

# RUN 11 RHIC MACHINE/EXPERIMENTS MEETING

14 Jun 2011

Agenda:

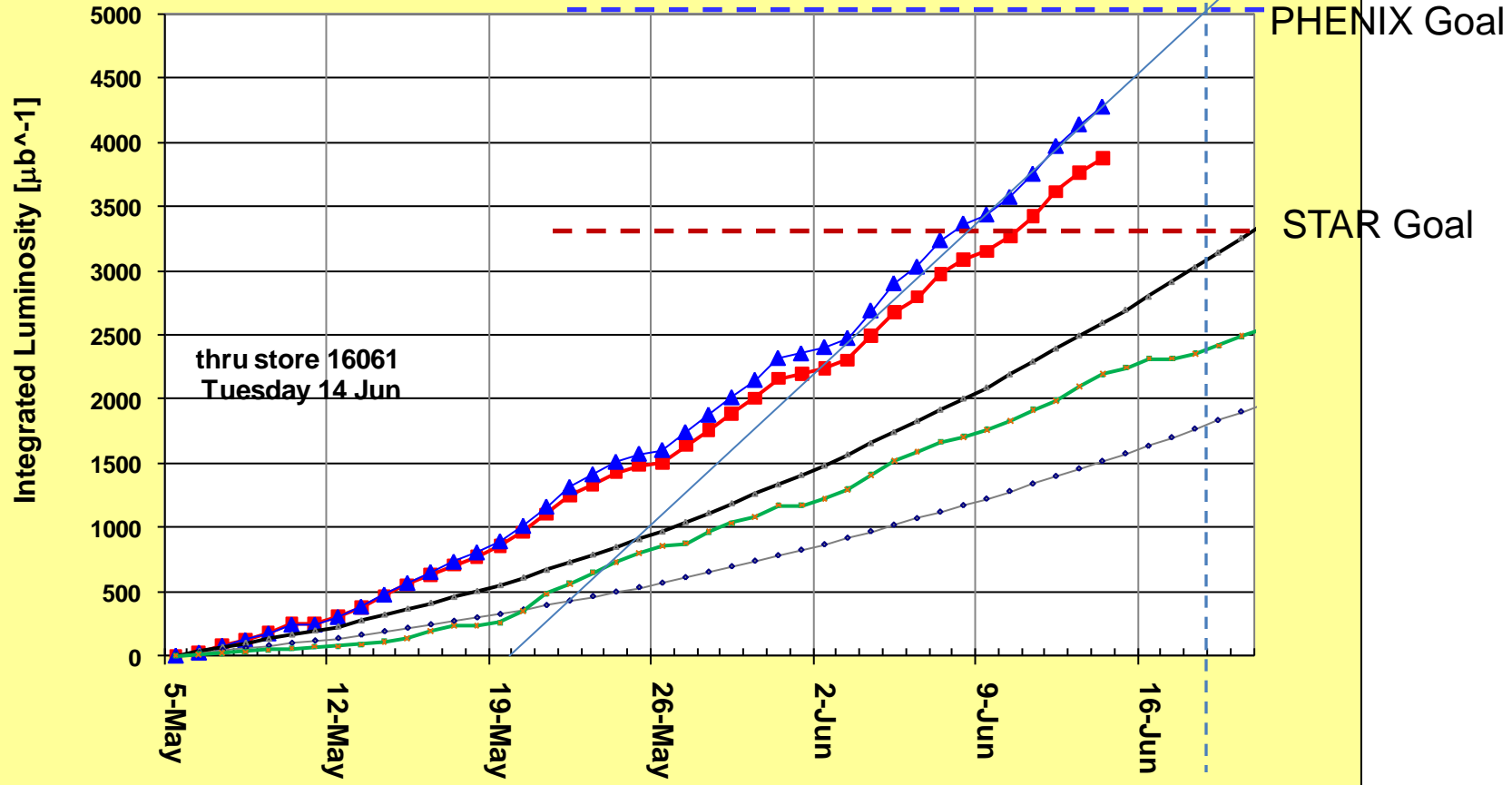
- $\sqrt{s} = 200$  GeV AuAu progress
- ZDC Calibration for AnDY – the plan
- Request from AnDY
- $\sqrt{s} = 27$  GeV Run Readiness
- $\sqrt{s} = 19$  GeV very preliminary results from STAR

**Run 11 Plan based on PAC recommendation/ALD Guidance and available funds  
6/14/10 update**

- 3 Jan, Begin cool-down to 4.5K
- 8 Jan, Cool-down to 4.5K complete in both rings, preliminary setup begins
- 24 Jan, 1 week Ramp-up with 8 hr/night beam to experiments
- **11 Feb (machine and ~experiments), begin ~10 week physics run ( $\sqrt{s} = 500$  GeV pp)**
- 7 Mar, cryo troubles, extended maintenance, 0900 hrs till 2000 hrs 14 Mar – lost 7.5 days
- 17 Mar, power distribution problem, extended maintenance, 1930 hrs till 0315 hrs 20 Mar – lost 2.3 days
- **18 Apr, end 9.4 week physics run at  $\sqrt{s} = 500$  GeV**
- 18 Apr jet target polarization measurement at injection (<5%)
- 19 Apr, short maintenance followed by setup for  $\sqrt{s} = 18$  GeV AuAu
- **23 Apr, begin ~1 week physics run ( $\sqrt{s} = 19.6$  AuAu)**
- **2 May 08:00, end 1.3 week physics run at  $\sqrt{s} = 19.6$  GeV**
- 2 May, begin setup for  $\sqrt{s} = 200$  AuAu
- 5 May, begin 2 day Ramp-up with 8 hr/night beam to experiments
- **6 May 11:37, begin ~8 week physics run at ( $\sqrt{s} = 200$  GeV/n AuAu)**
  
- **14 Jun- TODAY**
- **20 June 08:00, end 6.4 wk AuAu physics run at  $\sqrt{s} = 200$  GeV/n, begin 8 hr APEX**
- **20 -21 June, setup for  $\sqrt{s} = 27$  GeV/n**
- **22 June, begin 1 week  $\sqrt{s} = 27$  GeV/n physics run**
- **29 June, end 1 week  $\sqrt{s} = 27$  GeV/n physics run, begin warm-up**
- **30 June, cryo warm-up ~ complete, end 25.4 weeks cryo operation**

# Run11 RHC AuAu Integrated Luminosity for Physics ( $v_s = 200 \text{ GeV/n}$ )

■ STAR    ▲ PHENIX    — Lmax    ● Lmin    — PHENIX Run10

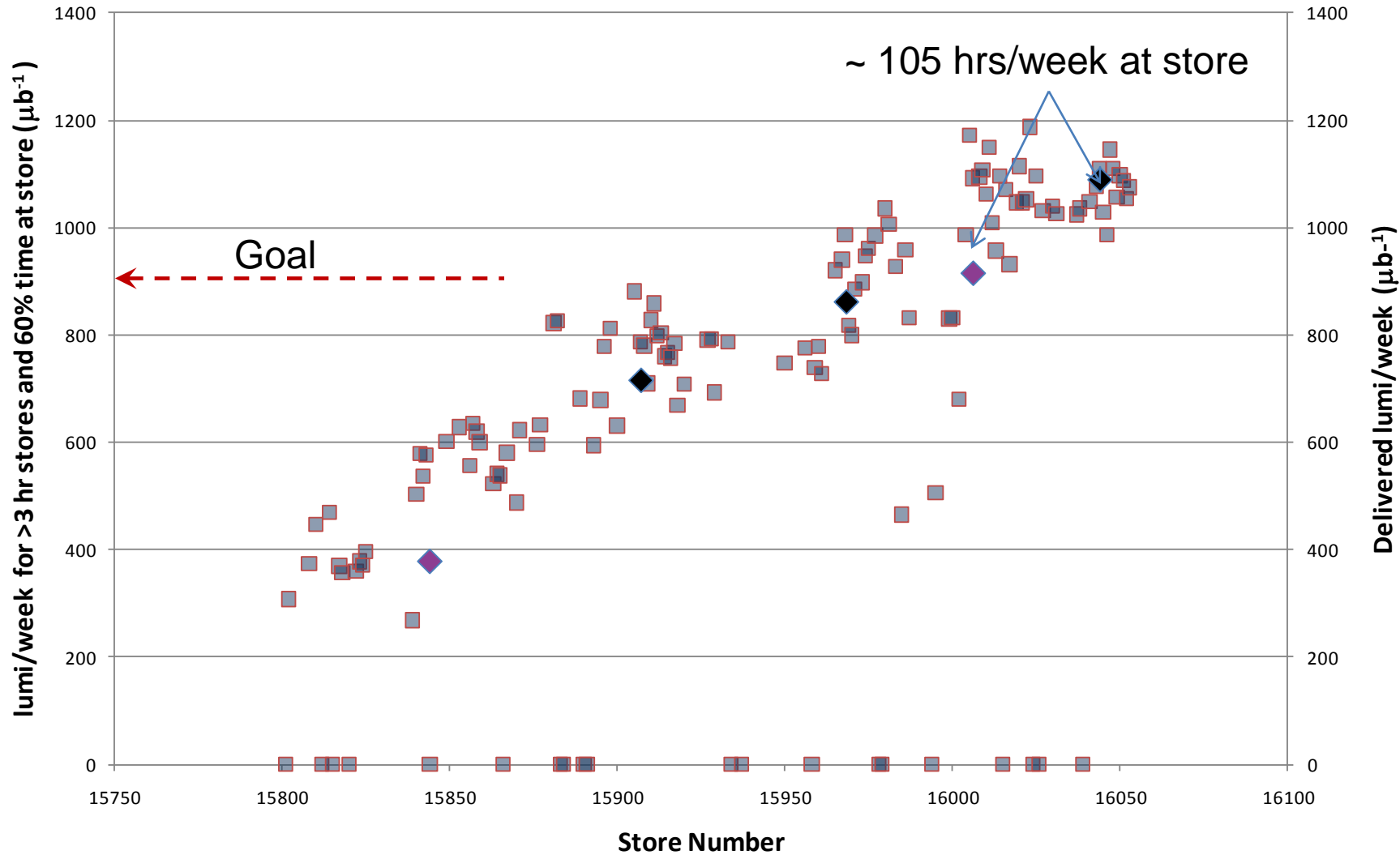


# Run 11 100 x 100 GeV/n Au-Au (Phenix)

thru fill 16053

■ 60% time at store Integrated lumi

◆ Delivered Integrated Lumi/week (Physics)

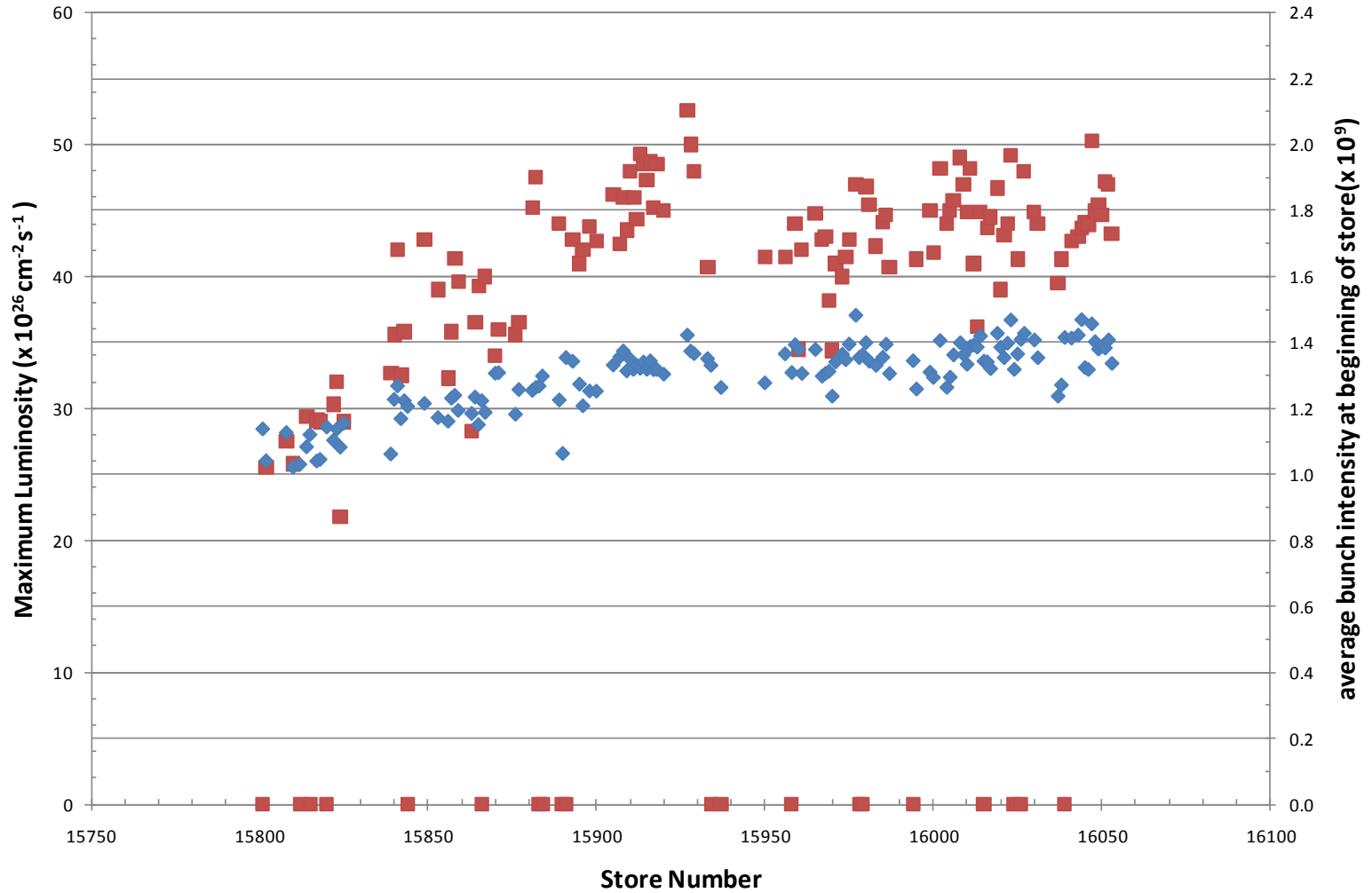


# Run 11 100 x 100 GeV/n Au-Au (Phenix)

thru fill 16053

■ Maximum Luminosity (>3 hr store)

