

CAD Machine Status & Update

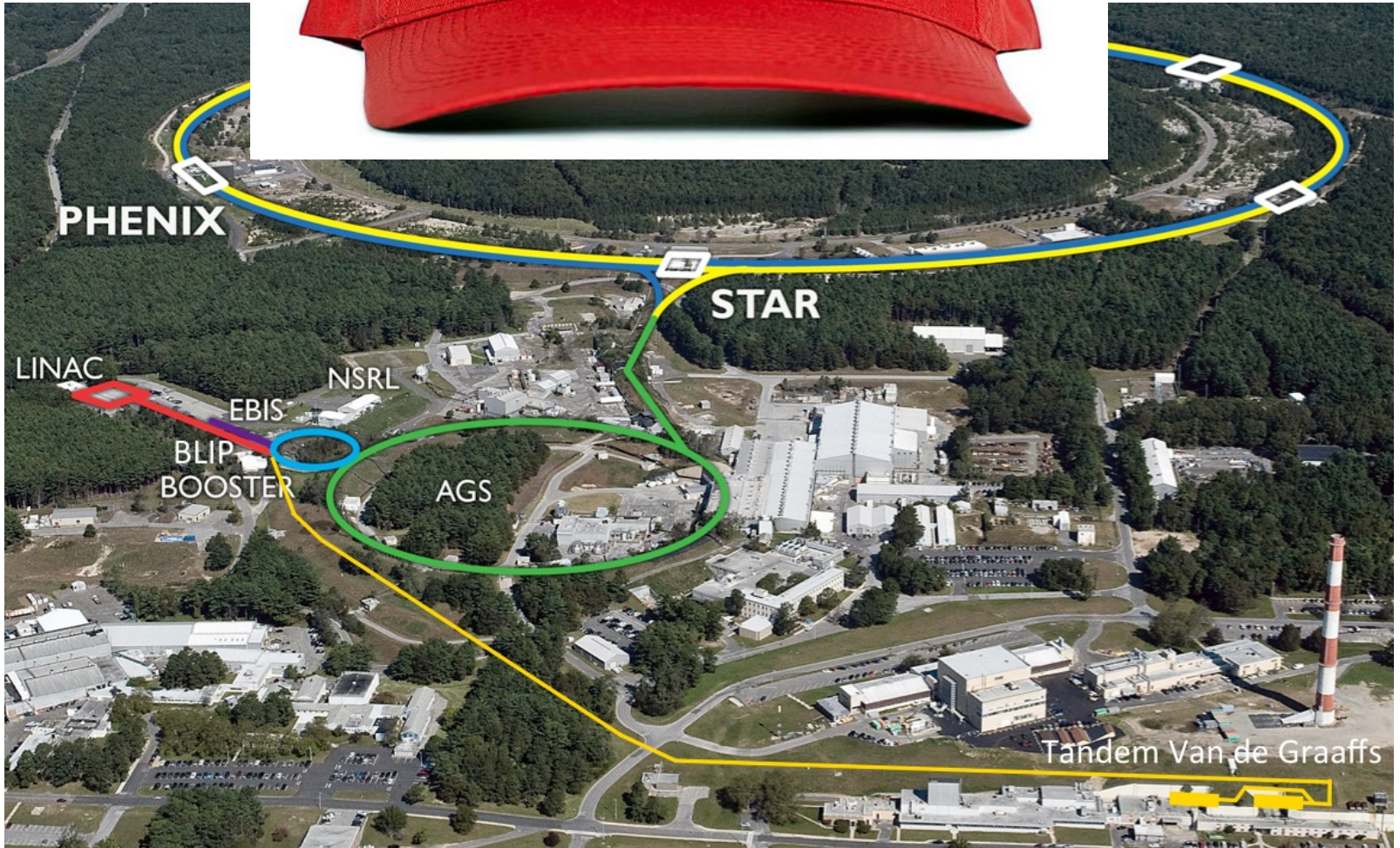
V. Ranjbar

Overview of RHIC 17 Run

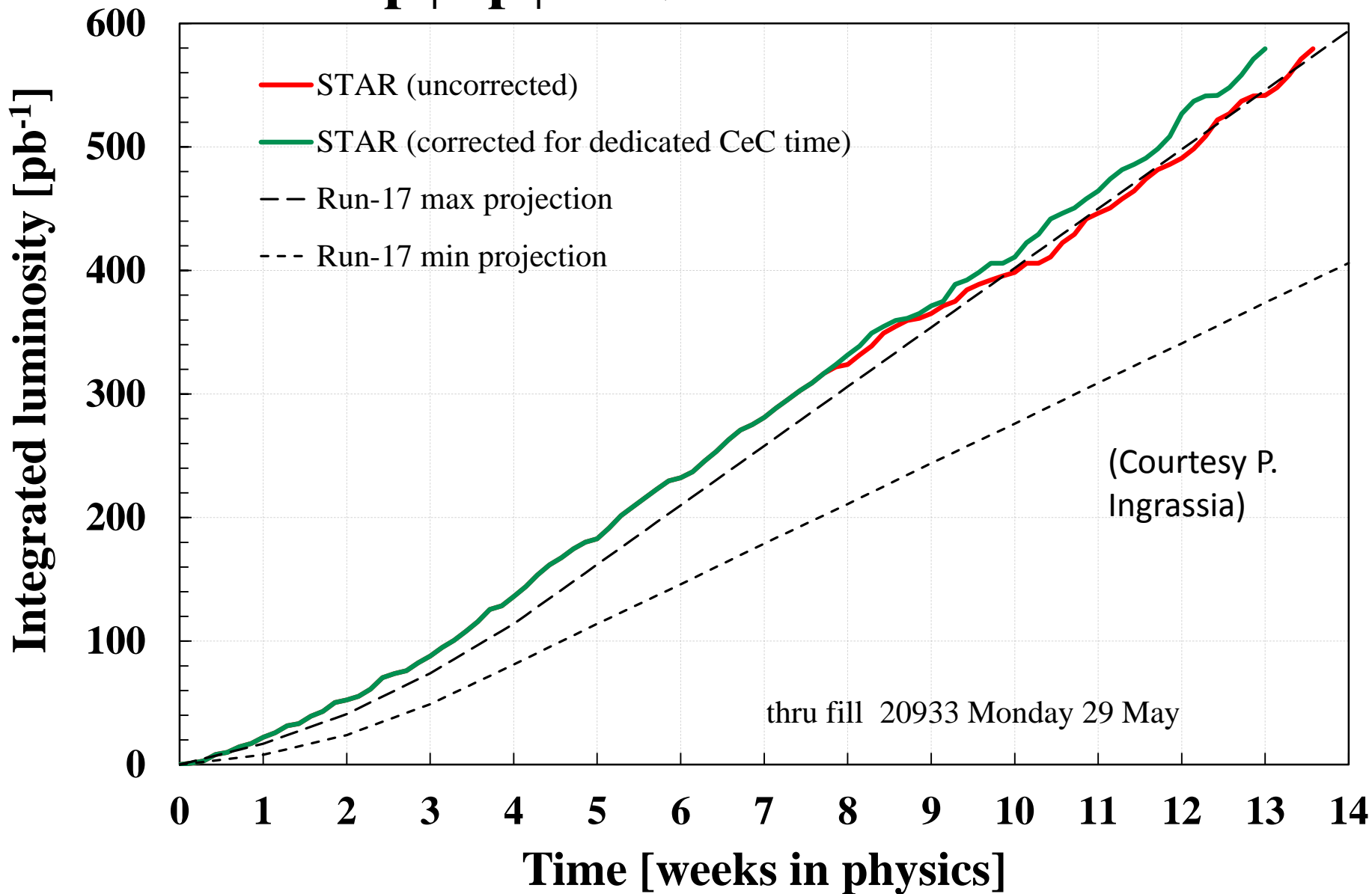
- Transversely polarized protons with collisions only at STAR at 510 GeV.
 - Luminosity leveled during Store
- 3 weeks 27 GeV Au-Au collisions
- 90 hours of dedicated CeC PoP development
- Beam extracted from DC Gun for LEReC
- 4 days of RHICf: radially polarized protons at 8 m Beta Star

