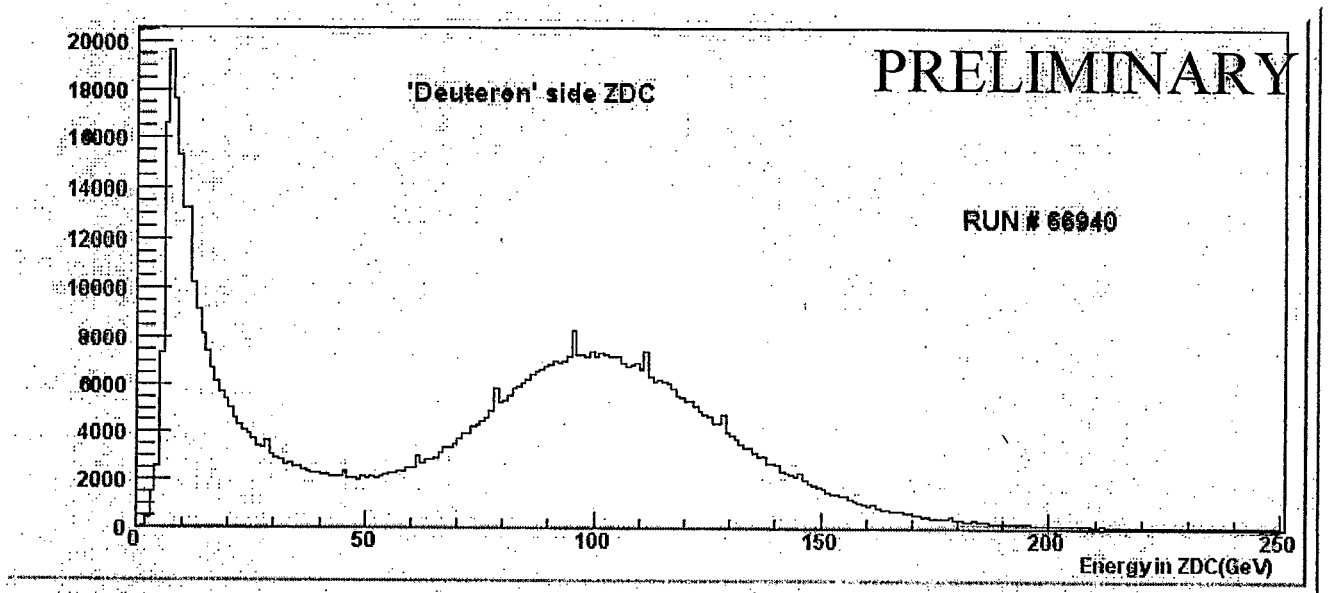
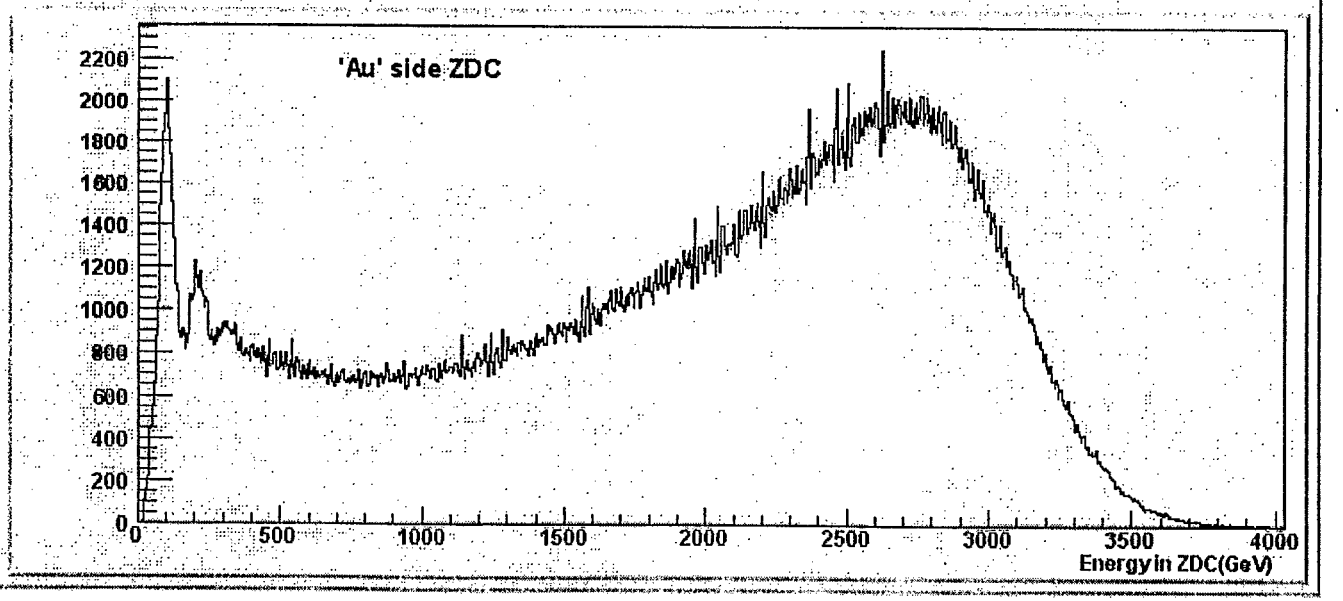
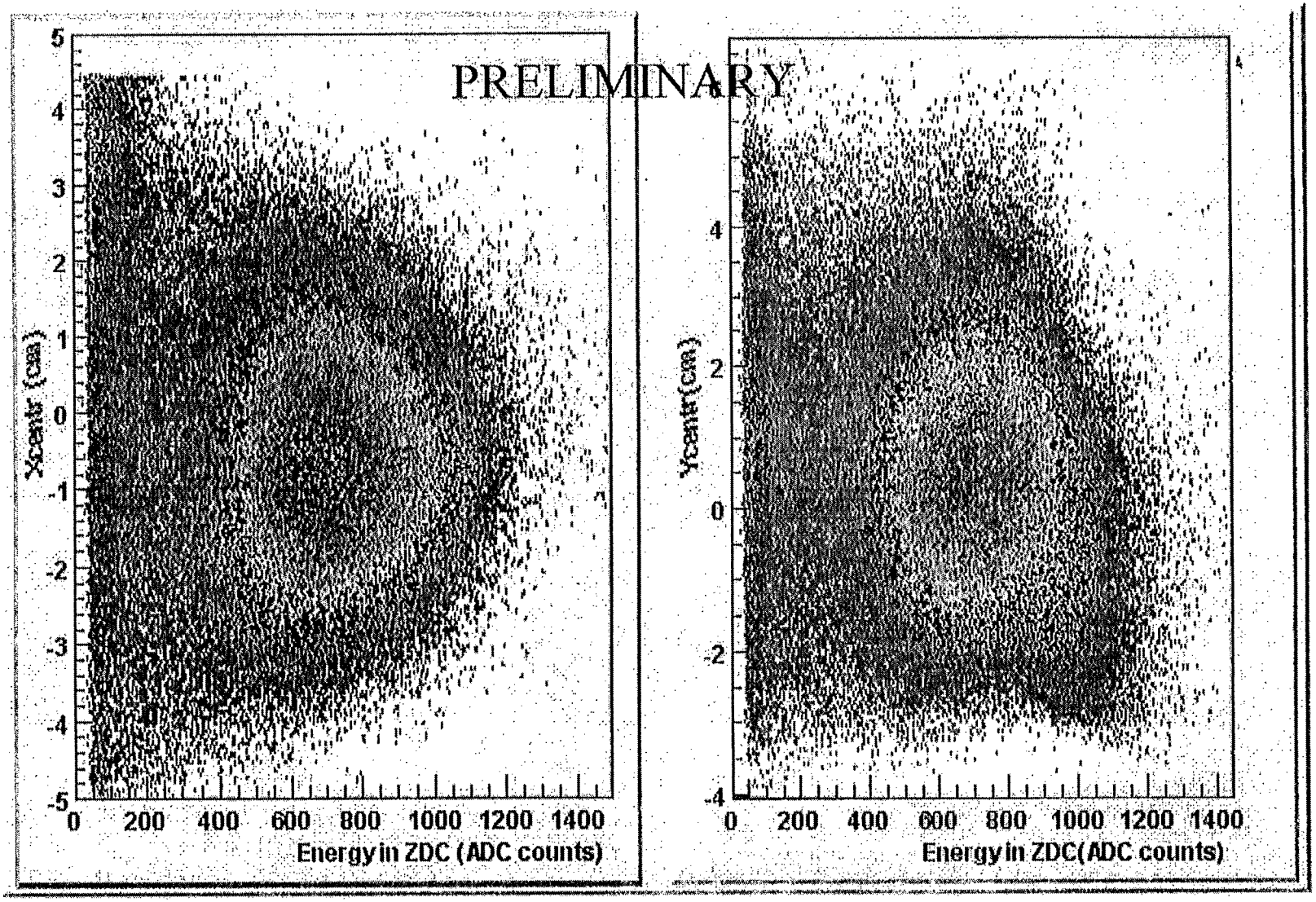
- ZDC Design known to all….
- Shower Max Detector (SMD):
  8 vertical & 7 horizontal scintillator strips cover the ZDC face
- SMD inserted between the first and the second ZDC unit
- Individually read out
- Sub-centimeter position resolution demonstrated

ZDC Operation in d-Au Run



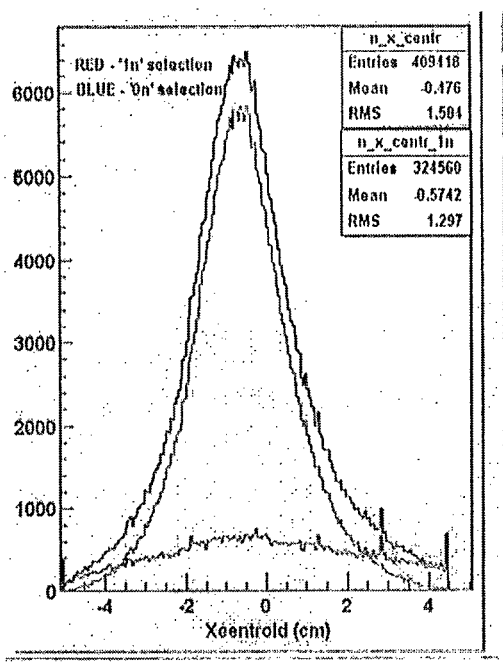


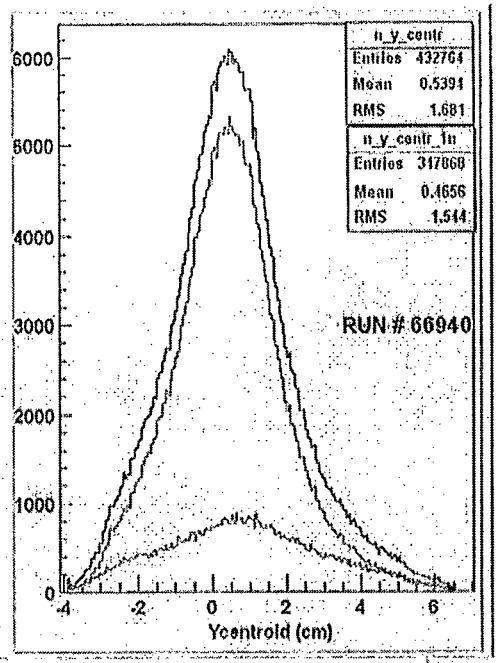
ADC counts vs. x/y centroids (no cuts)



90

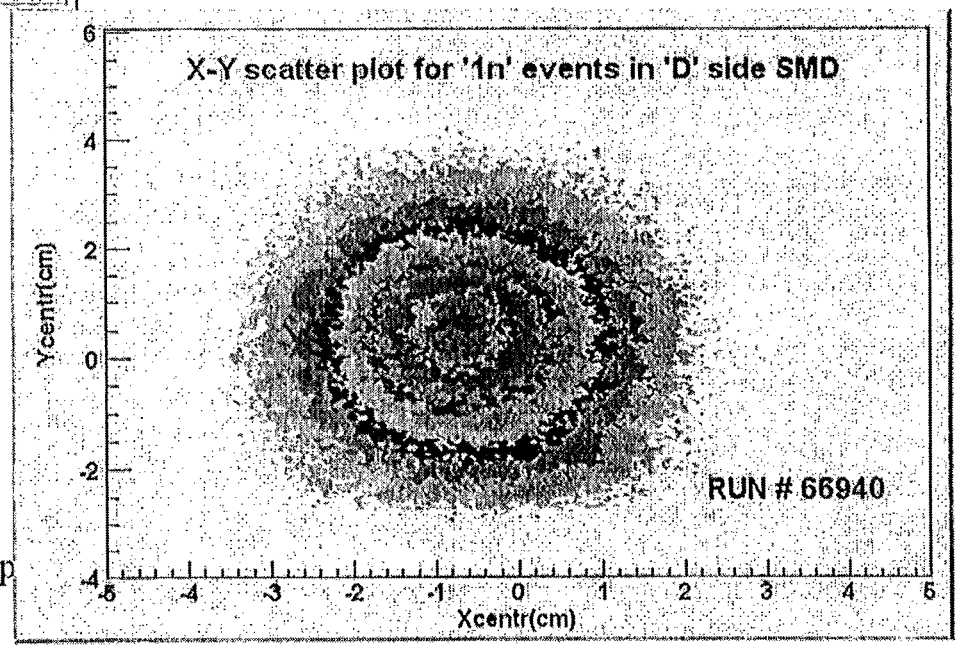
X centroids and Y centroids



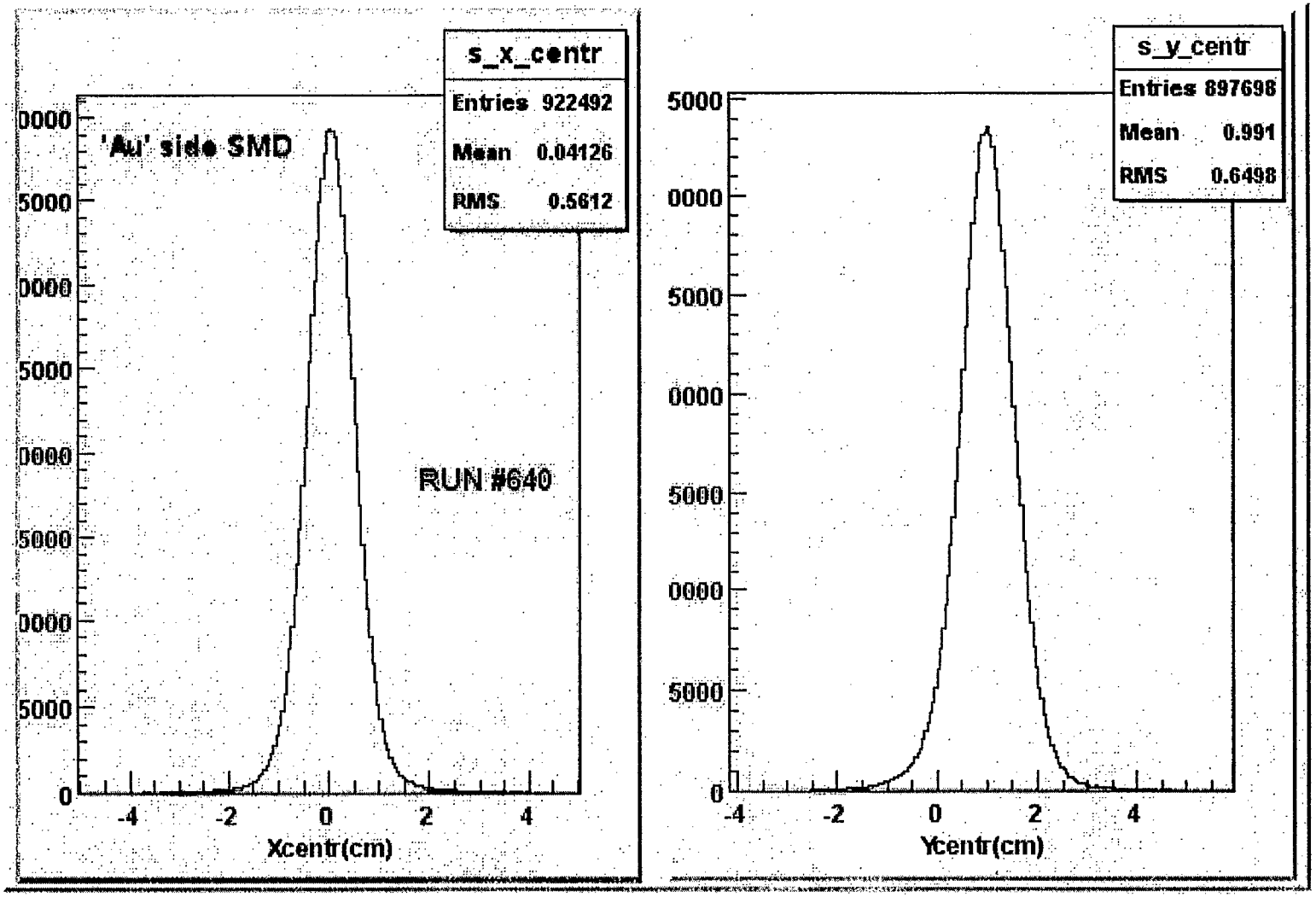


Select "1 neutron" events

PRELIMINARY



Position Resolution PRELIMINARY



Hardware in place

Detector Works

Basic software is ready

but

NOT

IN PHENIX

STANDARD CVS

DIRECTORY YET….

work in progress

Plan of action:

- Bring ZDC-SMDs back to the center (d-Au vs. p-p angles in experimental area)

- Trigger plan during commissioning of SRMs:
  BBC_NS (collision)+ZDC_N(neutron)
  BBC_NS (collision)+ZDC_S(neutron)

- Software setup: in progress
  → Basic BBC readout software ready & working in PHENIX
  → ZDC readout software ready & working in PHENIX
  Modifications to read SMD in PHENIX being implemented this week
- To be incorporated in to the PHENIX LVL2 Trigger Framework
  → After that it could also be incorporated in to the PHENIX On-Line-Monitoring (OnCal)

- Plan to test the entire chain during the d-A run and be ready at the beginning of the pp commissioning period.

Spin Rotator Magnet Calibration Day:

- Weekly Discussions with Waldo M., Les B., A. D. et al.
- Step 1
  - -- Get zero current reading for orientation of proton spin
  - -- Confirms our past results check for consistency as part of the full commissioning of the local polarimeter
- Step 2
  - -- turn on I_in & I_out and step through about 8-10 settings of SRM Currents
  - -- at each step confirm with CNI measurement that polarization is preserved
  - -- assuming 40% beam polarization and the analyzing power of IP12 time estimate for 3-4 sigma asymmetries is about 1-1.5 hrs
  - -- analyze data – online + in PHENIX LEVEL 2 trigger formalism
  - -- 10 minutes after end of run call up MCR and indicate the value of asymmetry seen at PHENIX
  - -- Change I_in and I_out and repeat the process (step 2)
- Estimate that there will be about 8 settings needed to arrive at the best guess of the zero angle point. ➔ 2hrs X 8 = 16hrs/beam
- Including contingency, this whole thing will take about 1 to 1.5 day for one ring.

STATUS REPORT ON STAR LOCAL POLARIMETRY

A. Ogawa, BNL

February 21, 2003

for

RHIC Spin Collaboration Meeting XV

RIKEN BNL Research Center

Local Polarimetry at STAR

- Local Polarimetry plan at STAR
- BBC upgrade
- FPD upgrade
- Scaler Boards upgrade

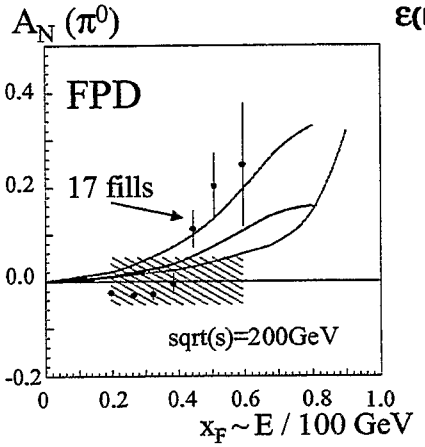
OGAWA Akio

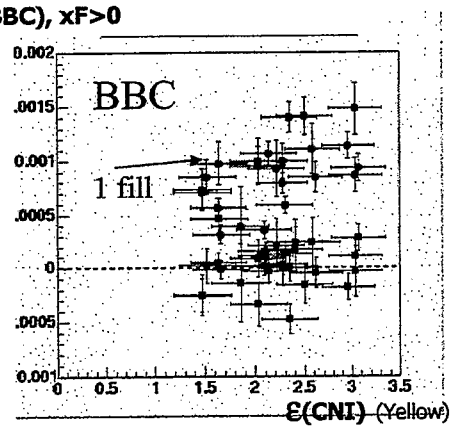
2003 Feb ~~18~~ 21

RSC meeting at BNL

Local Polarimetry @ STAR

From last year's pp run, we know where to look at...

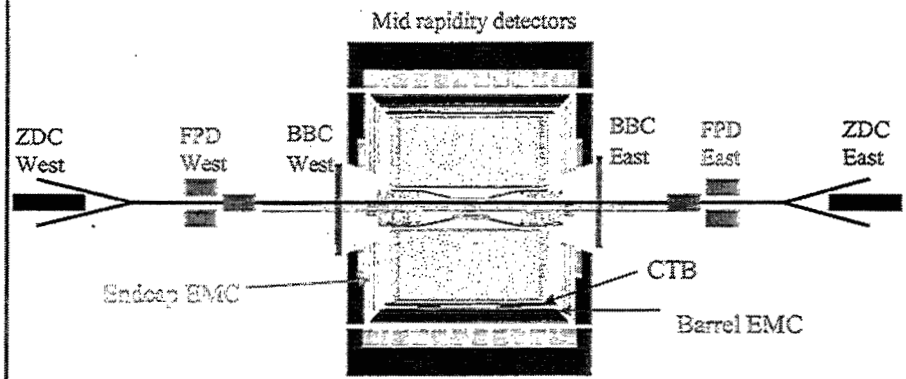




2002	2003?	2003?
P=15% L=$1*10^{30}$	P=30% L=$5*10^{30}$	P=45% L=$1*10^{31}$
F.o.M=1	F.o.M. =20	F.o.M = 90

1

STAR fast detectors

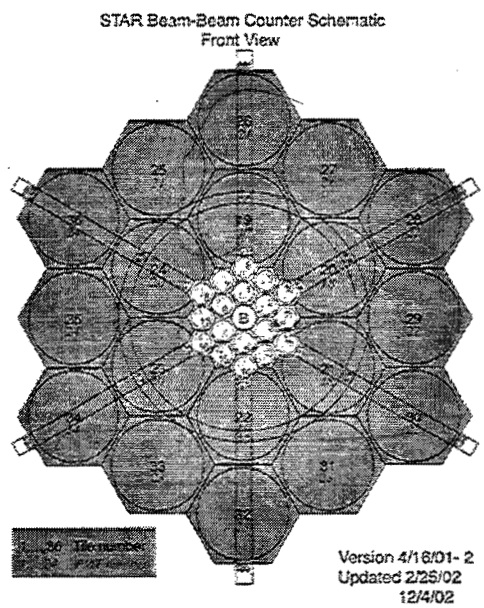


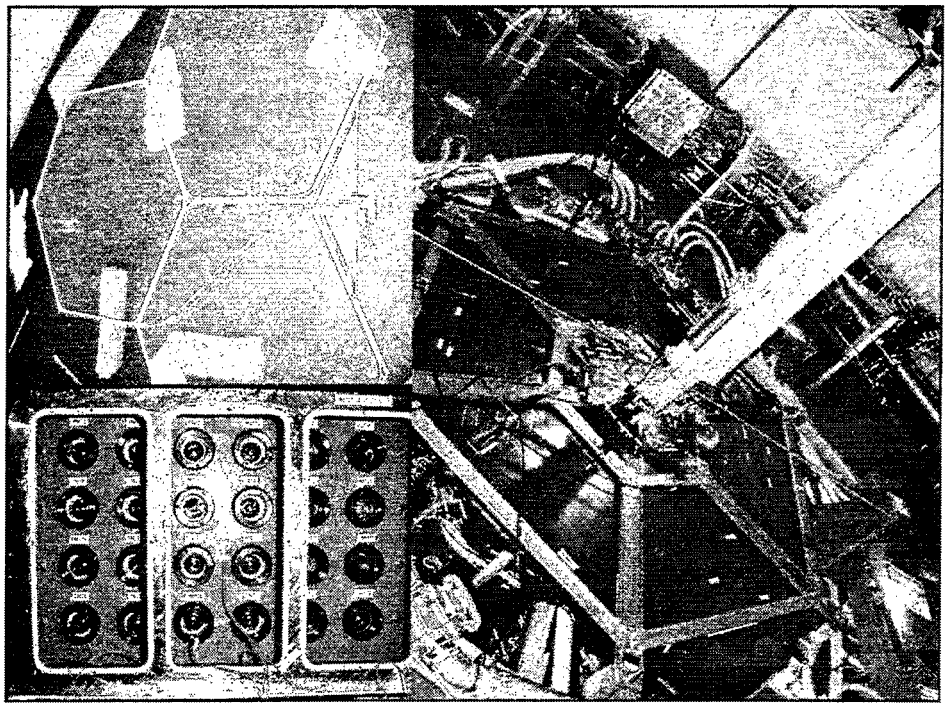
CTB/Barrel EMC	$\lvert\eta\rvert < 1$
Endcap EMC	$1 < \eta < 2$
BBC large tiles	$2.2 < \lvert\eta\rvert < 3.4$
FPD	$3.5 < \lvert\eta\rvert < 4.5$
BBC small tiles	$3.4 < \lvert\eta\rvert < 5$
ZDC	zero degree