◆ Blue/Yellow Average Bunch Intensity

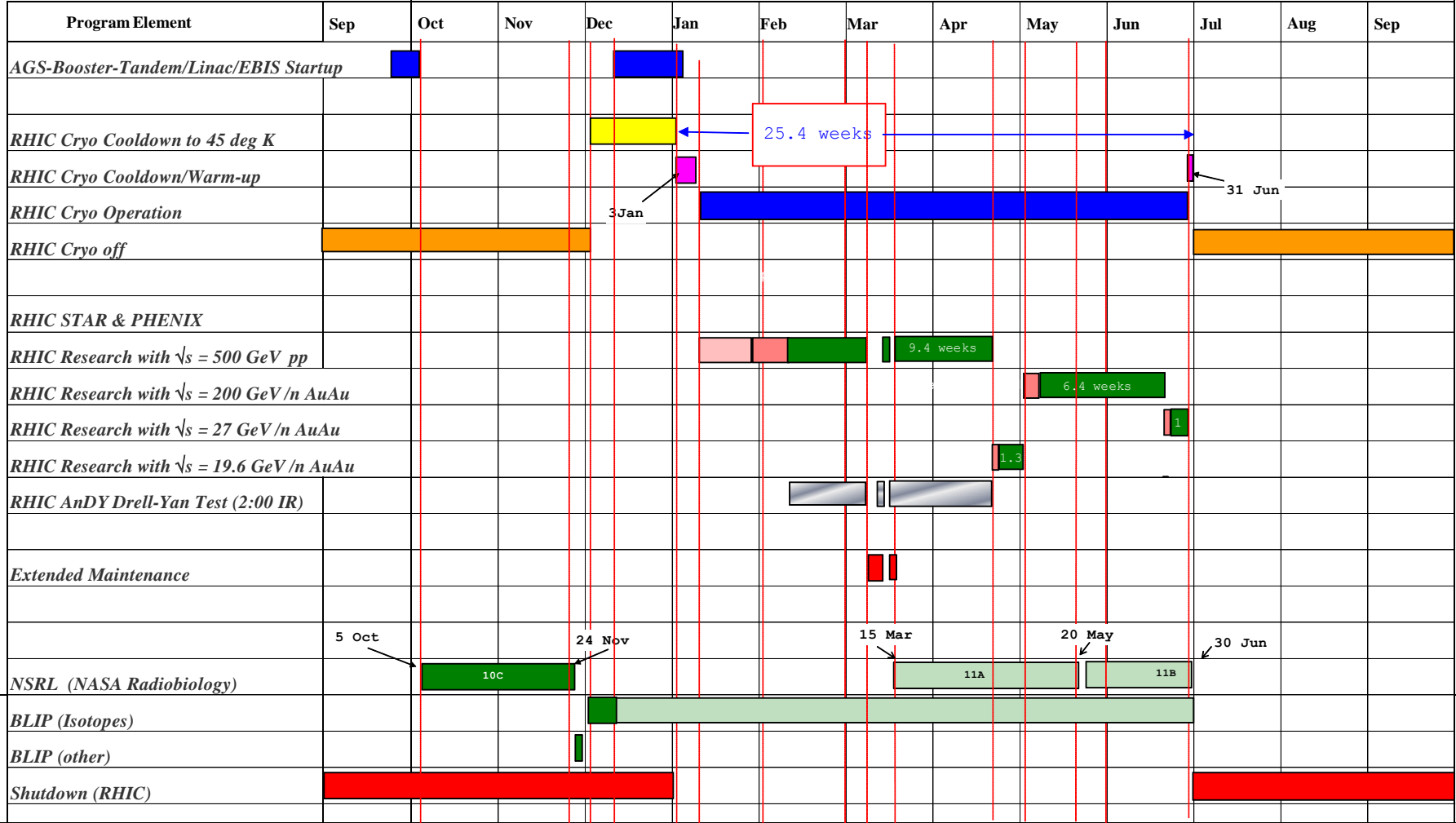


# C-A Operations-FY11

*as run/planned*

- concurrent with RHIC
- setup with beams
- ramp up luminosity

**FY 2011**



25.4 weeks

3Jan

31 Jun

5 Oct

24 Nov

15 Mar

20 May

30 Jun

10c

11A

11B

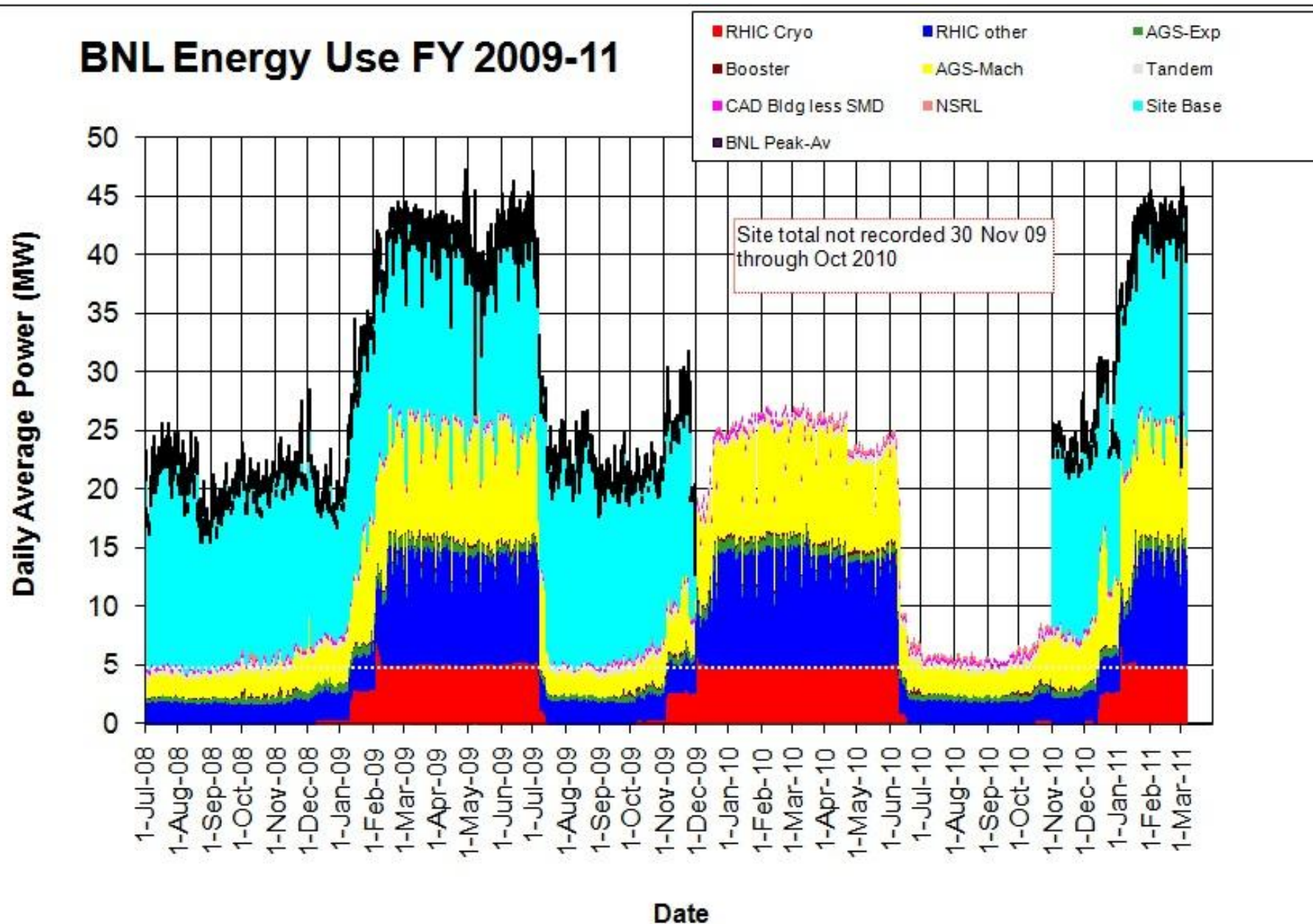
9.4 weeks

6.4 weeks

1.3

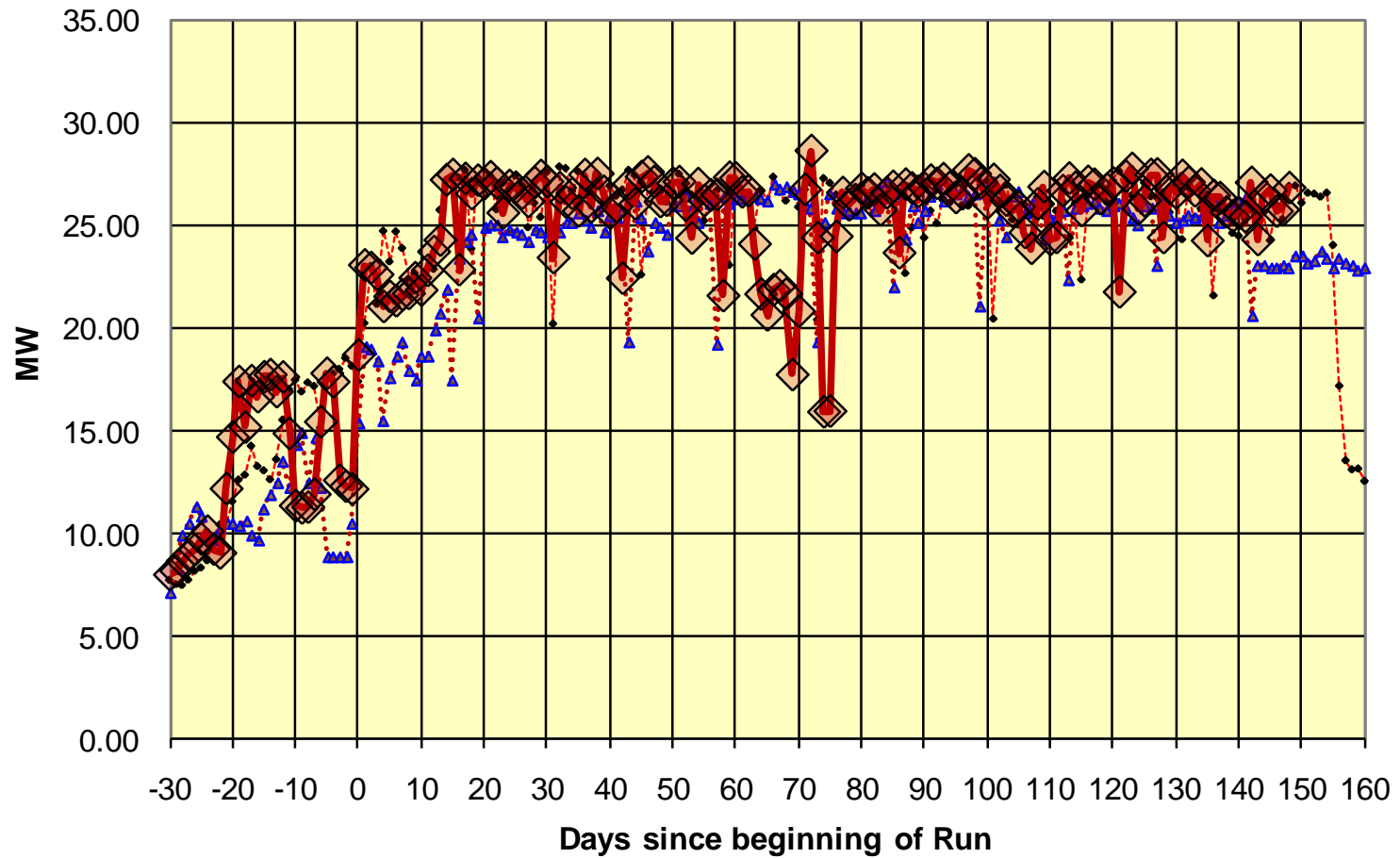
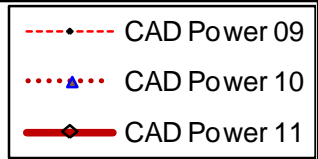
Through 31 May 2011

# BNL Energy Use FY 2009-11



thru 31 May

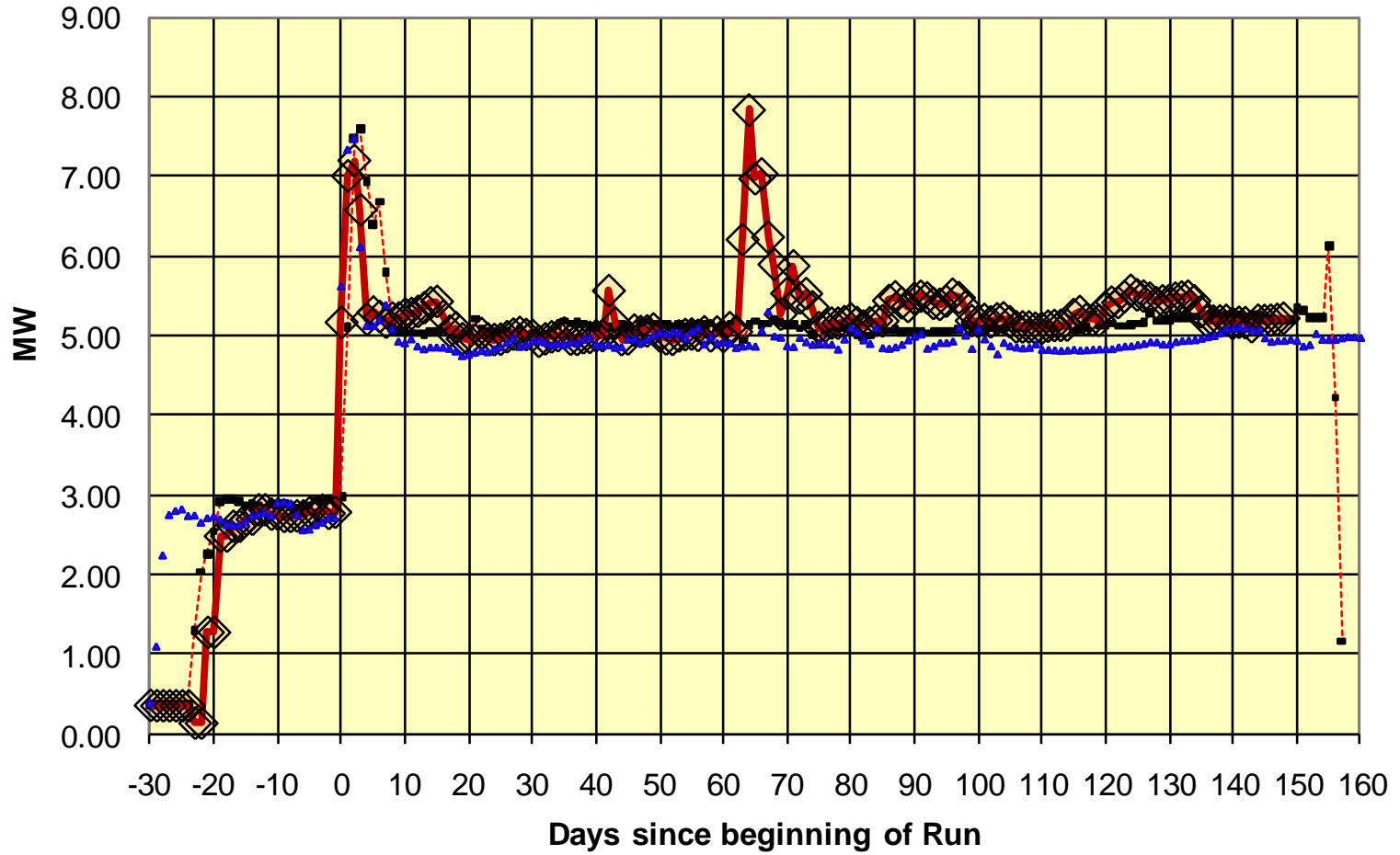
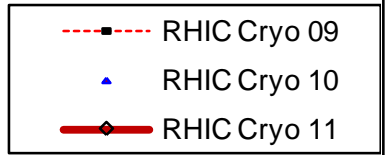
# RHIC Operations FY09-11





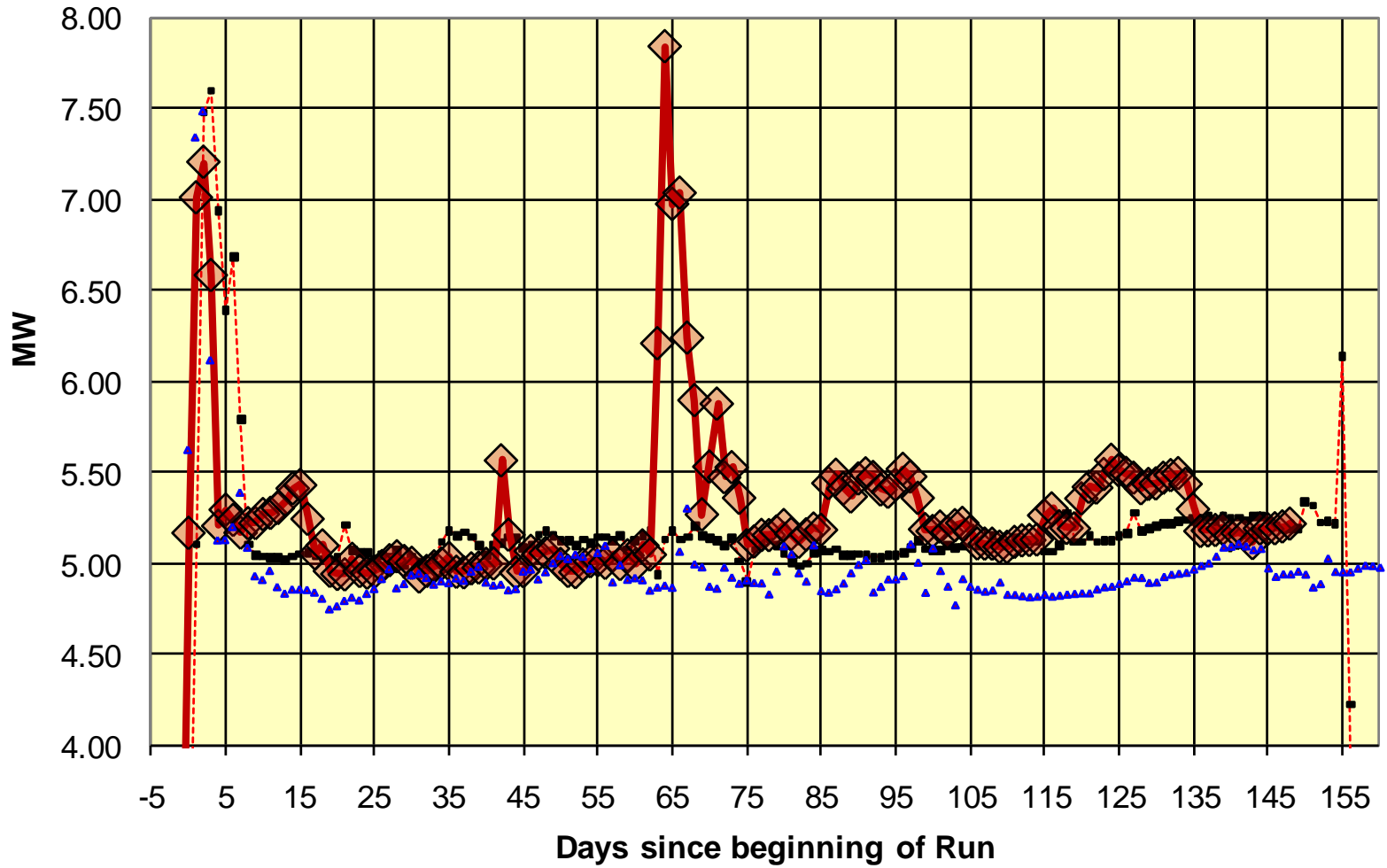
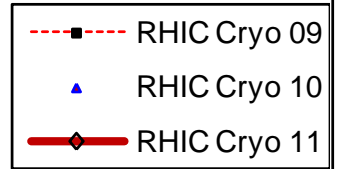
thru 31 May