MAKE GREAT AGAIN

The RHIC RUN



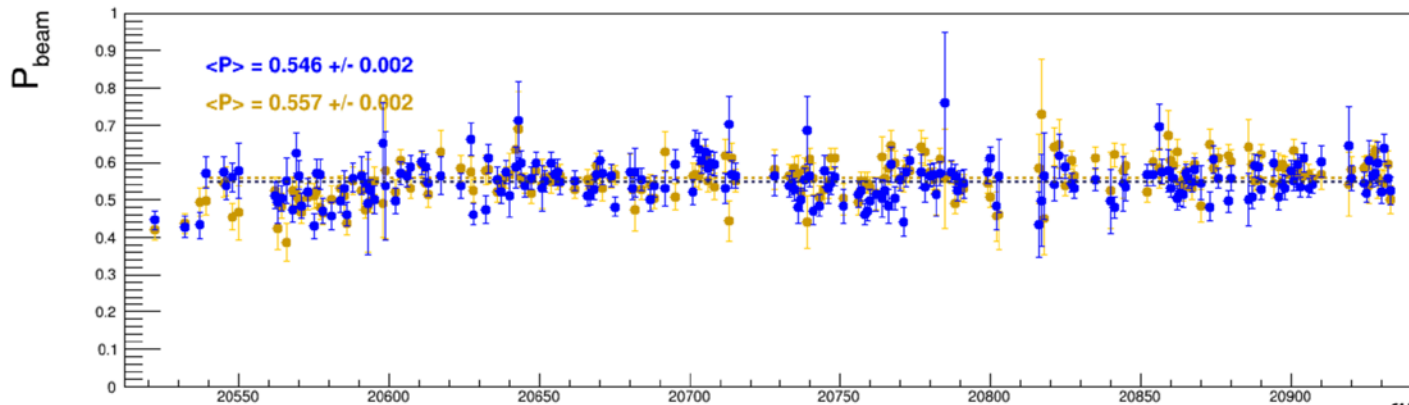
RHIC Run-17 delivered luminosity, $p\uparrow+p\uparrow$ at $\sqrt{s} = 510$ GeV



Achieved or Exceeded all of our Goals

- For the main PP run we exceed our maximum projections for integrated luminosity with 55% average Jet Polarization.
 - We saw improvements in machine performance across several areas
 - Polarization efficiency
 - Emittance-Intensity ratio
 - Due to Increase in OPPIS beam by 20%
 - Use of the dual Harmonic in AGS to reduce space-charge blow-up

Polarization Analysis



RUN 17 255 GeV Polarization

RUN 13 Polarization

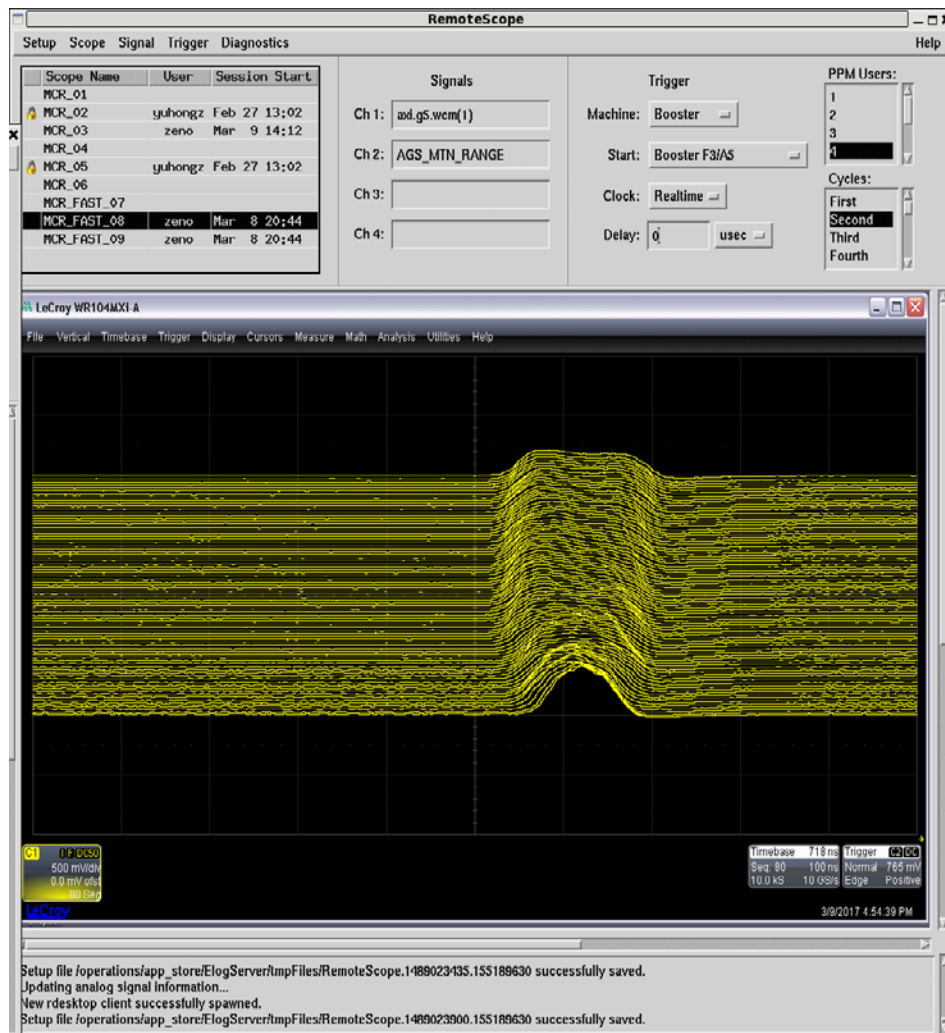
Measurement	Blue Ring	Yellow Ring	Blue Ring	Yellow Ring
Avg. Jet	54.6 +/- 0.2%	55.7 +/- 0.2%	49.49 +/- 0.2%	51.41 +/- 0.2%
Avg. CNI	57.53 +/- 0.18%	59.6 +/- 0.18%	55.53 +/- 0.2%	56.08 +/- 0.2%
Avg. Ramp eff.	92.84 +/- 0.25%	92.0 +/- 0.3%	88.5 +/- 0.3%	90.7 +/- 0.3%
Avg. AGS/RHIC eff.	87.21 +/- 0.3%	89.48 +/- 0.44%		
Store lifetime	-0.17 +/- 0.03%/hr	-0.30 +/- 0.02%/hr	-0.63 +/- 0.03%/hr	-0.75 +/- 0.03%/hr