BBC Upgrade

Increased # of PMT (24 per side)
Faster PMT (Burle 83112)
Completed large tiles
Dead time less readout
Fully integrated to STAR trigger
Vertex at L0 trigger (res ~ 30cm)

18 small tiles
16 faster PMTs
Digitize charge & time
$3.4 < \lvert\eta\rvert < 5$
18 large tiles
8 PMTs
Digitize charge
$2.2 < \lvert\eta\rvert < 3.4$

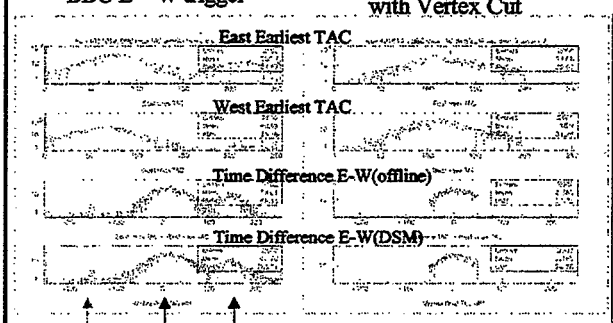




Commissioning with dAu Data

BBC E * W trigger

BBC E * W trigger with Vertex Cut

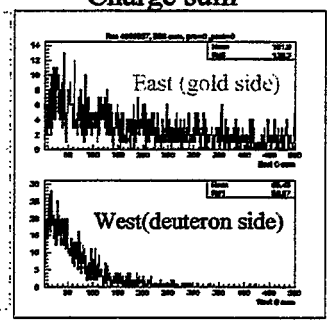


Blue Beam (deuteron) Gas

Collisions

Yellow Beam (gold) Gas

Charge sum

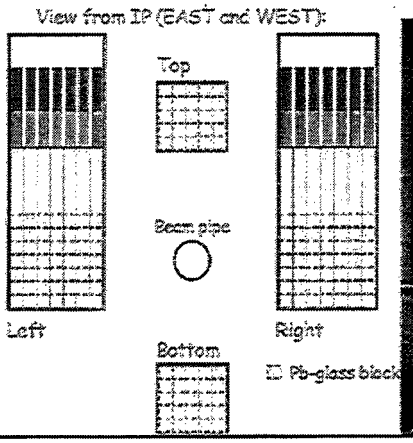


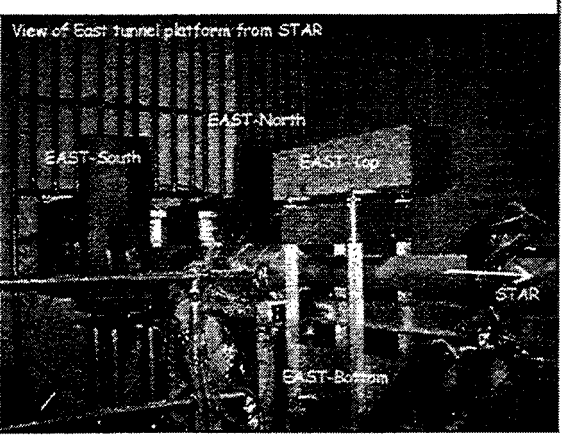
Ready to go & running

FPD Upgrade

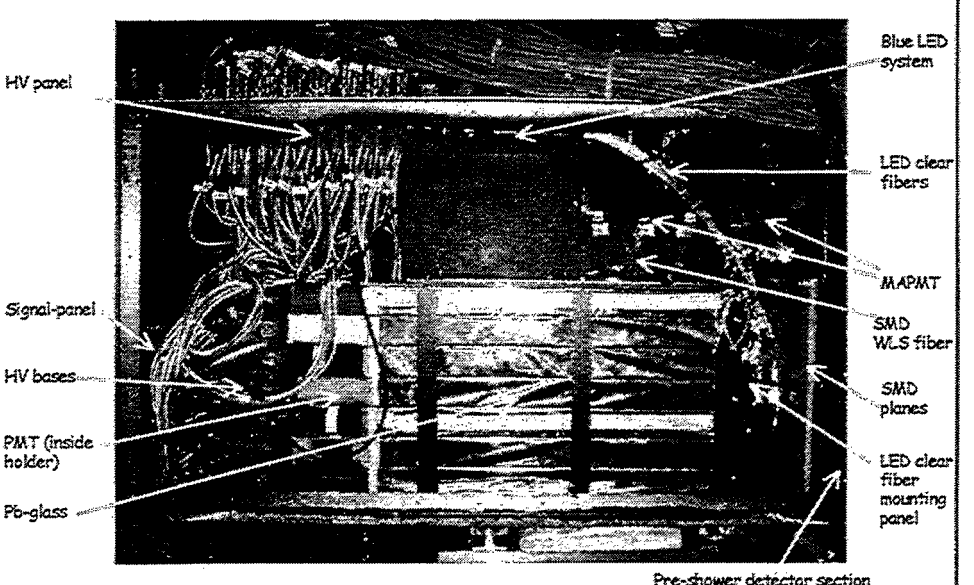
Left & Right : 7*7 = 49 Pb-glass blocks
+ 7 PreShower Pb-glass blocks
+ 2 SMD planes with 48 strips/plane

Top & Bottom : 5*5 = 25 Pb-glass blocks





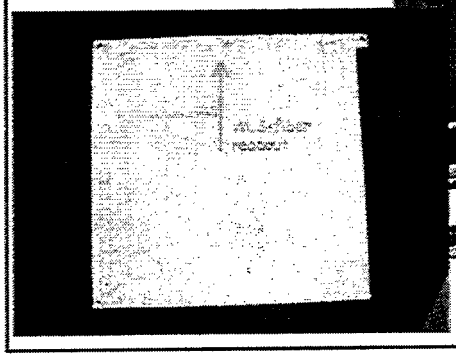
Inside of a L/R calorimeter module

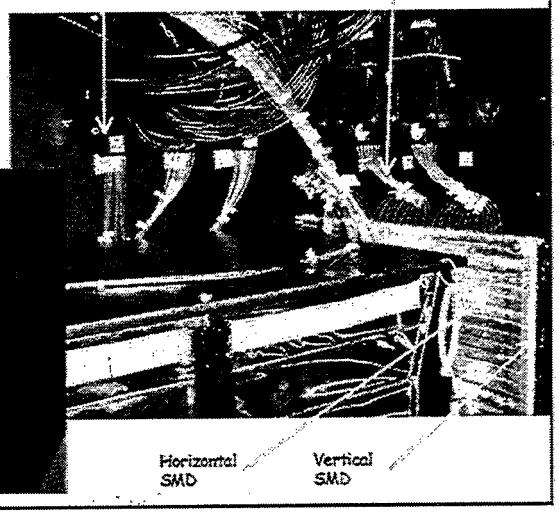


SMD planes

Triangle scinti. Strips
- width 1.0cm
- depth 0.7cm

48 strips per plane
2 (H and V) planes
WLS fibers &
MAPMT readout





Status of FY03 FPD

All 6 detectors are built, tested and installed (except one SMD)
- East : Left, Right, Top and Bottom
- West : Left and Bottom

Readout electronics are under commissioning
- Fully integrated to STAR trigger system with bunch id
- Dead time less readout
  - >50Hz with slow detectors
  - ~1kHz with fast detectors only
  - 9MHz into scaler boards

- East readout: working (by Feb19) and waiting for beam
- West readout: (almost) ready to be installed on Feb26
- SMD readout: yet to come…

Physics at d-Au "soon" and will be ready for pp

Scaler Board Upgrade

24bit scaler boards used in last years run with some improvements

- On board zero suppresion → Faster readout
- Ping-pong with 2 identical boards every few min → Time dependence within a run
- More boards (10 boards in place) for different purposes
- Fast online analysis + online DB + backup at HPSS

1,2	Trigger & detector busy SB:	Various trigger and detector busy bits
3,4	Luminosity SB:	BBC, ZDC, CTB, EMC + bunch ID
5,6	BBC Asymmetry SB:	BBC E/W & left/right/top/bottom with some rapidity info + bunch ID
7,8	FPD Asymmetry SB:	FPD E/W & left/right/top/bottom with 3 thresholds + bunch ID
9	BBC East SB:	BBC east small tile each PMT with BBC coincidence bit + bunch ID
10	BBC West SB:	BBC west small tile each PMT with BBC coincidence bit + bunch ID

Scaler Boards configration

Bits	Luminosity	BBC Asy	FPD Asy	BBCE	BBCW
0	BBCE timing	BBCET	BBCE*W	BBCE*W	BBCE*W
1	BBCW timing	BBCEB	FPDET1	BBCE1	BBCW1
2	BBCE>Th0	BBCEN	FPDET2	BBCE2	BBCW2
3	BBCW>Th0	BBCES	FPDEB1	BBCE3	BBCW3
4	BBCE>Th1	BBCWT	FPDEB2	BBCE4	BBCW4
5	BBCW>Th1	BBCWB	FPDEN1	BBCE5	BBCW5
6	BBCEL>Th2	BBCWN	FPDEN2	BBCE6	BBCW6
7	BBCWL>Th2	BBCWS	FPDES1	BBCE7	BBCW7
8	ZDC timing	BBCE 1stC	FPDES2	BBCE8	BBCW8
9	ZDCE>Th0	BBCW 1stC	FPDWT1	BBCE9	BBCW9
10	ZDCE>Th1	BBCE 2ndC	FPDWT2	BBCE10	BBCW10
11	ZDCW>Th0	BBCW 2ndC	FPDWB1	BBCE11	BBCW11
12	ZDCW>Th1	BBCEL>Th	FPDWB2	BBCE12	BBCW12
13	EMC>Th0	BBCWL>Th	FPDWN1	BBCE13	BBCW13
14	EMC>Th1	ZDC timing	FPDWN2	BBCE14	BBCW14
15	CTB>Th0	EMC>Th0	FPDWS1	BBCE15	BBCW15
16	CTB>Th1	CTB>Th0	FPDWS2	BBCE16	BBCW16
17-23	BunchId	BunchId	BunchId	BunchId	BunchId

Summary

STAR local polarimetry = BBC & FPD (& mid rapidity)

With improved beam polarization & luminosity

1 fill = whole 2002 run

BBC upgrade: Running with dAu beam

FPD upgrade: All detectors are in and tested

East side tower readout electronics are being commissioned now

More readout electronics are on the way

Scaler boards: All boards are in place

It's under commissioning now

SUMMARY OF PLANS FOR THE "EXPERIMENT-ACCELERATOR" INTERFACE FOR THE SPIN FLIPPER

B. Fox, BNL/RBRC

February 21, 2003

for

RHIC Spin Collaboration Meeting XV

RIKEN BNL Research Center

Attendees: Angelika, Les, Mei, Gerry, Me

February 24, 2003

[1] How to organize the flipping so that STAR, PHENIX, BRAHMS, pp2pp know what is going on before, during, after the flip?

Announced via paging system

[2] What is the sequence of events for a flip?

[A] polarization measurement

[B] flip
- send "start" flip event
- detune snake
- flip
- retune snake
- send "end" flip event

NOTE: flipper is green device, snake detuning/tuning is yellow or blue.

reset V124 with the "new" pattern

[C] polarization measurement

[3] What information goes into OPEV?

[A] Counter of flips per ring

[B] Snake/Flipper info (including read-back) during flip

[C] Polarization Measurement results

RHIC Spin Collaboration Meeting XV
February 21, 2003
RIKEN BNL Research Center

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RHIC Spin Collaboration Meeting XV
February 21, 2003
RIKEN BNL Research Center

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RHIC Spin Collaboration Meeting XV
February 21, 2003
RIKEN BNL Research Center

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RHIC Spin Collaboration Meeting XV
February 21, 2003
RIKEN BNL Research Center

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RHIC Spin Collaboration Meeting XV
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RIKEN BNL Research Center

RHIC Spin Collaboration Meeting XV

February 21, 2003

Small Seminar Room, Physics Dept., Brookhaven National Laboratory

*******AGENDA*******

Morning Session

09:00 – 09:45 Status Report on the AGS ..... L. Ahrens

09:45 – 10:30 Status Report on RHIC Running with the Tune Lock (PLL)..... P. Cameron

10:30 – 10:40 Coffee Break

10:40 – 11:10 Status Report on RHIC Running with 110 Bunches in dA..... T. Roser for W. Fischer

11:10 – 11:55 Status Report on the new AGS CNI Polarimeter..... J. Wood

11:55 – 12:25 Status Report on the 200 MHz rf Performance in dA..... M. Brennan

Afternoon Session

1:30 – 2:50 Readiness Report for Polarized Protons from each Experiment: *(20 minutes/experiment)*

- PHENIX – Matthias Grosse Perdekamp
- STAR – Bernd Surrow
- BRAHMS – Flemming Videbaek
- pp2pp – Wlodek Guryn

2:50 – 3:00 Coffee Break

3:00 – 3:10 Further Comments on Commissioning the Spin Rotators..... W. Mackay

3:10 – 3:40 Status Report on PHENIX Local Polarimetry..... A. Deshpande

3:40 – 4:10 Status Report on STAR Local Polarimetry..... A. Ogawa

4:10 – 4:20 Status Report on the RHIC Polarization in Run-02..... G. Bunce

4:20 – 4:30 Summary of Plans for the "Experiment-Accelerator" Interface for the Spin Flipper..... B. Fox

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Status Report on the AGS / AGS Polarization Update

L. Ahrens, BNL

March 18, 2003

for

RHIC Spin Collaboration Meeting XVI

RIKEN BNL Research Center

AGS Polarization Update 18Mar03 Lahrens

(What a group: both the CAD acc physics spinners and the CNI gang!)

Where are we?

0) taking the source for granted, stable, >70% polarization and plenty of intensity (>1.5e11 at AGS extraction achieved early on).

1) The "dead-reckoned" i.e. without using polarization (except the Booster measured at AGS injection) gave 20% at the RHIC injection field of ggam=46.5.

Involves predicting the timing of the rf dipole excitations, setting up the tune and chromaticity at each of these looking at the beam, flattening the AGS orbit (8th and 9th harmonics), setting up the snake to its nominal 5% strength, tuning the transverse emittances as small as possible.

2) 1.5 weeks of "tuning" has raised the polarization at 46.5 to about 40%.

pics: a) available time
b) rf dipole timing 12+ easy, 36+ hard; dead reckoned timing ok.
c)beam size (IPM)
vert 10pi -> 15pi (mmmr) normalized emittance
hori 20pi -> 30pi

d) snake strength optimization. (to seriously consider doing this due to the speed of the CNI)

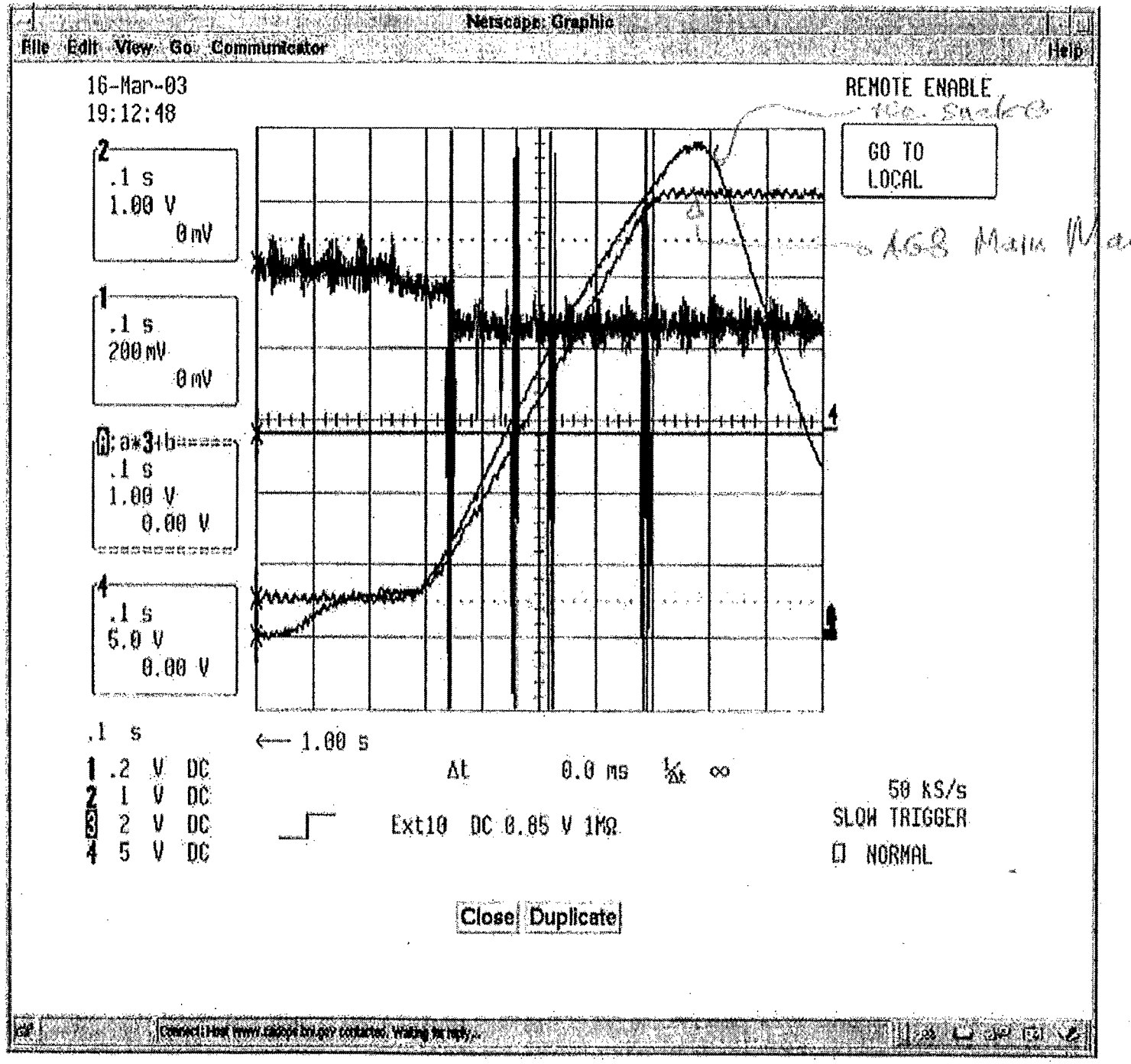
e) rf dipole setups
drive amp and tune separation (beam vs the drive frequency)

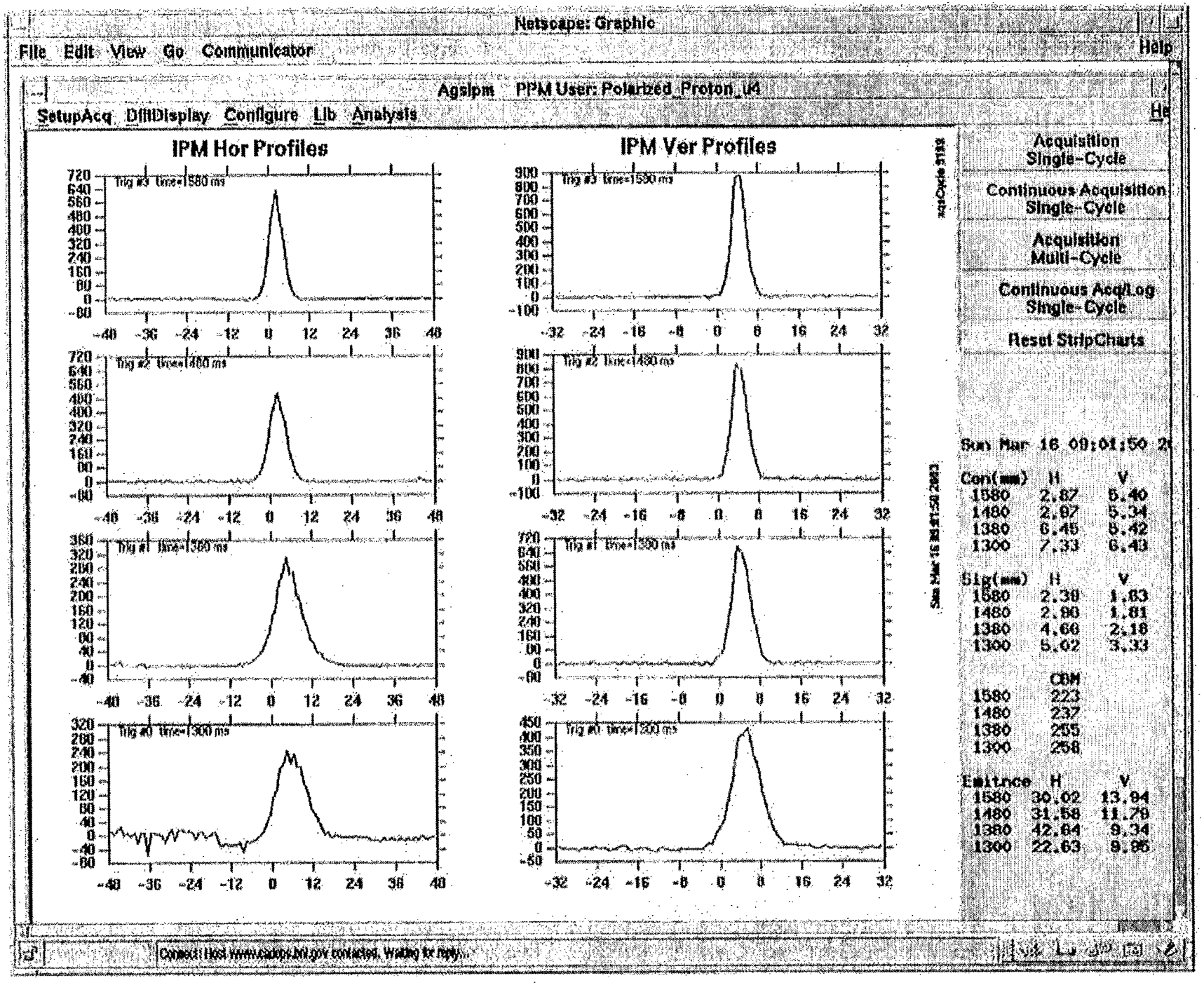
3) Plans:

a) multiple bunches in AGS, for CNI "up the ramp" commissioning.

b) parallel development of other AGS setups (ggam = 12.5 magnetic porch etc.)
(possible now that RHIC AU-d is in final configuration)

c) lots of parameters yet to scan. Where do we lose the polarization? And then, can we get it back?