# RHIC Cryo Operations FY09-11



thru 31 May

# RHIC Cryo Operations FY09-11

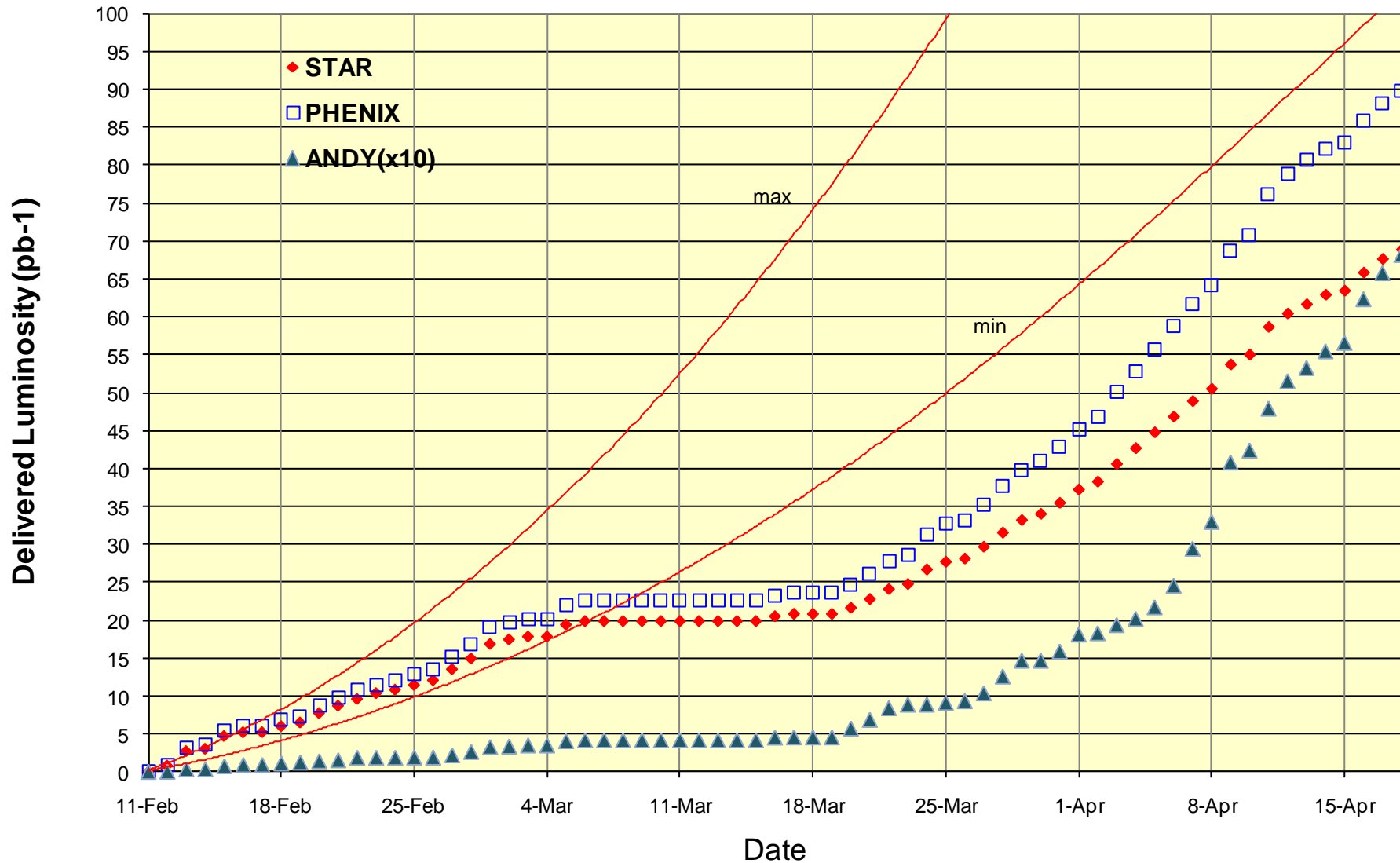


**Old information**

### Run 11 250 x 250 GeV pp, Luminosity

thru fill final 15472, 18 Apr

2.9 mb STAR, 2.7 mb PHENIX, 0.95 mb AnDY



# **$\sqrt{s} = 200 \text{ GeV/n AuAu}$ luminosity goals (24 May efficiencies)**

## **STAR**

2000  $\mu\text{b}^{-1}$  sampled / 60% = 3300  $\mu\text{b}^{-1}$  delivered

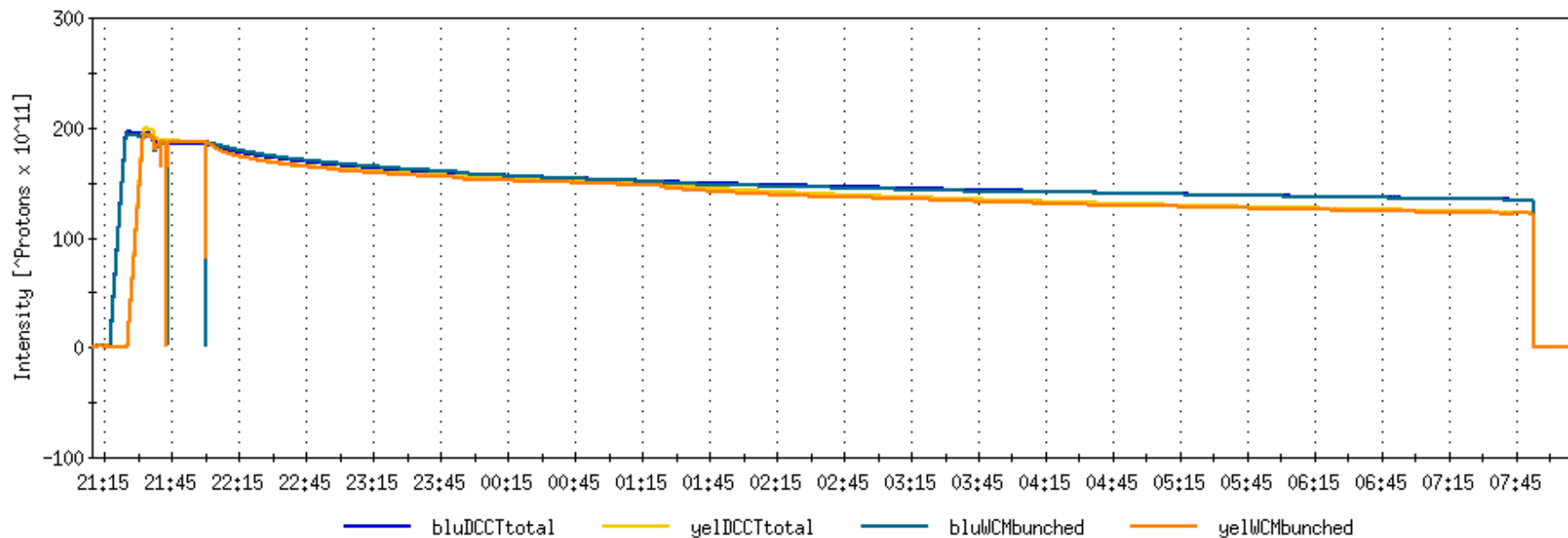
## **PHENIX**

700  $\mu\text{b}^{-1}$  sampled / 14% = 5000  $\mu\text{b}^{-1}$  delivered

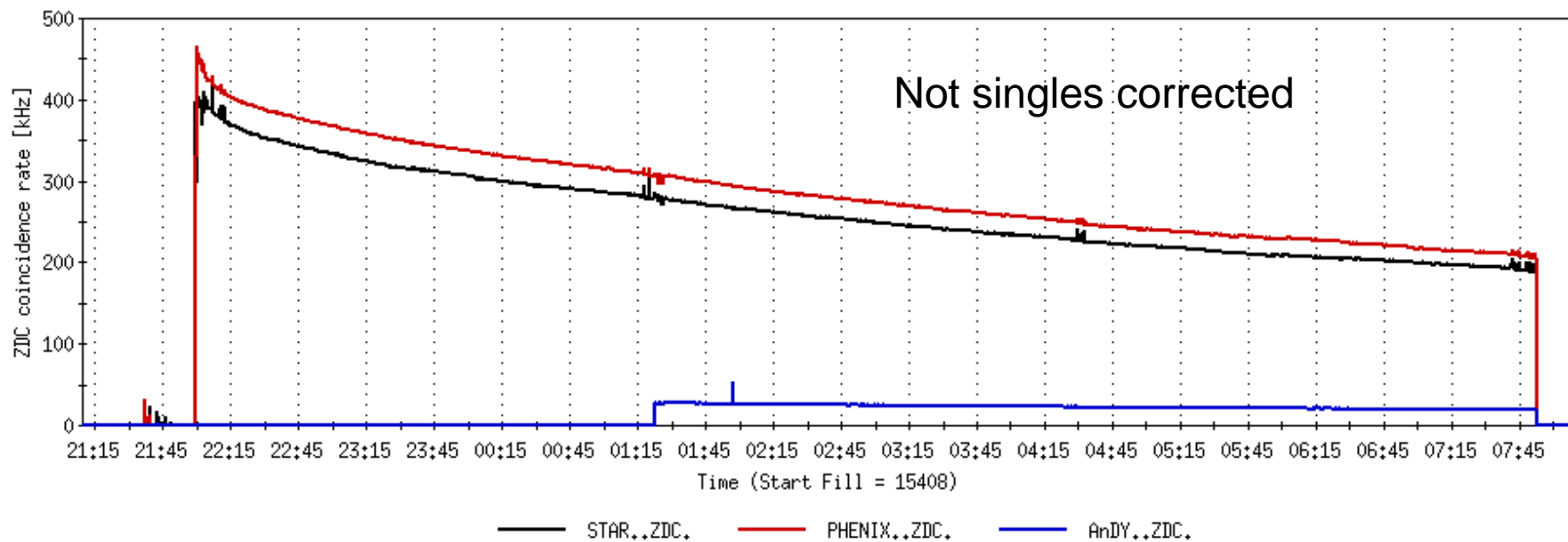
Estimate from PHENIX Beam Use Proposal – 15.8%

- Live Time = 97%
- Uptime = 65%
- +/- 10 cm vertex = 25%

# 9.7 hour store comparing AnDY Lumi to STAR and PHENIX



## Experimental Coincidence Signals



# 9.7 hour store comparing AnDY Lumi to STAR and PHENIX

$\beta^*$ 's  
 PHENIX  $\sim 0.7$  m  
 STAR  $\sim 0.8$  m  
 AnDY  $\sim 3$  m

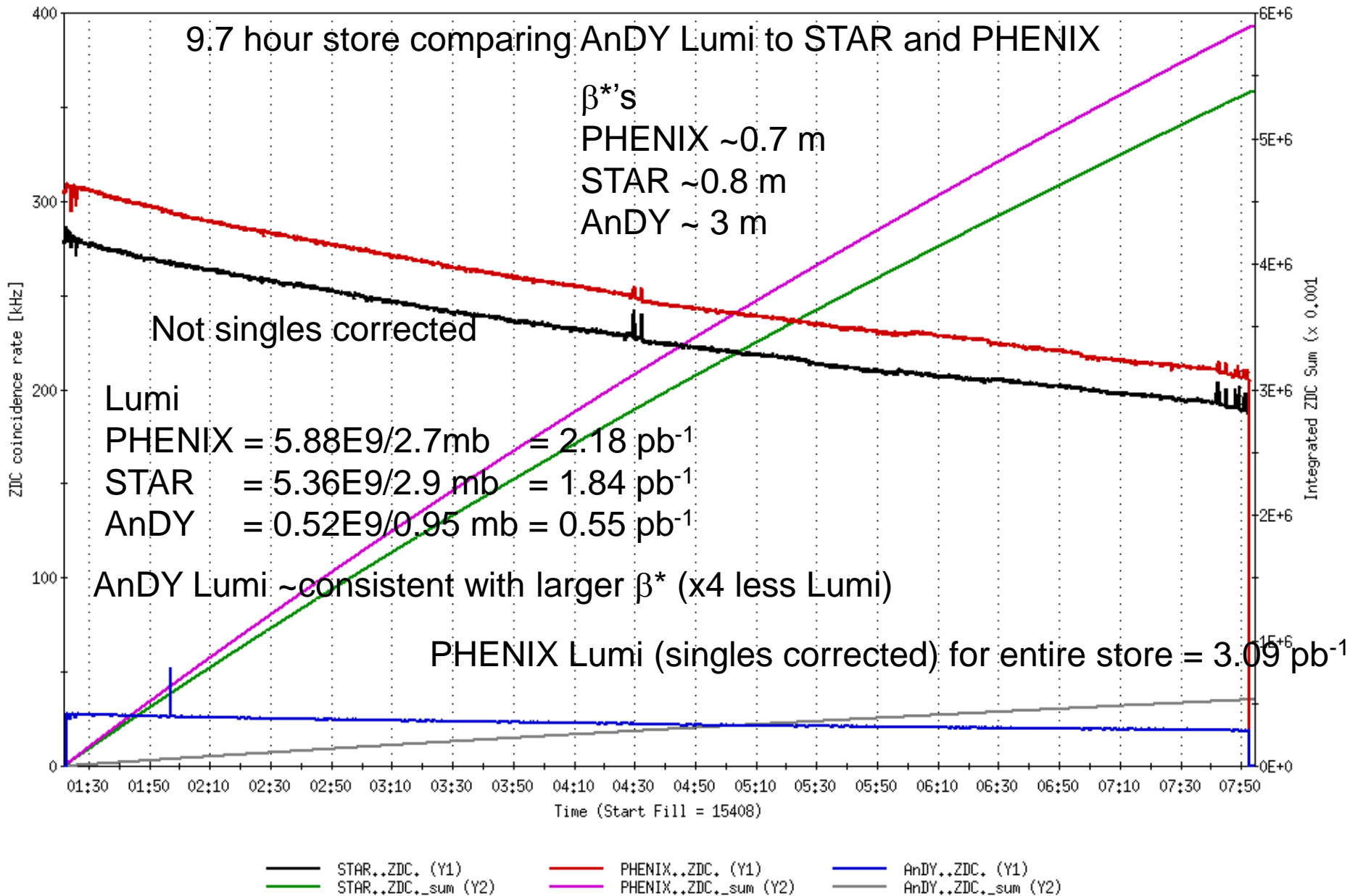
Not singles corrected

Lumi

PHENIX =  $5.88E9/2.7\text{mb} = 2.18 \text{ pb}^{-1}$   
 STAR =  $5.36E9/2.9 \text{ mb} = 1.84 \text{ pb}^{-1}$   
 AnDY =  $0.52E9/0.95 \text{ mb} = 0.55 \text{ pb}^{-1}$

AnDY Lumi  $\sim$  consistent with larger  $\beta^*$  (x4 less Lumi)

PHENIX Lumi (singles corrected) for entire store =  $3.09 \text{ pb}^{-1}$



— STAR..ZDC. (Y1)      — PHENIX..ZDC. (Y1)      — AnDY..ZDC. (Y1)  
 — STAR..ZDC.\_sum (Y2)      — PHENIX..ZDC.\_sum (Y2)      — AnDY..ZDC.\_sum (Y2)

Time = Thu Apr 7 07:53:47 2011(+3ms), PHENIX.ZDC.\_sum = 5.88466e+06  
 Time = Thu Apr 7 07:53:47 2011(+7ms), STAR.ZDC.\_sum = 5.36565e+06  
 Time = Thu Apr 7 07:51:30 2011(+70ms), AnDY.ZDC. sum = 526993

# Store 15408 – AnDY projection

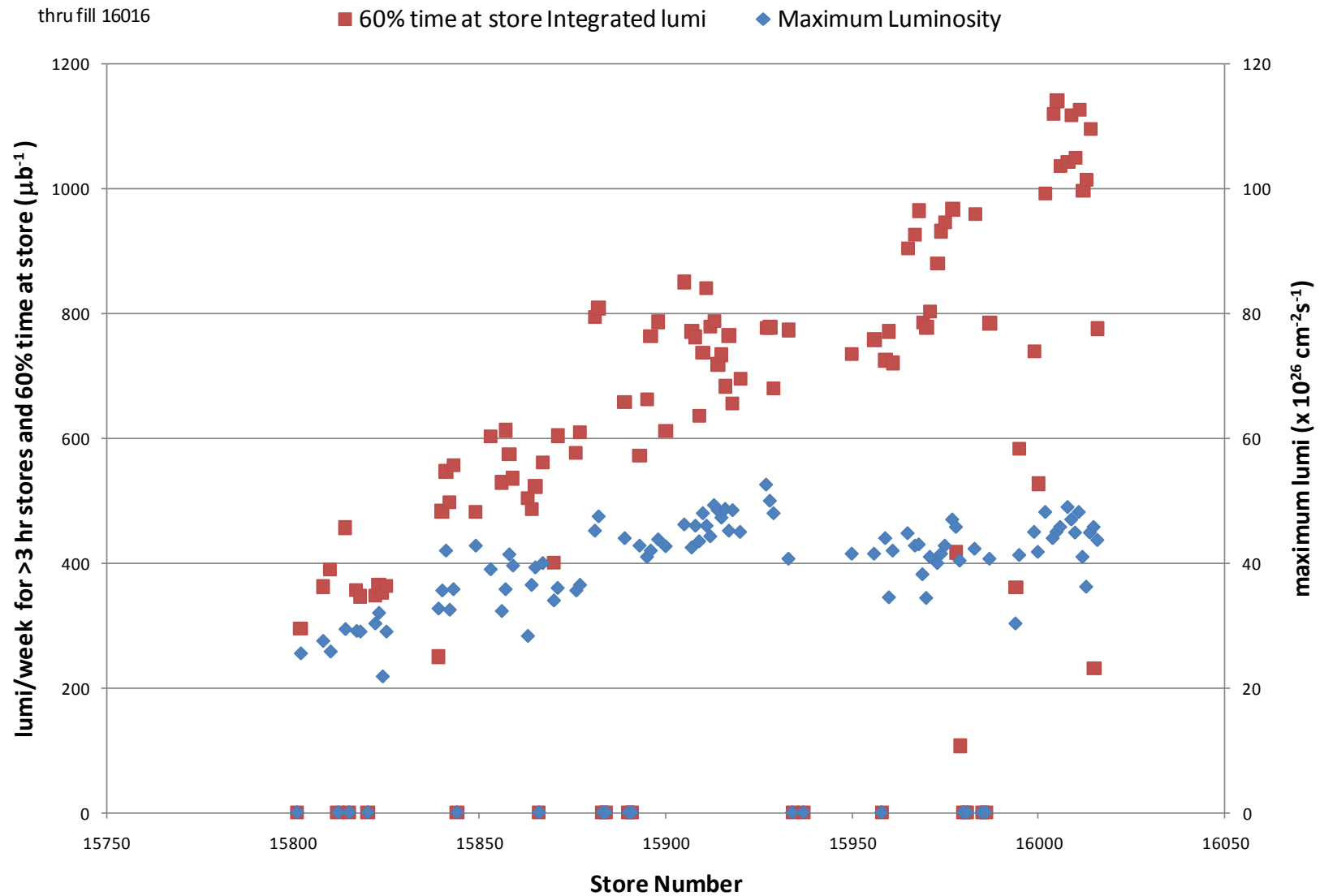
- 2:00  $\beta^* = 3$  meters
  - AnDY fraction of store 15408 =  $0.55/3.09 = 18\%$
- With 2:00  $\beta^* = 1.5$  meters
  - AnDY fraction of store 15408 would have been  $2 \times 18\% = 36\%$
  - using Fischer et.al. 11 May 2010 [Table 7](#) lumi projections for Run12

<u>Physics Weeks</u>	<u>Max Lumi</u>	<u>Min Lumi</u>	<u>AnDY Est (1.5 m <math>\beta^*</math>)</u>
8	276 pb <sup>-1</sup>	98 pb <sup>-1</sup>	35-99 pb <sup>-1</sup>
10	388 pb <sup>-1</sup>	134 pb <sup>-1</sup>	48-140 pb <sup>-1</sup>
12	500 pb <sup>-1</sup>	170 pb <sup>-1</sup>	61-180 pb <sup>-1</sup>