Changes which could have effected Polarization

- Better Emittance/Intensity
 - Due to dual harmonic in AGS
- Optics changes to Ramp and Store lattice
 - Attempt to minimize interfering spin resonance during strong intrinsic Spin resonance crossing on Ramp
 - Dispersion prime matching between snakes:
 - Reduction in spin tune spread

AGS Mountain Range Plots of Dual Harmonics

Thanks: Haixin Huang

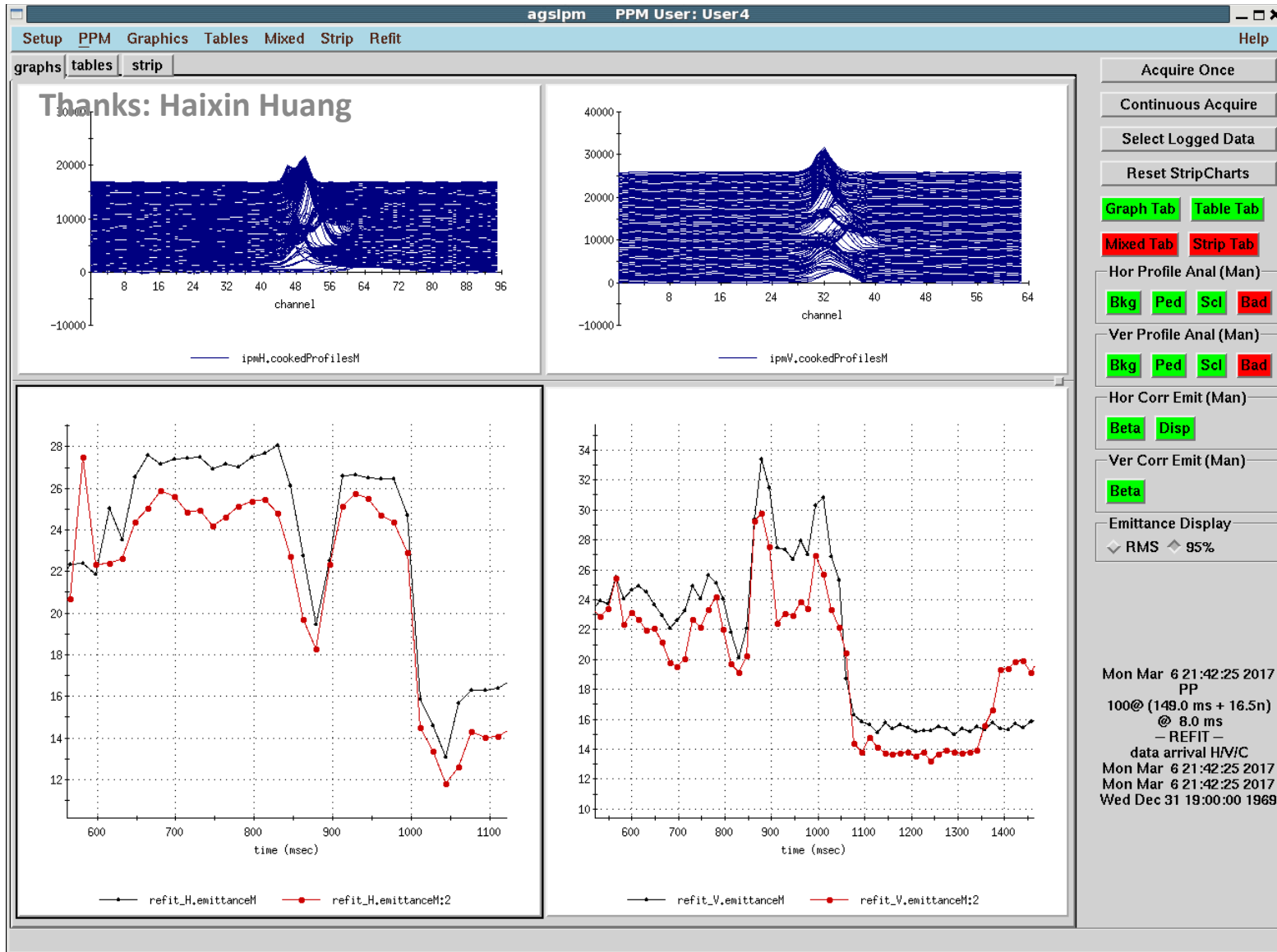


The use of Dual Harmonics in the AGS RF system permitted a reduction in the peak current at lower energies. This reduced the total emittance blow-up due to space charge effects which dominate at lower energies.

Thus we were able to achieve higher intensities with lower extracted emittances into RHIC

144-154ms.