Netscape: Graphic
File Edit View Go Communicator Help
16-Mar-03
19:12:48
REMOTE ENABLE
No Snake
GO TO
LOCAL
AGS Main Magnet
2
.1 s
1.00 V
0 mV
1
.1 s
200 mV
0 mV
a*3+b
.1 s
1.00 V
0.00 V
4
.1 s
5.0 V
0.00 V
.1 s
← 1.00 s
1 .2 V DC
2 1 V DC
3 2 V DC
4 5 V DC
Δt 0.0 ms 1/Δt ∞
Ext10 DC 0.85 V 1MΩ
50 kS/s
SLOW TRIGGER
NORMAL
Close
Duplicate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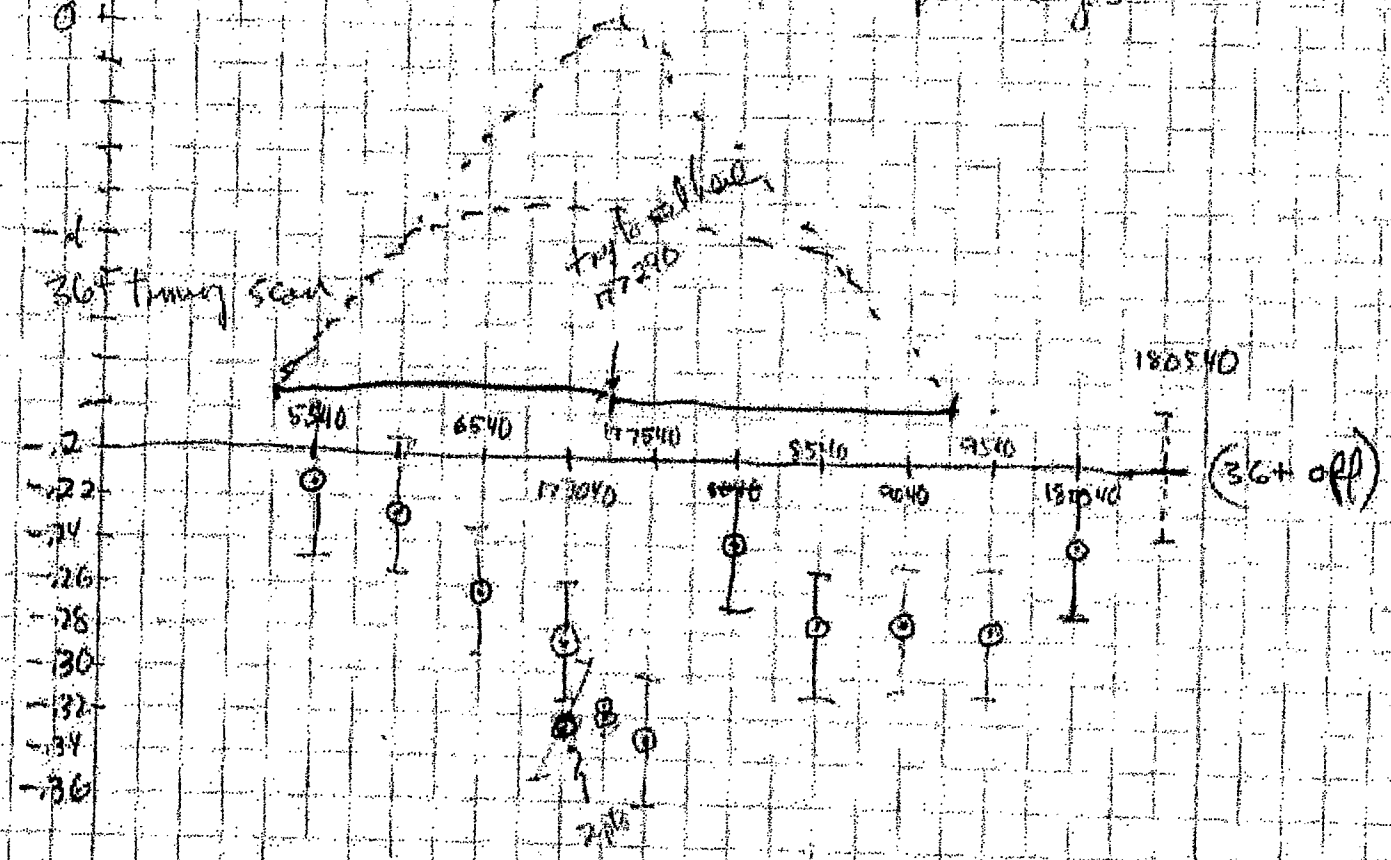
Help
Agsipm PPM User: Polarized_Proton_u4
SetupAcq DiffDisplay Configure Lib Analysis
IPM Hor Profiles
IPM Ver Profiles
Acquisition Single-Cycle
Continuous Acquisition Single-Cycle
Acquisition Multi-Cycle
Continuous Acq/Log Single-Cycle
Reset StripCharts
Sun Mar 16 09:01:50 2
Con(mm) H V
1580 2.87 5.40
1480 2.97 5.34
1380 6.45 5.42
1300 7.33 6.43
Sig(mm) H V
1580 2.30 1.83
1480 2.90 1.81
1380 4.66 2.18
1300 5.62 3.33
CBM
1580 223
1480 237
1380 255
1300 258
Emitnce H V
1580 30.02 13.94
1480 31.58 11.79
1380 42.64 9.34
1300 22.63 9.95
Connect: Host www.cadops.bnl.gov contacted. Waiting for reply...

.7110
.7020
.0090

16 March 02 00:00 Alvers

GS = 36+

Sieve is midway in a timing scan @ 36+
if push too late, the ~~[illegible]~~ pulses go away!



36+ : time is below due 8.713 – 8.7165

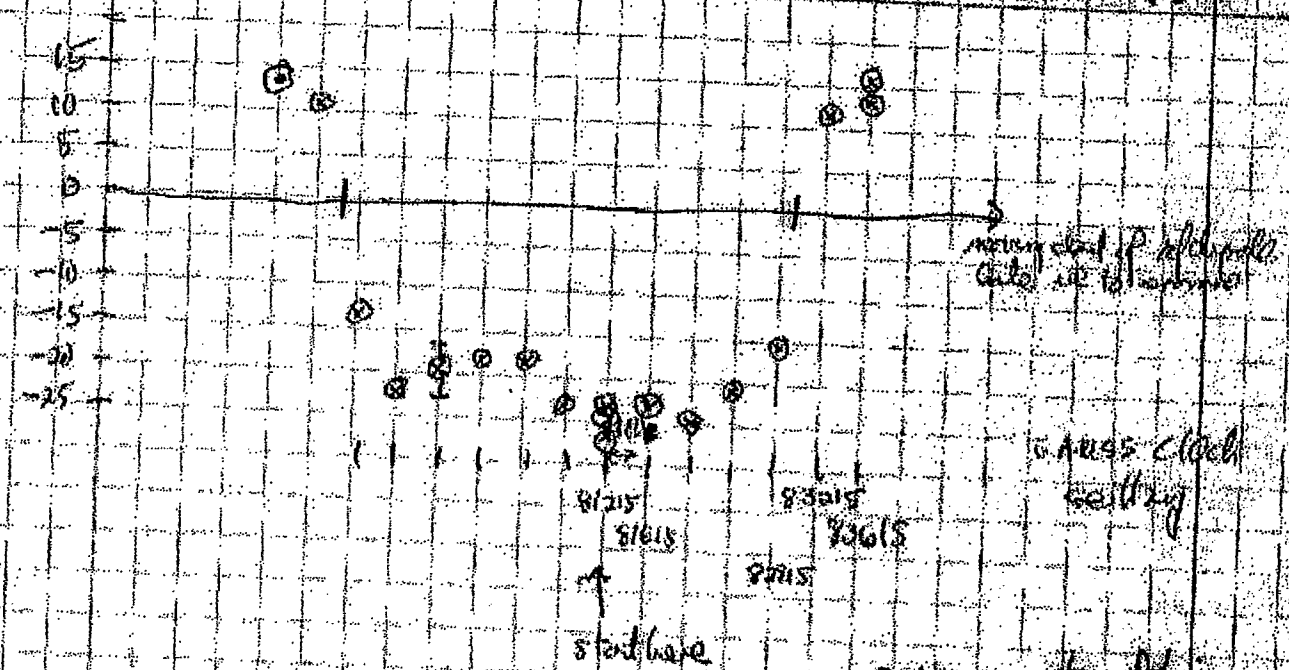
@250 – if ok @ 177290 a) bring on IPM + 1 cube (456) (155 mm)

[illegible] b) lower 36+ time to [illegible] approx set = 8.682 + 8.6815

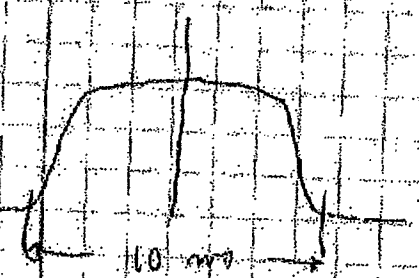
c) adj [illegible] @ 36+ – see if can improve [illegible] 8.6817

26 14 March 03 Alex (+ Christoph) Timing Scan 124

$C\gamma = 124$



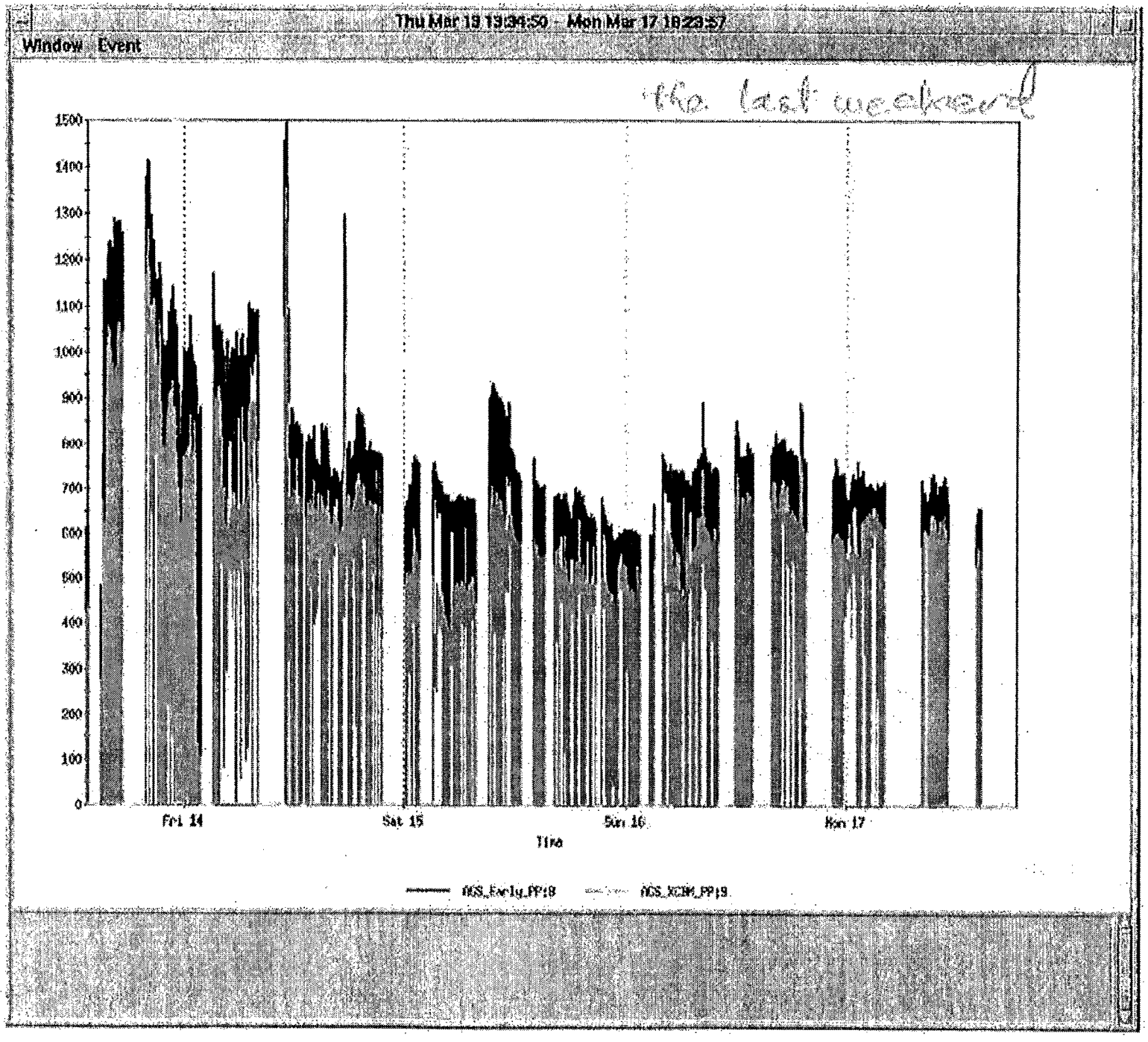
easy - it flips



@ 21.9 Gauss/m2 (mean) + 219G = 4271

177805 is near 364 timing, (177025 is average timing but not there [illegible])

(177803 is [illegible])


Thu Mar 13 13:34:50 - Mon Mar 17 18:23:57
Window Event
the last weekend
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Fri 14
Sat 15
Sun 16
Mon 17
Time
AGS_Early_PP:8
AGS_XCBM_PP:9

Status Report on the New AGS CNI Polarimeter

S. Bravar, BNL

March 18, 2003

for

RHIC Spin Collaboration Meeting XVI

RIKEN BNL Research Center

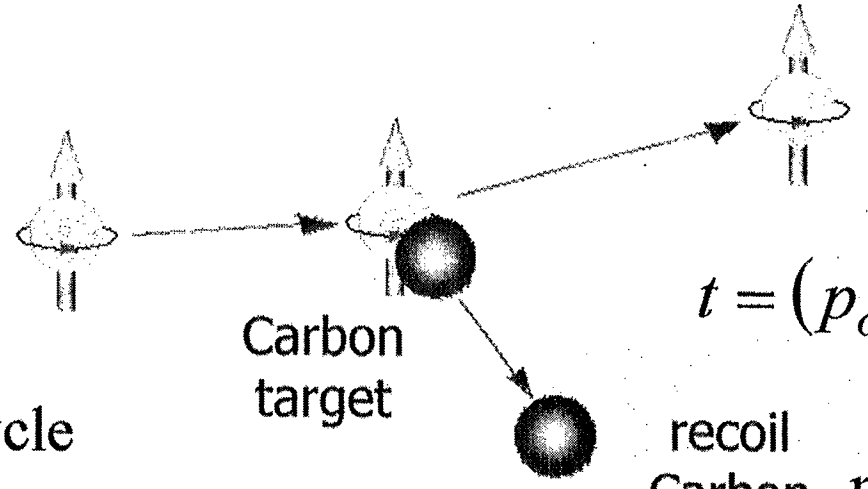
STATUS of AGS CNI POLARIMETER

Dima, Gerry, Haixin, Igor, Jeff, Osamu, Sandro *et al.*

UP & RUNNING !

P_{BEAM} > 40% and rising

Principle



flip spin
each AGS cycle

$$t = (p_{out} - p_{in})^2 < 0$$

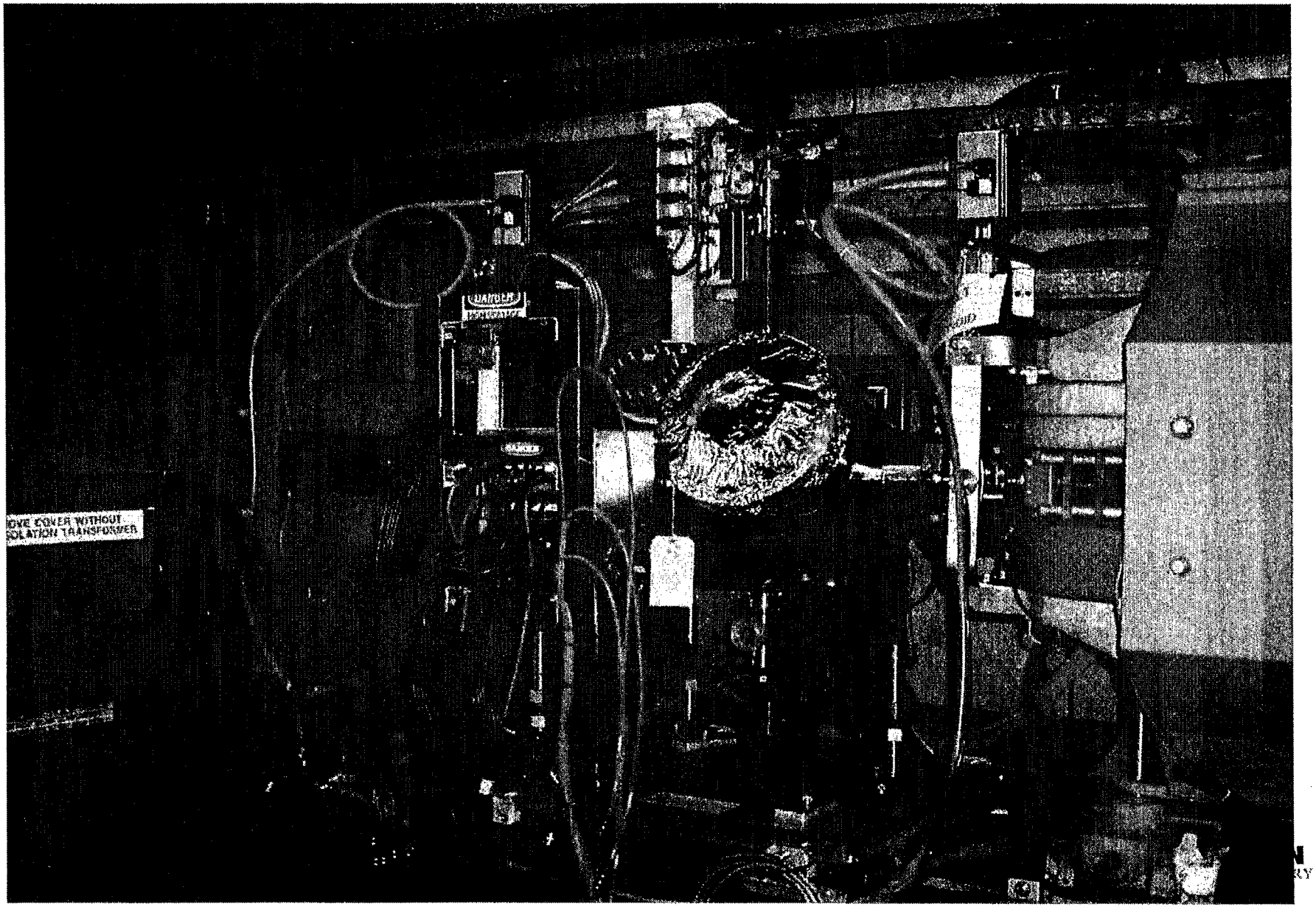
measured with
Si detectors
left – right of the beam
and WFD
time – energy info

$$P_{beam} = -\frac{1}{A_N} \cdot \frac{N_{left} - N_{right}}{N_{left} + N_{right}}$$

we are detecting
the recoil

$A_N \sim 1\%$ … small
requires large
statistics $> 10^7$

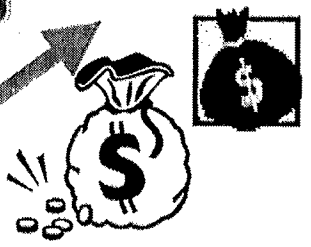
A Picture of the Setup



Hall of Fame '03: 40 % and rising

Haixin

> 50 % ?



40 % and more

03/17

39 %

Leif
03/15

Waldo
03/14

38 %

32 %

Waldo
03/14

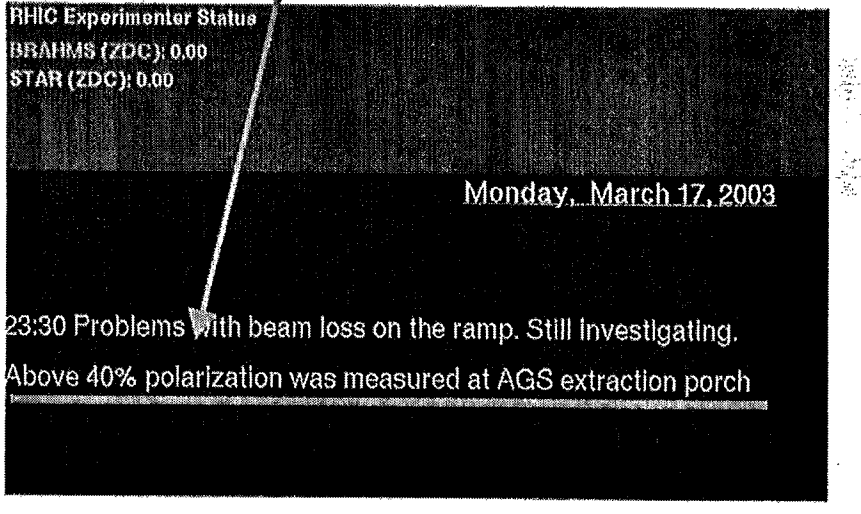
30 %

Mei
03/11

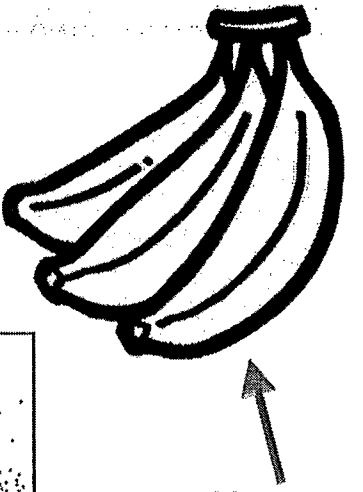
17 %

Mei
02/28

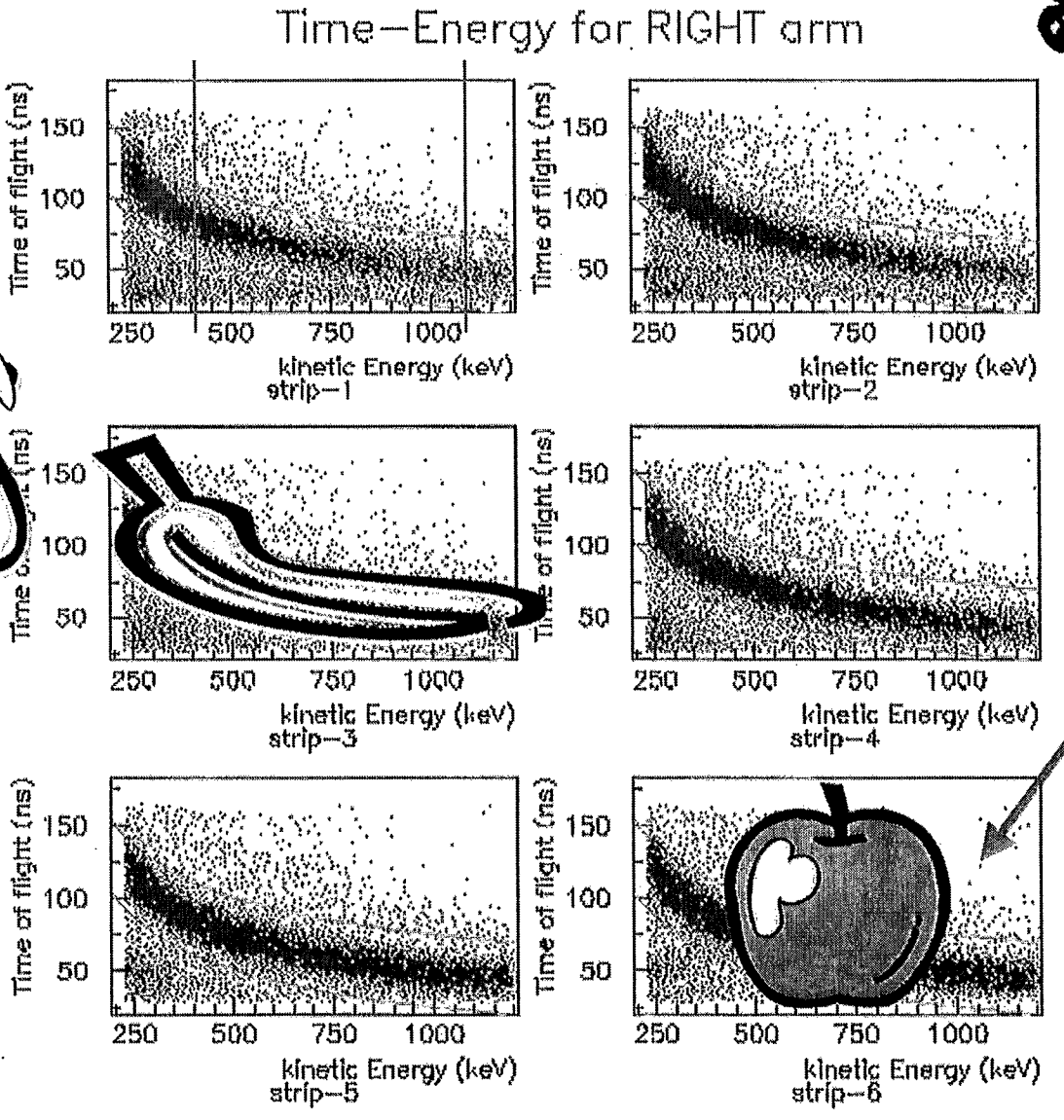
while Osamu
was sleeping …



Time of Flight vs. Energy i.e.