→ 100 pb<sup>-1</sup> is not an unreasonable expectation for a 10-12 week run



# Run 11 100 x 100 GeV/n Au-Au (Phenix)

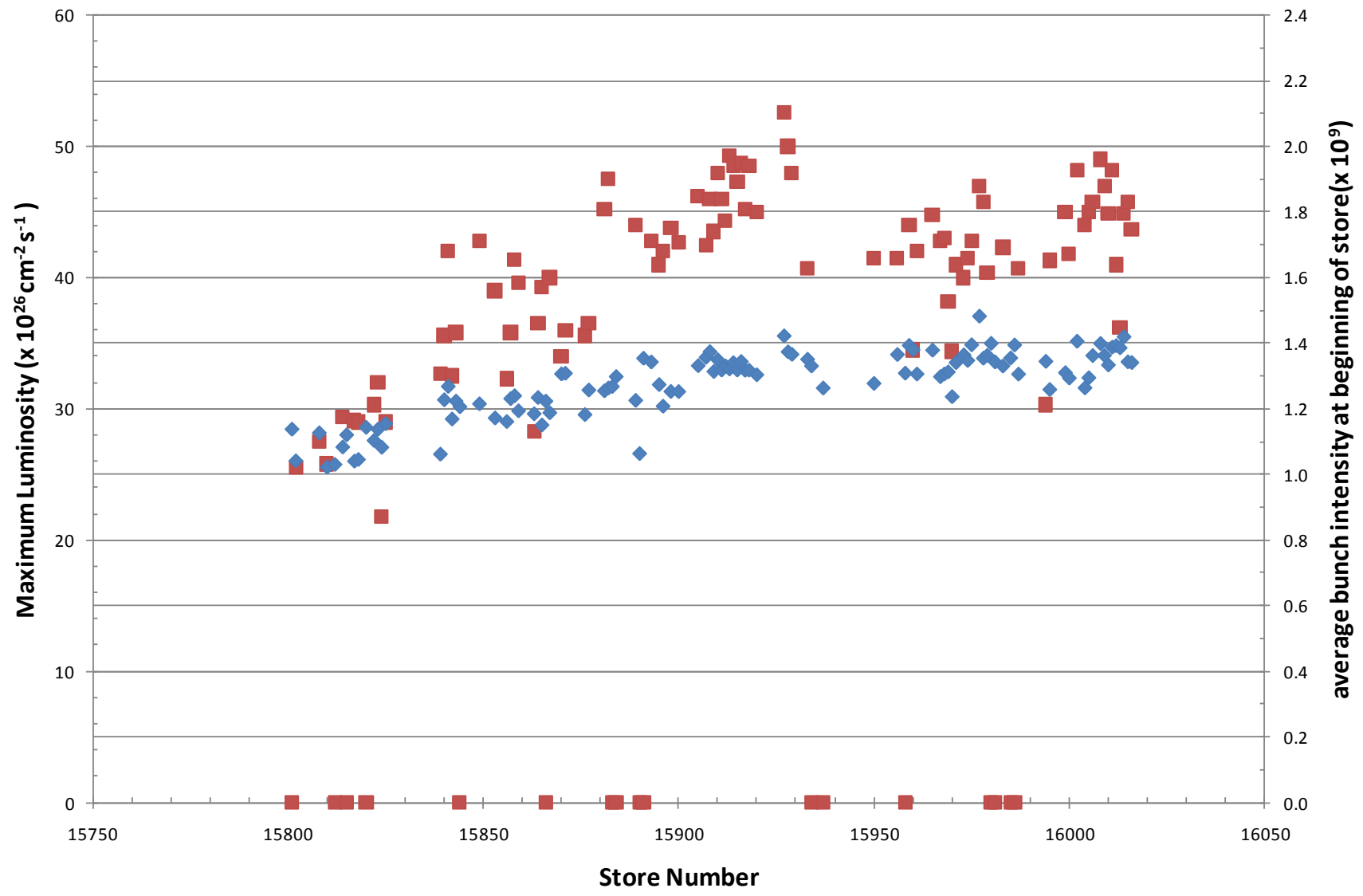


# Run 11 100 x 100 GeV/n Au-Au (Phenix)

thru fill 16016

■ Maximum Luminosity (>3 hr store)

◆ Blue/Yellow Average Bunch Intensity

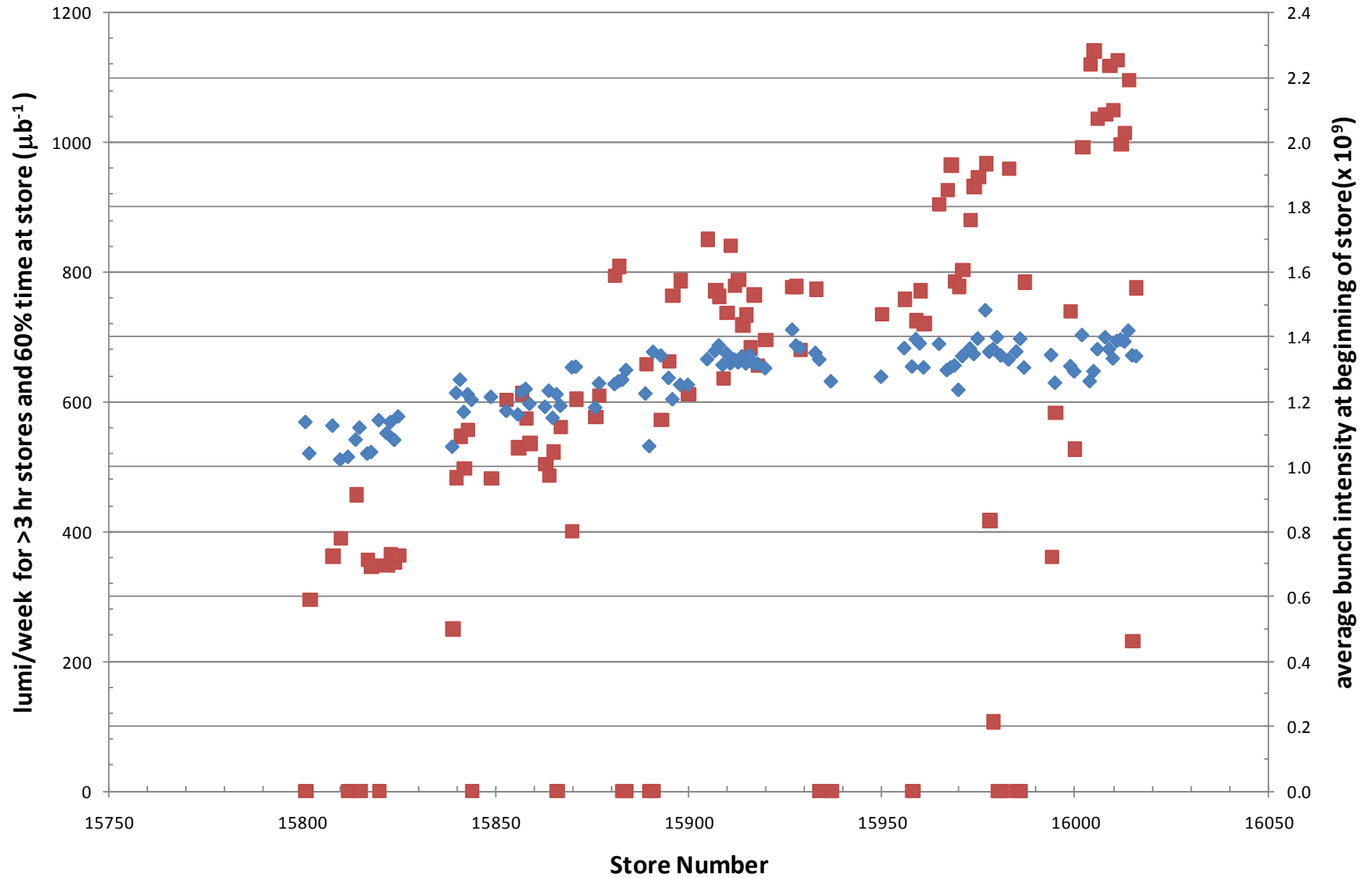


# Run 11 100 x 100 GeV/n Au-Au (Phenix)

thru fill 16016

■ 60% time at store Integrated lumi

◆ Blue/Yellow Average Bunch Intensity

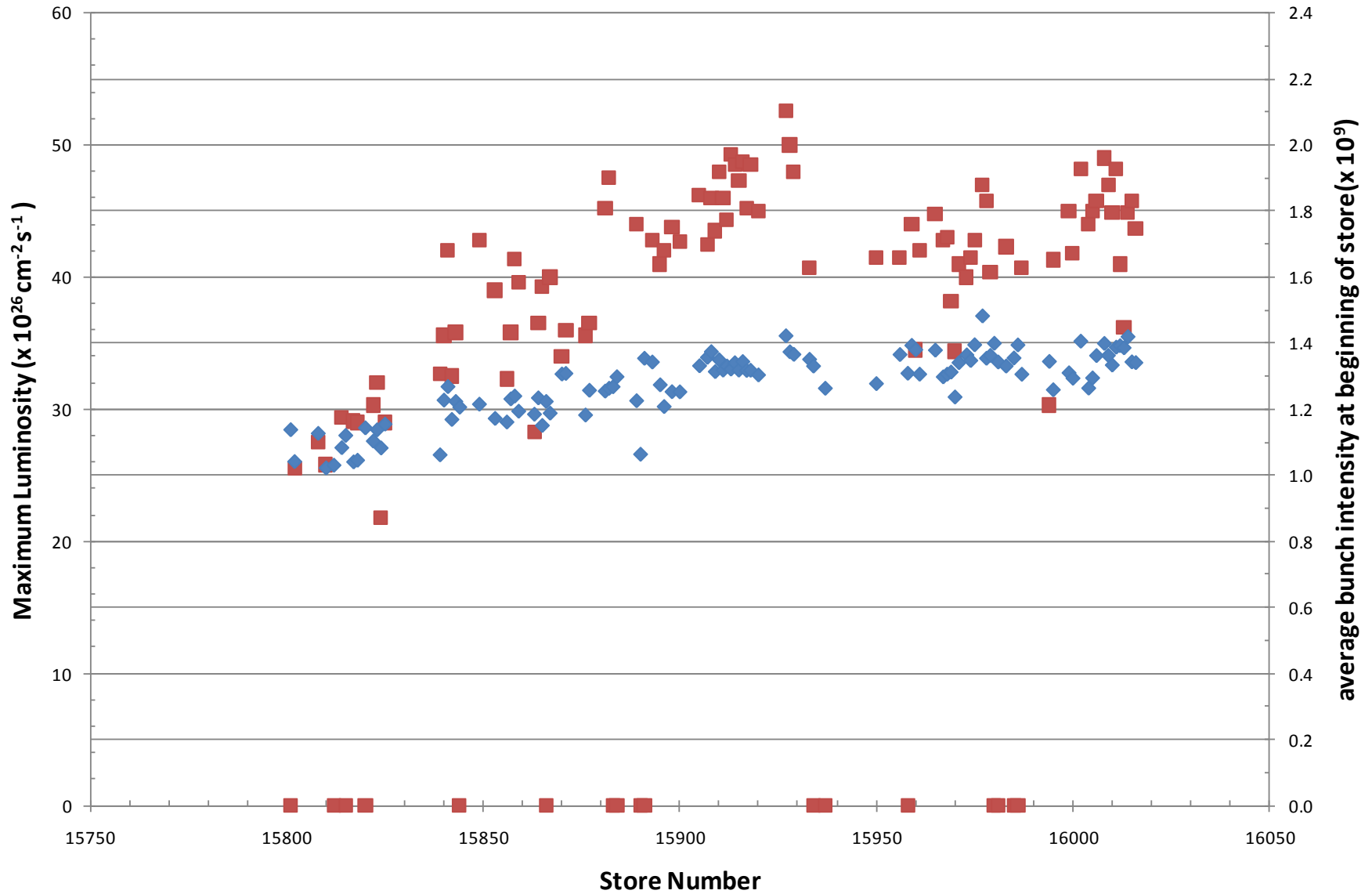


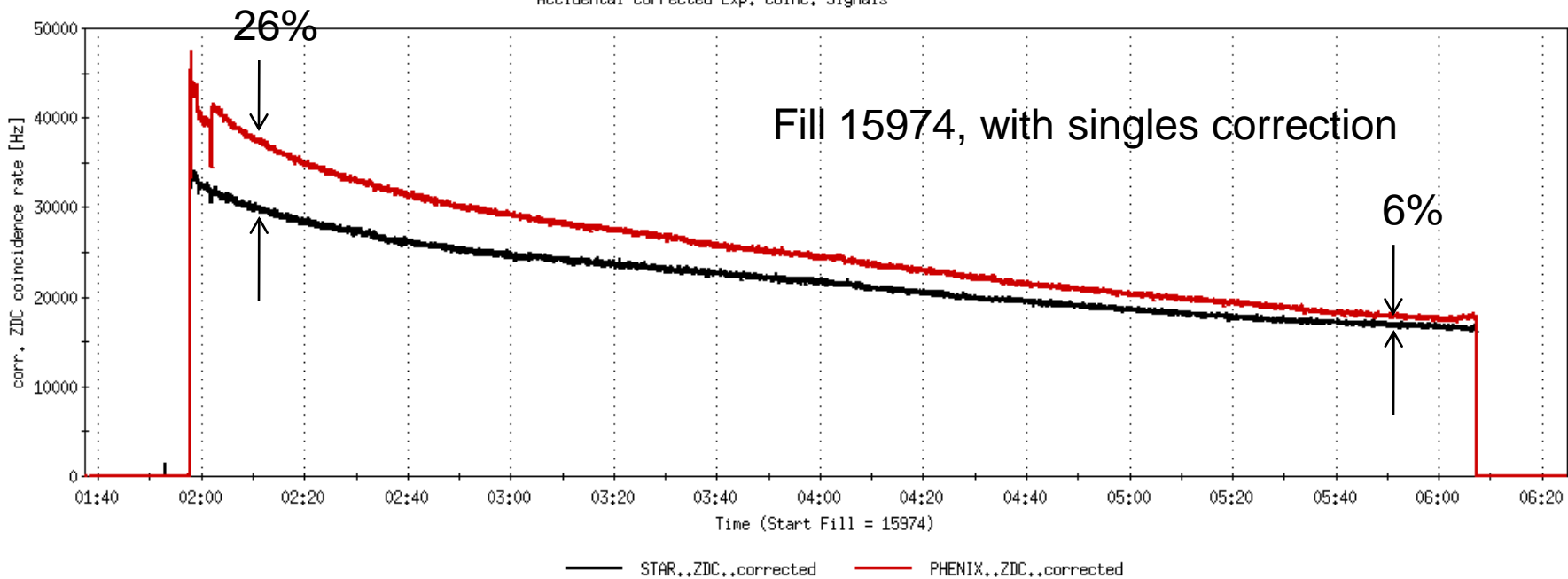
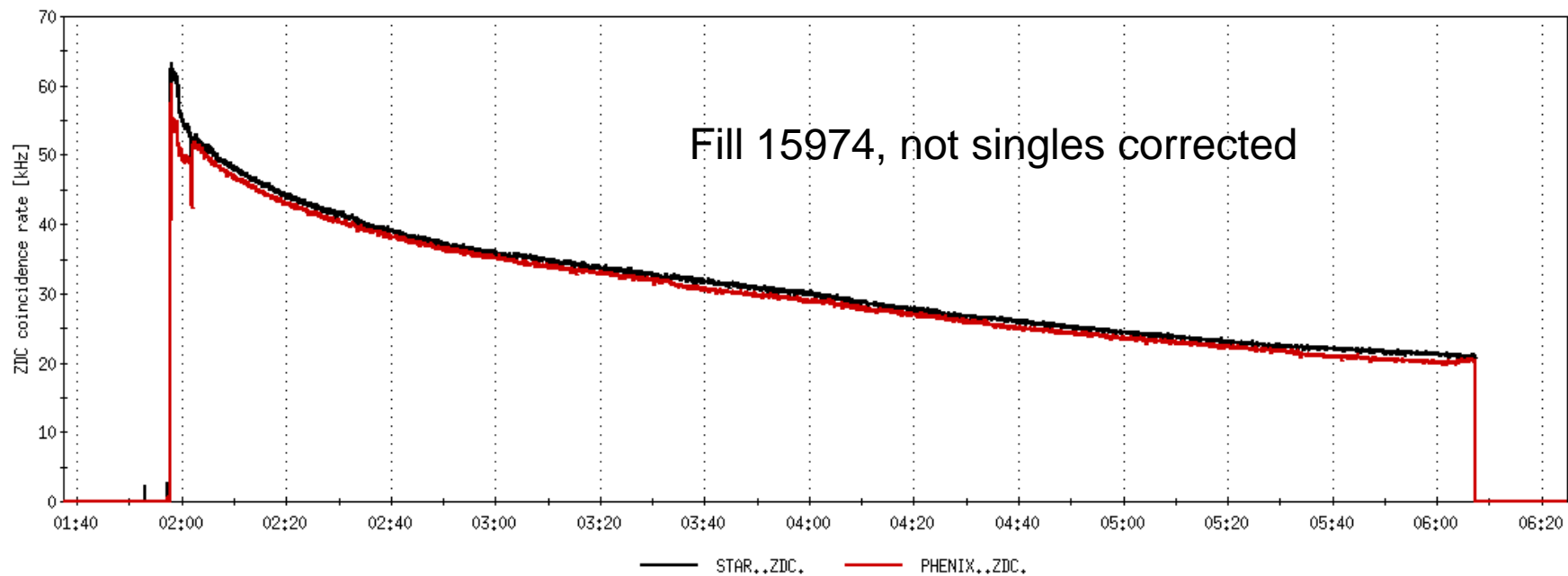
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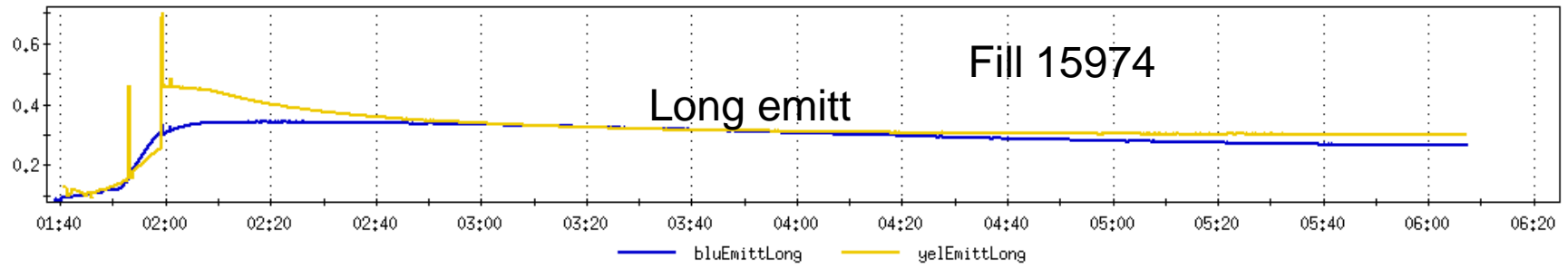
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■ Maximum Luminosity (>3 hr store)