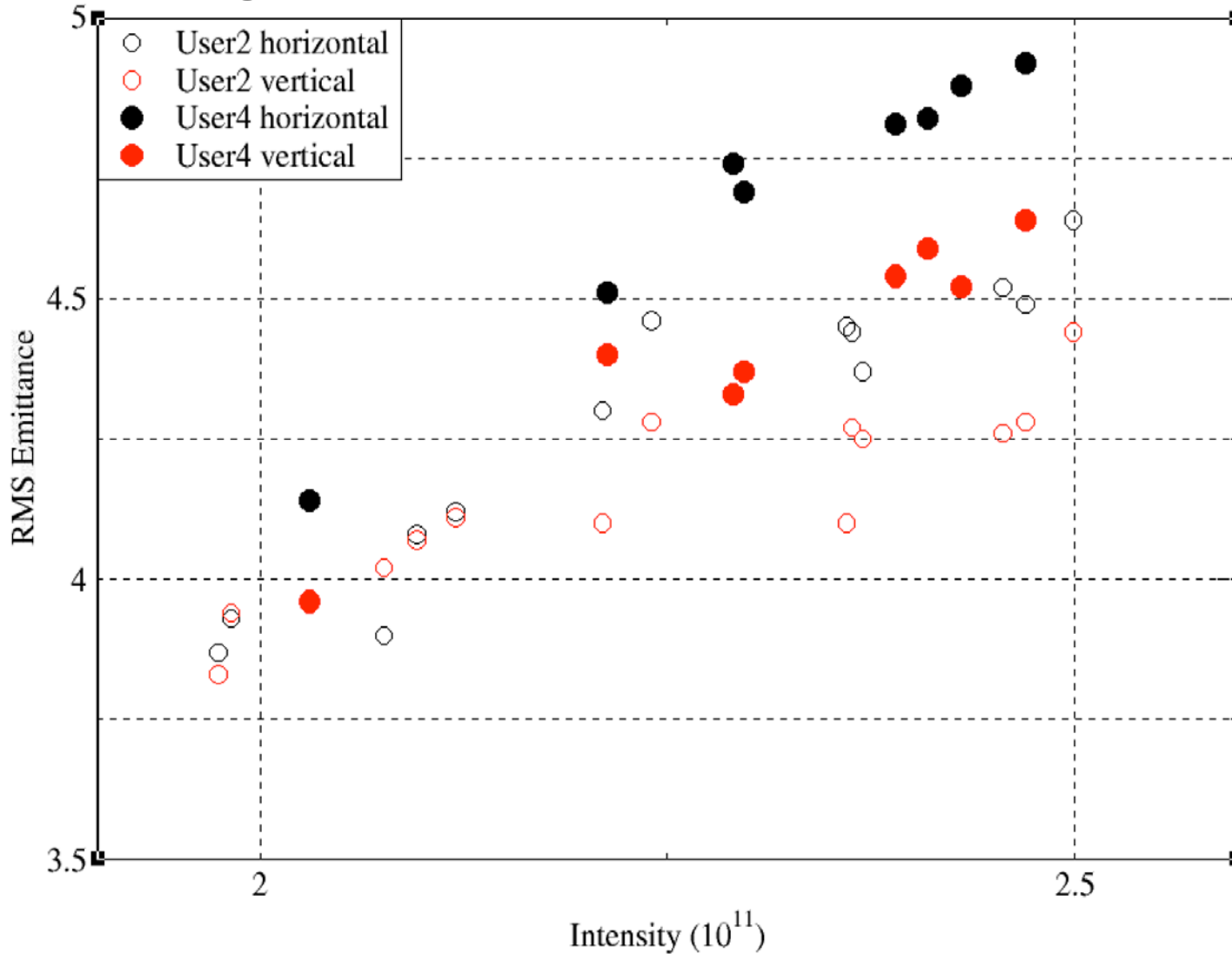
AGS Emittance by the old IPM



RF is off at 1000ms. Extraction bump around 900ms. Normalized 95% emittance is used. Red: user2(dual harmonics), Black: user4. RF was shut off at 1000ms.

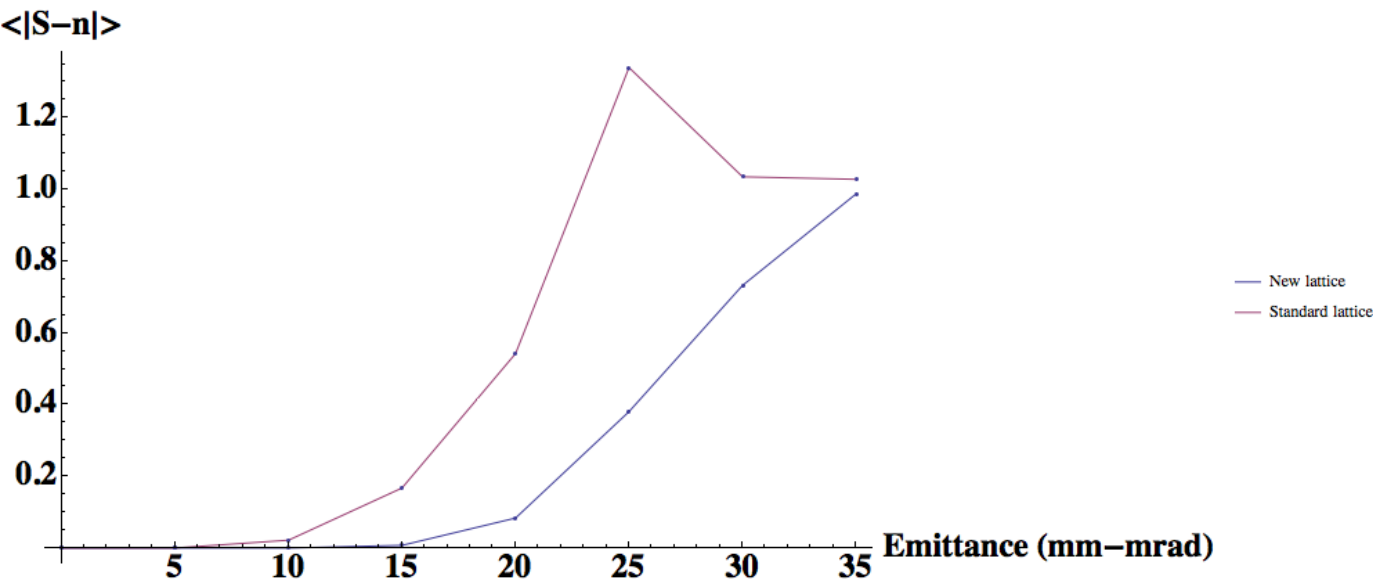
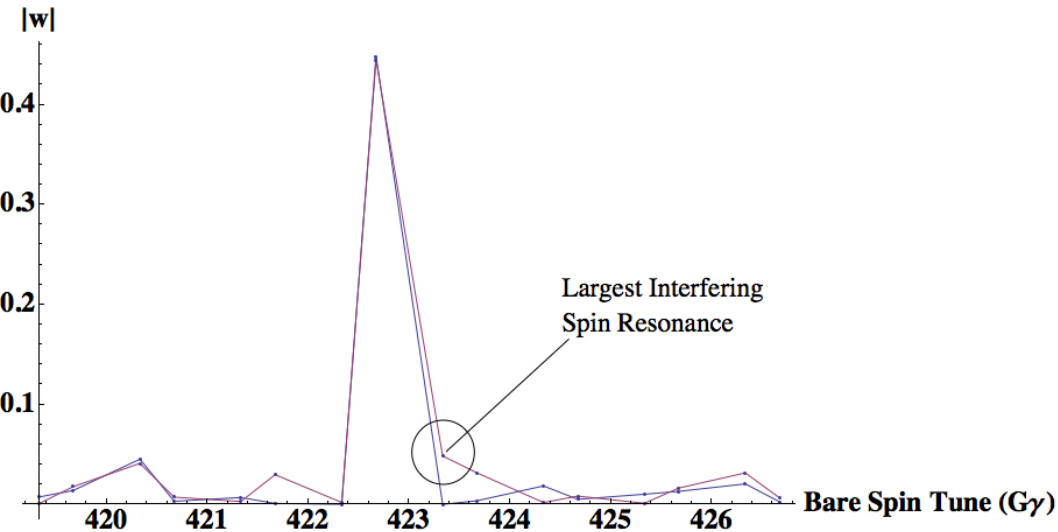
AGS Emittance vs. Intensity

Thanks: Haixin Huang



Normalized rms emittance from old IPM at 600ms (on flattop) is plotted. There is space charge effect on these values. For March 8-10(user4) and 10-14(user2).