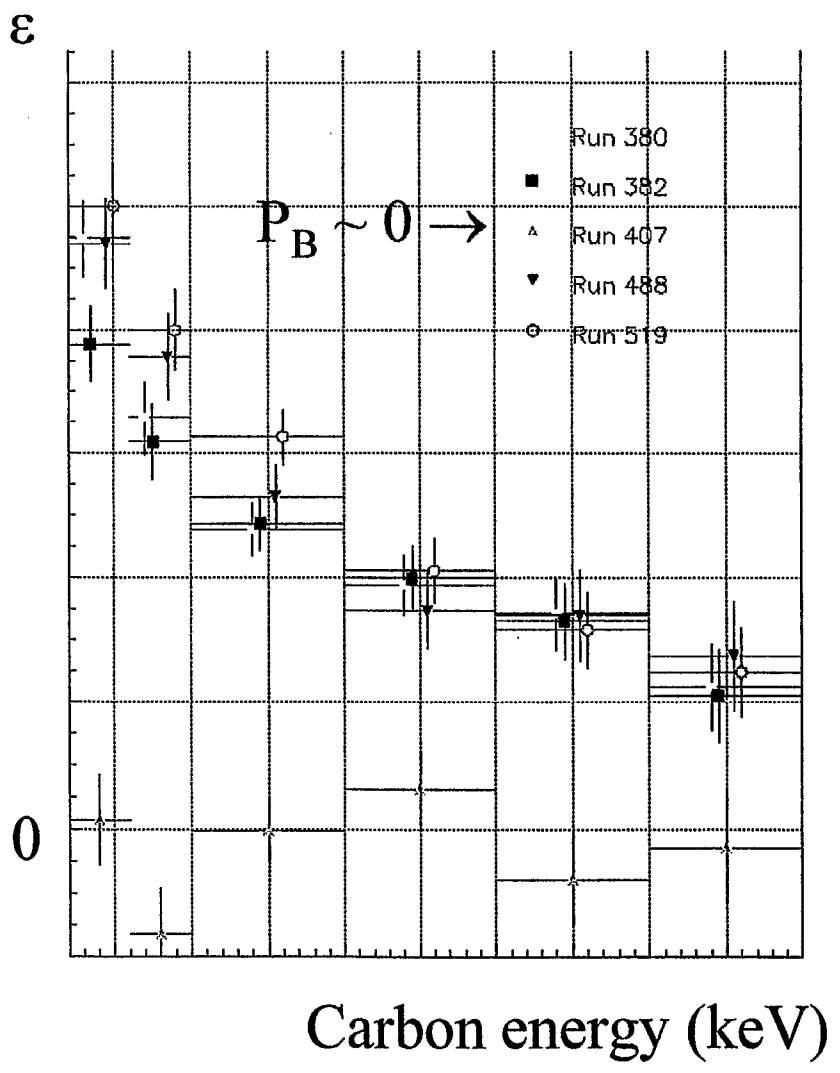


pileup ?



does not pass the cuts

Raw Asymmetry



$$P_{beam} = \frac{1}{\langle A_N \rangle} \cdot \varepsilon_N$$

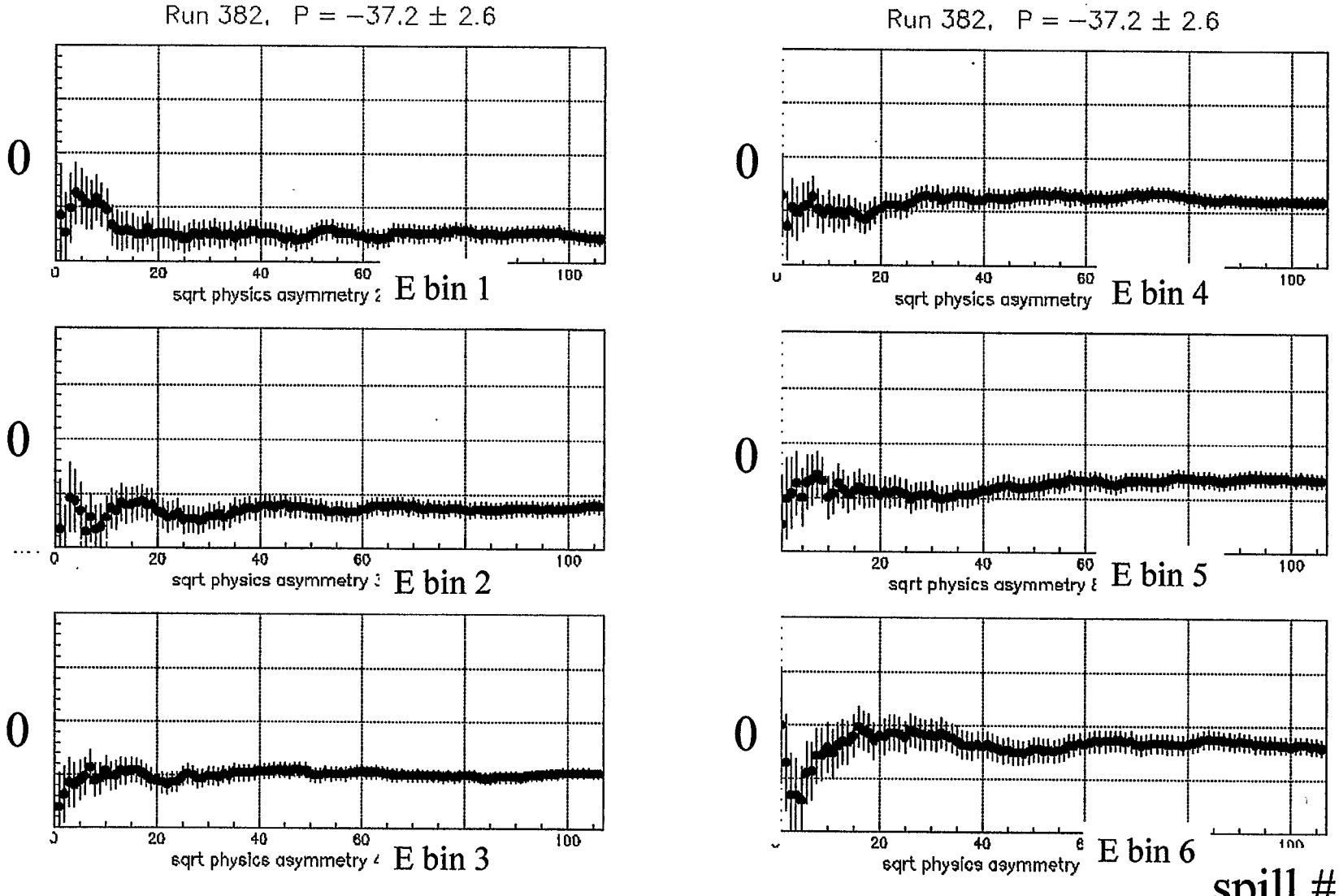
$$\langle A_N \rangle = \frac{\sum N(t_i) A_N^{th}(t_i)}{\sum N(t_i)}$$

calculated over several t bins

A_N^{th} from Larry's fit to E950 data

$$< A_N > = 1.08$$
$$0.009 < |t| < 0.025$$

Raw Asymmetry Spill by Spill (Integral)



spill #

for different Carbon energy bins

Comparison with E880 Polarimeter

polarization measurements

AGS - CNI	E880
-0.365 ± 0.030	
-0.359 ± 0.029	
-0.349 ± 0.030	-0.370 ± 0.045
-0.349 ± 0.030	

E880 proven to be correct (just kidding …)

AGS-CNI works! YES !!!

Larry's fit is GREAT

Looking Forward

- polarimetry
  - decrease measurement time, below 5 min.
  - 6 bunch mode
  - measure beam polarization on the ramp
  - run at higher intensities
  - transfer polarimeter to *operators*
- physics
  - different energies between 4 to 24 GeV
  - broader t range, $0.004 < |t| < 0.2$ GeV^2

Run Plan for Polarized Protons in RHIC / FY03 *pp* Run Preparation

H. Huang, BNL

March 18, 2003

for

RHIC Spin Collaboration Meeting XVI

RIKEN BNL Research Center

FY03 *pp* Run Preparation

Two running modes:

100 GeV collision run

250 GeV acceleration commissioning (optional)

Running scenario:

injection: $>1\times10^{11}$/bunch, 110 bunches, emittance 25 π, 50% polarization, β^*=10m.

(last year: $.7\times10^{11}$/bunch, 55 bunches, emittance 25 π, ~25% polarization, β^*=3m.)

β squeeze at flat top.

STAR: 1wk vertical polarization, 2wks long. polarization.

PHENIX: 3 wks longitudinal polarization.

The nominal switch date is March 21. It will be followed by a few days maintenance for possible power supply work and experimenters setup.

H. Huang

5 weeks of spin commissioning

Establish RHIC Operations (1 wk)

-- Ramp to 100 GeV with tune feed back, beta* squeeze at flat top 6x6

-- Lock rf frequency of both rings

Fine tuning (1 wk)

-- CNI polarimetry setup (Measurements at inj. & 100 GeV)

-- Work on the snake magnets

-- Rebucketing/Recogging

Luminosity maximization at experiments 110x110 (1 wk)

--Is background a problem?

-- local polarimeter commissioning

-- Increase bunch intensity, 110 bunches (watch vacuum pressure)

Spin Rotator and Spin Flipper Commissioning (1 wk)

--Spin Rotator first. May not scan the angle curves.

Down Ramp (1 wk)

Acceleration polarized protons to 250GeV (>3 days)

H. Huang

FY03 *pp* Pre-Run Job List

Shift schedule (Todd/Haixin)

2 weeks 3-shifts/day

Power supply work (DX/D0) when switch species (George)

12 hours work

Spin Rotator Commissioning (Waldo/George)

Check power supply polarity with d/Au beam.

Turn on one spin rotator and monitor the BPM in the middle of the rotator.

It could be done at injection or end of a store.

Polarization confirmation pattern from source (Omar)

Get data from Lamb-shift polarimeter for each bunch and log the data

Spin Flipper Application(Mei)

Tune Feedback along the ramp (Peter)

H. Huang

FY03 *pp* Pre-Run Job List (2)

New ramps (Johannes, Al)
β^*=10m at injection, no squeeze along the ramp, squeeze at flattop to β^*=1m/2m
need both up and down ramps (with beam survived and polarization preserved).
The framework is done.

Beam Scrubbing to increase bunch intensity (SY/Haixin)
We have a plan, will try as schedule allowed

AGS polarized proton commissioning (Leif)
Goal is to reach 50% at AGS extraction

RHIC polarimeter automatic switch for calibration (Sandro/Sergio)
The attenuator circuit board design is done
Delivery date delayed to April

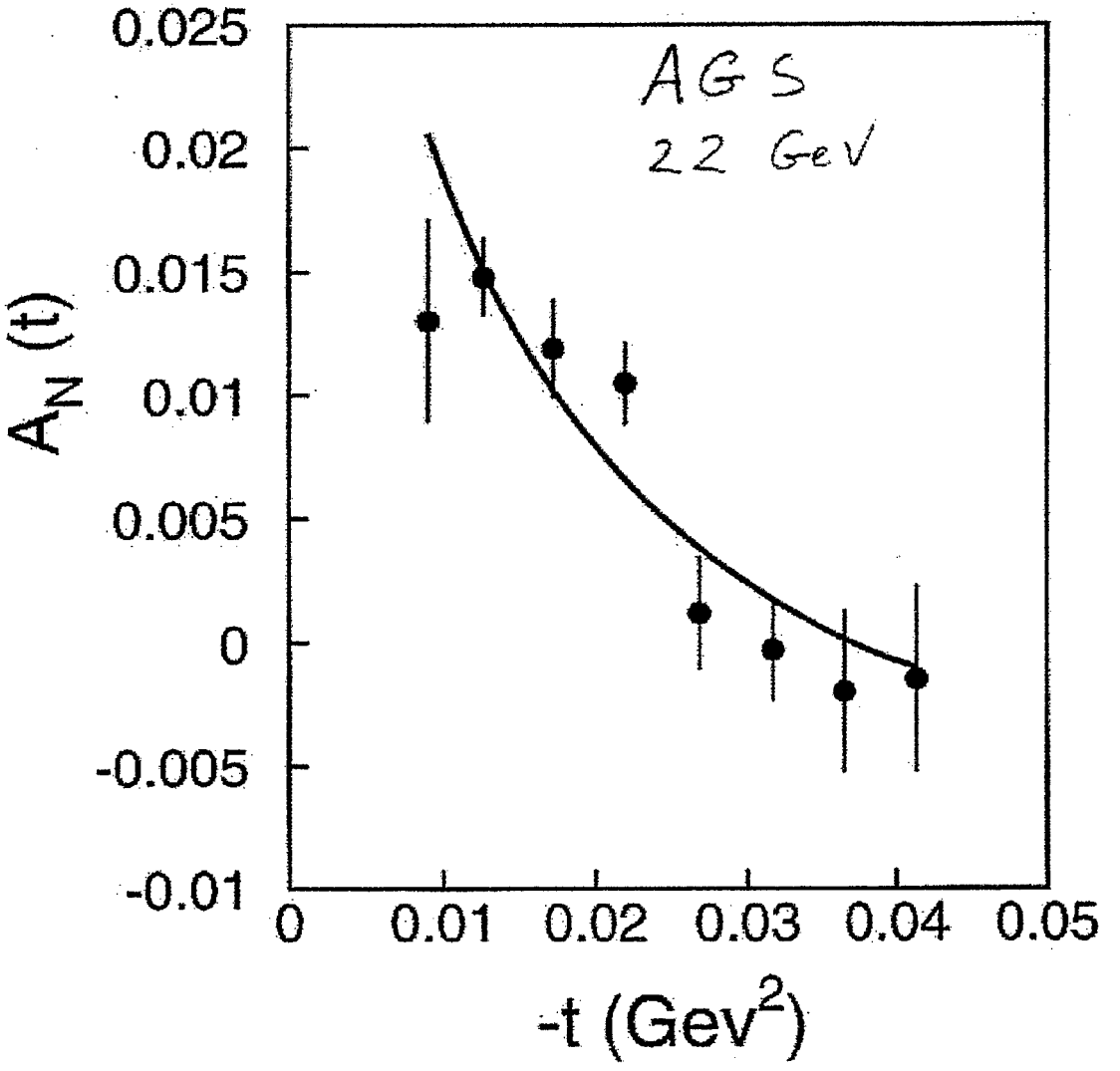
H. Huang

p-C CNI polarimetry revisited

Boris Kopeliovich

BNL

March, 2003



$Re\, r_5 = 0.084 \pm 0.042$

$Im\, r_5 = -0.156 \pm 0.170$

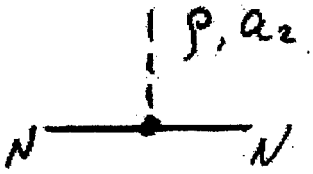
Comparison with hadronic data

22 GeV is not a high enery. Where the observed r_s originate from, Pomeron, Reggeons ?

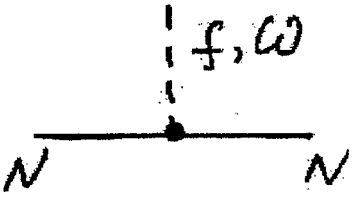
The answer is crucial for predicting the higher energy behavior.

pN is known to have contributions from $\mathbb{P}$, f, ω, ρ, a_2

Since pN do not have poles in s-channel $f-\omega$ and $\rho-a_2$ must cancel in the Imaginary part, but add up in the Real part of the amplitude



is mostly <u>spin-flip</u> and <u>small</u>



is mostly <u>non-flip</u> and <u>large</u>

We know that from πN elastic and charge-exange.

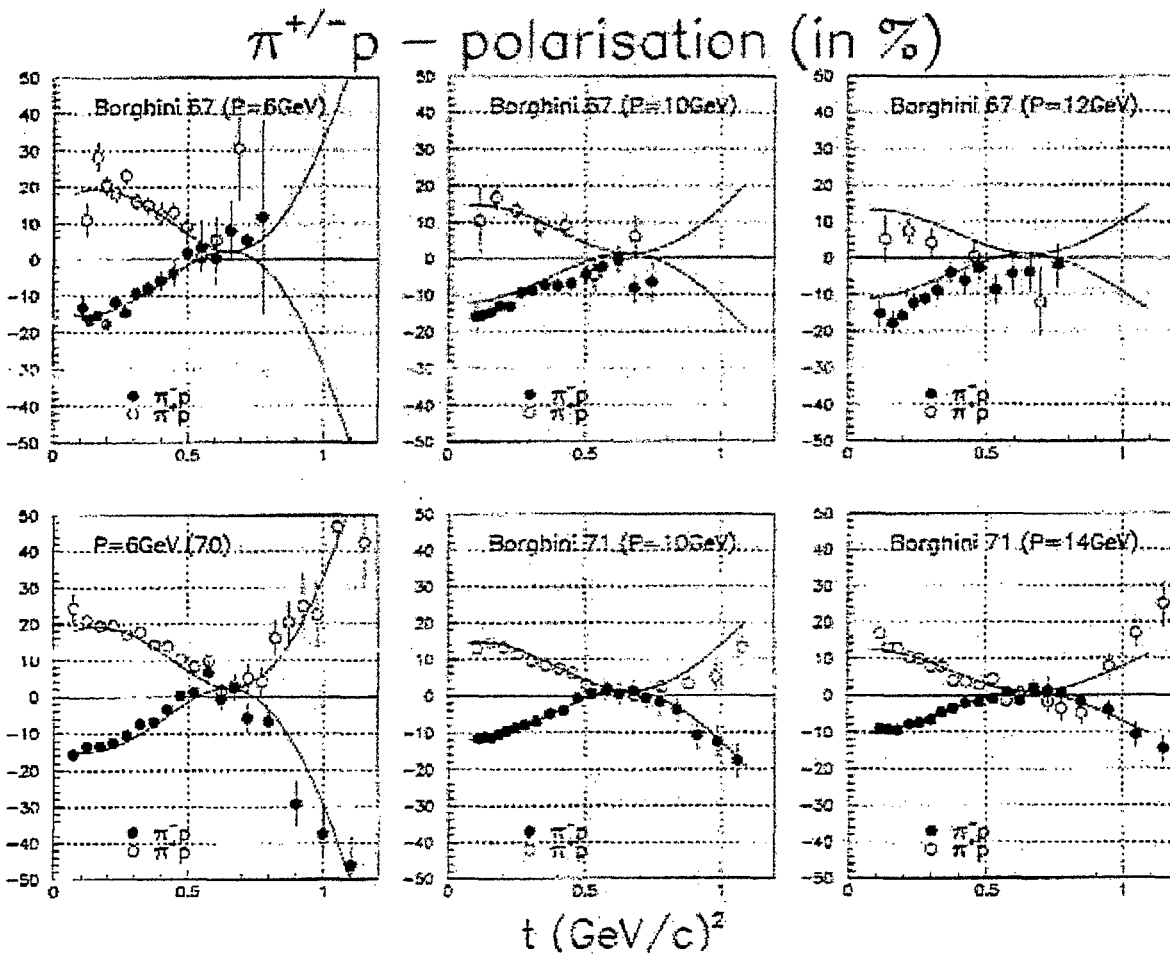
The symmetry for A_N in $\pi^{\pm}p$ elastic can be broken only by $\mathbb{P}$ and f, but it is rather precise.

★ One should expect a similar symmetry for A_N in pp and pn, but ...

6 What do we know about the Pomeron spin-flip?

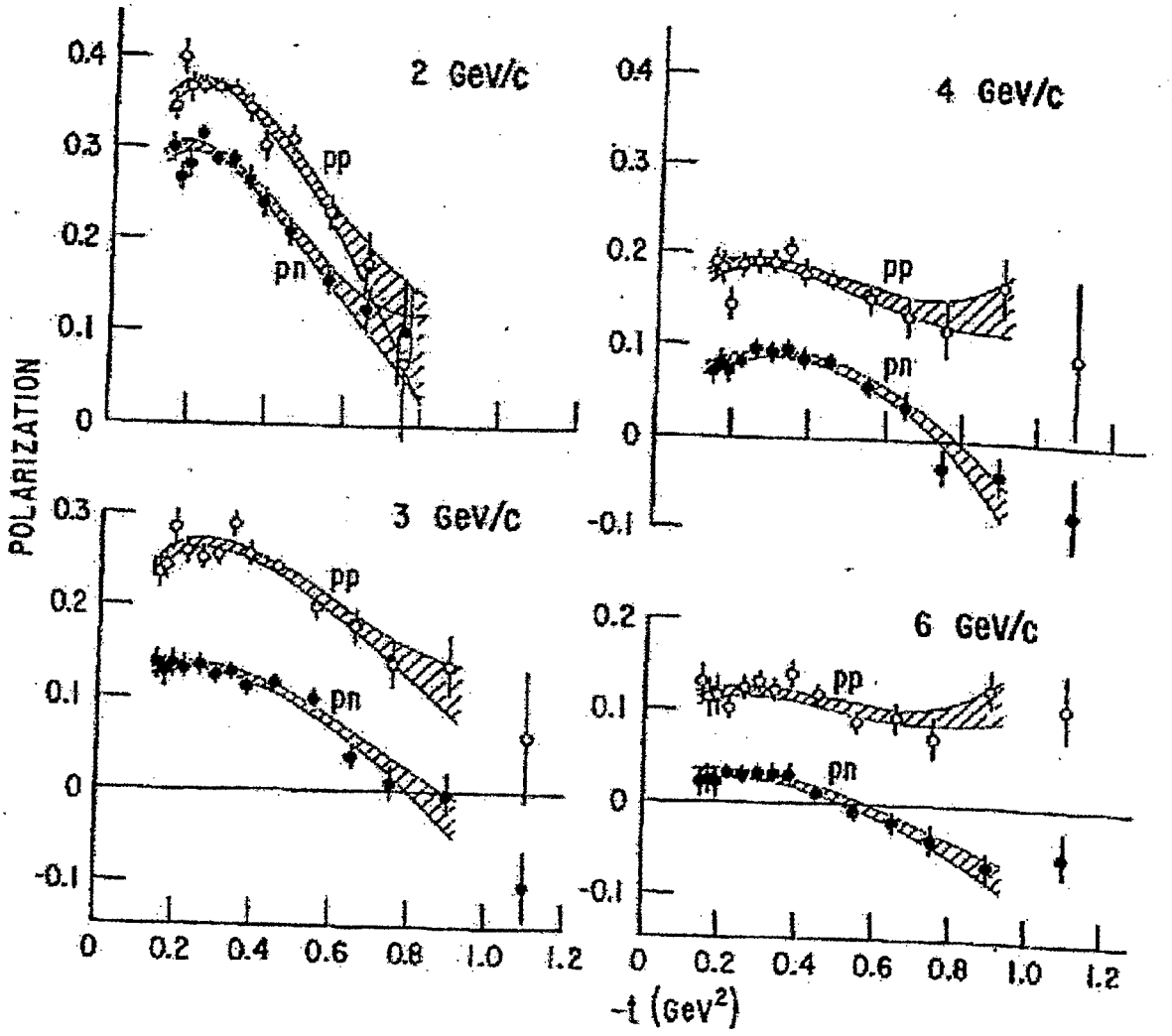
- $\pi^{\pm}p$ elastic scattering

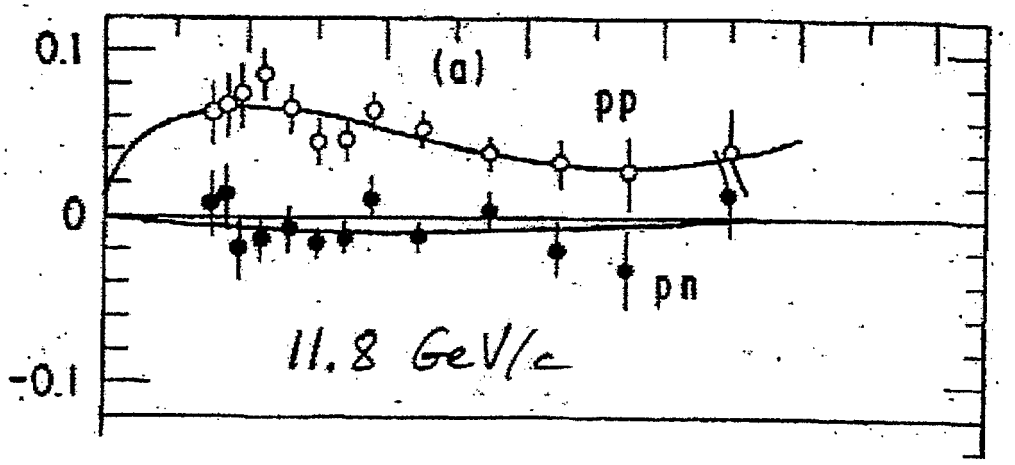
$$A_N^{\pi p}(s,t) \propto \left(\frac{s}{s_0}\right)^{\alpha_\rho(t) - \alpha_{I\!P}(t)}$$



$$\begin{matrix}\Sigma_{\pi p}(s,t) \\ \Delta_{\pi p}(s,t)\end{matrix} = \delta_+(s,t)\, A_N^{\pi^+ p}(s,t) \pm \delta_-(s,t)\, A_N^{\pi^- p}(s,t)$$

Fit:


2 GeV/c
4 GeV/c
3 GeV/c
6 GeV/c
pp
pn
POLARIZATION
-t (GeV²)


(a)
pp
pn
11.8 GeV/c

Aparently, there is a large <u>iso-scalar</u> contribution to the <u>spin-flip</u> amplitude of NN which does not contribute to πN.

This is very important for pC where the iso-vector part is absent.