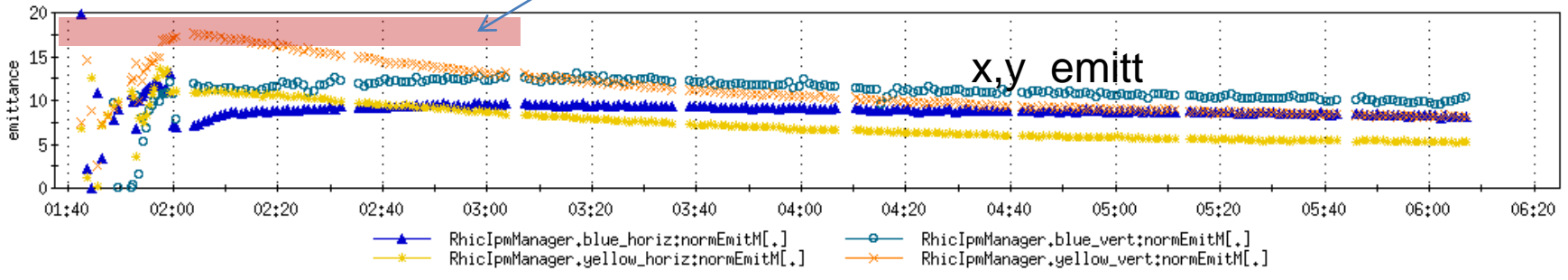
◆ Blue/Yellow Average Bunch Intensity



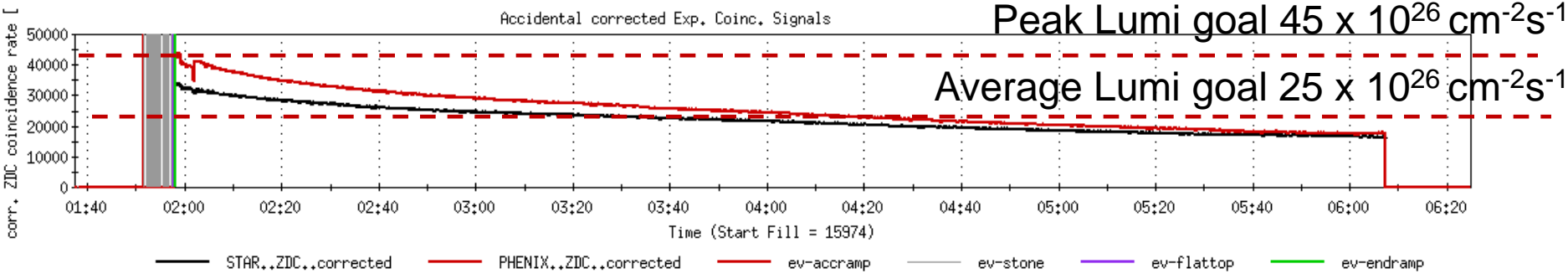
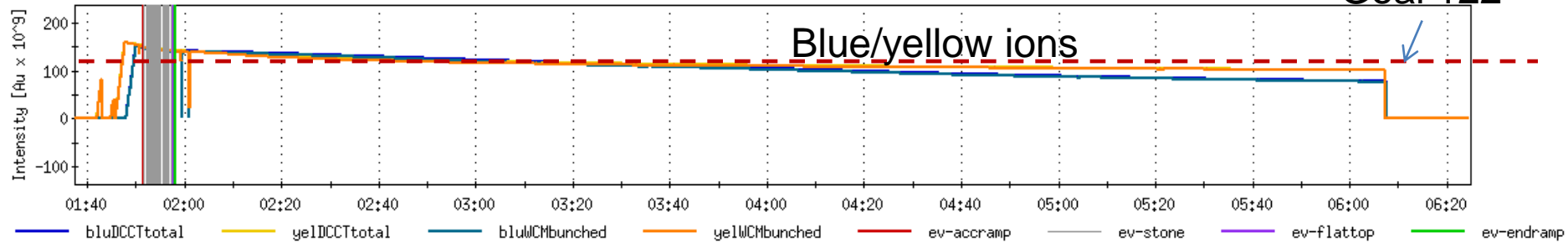




Goal 17-20



Goal 122



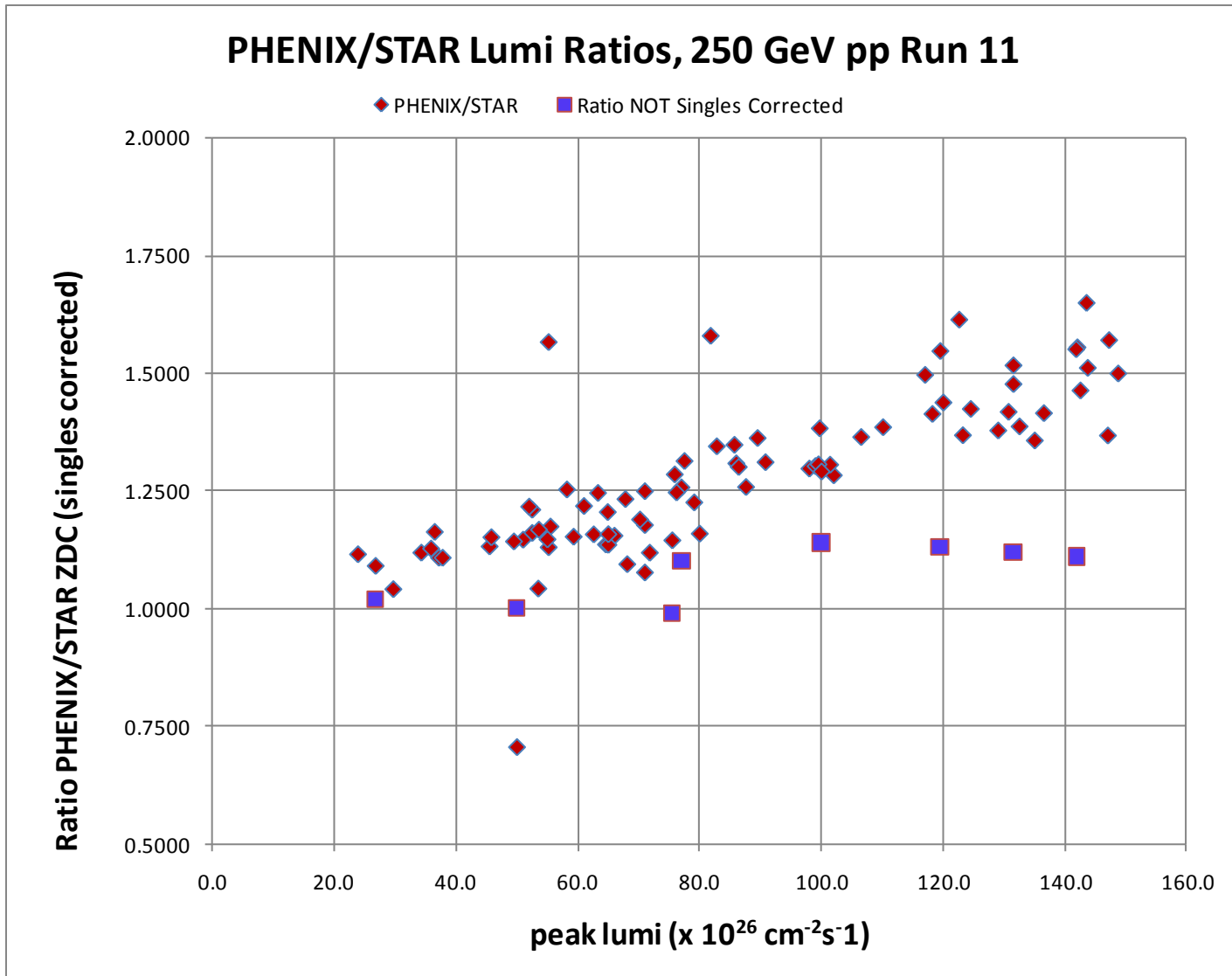
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12	500 pb <sup>-1</sup>	170 pb <sup>-1</sup>	61-180 pb <sup>-1</sup>

→ 100 pb<sup>-1</sup> is not an unreasonable expectation for a 10-12 week run

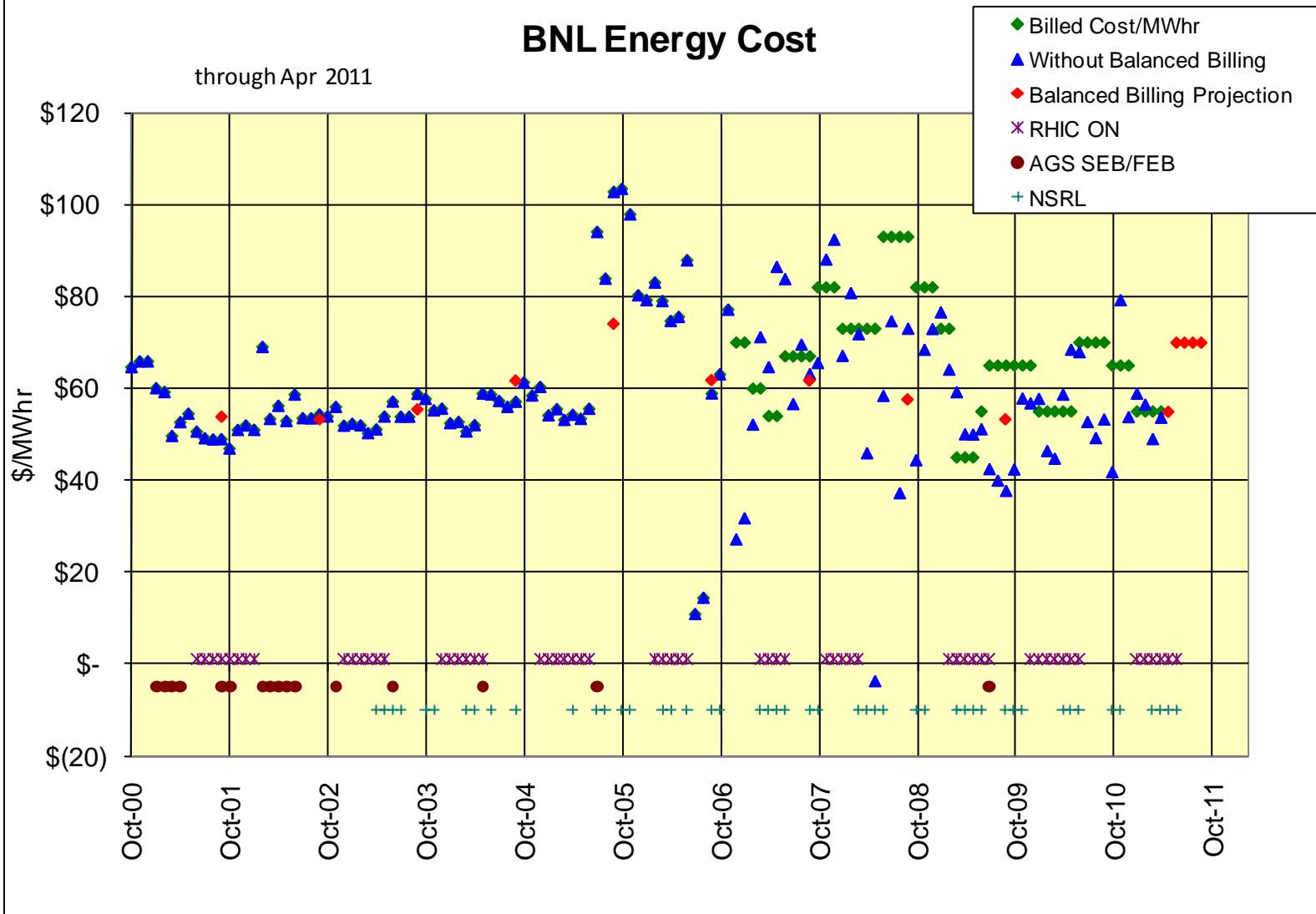
i.e. there's still an issue with singles corrections.





# BNL Energy Cost

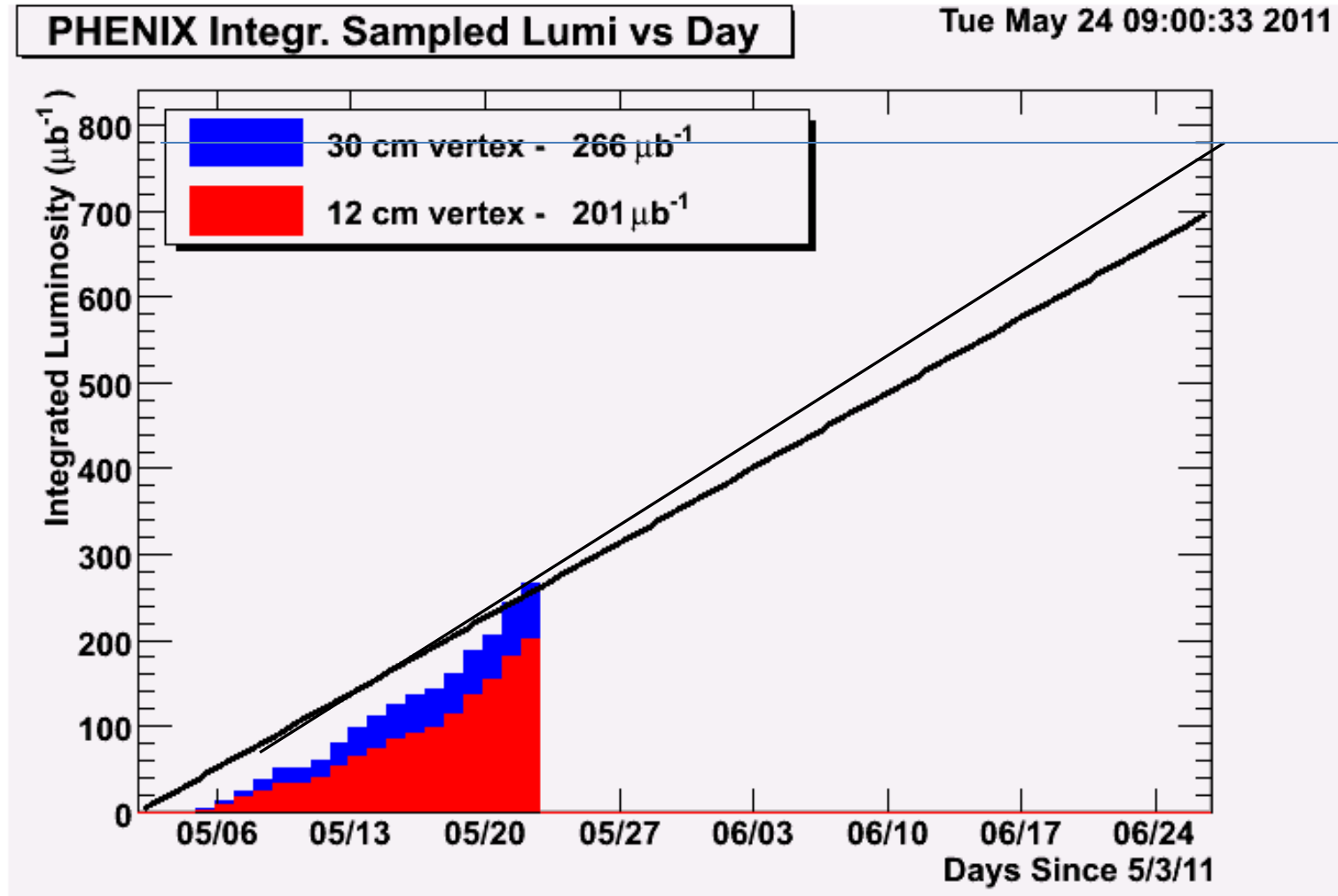
through Apr 2011



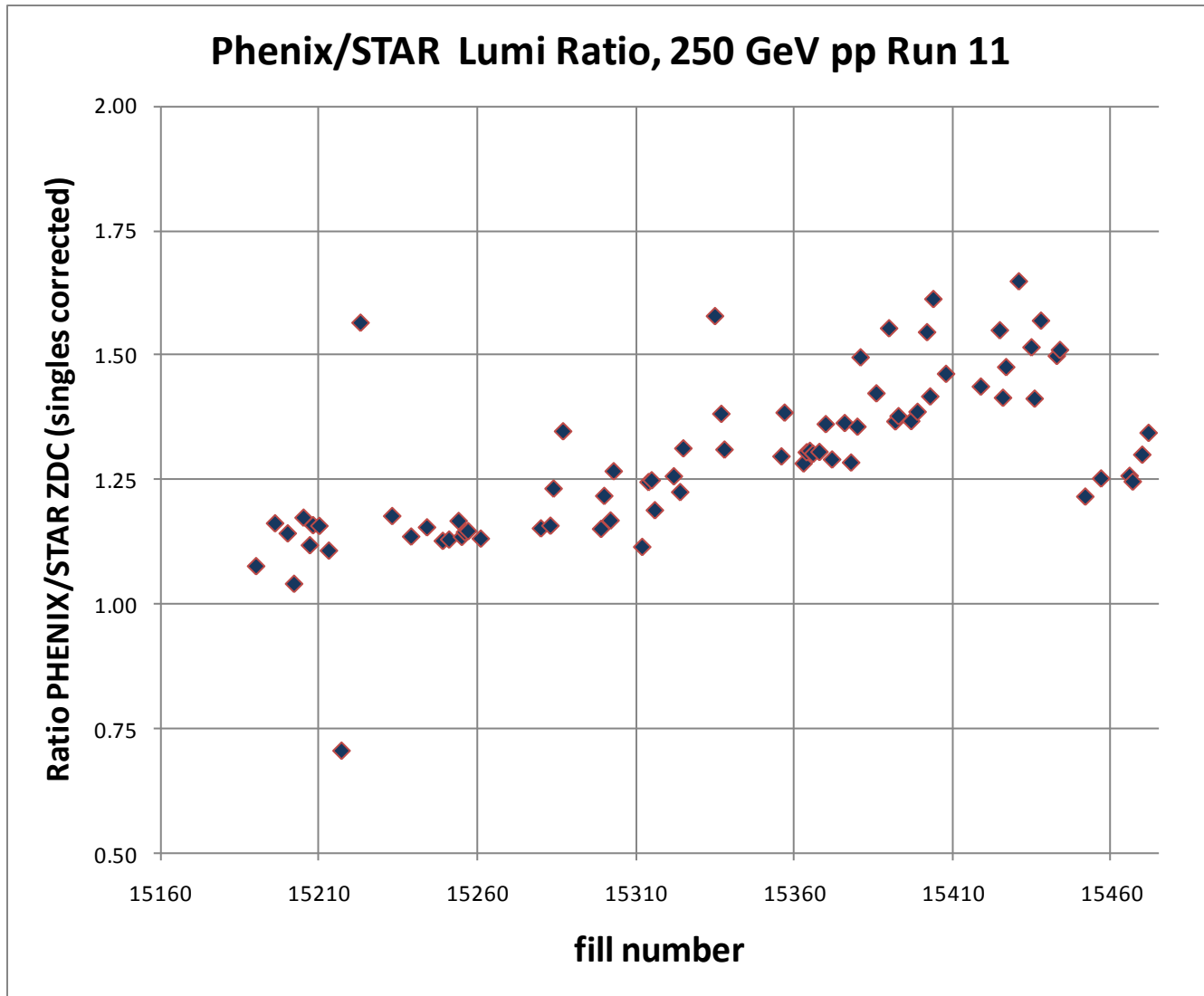
Through fill 15928 delivered 1474  $\mu\text{b}^{-1}$