Ramp Optics Modification

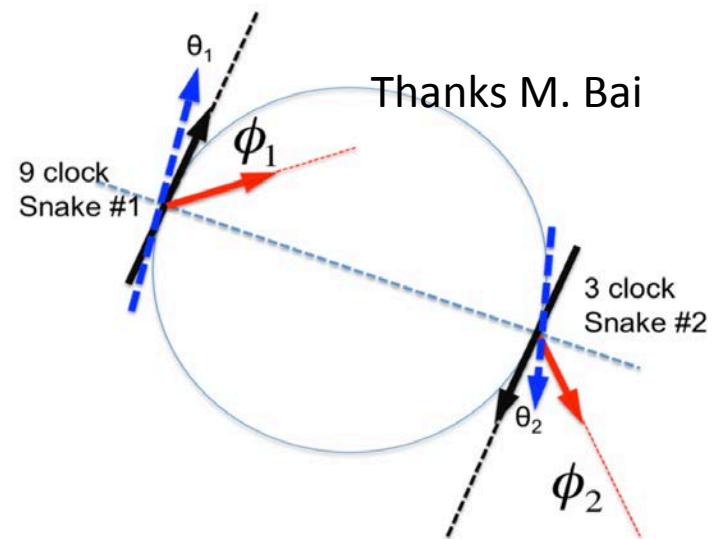


We modified the Optics at the three strongest intrinsic resonances on the Ramp. This was an attempt to reduce the influence of the interfering neighboring spin resonances. In theory this should've improved polarization transmission. However results are inconclusive at this point.

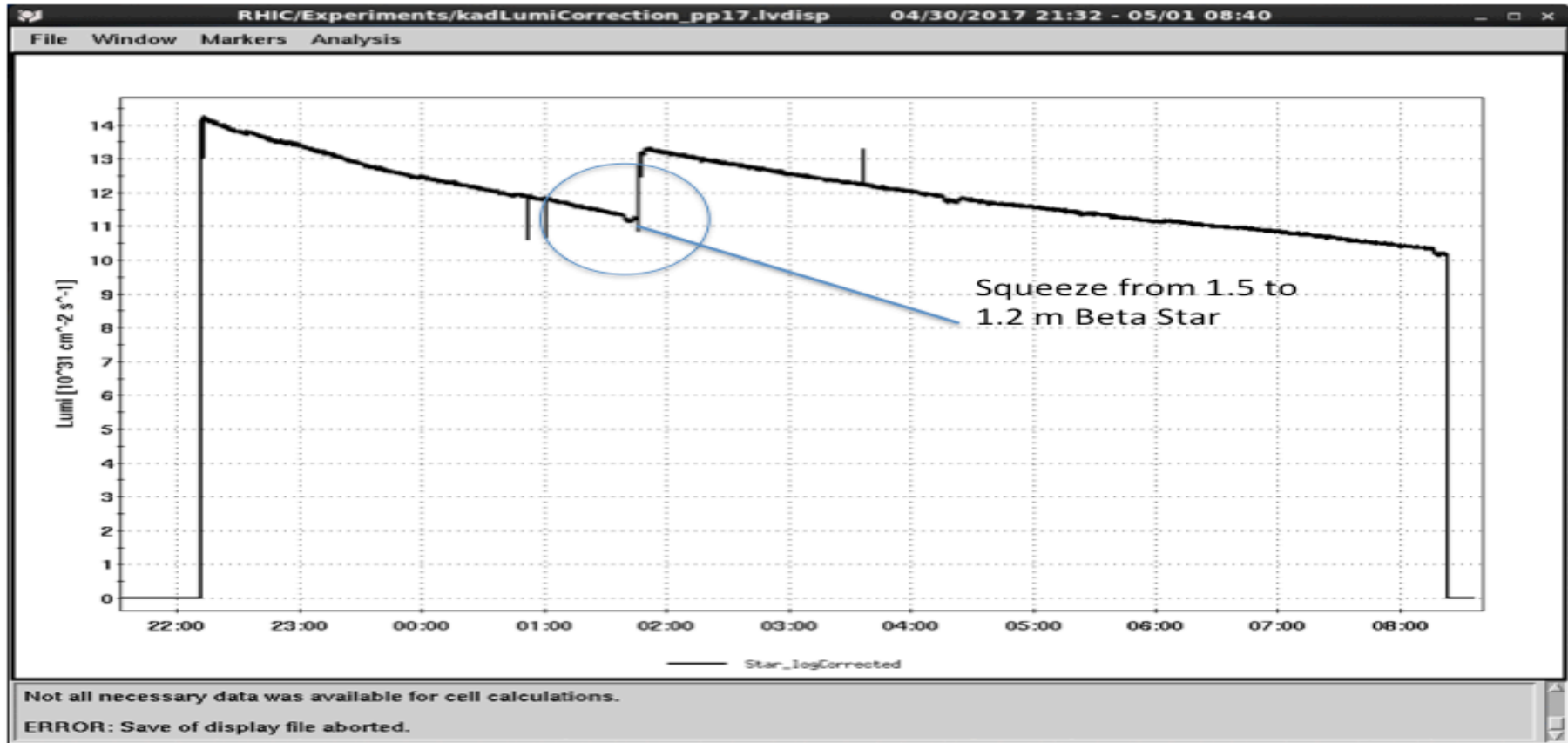
Reduction of Spin Tune Spread

- Matching of the slope of the Dispersion at the snakes is crucial to control the amount of spin tune spread
- This was achieved to an unprecedented level at Injection in RHIC. Spin tune spread reduced by a factor of 10.
 - Permitted Spin flipper to achieve 97% spin flipping efficiency!
- This was also applied to the ramp Optics to help improve polarization transmission. However results are still inconclusive.