This might be a source of large iso-scalar spin-flip at 22 GeV.

S.L. Kramer et al.
PRD 17 (1978) 1709

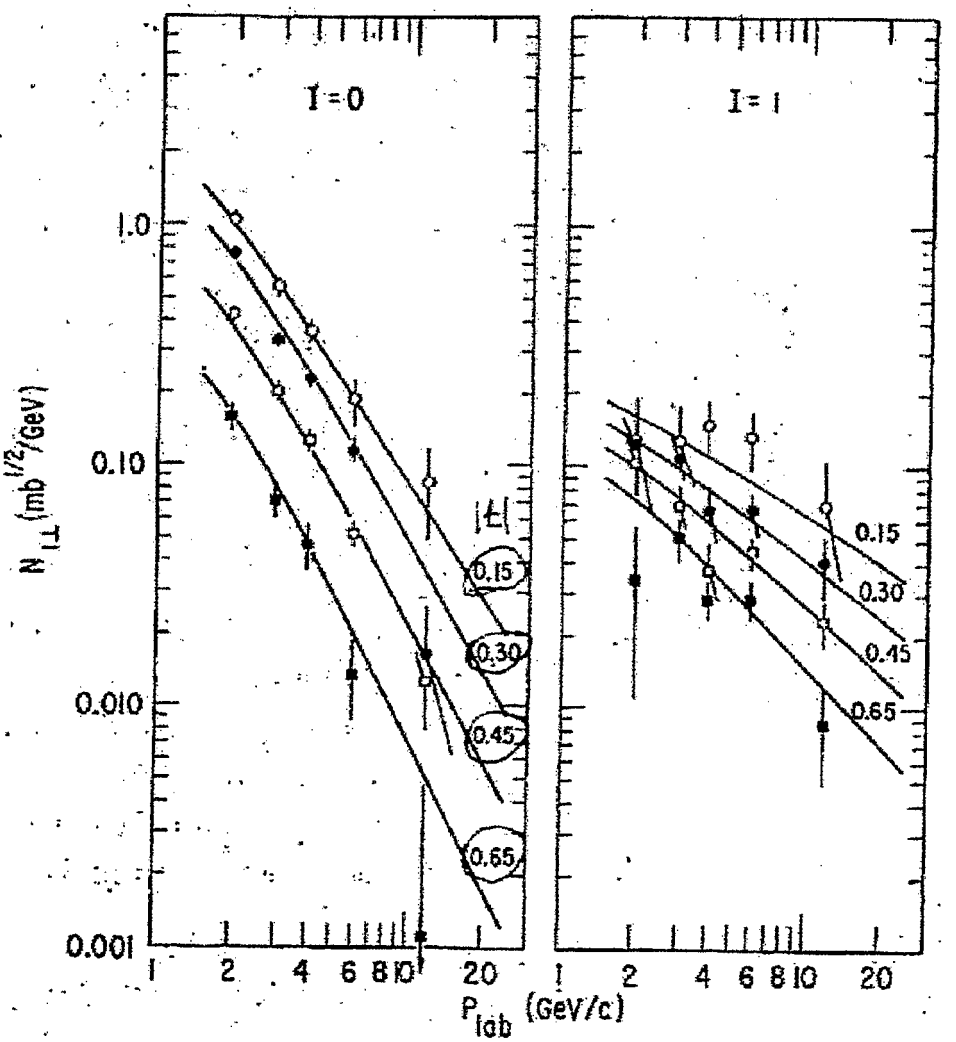


FIG. 2. The $N_{1\perp}^0$ and $N_{1\perp}^1$ amplitudes from Eqs. (6) and (7) as functions of p_{lab} for the t values (GeV^2) indicated. The curves are the results of fits based on Eq. (11) in the momentum range 3 to 11.8 GeV/c and $-t$ range 0.15 to 1.0 GeV^2; for $N_{1\perp}^0$ only the term corresponding to the low-lying σ trajectory was used (parameter C), while for $N_{1\perp}^1$ only the ρ-exchange term was used (parameter B).

$$N(s,t) \propto s^{\alpha_{eff}(t)-1}$$

$$\alpha_{eff}^{I=1}(t) = (0.69 \pm 0.17) + (0.95 \pm 0.44)\, t$$

$$\alpha_{eff}^{I=0}(t) = (-0.33 \pm 0.17) + (1.12 \pm 0.47)\, t$$

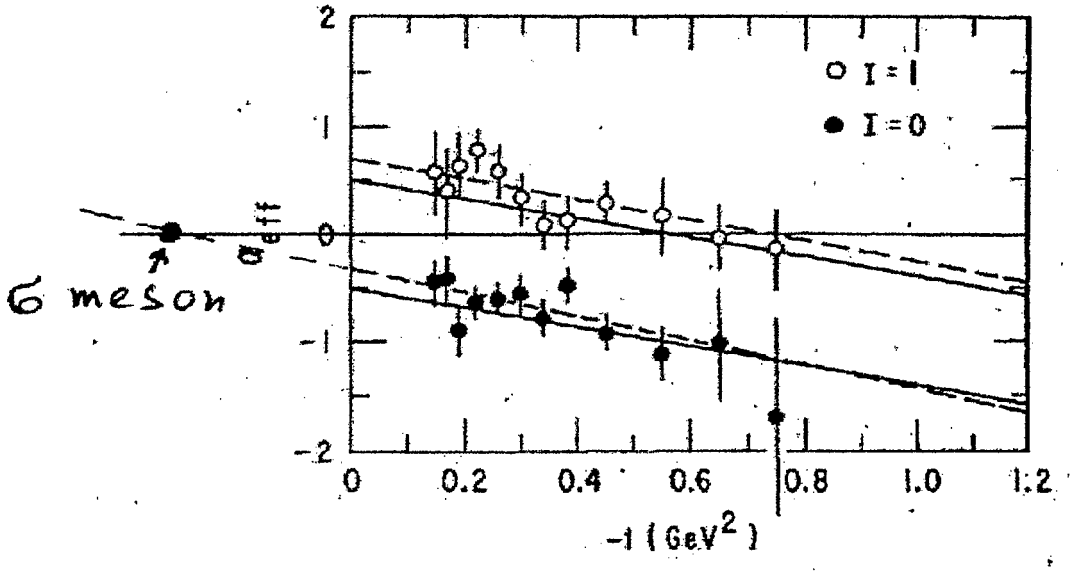


FIG. 3. The effective trajectories for $N_{1\perp}^0$ and $N_{1\perp}^1$ obtained from fits to Eq. (9). The solid lines represent the ρ trajectory, $\alpha = 0.5 + 0.9t$ from Ref. 21, and a low-lying trajectory displaced by one unit of α. The dashed lines are the result of the linear fits to $\alpha_{eff}(t)$ described in the text.

The first state on the Regge trajectory has mass $m_\sigma \sim 0.4$ GeV - σ meson

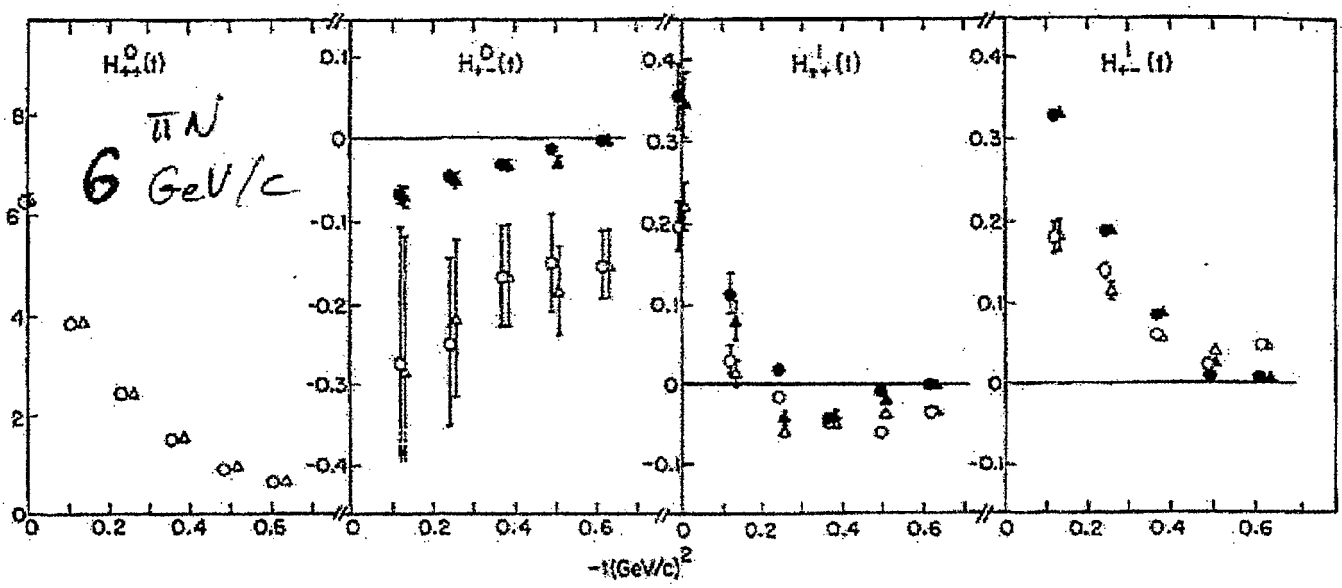
Extrapolating the Argonne data to 22 GeV we get

$$\mathrm{Re}\ r_5 (p_L = 22\,\mathrm{GeV}) \approx 0.02$$

This is confirmed by data from BNL (D.G. Crabb et al. NPB 121 (1977) 231; B 201 (1982) 365)

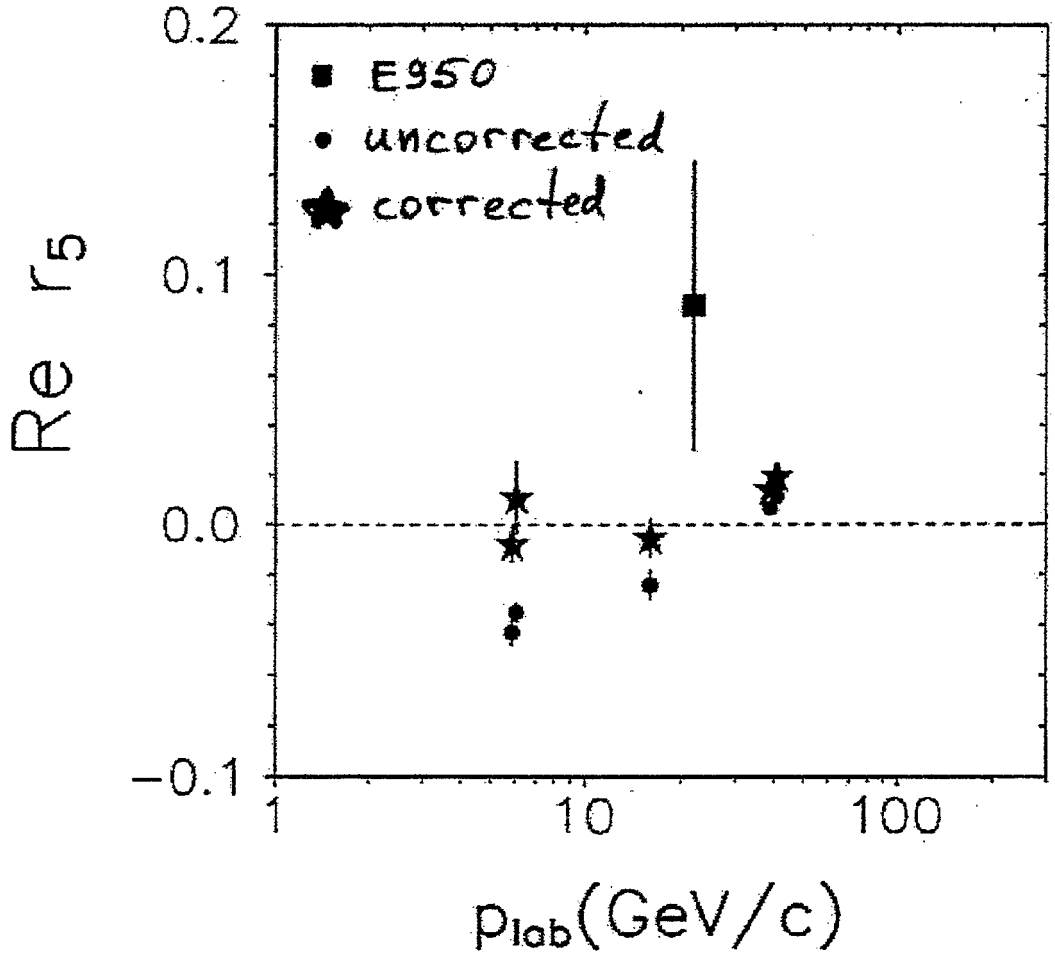
$$\mathrm{Re}\ r_5 (p_L = 24\,\mathrm{GeV}) = 0.016 \pm 0.01$$

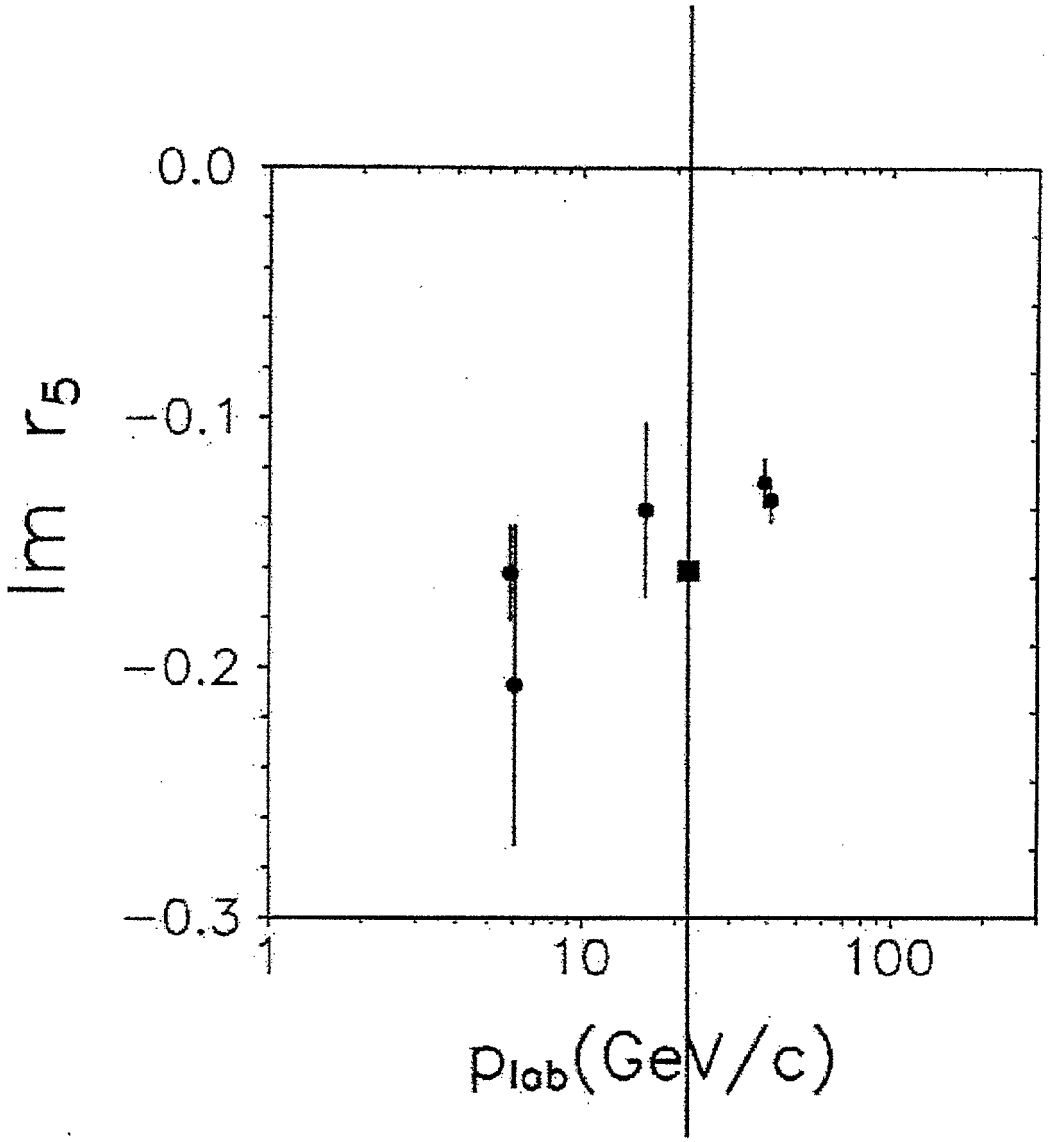
This is much less than follows from the E950 data.



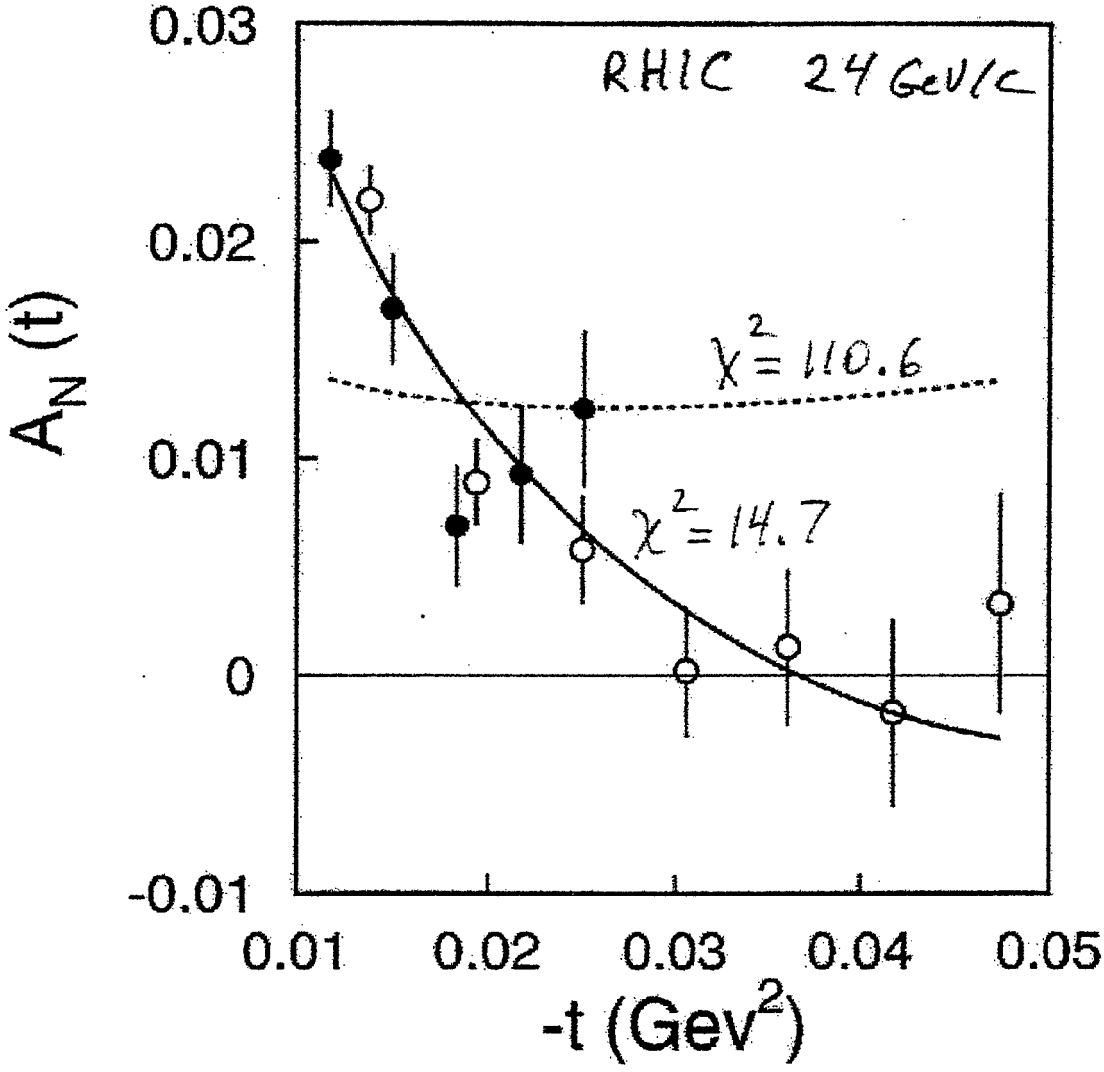
mplitudes at 6.0 GeV/c. The filled and hollow symbols represent real and imaginary pectively. The triangles and circles are obtained by using σ^+ and σ^- data of Refs. 1 ints are at $-t=0.0$, 0.125, 0.250, 0.375, 0.500, and 0.625 $(\mathrm{GeV}/c)^2$.

More evidence for a small iso-scalar spin-flip comes from π-N data if one relies on Regge factorization.


E950
uncorrected
corrected
Re r_5
0.2
0.1
0.0
−0.1
1
10
100
p_{lab}(GeV/c)

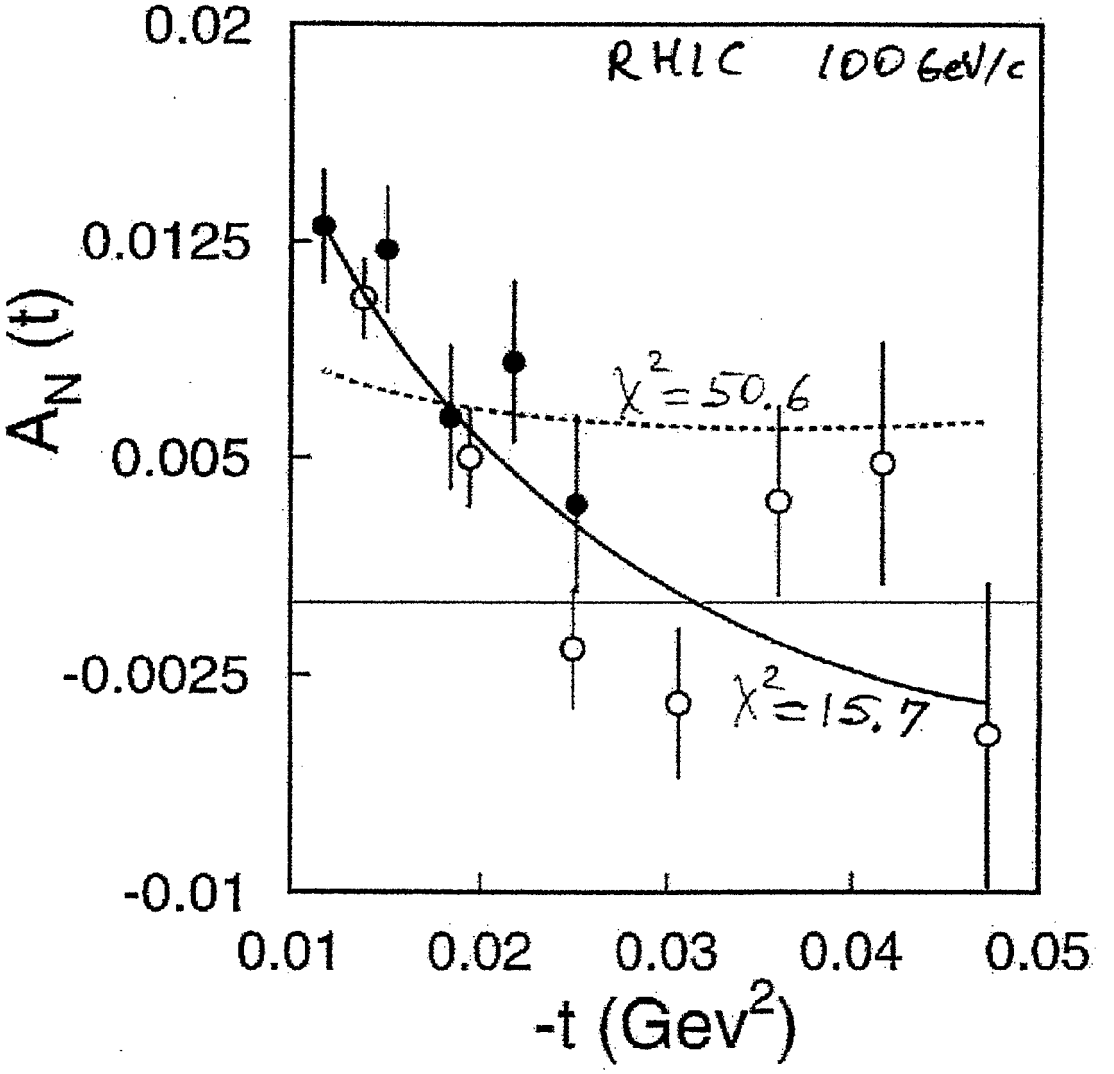

0.0
−0.1
−0.2
−0.3
Im r5
1
10
100
Plab(GeV/c)

Do the new RHIC data support a small Re r_5 ? — No!