201  $\mu\text{b}^{-1}$  of 700  $\mu\text{b}^{-1}$  accumulated in 12cm vertex

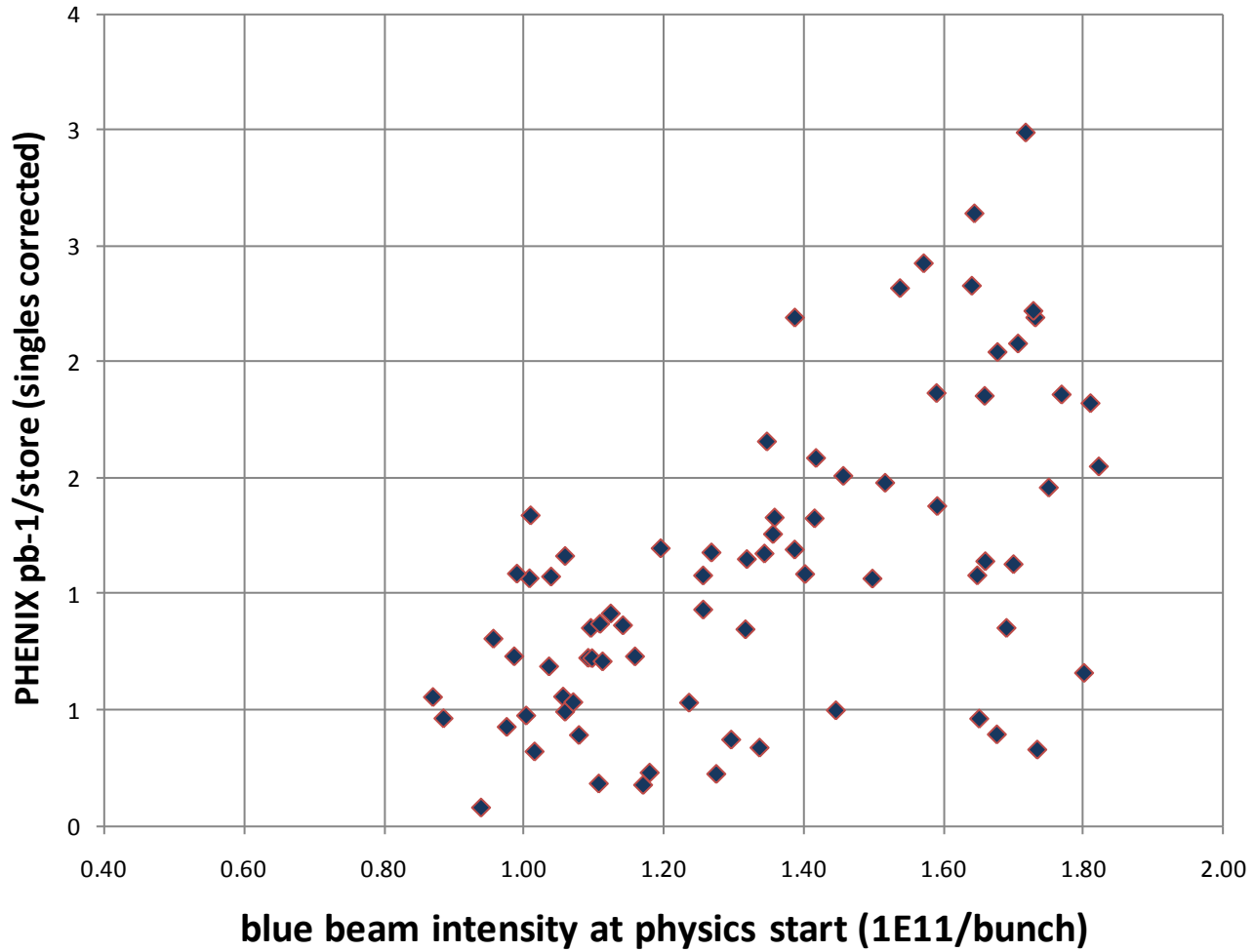
→ Efficiency =  $201/1474 = 14\%$



Final Lumi should change as it appears there's an issue with the singles correction



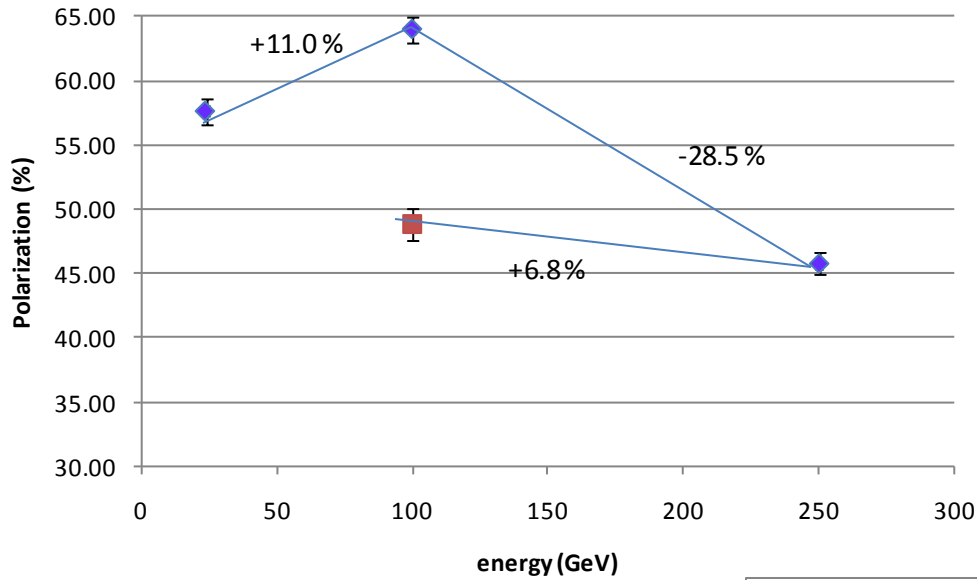
Phenix Lumi vs beam intensity, 250 GeV pp Run 11



## Run 11 Plan based on PAC recommendation/ALD Guidance and available funds 4/26/10 update (1/2)

- 3 Jan, Begin cool-down to 4.5K
- 8 Jan, Cool-down to 4.5K complete in both rings, preliminary setup begins
- ~11 Jan, 2 ½ weeks beam setup for  $\sqrt{s} = 500$  GeV pp in RHIC begins.
- 15 Jan, power supply work/DX training complete
- 17 Jan, first successful ramp
- 19 Jan, 1<sup>st</sup> maint day
- 24 Jan, 1 week Ramp-up with 8 hr/night beam to experiments
- **11 Feb (machine and ~experiments), begin ~10 week physics run ( $\sqrt{s} = 500$  GeV pp)**
- 16 Feb, AGS Jump Quads in routine operation for RHIC injection
- 24 Feb, 9 MHz cavity in routine operation
- 7 Mar, cryo troubles, extended maintenance, 0900 hrs till 2000 hrs 14 Mar – lost 7.5 days
- 17 Mar, power distribution problem, extended maintenance, 1930 hrs till 0315 hrs 20 Mar – lost 2.3 days
- 28 March – 1 April, PAC 2011
- **15 April Continuing Resolution Ends, guidance to follow**
- **18 Apr, end 9.4 week pp physics run at  $\sqrt{s} = 500$  GeV**
- 18 Apr jet target polarization measurement at injection (<5%)
- 19 Apr, short maintenance followed by setup for  $\sqrt{s} = 18$  GeV AuAu
- **23 Apr, begin ~1 week physics run ( $\sqrt{s} = 19.6$  AuAu)**
  
- **2 May, end 1.3 week physics run at  $\sqrt{s} = 19.6$  GeV**

**Up down ramp, Blue Beam  
polarization with current analyzing powers**

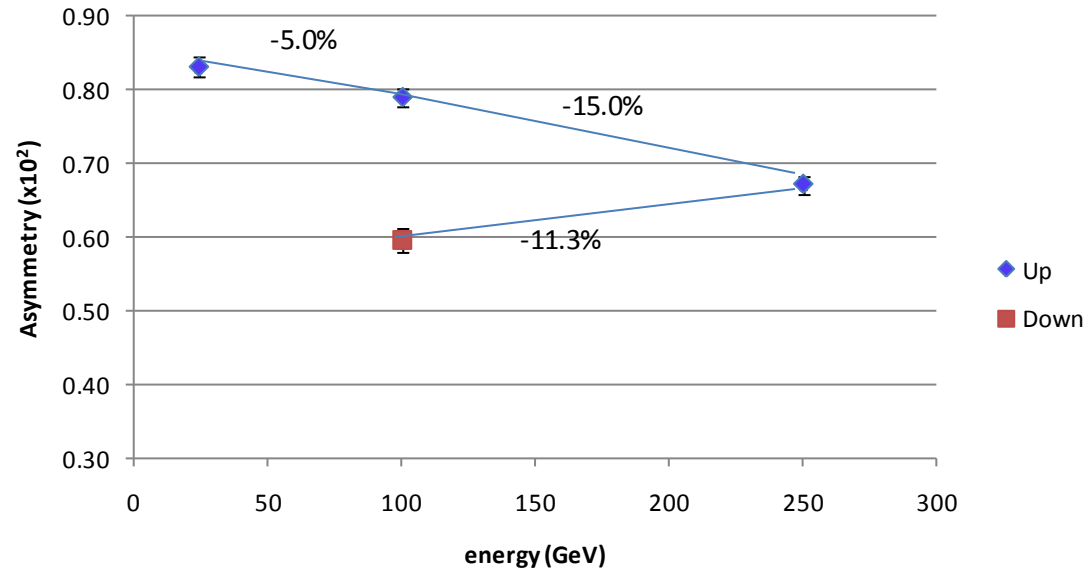


7 April Up-Down Ramp measurement  
Blue Beam

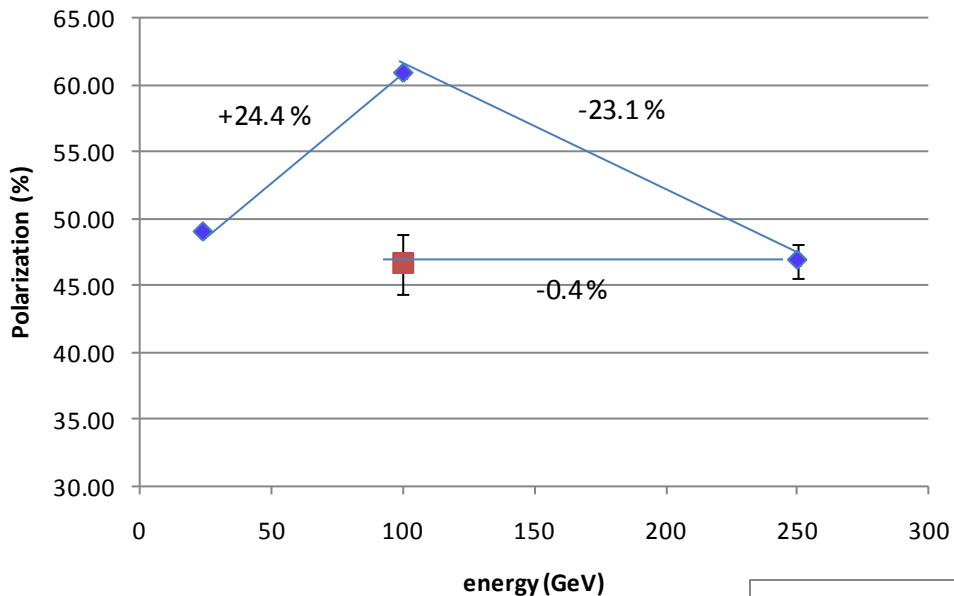
Current CNI average analyzing powers are:

Energy	AN
24	0.0144
100	0.0122
250	0.0147

**Up down ramp, Blue Beam  
Asymmetry**



**Up down ramp, Yellow Beam**  
**polarization (#1 only) with current analyzing powers**



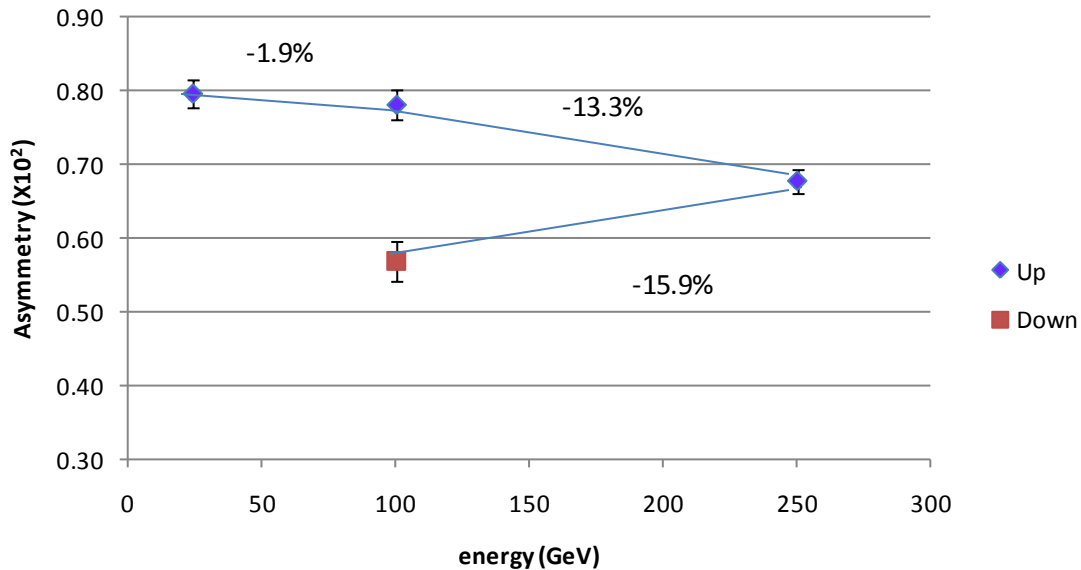
7 April Up-Down Ramp measurement  
 Yellow Beam (only Yellow 1 was used as Yellow 2 was acting up)

Current CNI average analyzing powers are:

Energy	AN
24	0.0144
100	0.0122
250	0.0147

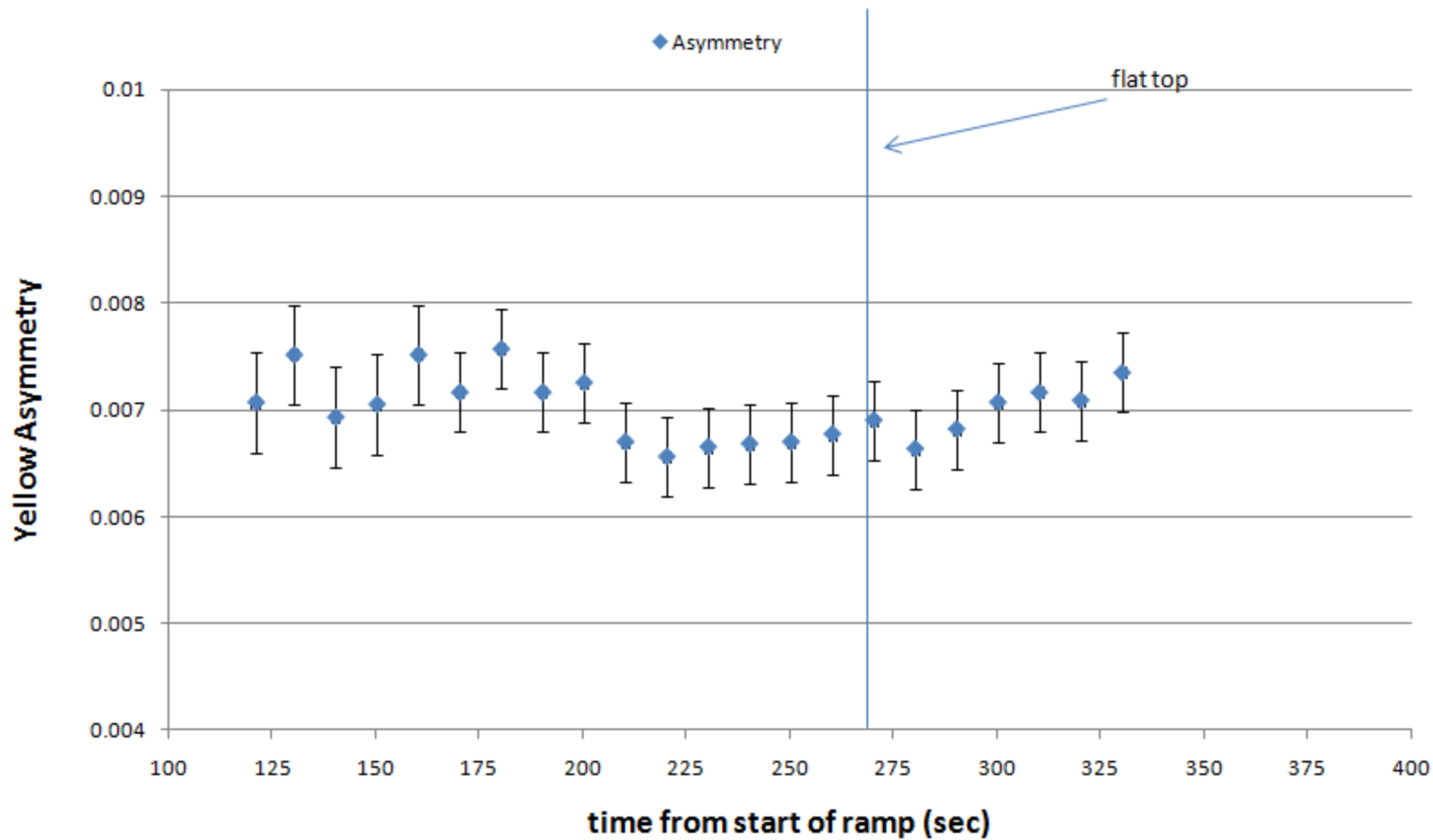
◆ Up  
 ■ Down

**Up down ramp, Yellow Beam**  
**asymmetry (CNI #1 only)**



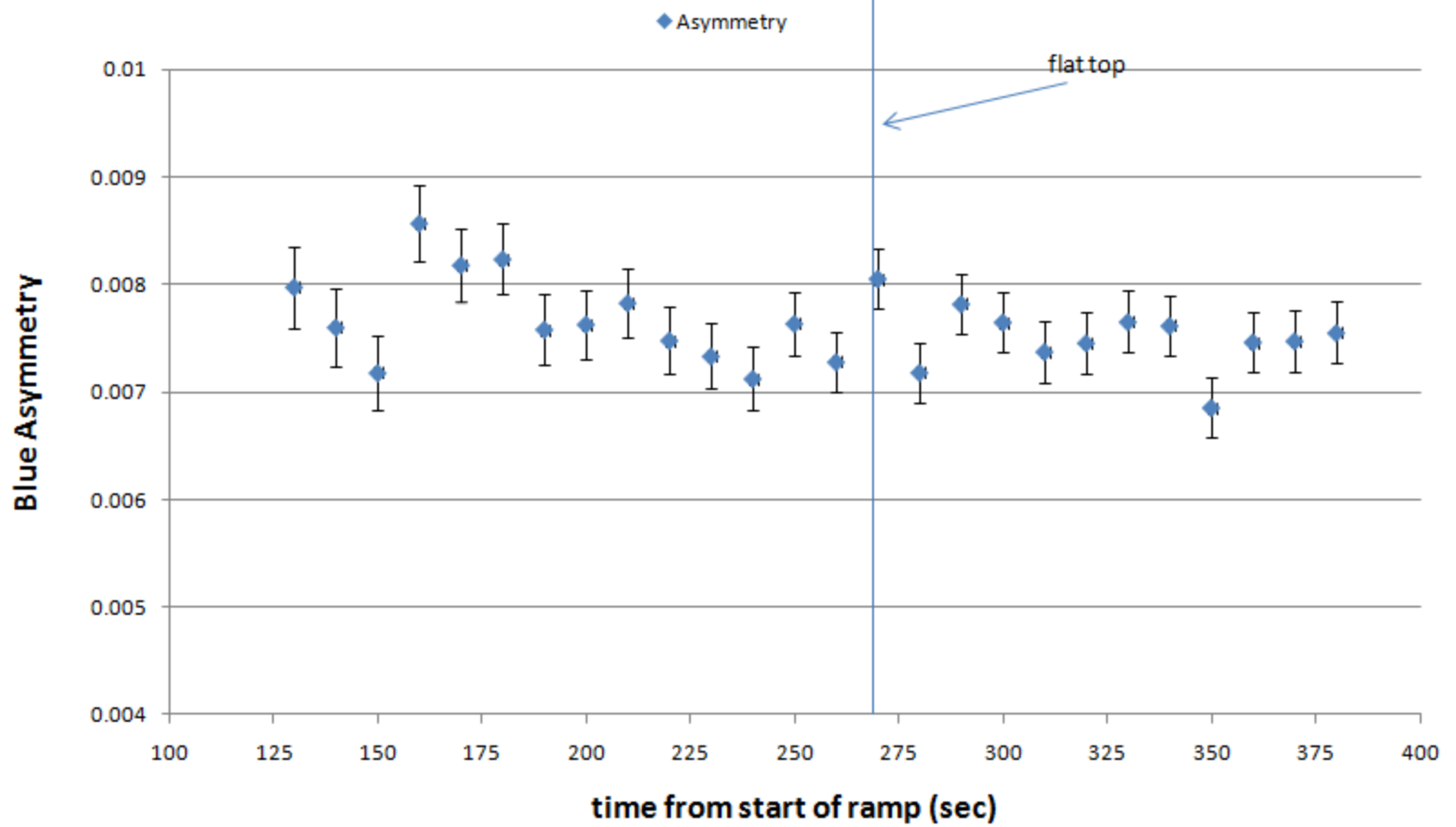
◆ Up  
 ■ Down

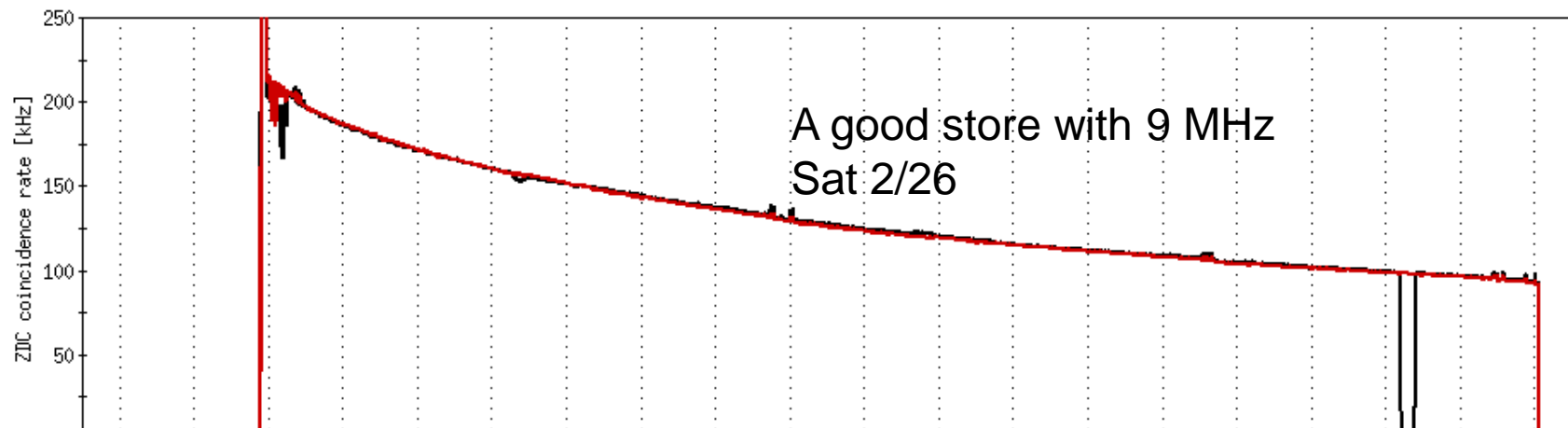
### CNI On the Ramp, fill 15366



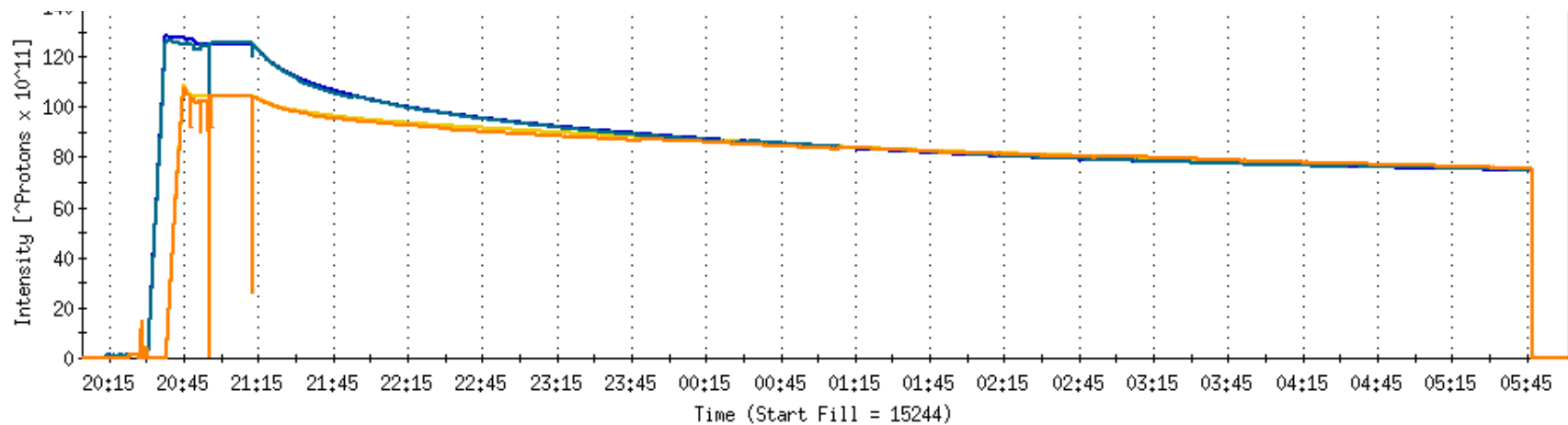
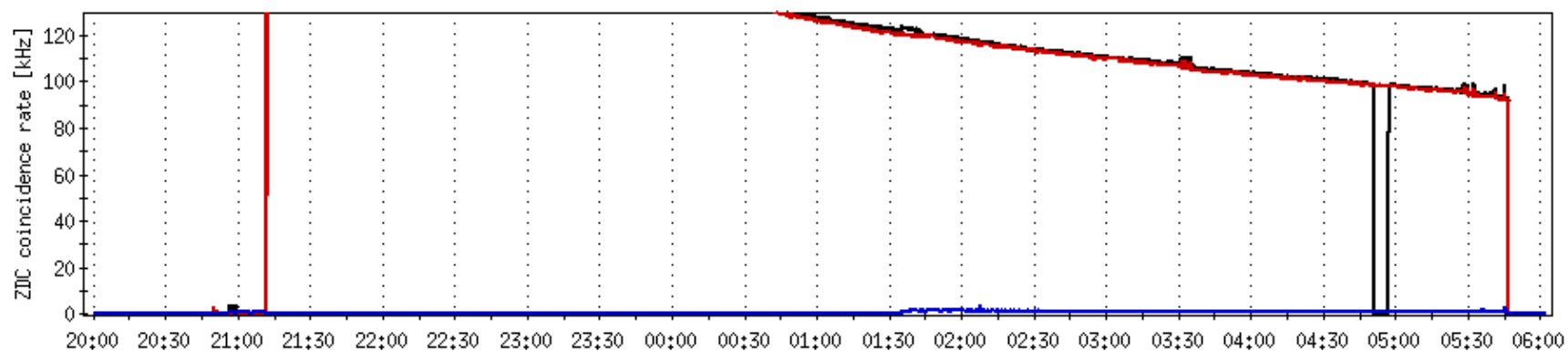


### CNI On the Ramp, fill 15378





Experimental Coincidence Signals



bluDCCTtotal

yelDCCTtotal

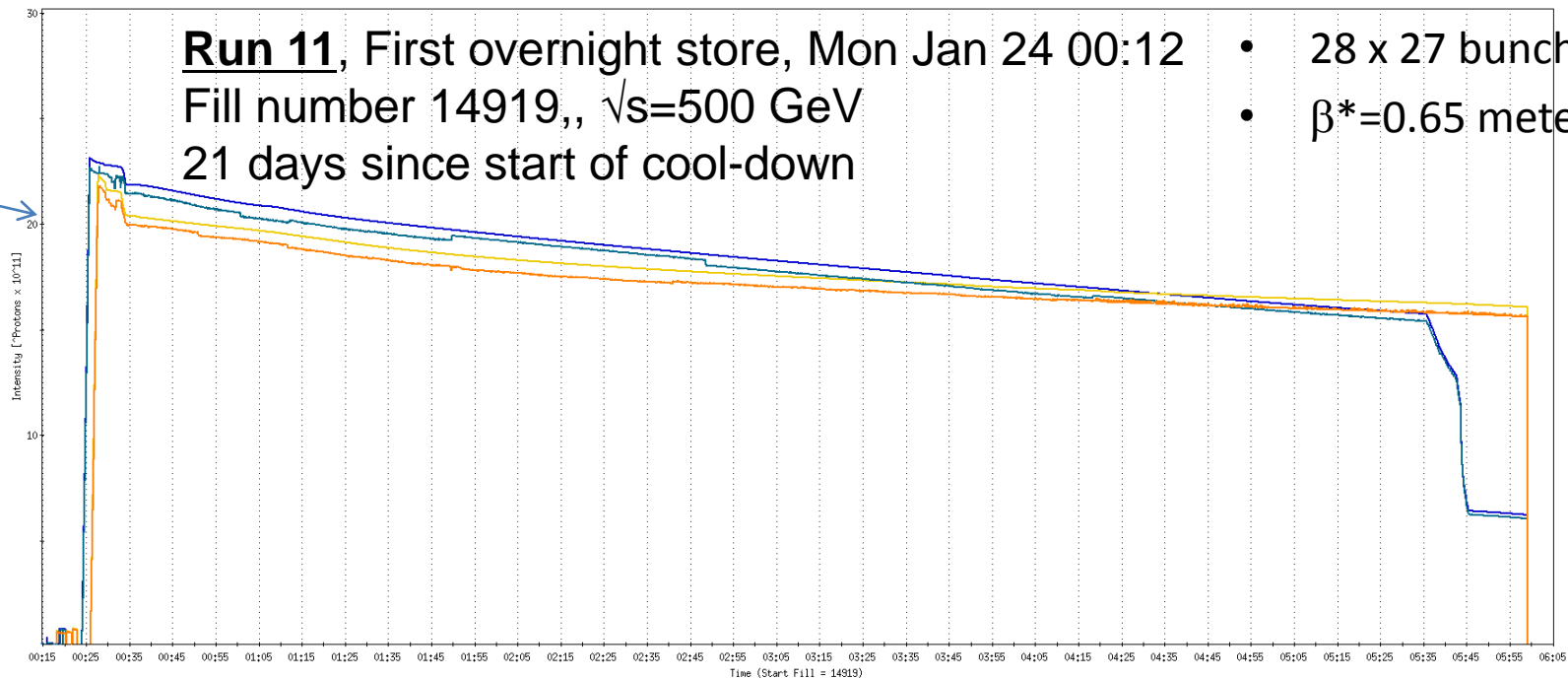
bluWCBunched

yelWCBunched

**Run 11**, First overnight store, Mon Jan 24 00:12  
Fill number 14919,,  $\sqrt{s}=500$  GeV  
21 days since start of cool-down

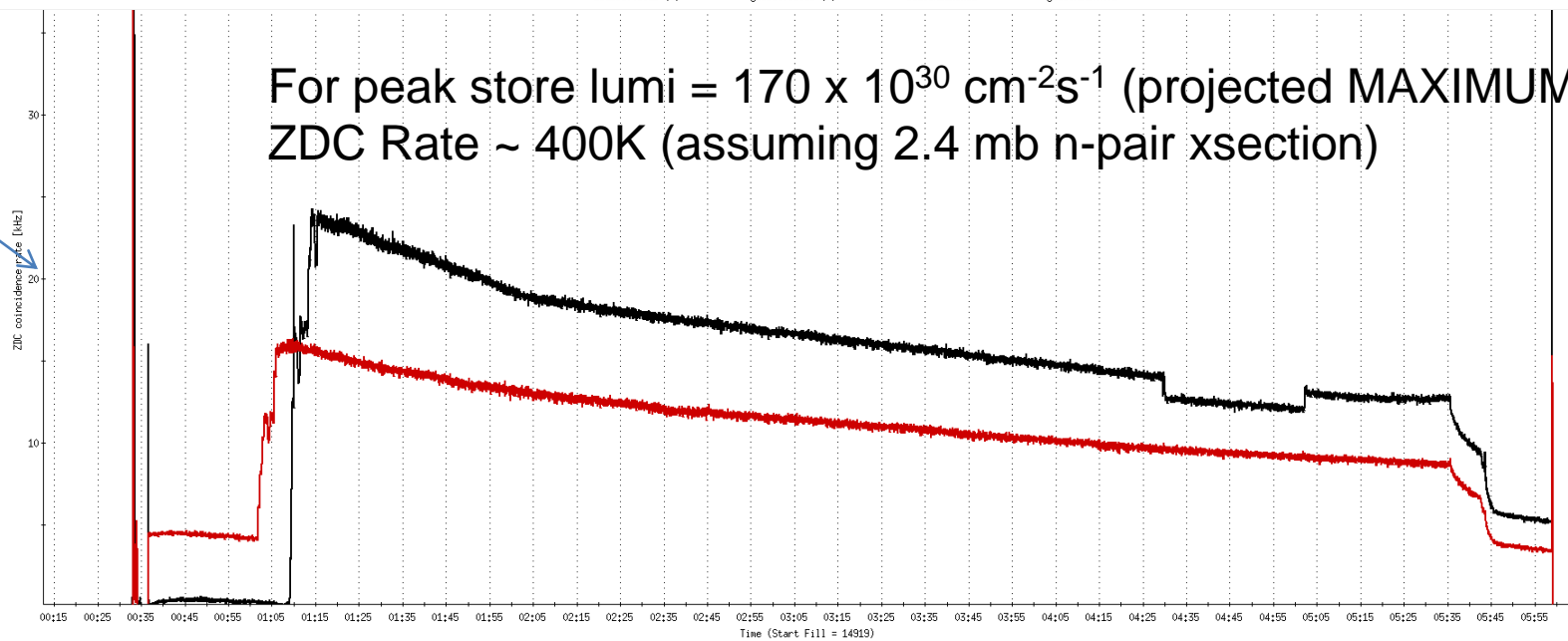
- 28 x 27 bunches
- $\beta^*=0.65$  meters

20 x 10<sup>11</sup>



For peak store lumi =  $170 \times 10^{30} \text{ cm}^{-2}\text{s}^{-1}$  (projected MAXIMUM)  
ZDC Rate ~ 400K (assuming 2.4 mb n-pair xsection)