$$\delta Q_s = \frac{G\gamma}{\pi} \Delta D' \frac{\Delta p}{p}$$



Luminosity Leveling: 2nd Beta squeeze



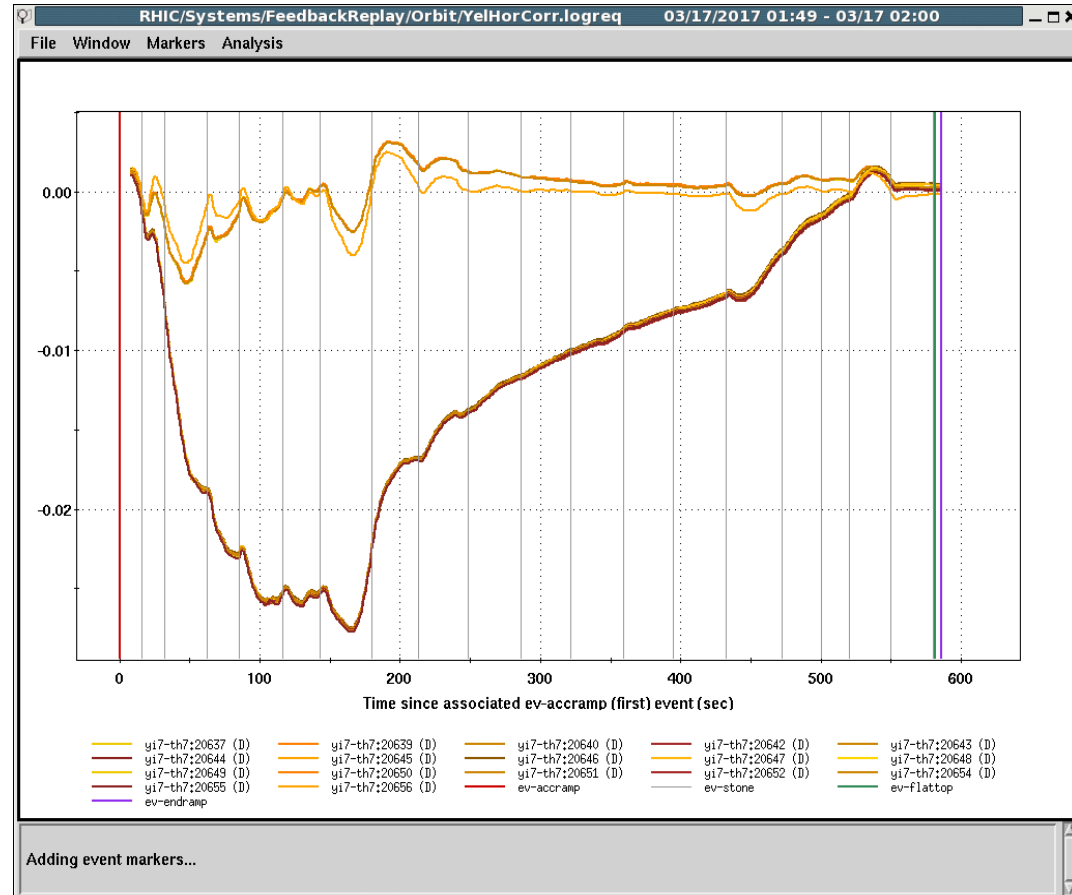
Luminosity leveling was driven due to limitations of the STAR detector caused by signal pile up. This required the collision rates to be held within the optimal rate level throughout the store. To accomplish this we instituted a secondary beta squeeze. Stores were began at 1.5 m beta star and then when rates dropped below $1.15 \times 10^{32} \text{cm}^{-2} \text{s}^{-1}$ the lattice was squeezed to 1.2 m beta star to bring the rates back up to about $1.35 \times 10^{32} \text{cm}^{-2} \text{s}^{-1}$

Machine Protection

- This year we tested a new machine protection system. On occasion the abort kicker's thyatron would pre-fire outside of the abort gap region and create large losses around the ring
- This year mechanical serial switches were added after the thyatron to prevent these pre-fires. To accommodate the slower response time of the serial switches new permit inputs were added to the machine protection system. These included, RF, orbit correctors, 10 Hz orbit feedback and fast BPM readings (coherence signal). Also the BLM thresholds were lowered at store.

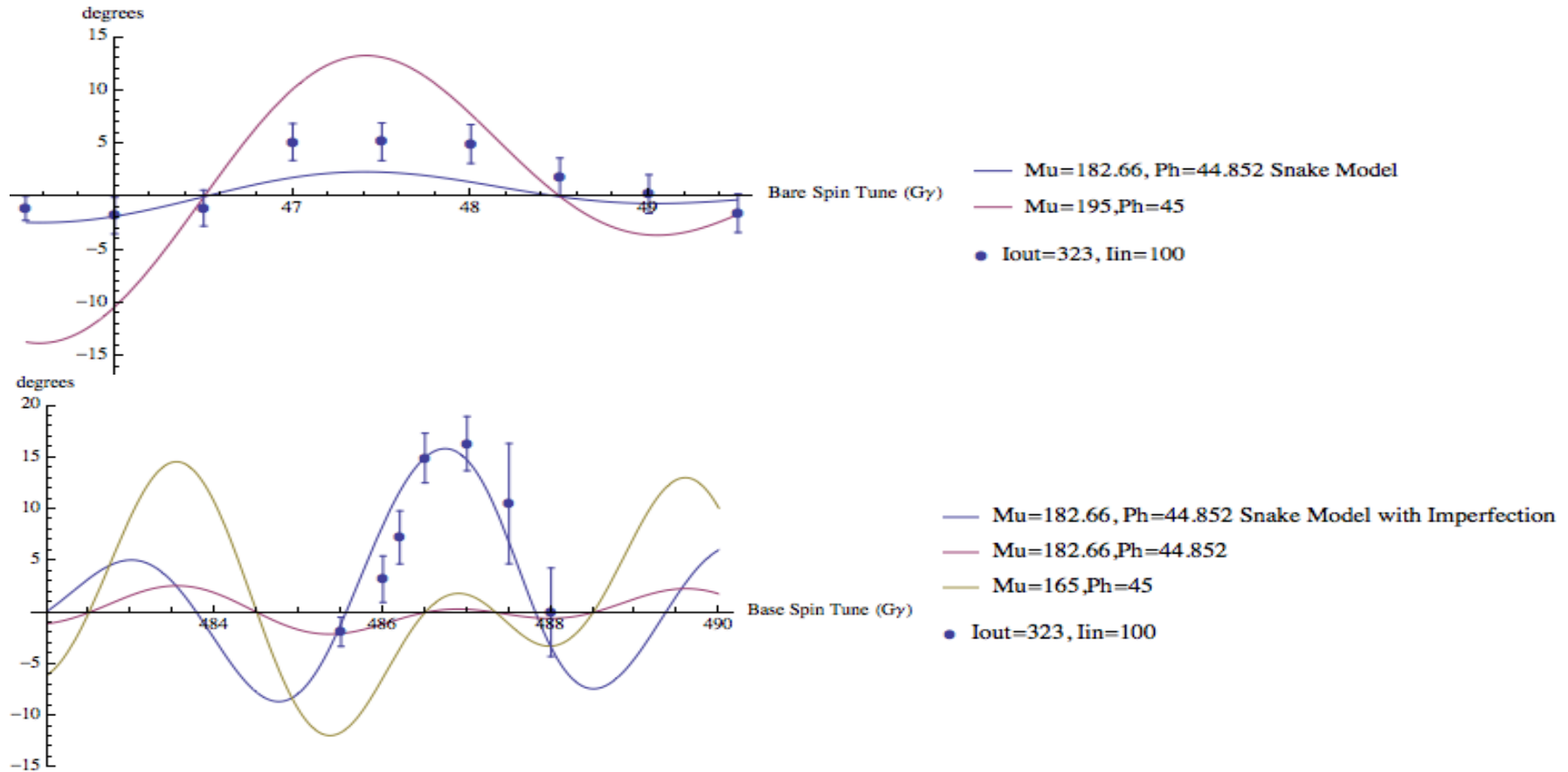
Damage to Magnet Diode

- During a test of the machine protection new system, RHIC sustained severe quenches in the yellow ring when 4 of 5 new mechanical serial switches failed to close after a beam dump.
- As a result of this event, dipole magnet, yi7-d6 sustained damage to its quench protection diode. This manifested itself as a small bypass current. In order to reduce the bypass current the ramp rate was reduced by a factor of 2.