—— Re r_5 = 0.084 $N = 1.447 \pm 0.073$
Im r_5 = −0.156 The data must be divided by N

--- Re r_5 = 0
Im r_5 = −0.12 $N = 0.435 \pm 0.0254$



— $\mathrm{Im}\, r_5 = -0.156$
$\mathrm{Re}\, r_5 = 0.058 \pm 0.004$
$N = 0.83 \pm 0.098$

---- $\mathrm{Re}\, r_5 = 0$
$\mathrm{Im}\, r_5 = -0.12$
$N = 0.28 \pm 0.027$

Conclusions

- New RHIC data at 24 and 100 GeV well agree with the results of E950
- Data for A_N at 24 GeV should be reduced by factor $1/N = 0.69$
- Data for A_N at 100 GeV should be increased by factor $1/N = 1.2$
- Data for NN and πN scattering demand a much smaller $\mathrm{Re}\, r_5$ and are inconsistent with the results of pC CNI.
- This controvercy must be settled in order to make it sure that we understand what we are doing

Overview on Absolute Luminosity in RHIC

A. Drees, BNL

March 18, 2003

for

RHIC Spin Collaboration Meeting XVI

RIKEN BNL Research Center

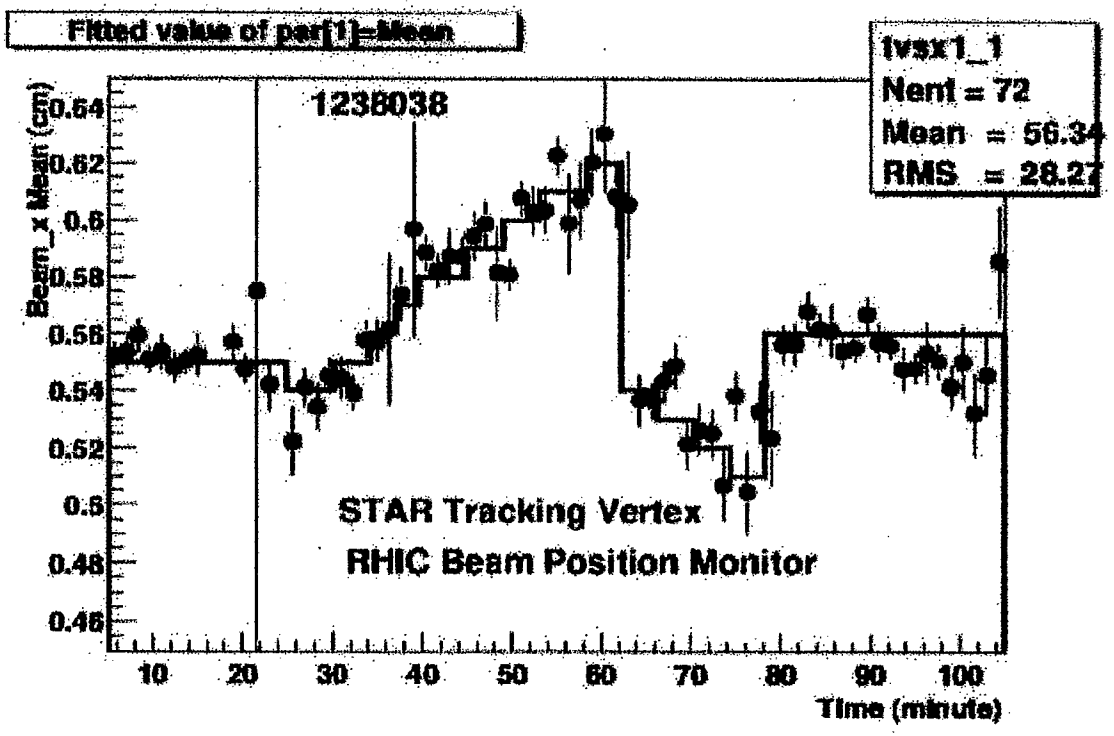
What are Vernier Scans?

Van–der–Meer Scans or Vernier Scans are done by stepwise sweeping one beam across the other while measuring collision rates as a function of beam displacement. This is done in both planes.

Needed basic instrumentation: the ZDCs or other collision monitors (BBC ...) at the various IRs, corrector magnet control to apply 4–bump at IR, DX Beam Position Monitors (BPM) and beam current measurements from Wall Current Monitor (WCM).

A Gauss function is fitted to the result yielding the maximum rates (R_x^{max}, R_y^{max}) the location of the maximums (x_{max}, y_{max}) and the effective beam widths (σ_x, σ_y) in both planes.

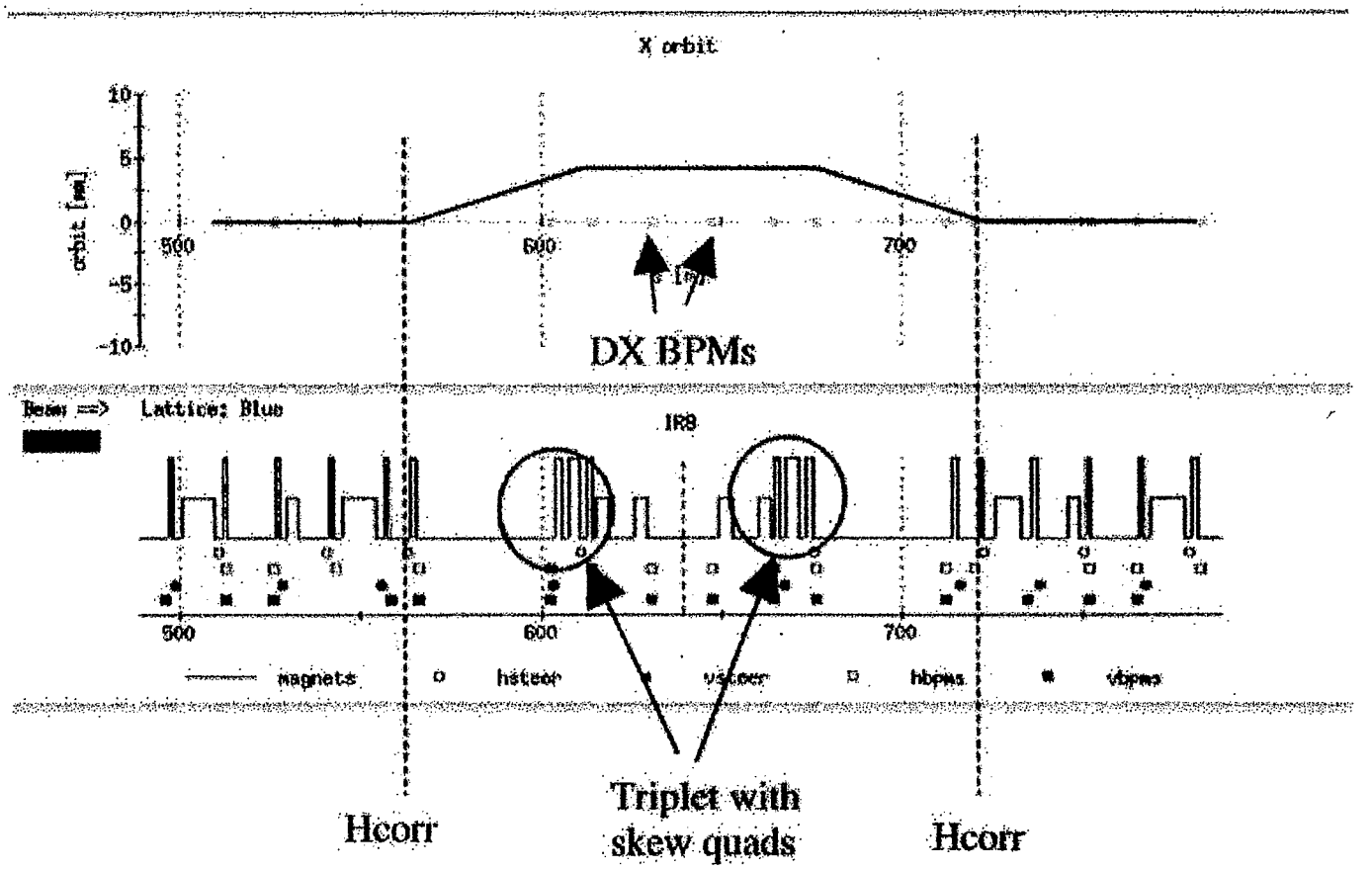
The Method



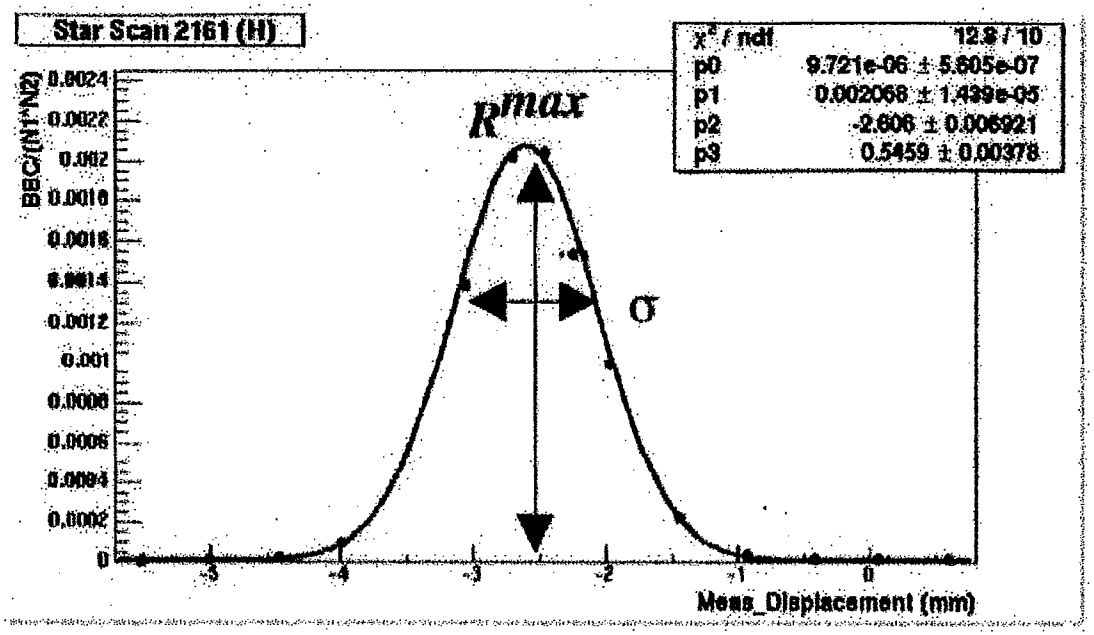
STAR reconstructed vertex during a horizontal scan in 2000 (arbitrary offset added to adjust both data sets).

- **Sweeping blue or yellow beam**
- **Stepsize: 100–500 μm**
- **approx. 2 min./point**
- **good agreement with STAR data**

Method: IR bumps



- New since 2001–02: skew quads in triplets!
- Different optics (β*) requires different corrector settings.
- Only one beam is moved per scan



- do both planes (varying order)
- approx. 30 min. / scan
- fit Gauss function to data
- reasonable c2/ndf
- get fit parameters to calculate luminosity and cross section

$$\sigma_{(BBC)} = R^{max}\ 2\pi\sigma_x\sigma_y k_b/f_{rev}$$

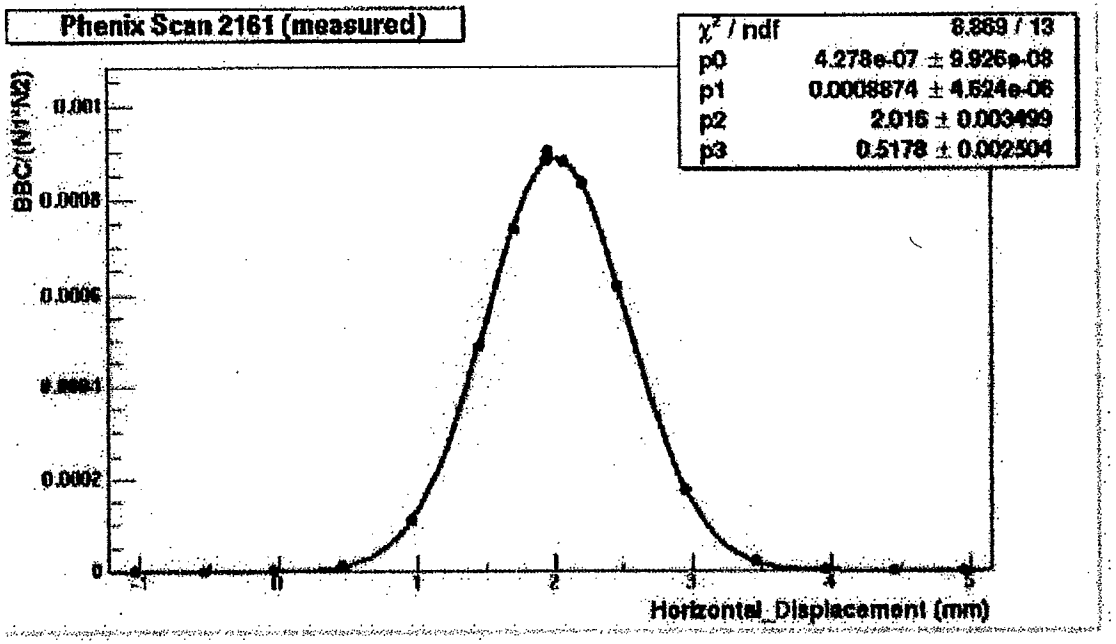
$\sigma_x\ \sigma_y$: horz./vert. profiles

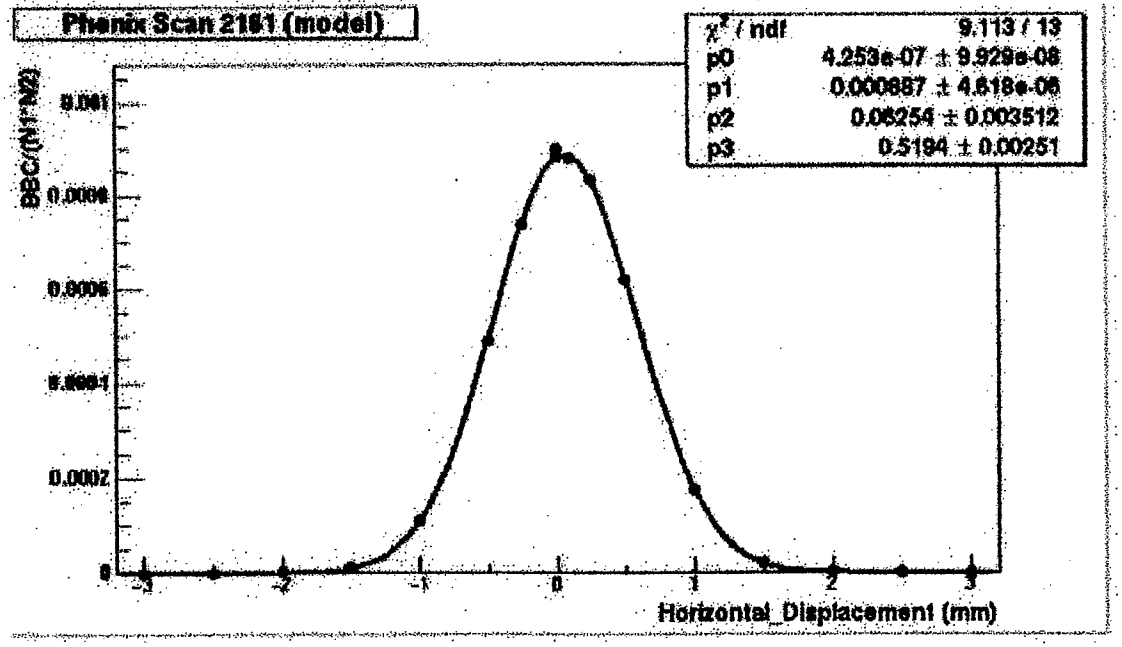
k_b : number of bunches

f_{rev} : revolution frequency

Available Data from Scans in run pp_fy02

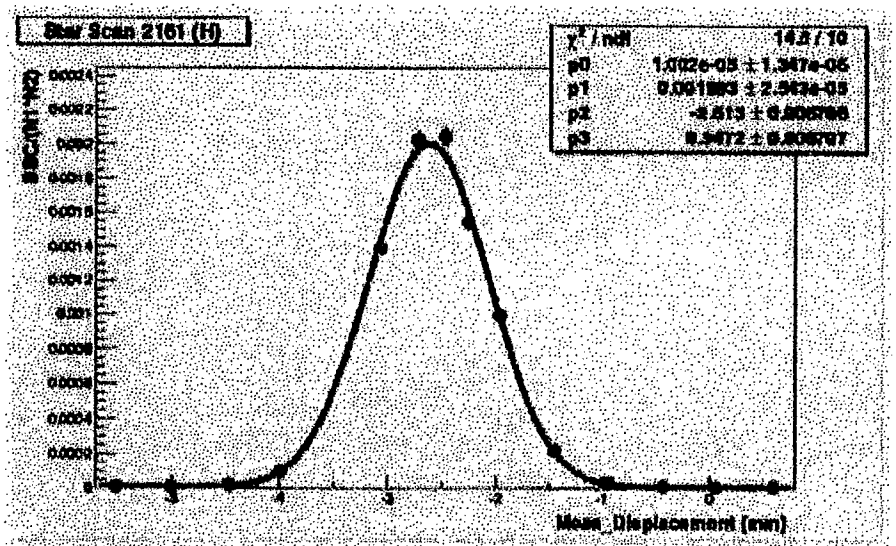
Fill number	IR	date	β*	comment
2119	STAR	12/30/01	3 m	horiz. only, no ZDC
2136	PHENIX	1/3/02	3 m	no ZDC
2161	STAR	1/6/02	3 m	
2161	PHENIX	1/6/02	3 m	
2193	STAR	1/10/02	3 m	no bpm
2193	IR2	1/11/02	3 m	one side bpm
2233	IR2	1/15/02	3 m	one side bpm
2277	STAR	1/20/02	3 m	
2277	PHENIX	1/20/02	3 m	

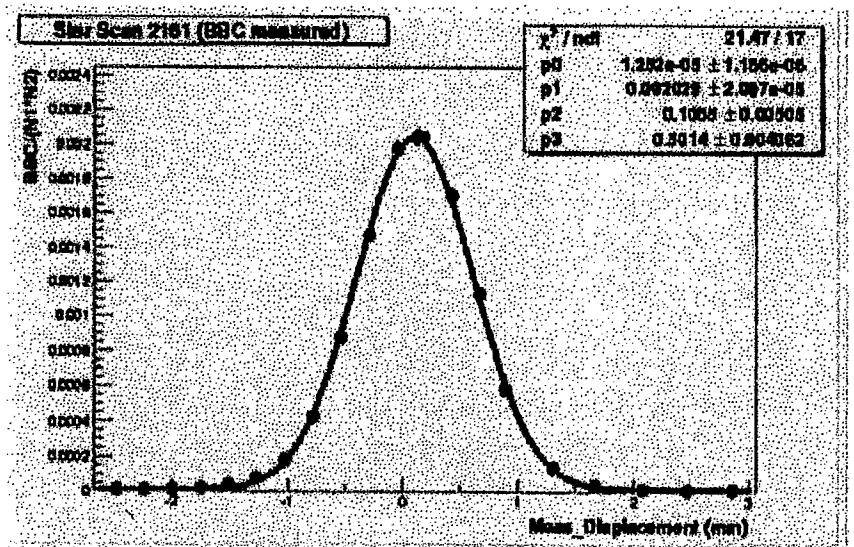


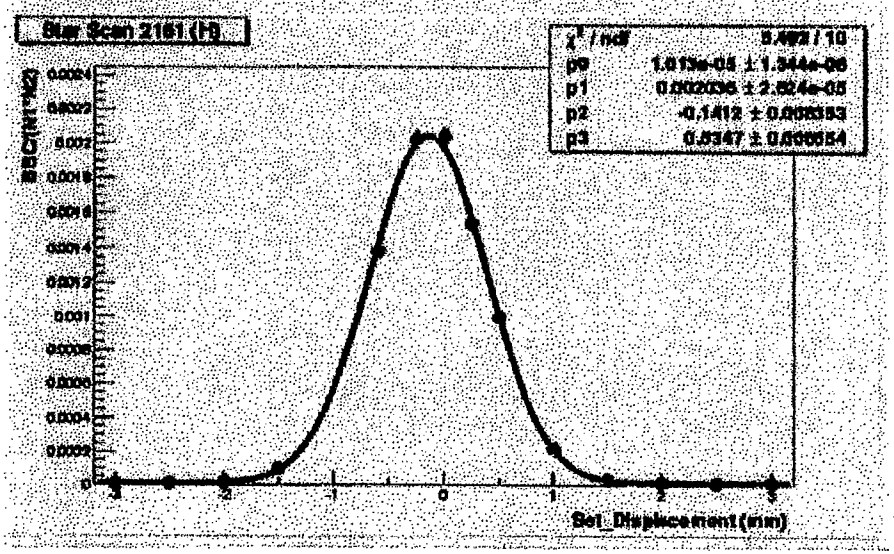


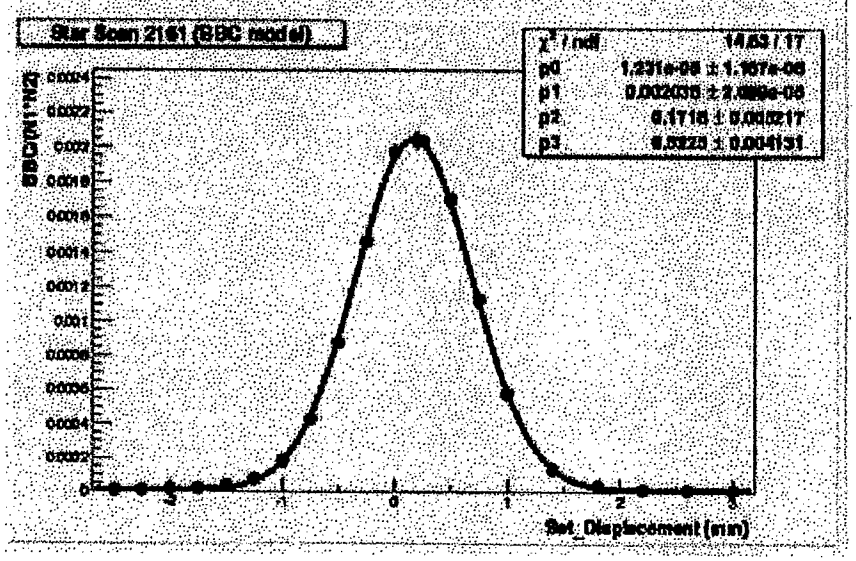
Fill 2161
Horizontal scan
Yellow beam moved

STAR PP scan 2161:

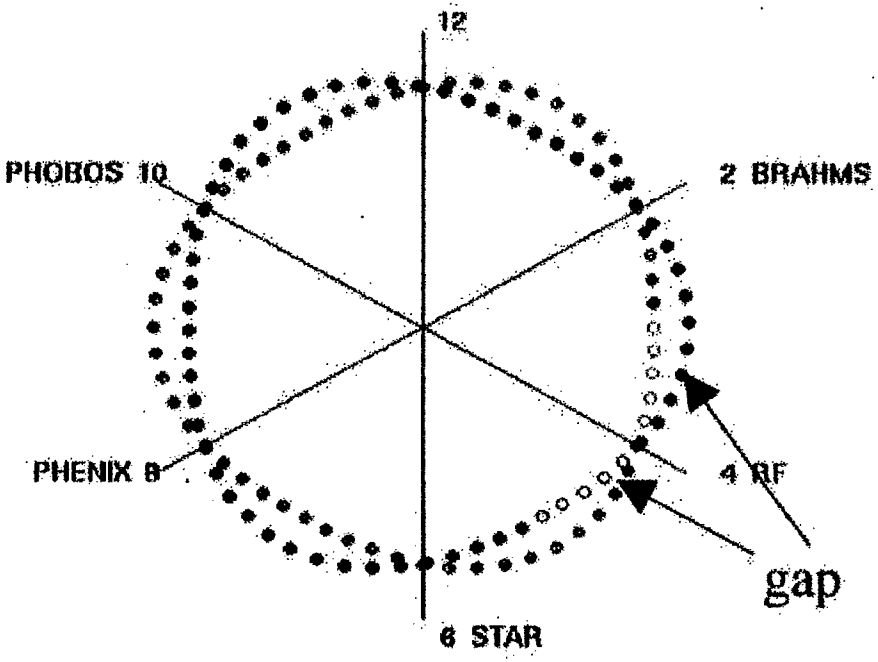








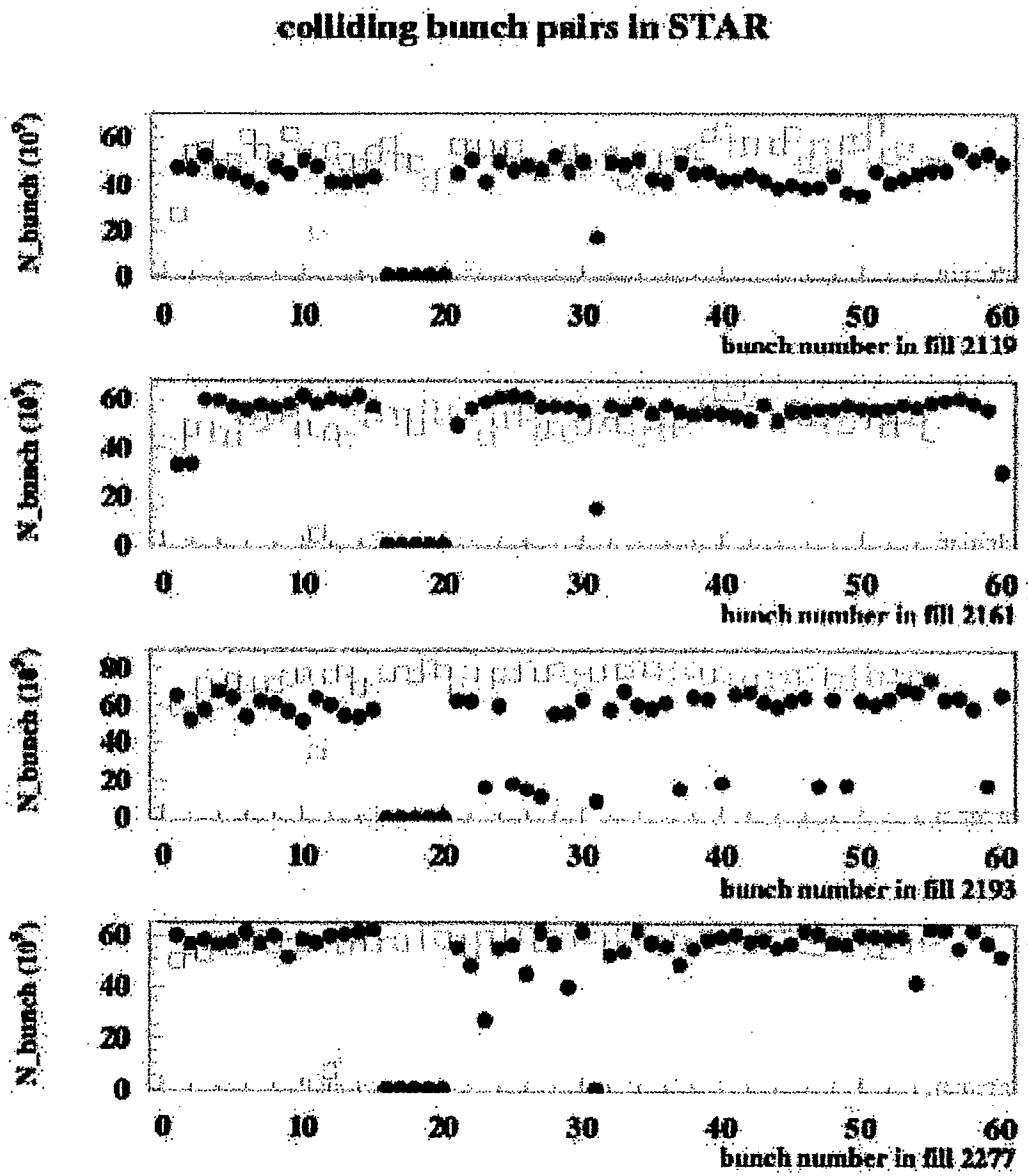
Correction: Fill Pattern



Crossings per Turn: 2:50 4:55 6:50 8:50 10:55 12:50

- Total beam current has to be corrected for actual colliding pairs of bunches at the IRs.

- With 55 bunches (and 60 bunch pattern) this is 9% (5 out of 55) at all IPs except IR8 and IR2 (Au–Au) or IR4 and IR10 (pp). Correction varies from fill to fill slightly.



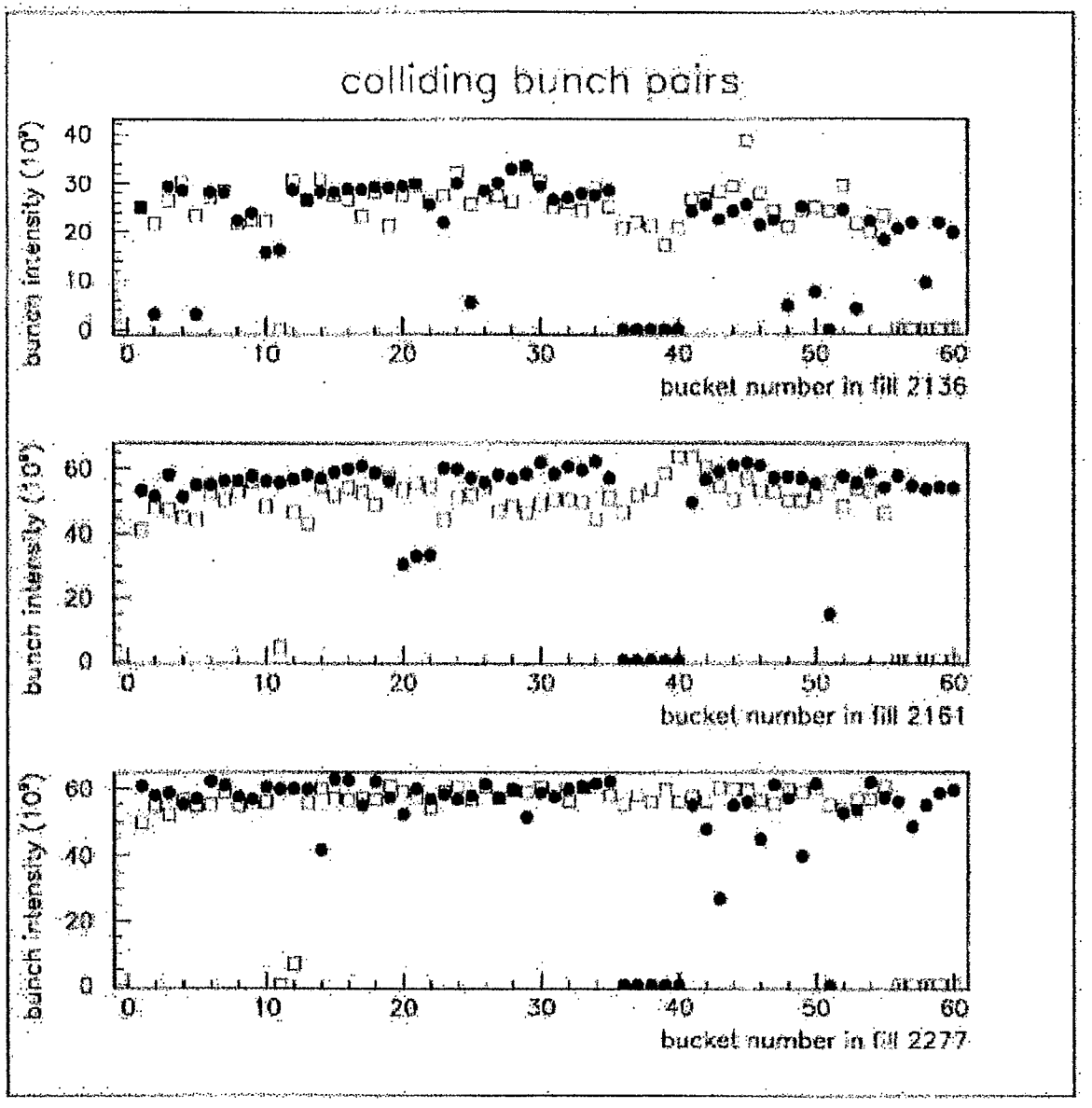
correction:

0.90

0.91

0.90

0.90

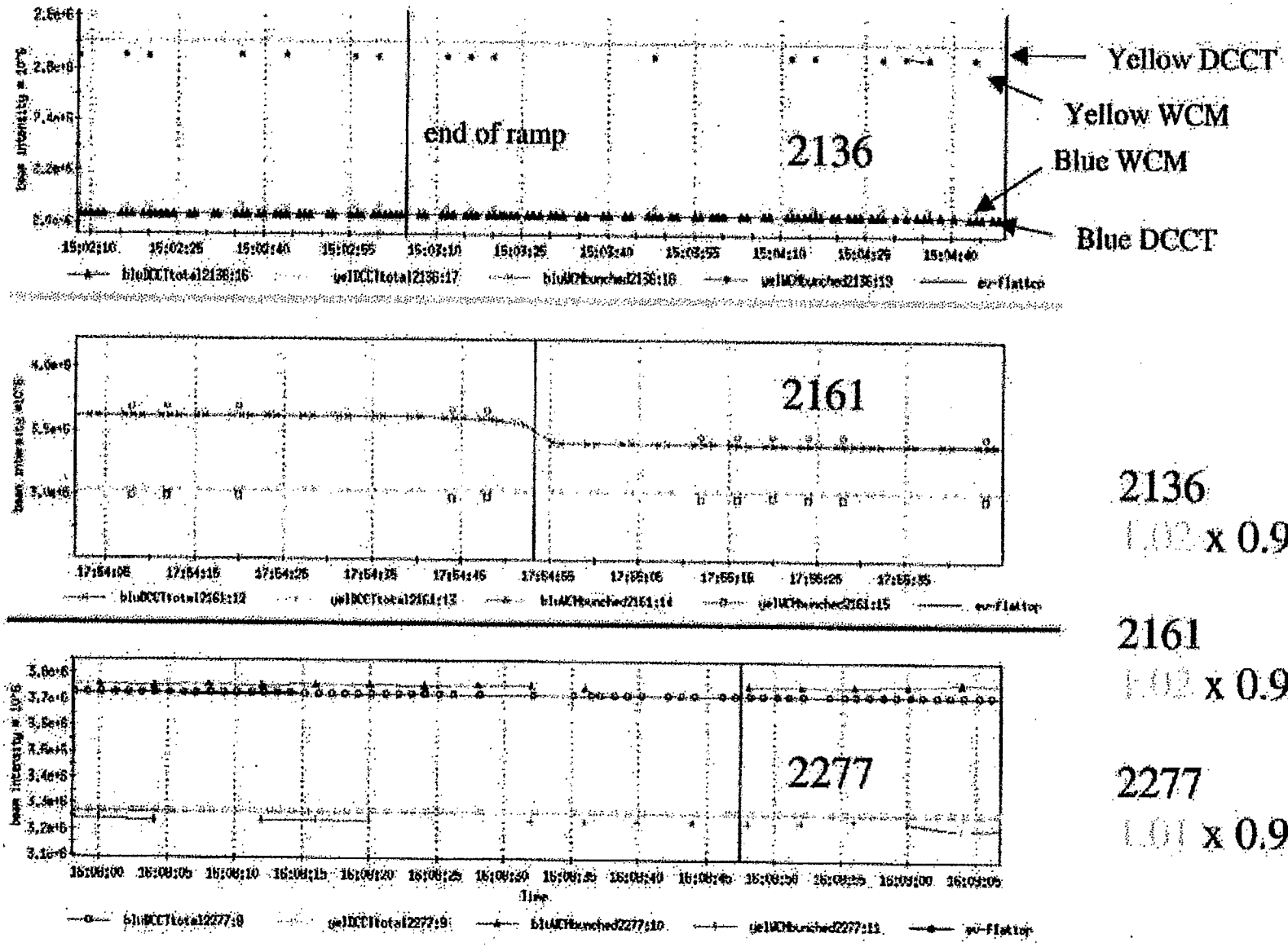


2136
0.97

2161
0.90

2277
0.90

Beam Current Measurements and Errors:



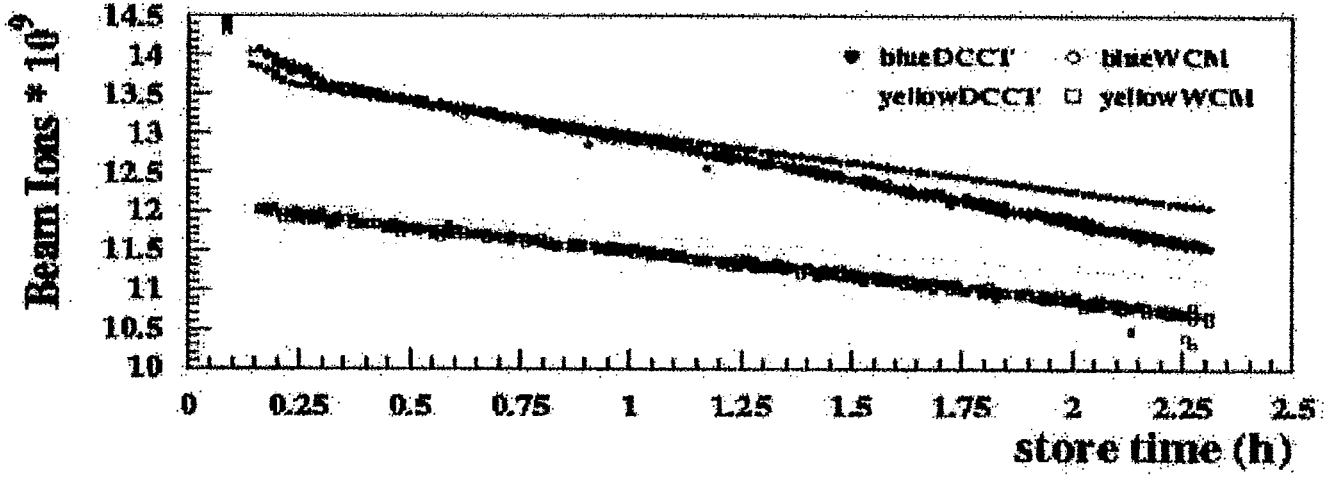
2136
1.02 x 0.98

2161
1.02 x 0.98

2277
1.01 x 0.99

Analysis: The WCM

WCM and DCCT readings during a store as fct. of time



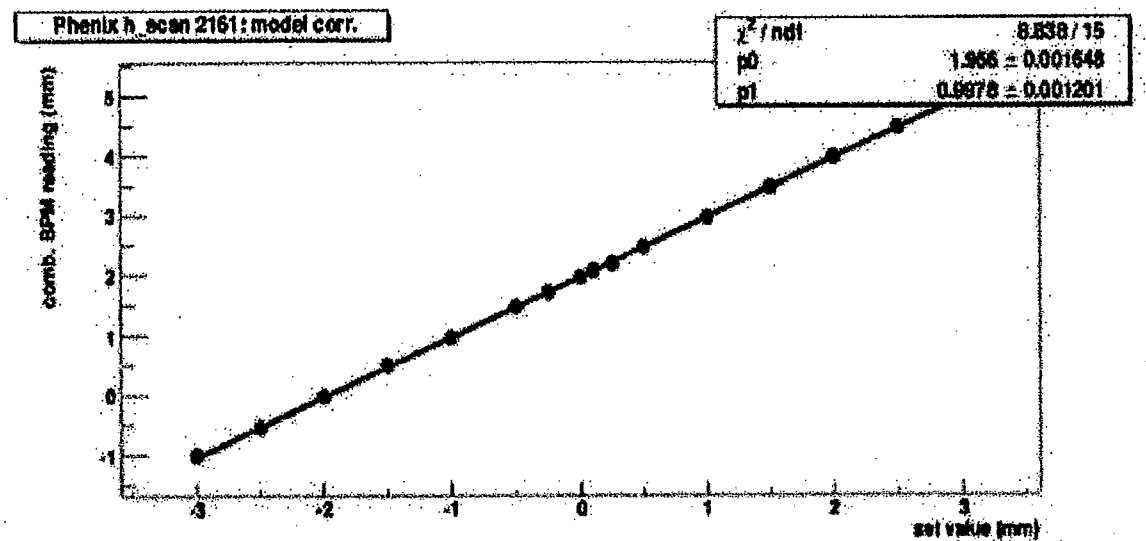
★DCCT: accurate (0.2%) device to measure ANY coasting beam in RHIC

★WCM : measures **BUNCHED** beam only

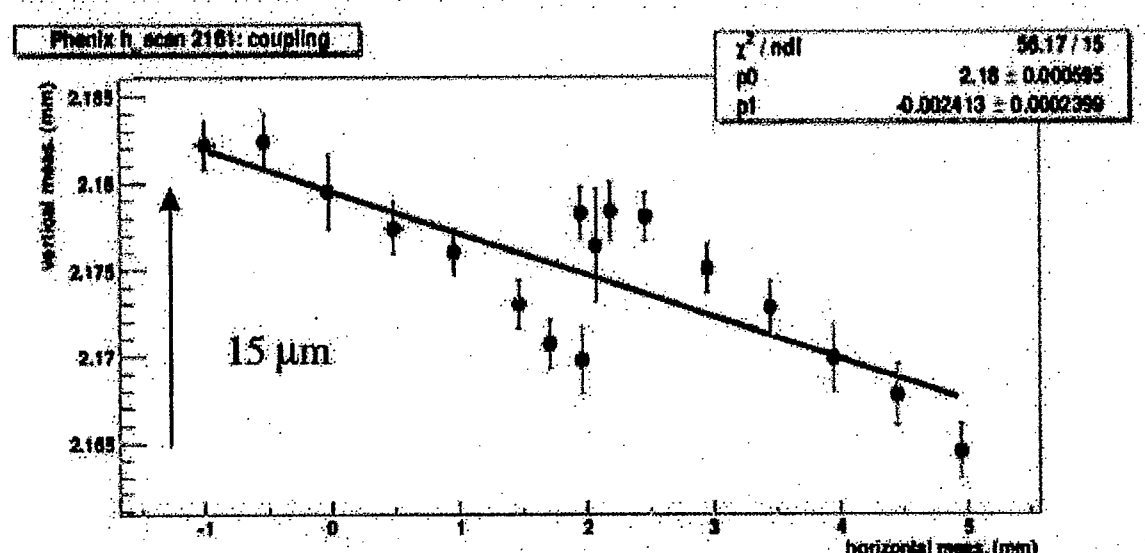
★Calibrate WCM with DCCT at beginning of store only

★Observed deviation around 2 –3%

Coupling and Model Corrections at PHENIX



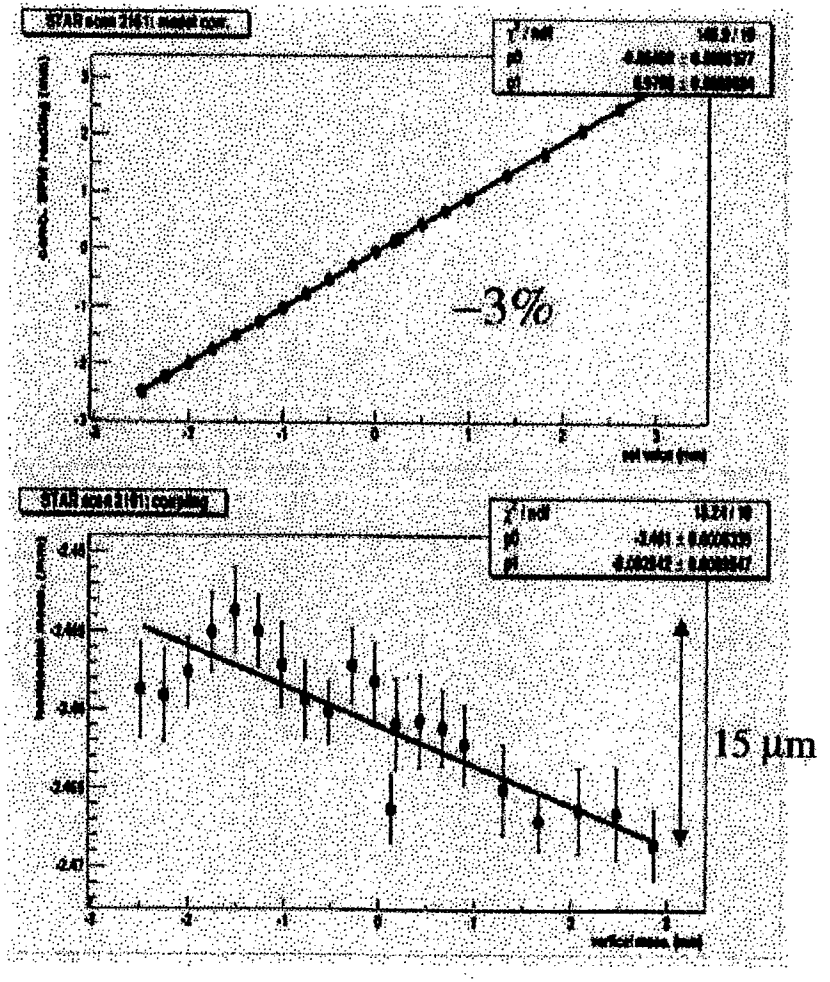
meas. vs. model (set) used for consistency check



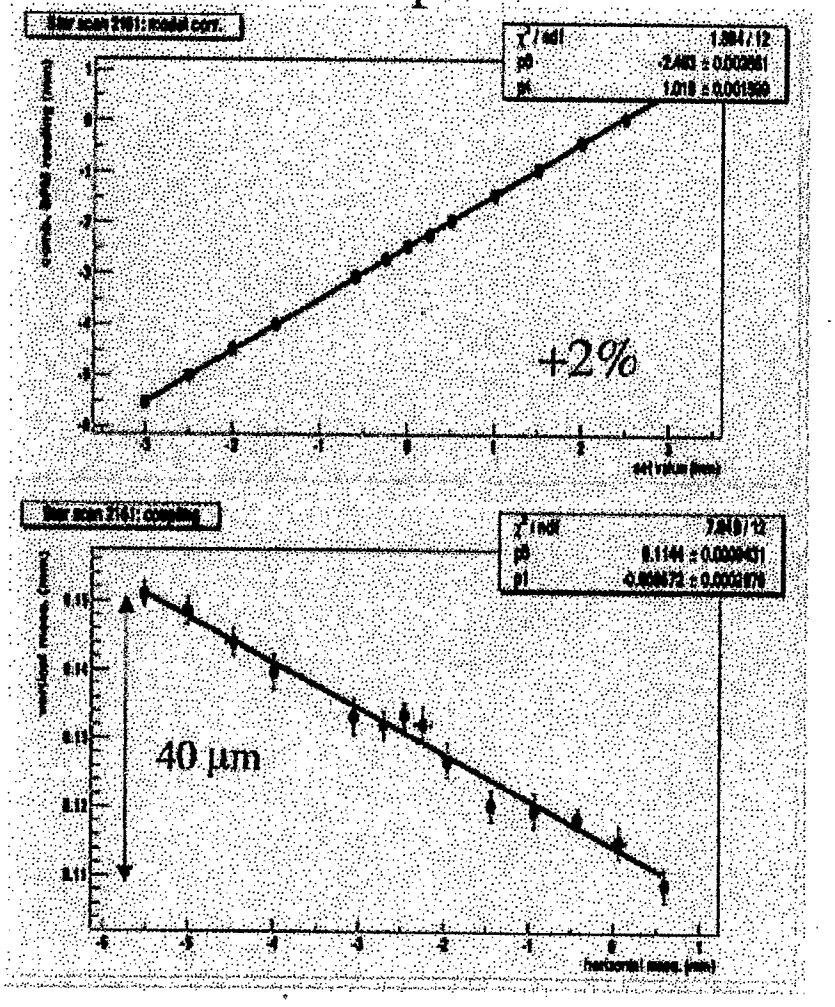
"cross talk", i.e. movement in v–plane while moving in h–plane, is corrected for

Coupling and Model corrections STAR scan 2161

vertical plane:

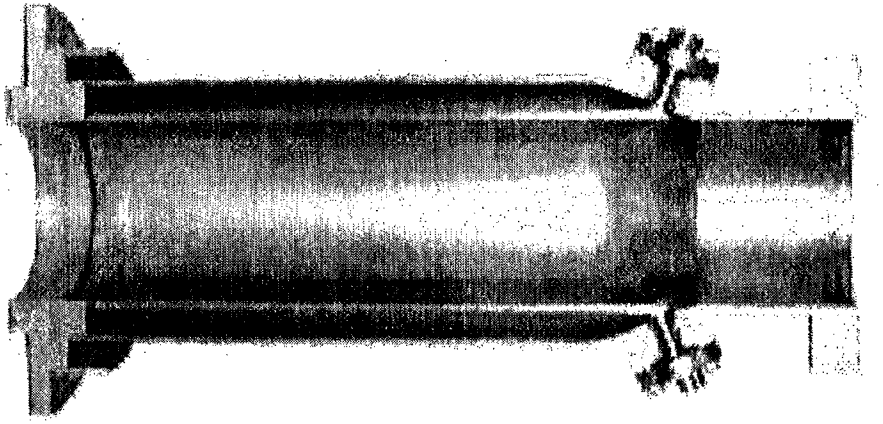


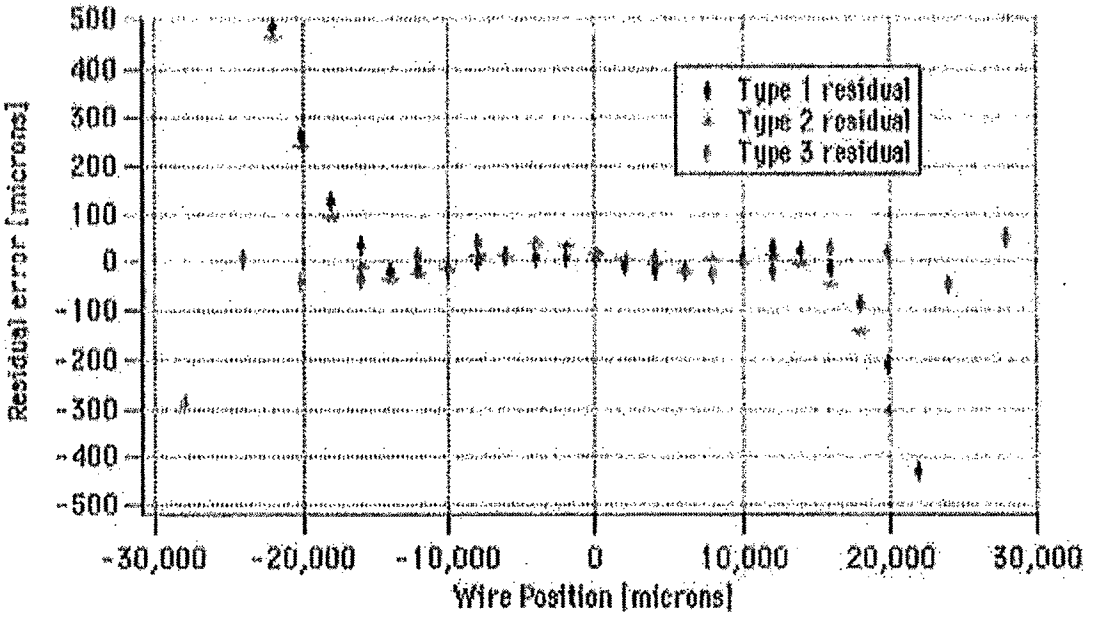
horizontal plane:



BPM precision/resolution

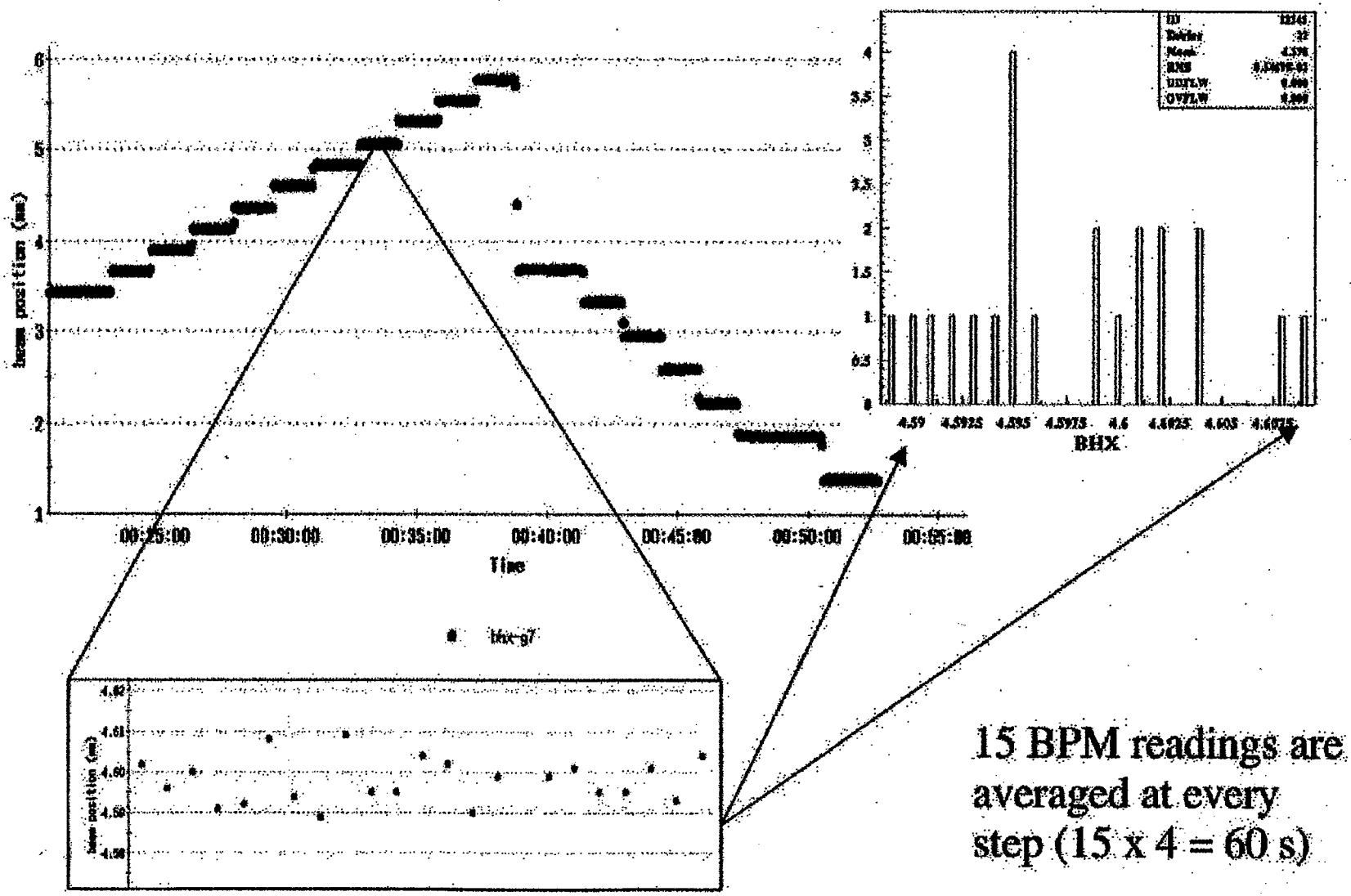
DX BPMS: type2
Dual plane
Small aperture





An absolute error of 2% is added

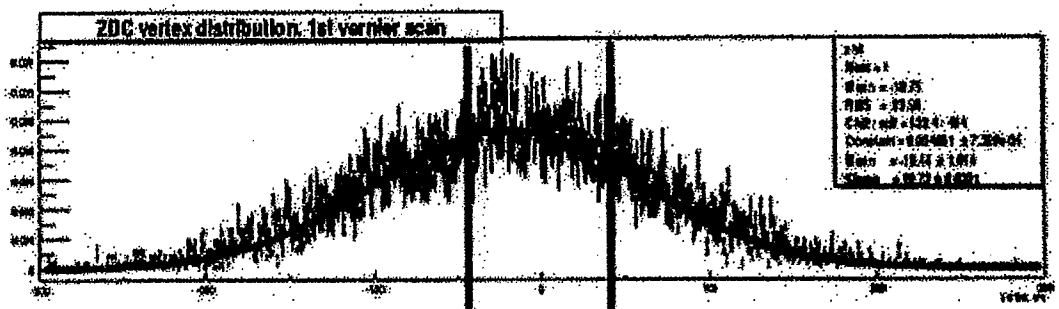
BPM resolution



15 BPM readings are averaged at every step (15 x 4 = 60 s)

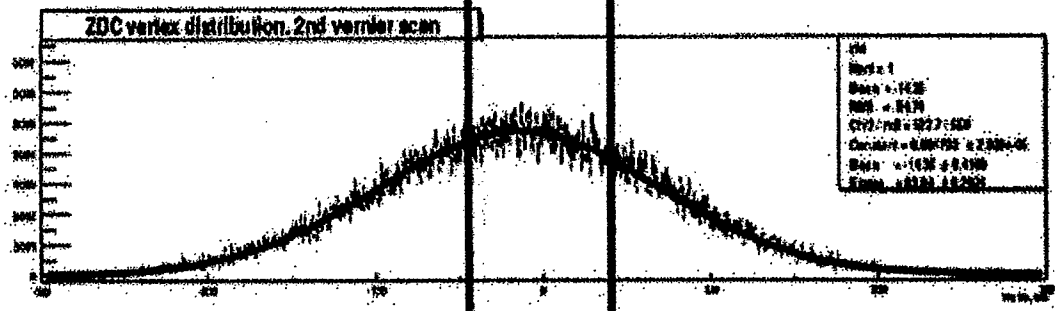
Scaling 75cm–>30cm & ZDC normalization

2136



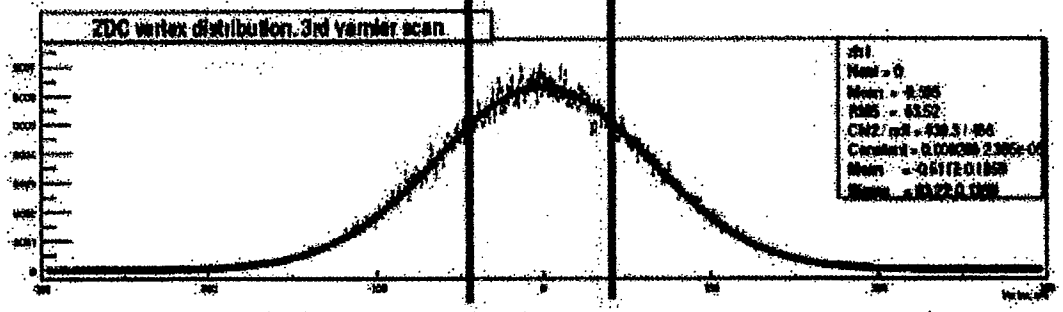
0.466 +/– 0.006
0.281 +/– 0.007

2161



0.459 +/– 0.002
0.271 +/– 0.003

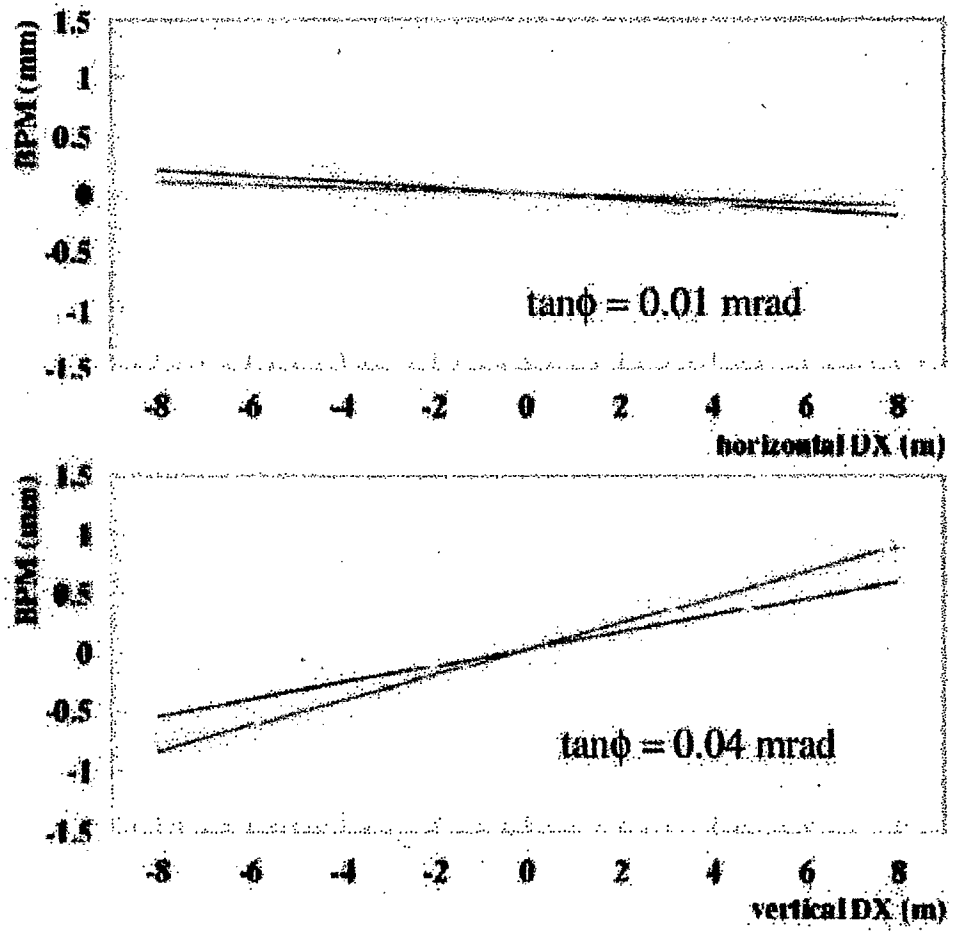
2277



0.497 +/– 0.003
0.364 +/– 0.001

PHENIX data are used to scale from 75 cm–> 30cm
and to normalize to the cross section as seen by the ZDC

PHENIX crossing angle fill 2277



Correction for crossing angles:

$$R = \sqrt{1 + \left(\frac{\sigma_z}{\sigma_x} \tan\phi\right)^2}$$

$\tan\phi$: ½ cross. angle

σ_Z: long. bunch profile 1m (avg.)

σ_X: horiz. bunch profile 360 μm (avg.)

$\tan\phi = 0.1$ mrad R=1.01

$\tan\phi = 0.2$ mrad R=1.04

$\tan\phi = 0.5$ mrad R=1.20

Data taken after vernier scan (no transv. offsets)

Adjusted by 0.–0.4 mm to cross at 0/0 –> uncertainty of 0.1 mrad

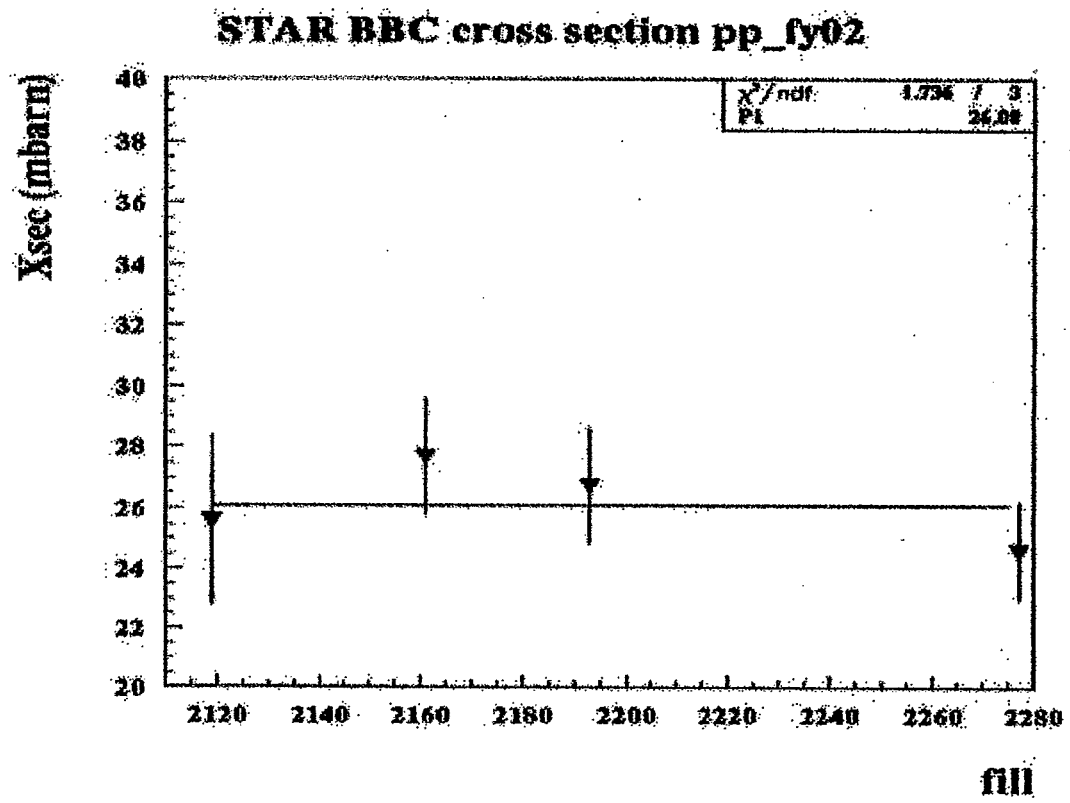
Systematic Errors and Final Corrections

BPM scatter	BC calibration x2	Crossing angle	Scaling 75–>30 cm	Abs. BPM	Blow up
3%	1.4–2.8%	1%	1%	2%	1%

Point to point absolute

fill	σ(BBC) (mbarn)	Fill patt.	Cross. angle	Scale factor	σ(BBC) +/-30cm	Stat.	Syst.
2136	11.7	0.97 −1	+0.2	1.66	20.4	0.2	1.3
2161	11.7	0.90 −1	–	1.7	22.1	0.2	1.4
2277	15.4	0.90 −1	–	1.38	23.6	0.1	1.0

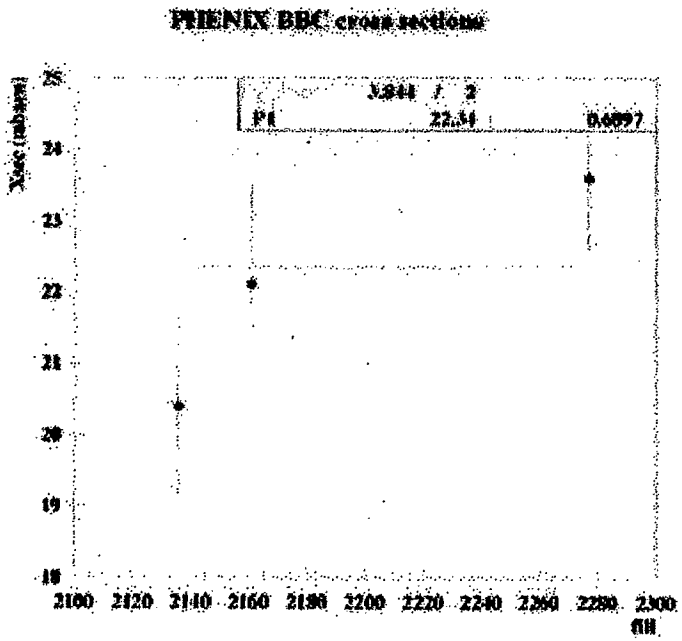
STAR



stat. & syst. errors!!

$\sigma_{BBC,STAR}$ = 26.1 +/– 0.2 (stat) +/– 1 (syst.) +/– 0.8 (abs.) mbarn

Summary: BBC$^{+/-\ 30\ cm}$ Cross Section



Total inelastic cross section
World average:
42.2 +/– 1.9 mbarn

BBC cross section is 53%
(consistent with simulations)

Final number after all corrections:

$\sigma_{BBC,+/-30\ cm}$ = 22.3 +/– 0.1 (stat) +/– 0.6 (syst) +/– 0.7 (abs.)

RHIC Spin Collaboration Meeting XVI
March 18, 2003
RIKEN BNL Research Center

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March 18, 2003

Small Seminar Room, Physics Dept., Brookhaven National Laboratory

*******AGENDA*******

Morning Session

09:00 – 09:45	Status Report on the AGS	L. Ahrens
09:45 – 10:30	Status Report on the New AGS CNI Polarimeter	S. Bravar
10:30 – 10:45	Coffee Break	
10:45 – 11:30	Run Plan for Polarized Protons in RHIC	H. Huang
11:30 – 12:15	Discussion on the Morning Session	G. Bunce

Afternoon Session

2:30 – 3:15	Theory Talk: "Elastic Scattering at Small Angles"	B. Kopeliovich
3:15 – 3:30	Coffee Break	
3:30 – 4:15	Overview on Absolute Luminosity in RHIC	A. Drees

Additional RIKEN BNL Research Center Proceedings:

Volume 51 – RHIC Spin Collaboration Meetings XV, XVI – BNL-
Volume 50 – High Performance Computing with QCDOC and BlueGene – BNL-71147-2003
Volume 49 – RBRC Scientific Review Committee Meeting – BNL-52679
Volume 48 – RHIC Spin Collaboration Meeting XIV – BNL-71300-2003
Volume 47 – RHIC Spin Collaboration Meetings XII, XIII – BNL-71118-2003
Volume 46 – Large-Scale Computations in Nuclear Physics using the QCDOC – BNL-52678
Volume 45 – Summer Program: Current and Future Directions at RHIC – BNL-71035
Volume 44 – RHIC Spin Collaboration Meetings VIII, IX, X, XI – BNL-71117-2003
Volume 43 – RIKEN Winter School – Quark-Gluon Structure of the Nucleon and QCD – BNL-52672
Volume 42 – Baryon Dynamics at RHIC – BNL-52669
Volume 41 – Hadron Structure from Lattice QCD – BNL-52674
Volume 40 – Theory Studies for RHIC-Spin – BNL-52662
Volume 39 – RHIC Spin Collaboration Meeting VII – BNL-52659
Volume 38 – RBRC Scientific Review Committee Meeting – BNL-52649
Volume 37 – RHIC Spin Collaboration Meeting VI (Part 2) – BNL-52660
Volume 36 – RHIC Spin Collaboration Meeting VI – BNL-52642
Volume 35 – RIKEN Winter School – Quarks, Hadrons and Nuclei – QCD Hard Processes and the Nucleon Spin – BNL-52643
Volume 34 – High Energy QCD: Beyond the Pomeron – BNL-52641
Volume 33 – Spin Physics at RHIC in Year-1 and Beyond – BNL-52635
Volume 32 – RHIC Spin Physics V – BNL-52628
Volume 31 – RHIC Spin Physics III & IV Polarized Partons at High Q^2 Region – BNL-52617
Volume 30 – RBRC Scientific Review Committee Meeting – BNL-52603
Volume 29 – Future Transversity Measurements – BNL-52612
Volume 28 – Equilibrium & Non-Equilibrium Aspects of Hot, Dense QCD – BNL-52613
Volume 27 – Predictions and Uncertainties for RHIC Spin Physics & Event Generator for RHIC Spin Physics III – Towards Precision Spin Physics at RHIC – BNL-52596
Volume 26 – Circum-Pan-Pacific RIKEN Symposium on High Energy Spin Physics – BNL-52588
Volume 25 – RHIC Spin – BNL-52581
Volume 24 – Physics Society of Japan Biannual Meeting Symposium on QCD Physics at RIKEN BNL Research Center – BNL-52578
Volume 23 – Coulomb and Pion-Asymmetry Polarimetry and Hadronic Spin Dependence at RHIC Energies – BNL-52589
Volume 22 – OSCAR II: Predictions for RHIC – BNL-52591
Volume 21 – RBRC Scientific Review Committee Meeting – BNL-52568
Volume 20 – Gauge-Invariant Variables in Gauge Theories – BNL-52590

Additional RIKEN BNL Research Center Proceedings:

Volume 19 – Numerical Algorithms at Non-Zero Chemical Potential – BNL-52573
Volume 18 – Event Generator for RHIC Spin Physics – BNL-52571
Volume 17 – Hard Parton Physics in High-Energy Nuclear Collisions – BNL-52574
Volume 16 – RIKEN Winter School - Structure of Hadrons - Introduction to QCD Hard Processes – BNL-52569
Volume 15 – QCD Phase Transitions – BNL-52561
Volume 14 – Quantum Fields In and Out of Equilibrium – BNL-52560
Volume 13 – Physics of the 1 Teraflop RIKEN-BNL-Columbia QCD Project First Anniversary Celebration – BNL-66299
Volume 12 – Quarkonium Production in Relativistic Nuclear Collisions – BNL-52559
Volume 11 – Event Generator for RHIC Spin Physics – BNL-66116
Volume 10 – Physics of Polarimetry at RHIC – BNL-65926
Volume 9 – High Density Matter in AGS, SPS and RHIC Collisions – BNL-65762
Volume 8 – Fermion Frontiers in Vector Lattice Gauge Theories – BNL-65634
Volume 7 – RHIC Spin Physics – BNL-65615
Volume 6 – Quarks and Gluons in the Nucleon – BNL-65234
Volume 5 – Color Superconductivity, Instantons and Parity (Non?)-Conservation at High Baryon Density – BNL-65105
Volume 4 – Inauguration Ceremony, September 22 and Non -Equilibrium Many Body Dynamics – BNL-64912
Volume 3 – Hadron Spin-Flip at RHIC Energies – BNL-64724
Volume 2 – Perturbative QCD as a Probe of Hadron Structure – BNL-64723
Volume 1 – Open Standards for Cascade Models for RHIC – BNL-64722