20K



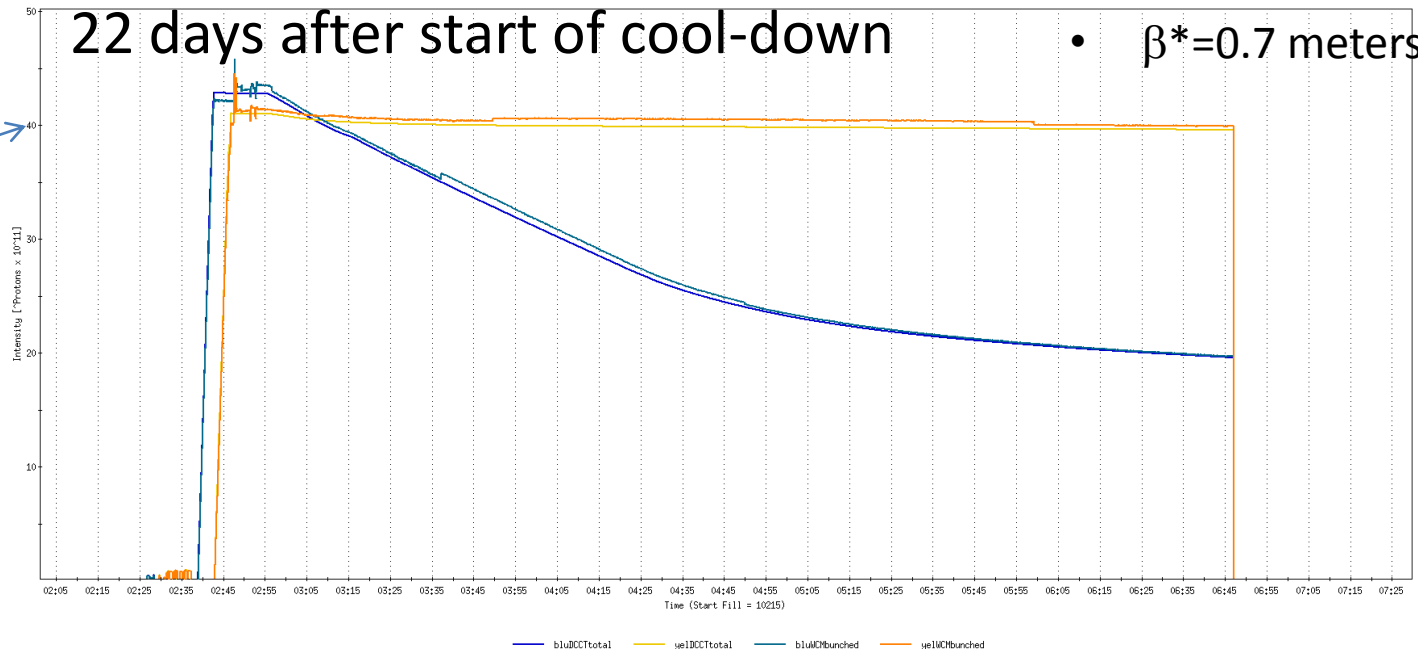
# Run 9, First overnight store at $\sqrt{s}=500$ GeV

• 56 x 56 bunches

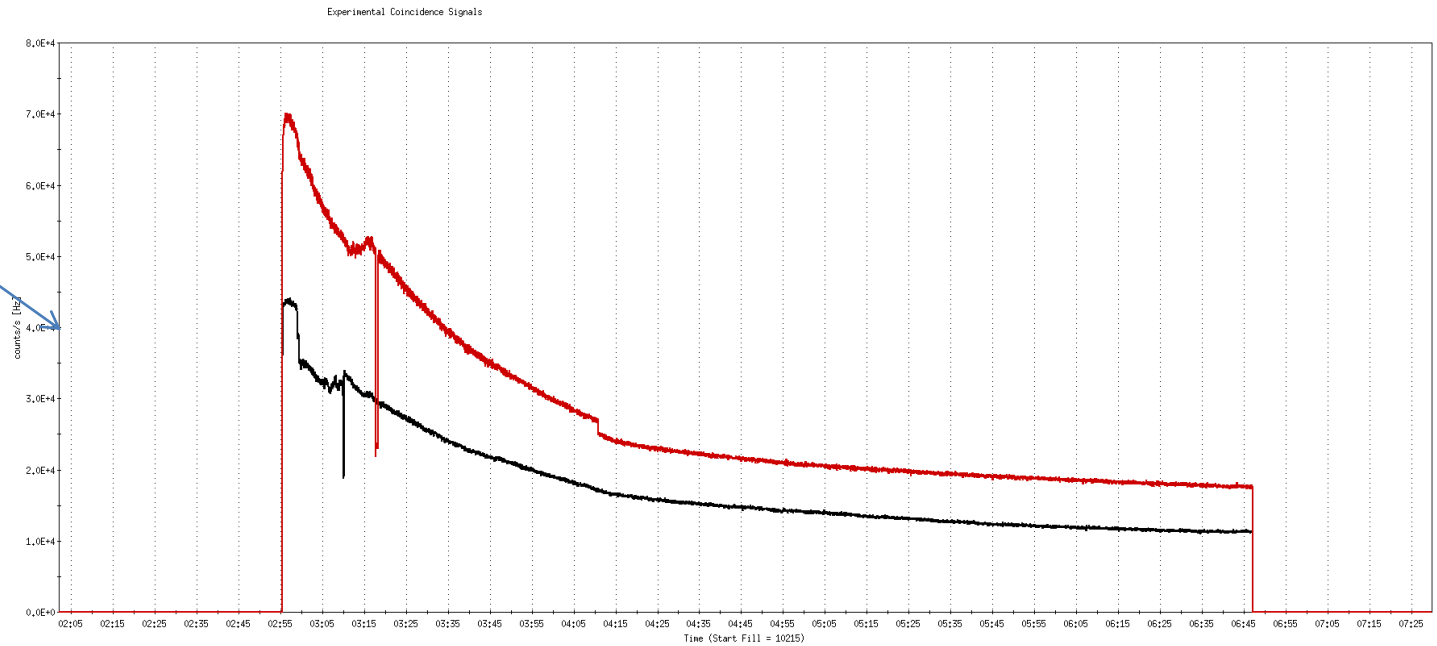
•  $\beta^*=0.7$  meters

## 22 days after start of cool-down

$40 \times 10^{11}$

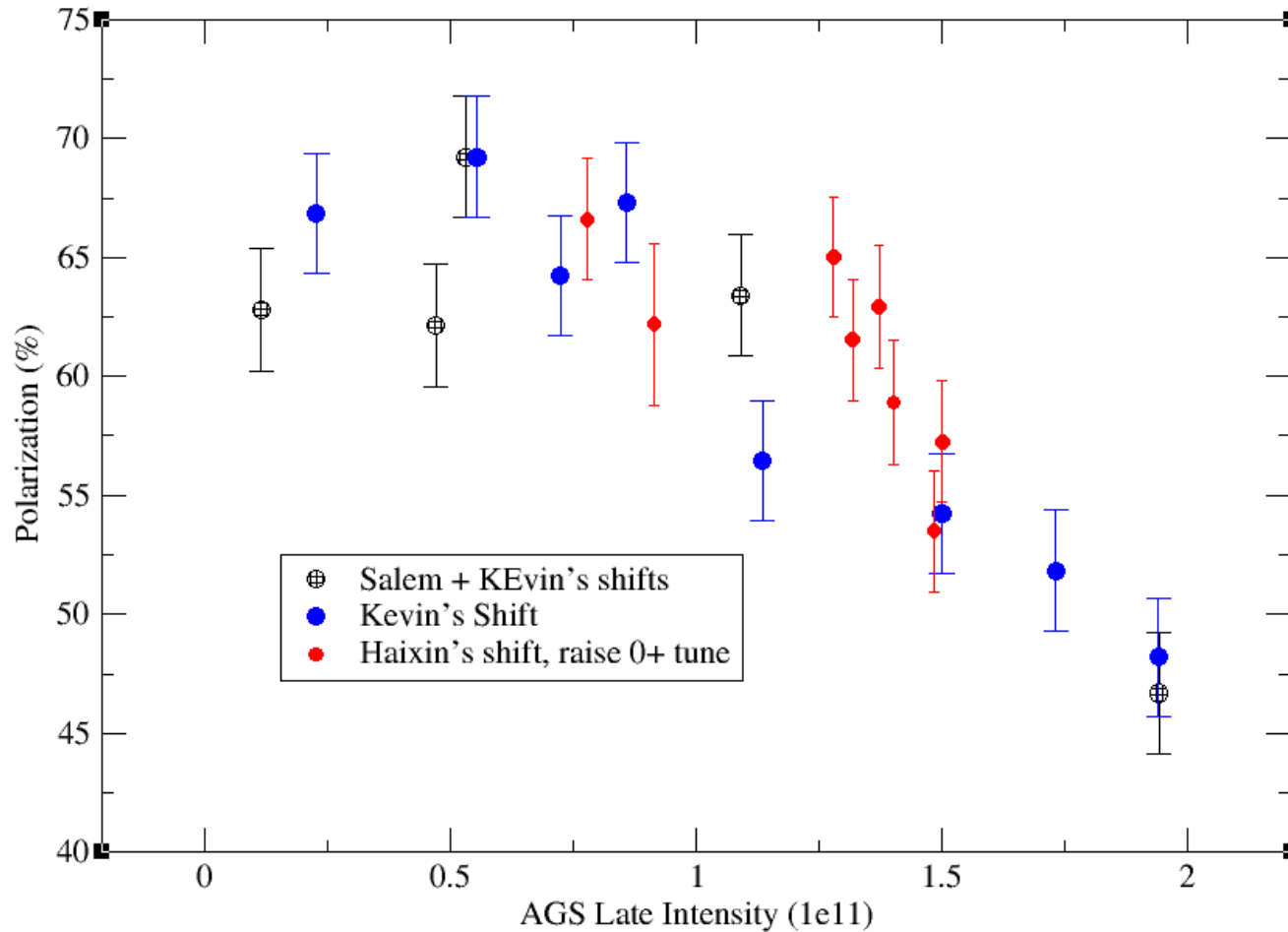


40K



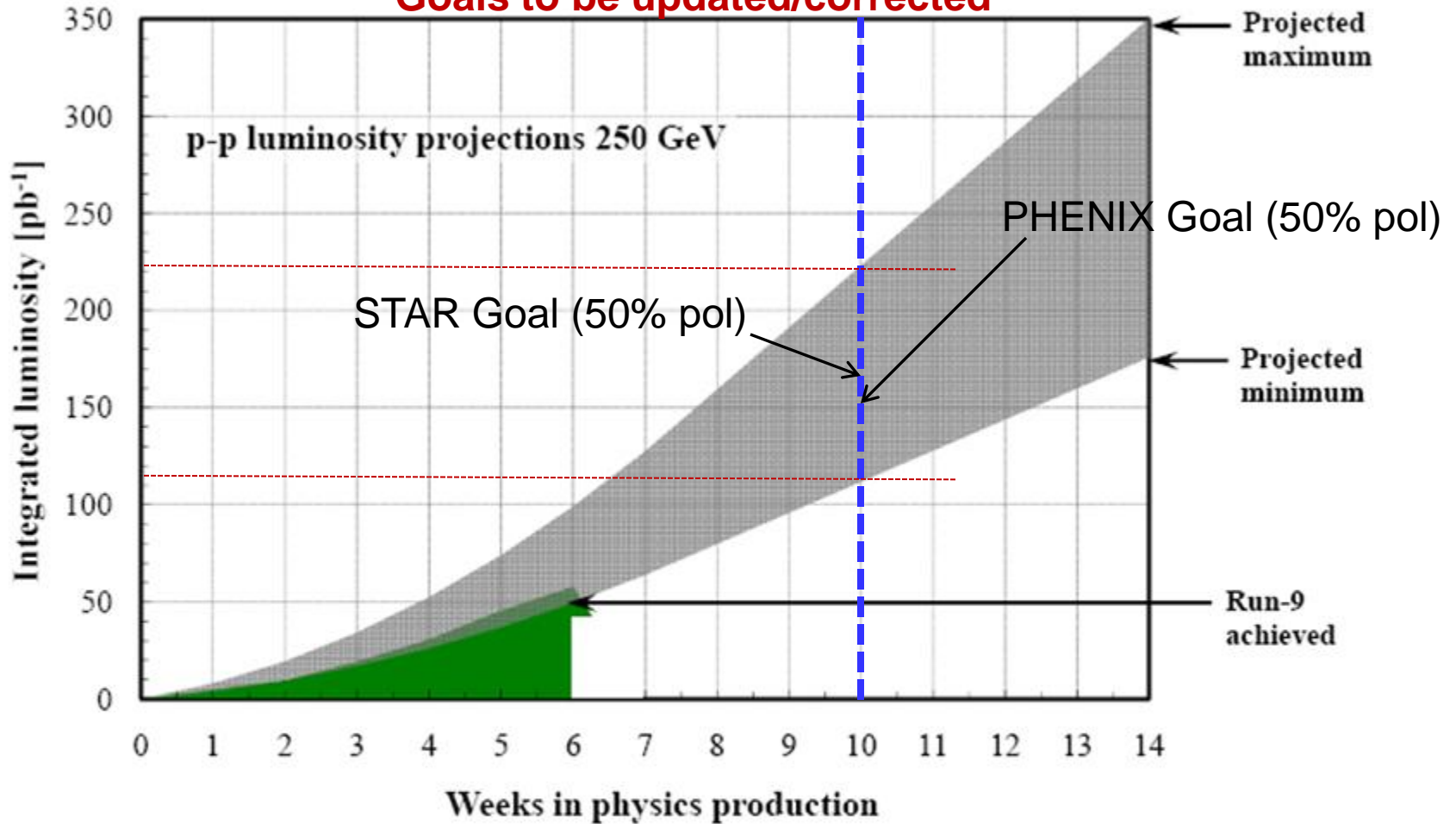
G0: X, Y = [-0.402176, 34.134]

## AGS pp log, 23 Feb 09, 00:26



# Run-11 p<sup>↑</sup>-p<sup>↑</sup> luminosity projections

Goals to be updated/corrected

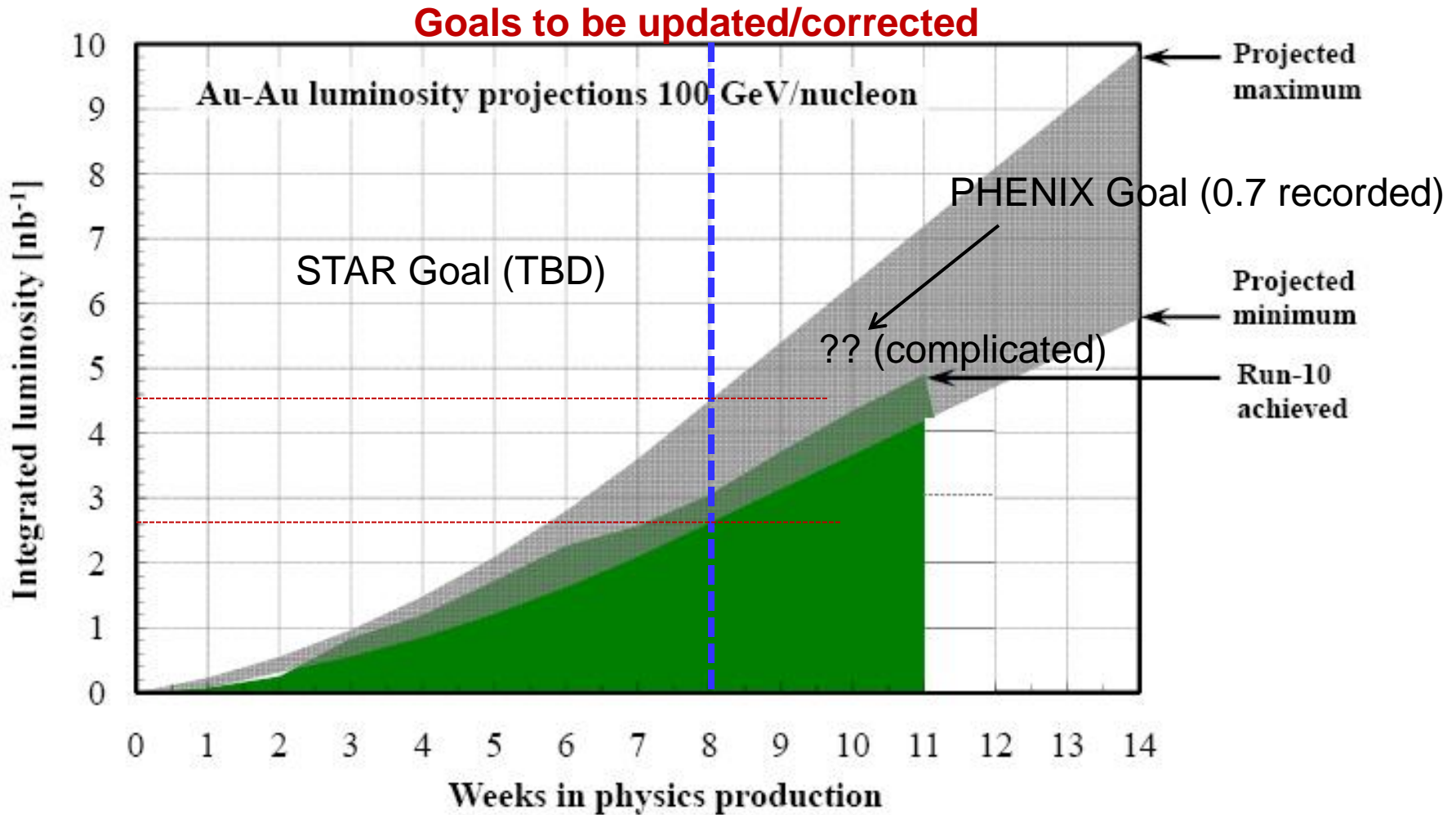


Assume 8 weeks to ramp-up for max.

Expect store  $P_{\text{avg}} = 35\text{-}50\%$ ,  $L_{\text{avg}}$  up to  $100 \times 10^{30} \text{cm}^{-2} \text{s}^{-1}$  (+80%).

[from Run-9 to max projection:  $\beta^* = 0.7 \rightarrow 0.6 \text{ m}$ ,  $N_b = 1.1 \rightarrow 1.4 \times 10^{11}$ ]

# Run-11 Au-Au luminosity projections 100 GeV/nucleon



Assume 6 weeks to ramp-up for min, and 8 weeks for max (stoch. cooling re-commissioning).

**Expect  $L_{\text{avg}}$  up to  $25 \times 10^{26} \text{cm}^{-2} \text{s}^{-1}$  (+25%).**

**[from Run-10 to max:  $\beta^* = 0.75 \rightarrow 0.65$  m,  $N_b = 1.1 \rightarrow 1.1 \times 10^9$ , more cooling]**