Changes to the strength required in a corrector magnet to compensate loss of current in yi7-d6 dipole due to damage to the quench protection diode

Diagnosis of Anomalous SpinTilt

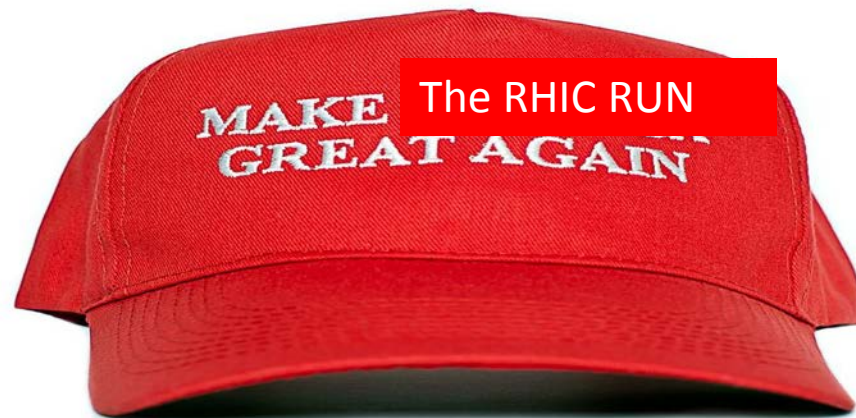


Energy scans of the projection of average spin tilt into horizontal plane at Injection (top) and at store (bottom) in Blue ring. We compared response to simple model with snakes at settings based on model value for Iin=100 and Iout=323 amps and with detuning of snakes and a strong imperfection source

Accomplishments of Au-Au 27.2 GeV Run

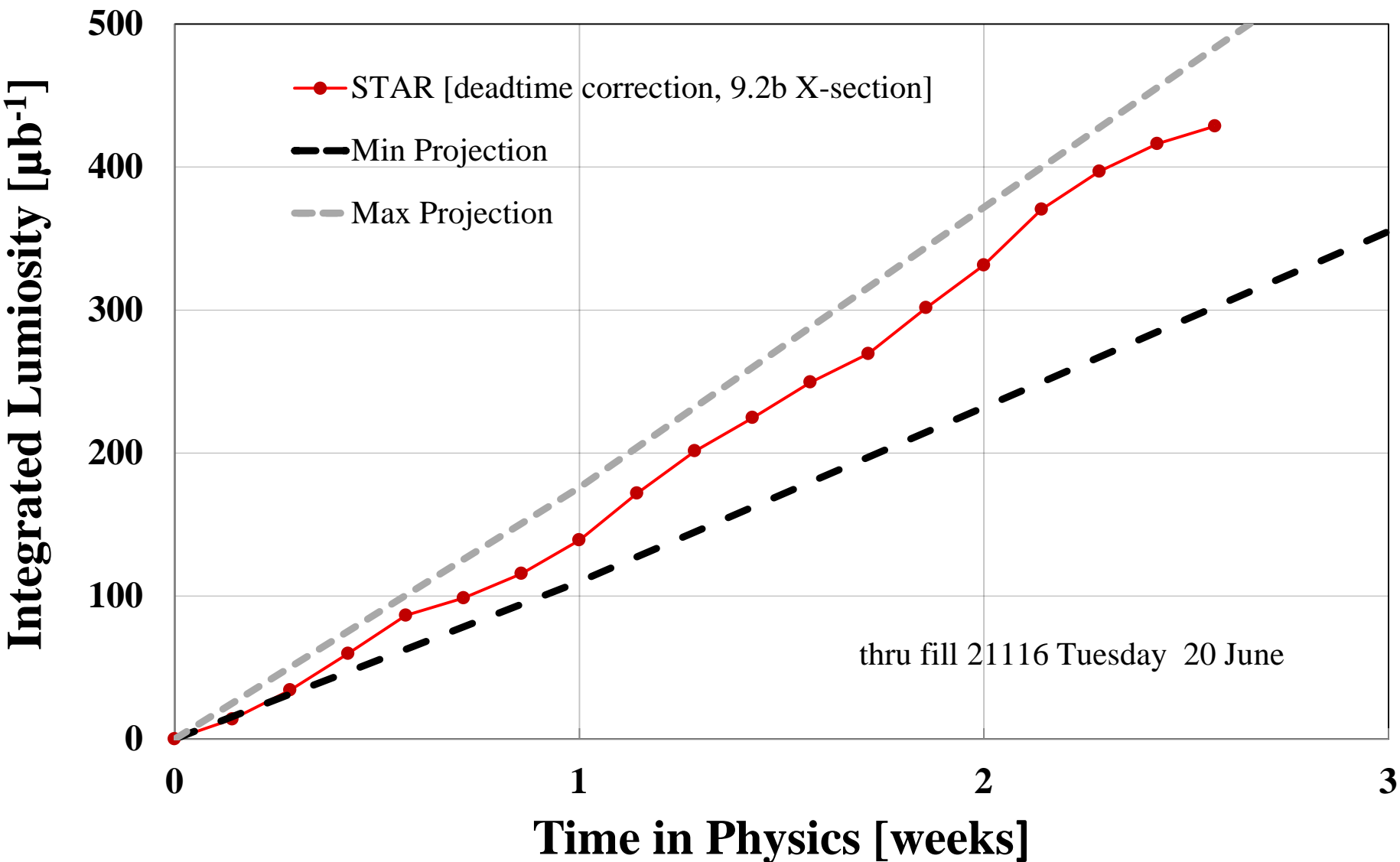
Thanks G. Marr

- Despite a series of consecutive failures that delayed our start, the gold run ran well in large part due to:
 - Low failure rate during run
 - Short energy ramp length
 - Fast turnaround times with comparatively few interruptions between stores
 - Reduced beam intensity for longer store lifetimes



Integrated Luminosity

Run17 27.2Gev Au x 27.2 GeV Au (Courtesy P. Ingrassia)

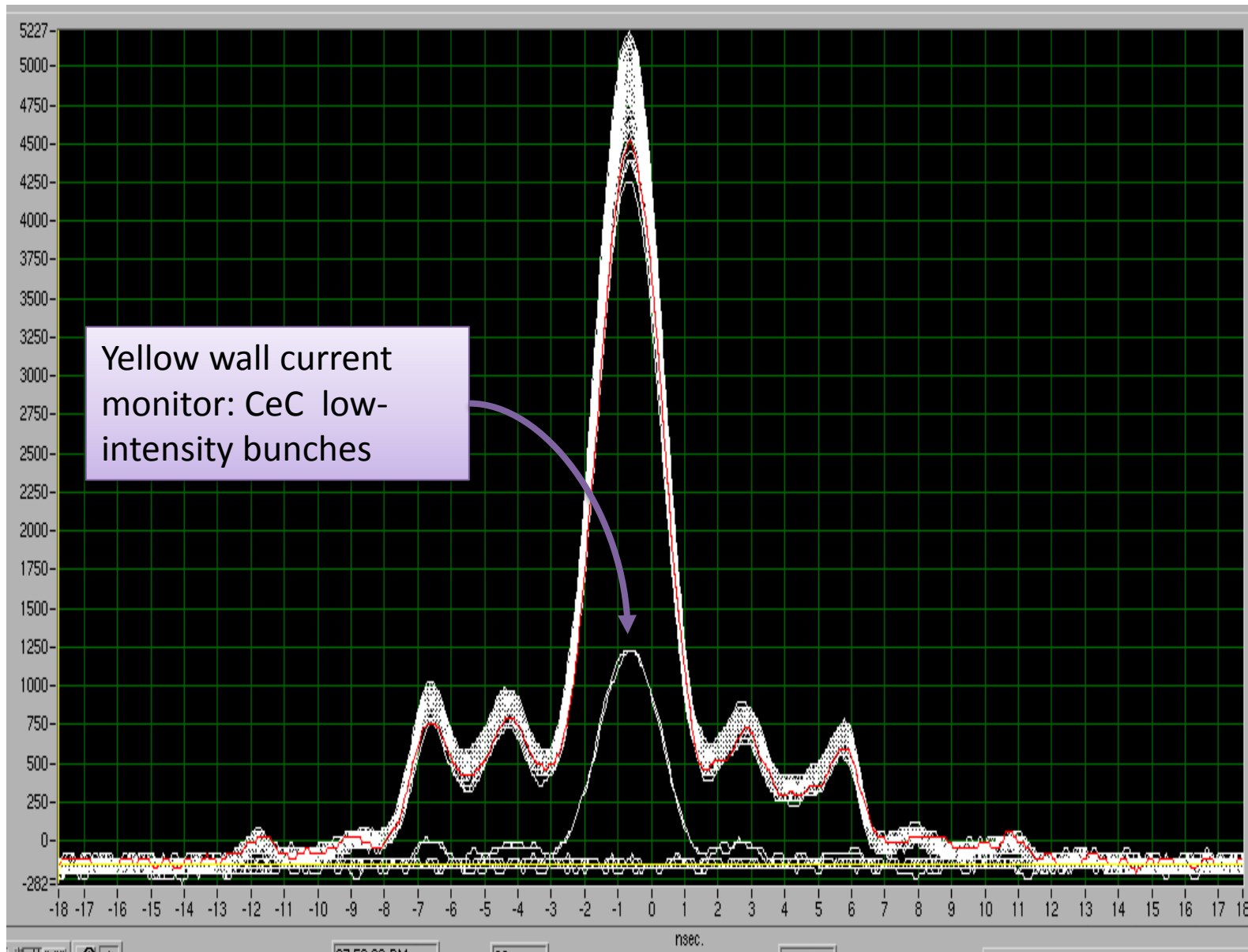


Operation with CeC

Thanks G. Marr

The collision energy was chosen to allow concurrent operation of the coherent electron cooling project.

Low intensity “pilot” bunches were inserted at the end of the Yellow ring fill which allowed CeC to use beam while collisions with



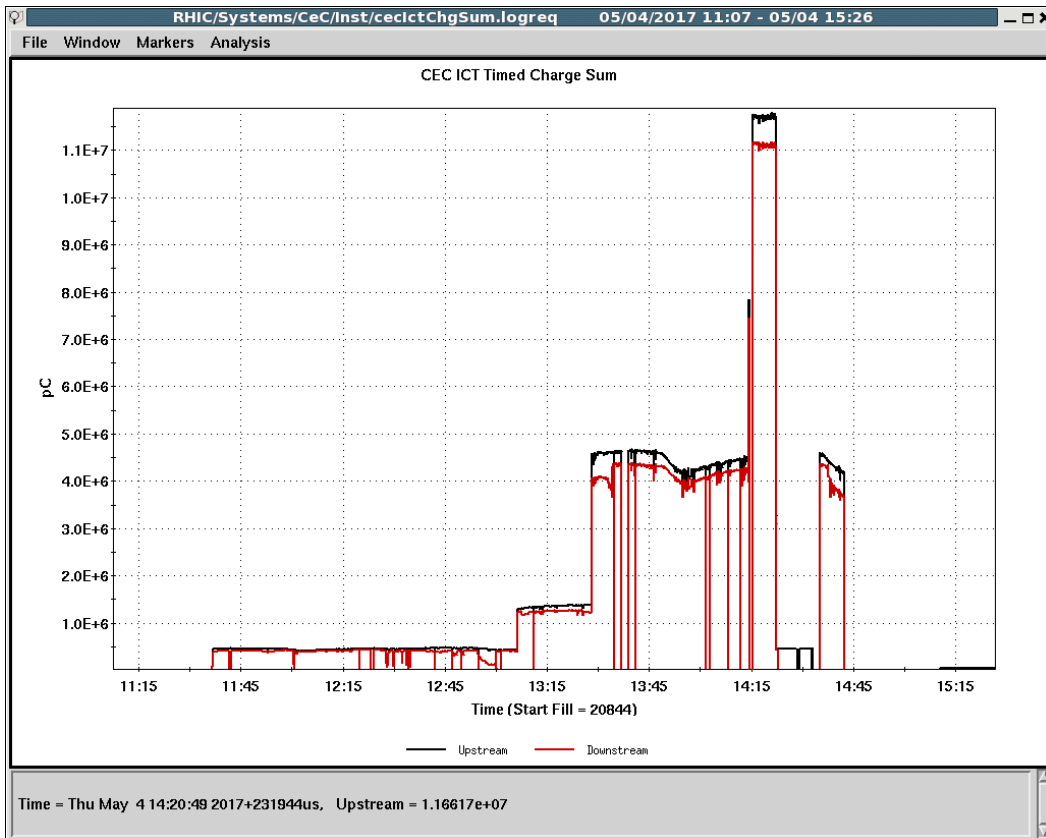
Conclusion and Prospects

- Despite near catastrophe with the damage to the quench protection diode we managed to have an outstanding Run this year.
 - Achieved all our goals
 - Saw some significant progress in accelerator performance and R&D work
 - CeC PoP
 - RF dual harmonic in AGS
 - Spin Flipper achieved polarization flip for first time.
 - General progress in advanced lattice design for Polarization

Back up Slides

Radiation Surveys with Full Beam

- The machine protection system was commissioned
- We have propagated 26 kHz (78/3) 0.5 nC beam to the high power dump
- We have performed radiation survey with 180 W beam power to the high power dump
- Fault studies were performed



No substantial radiation was observed