RUN 11 RHIC MACHINE/EXPERIMENTS MEETING

21 Jun 2011

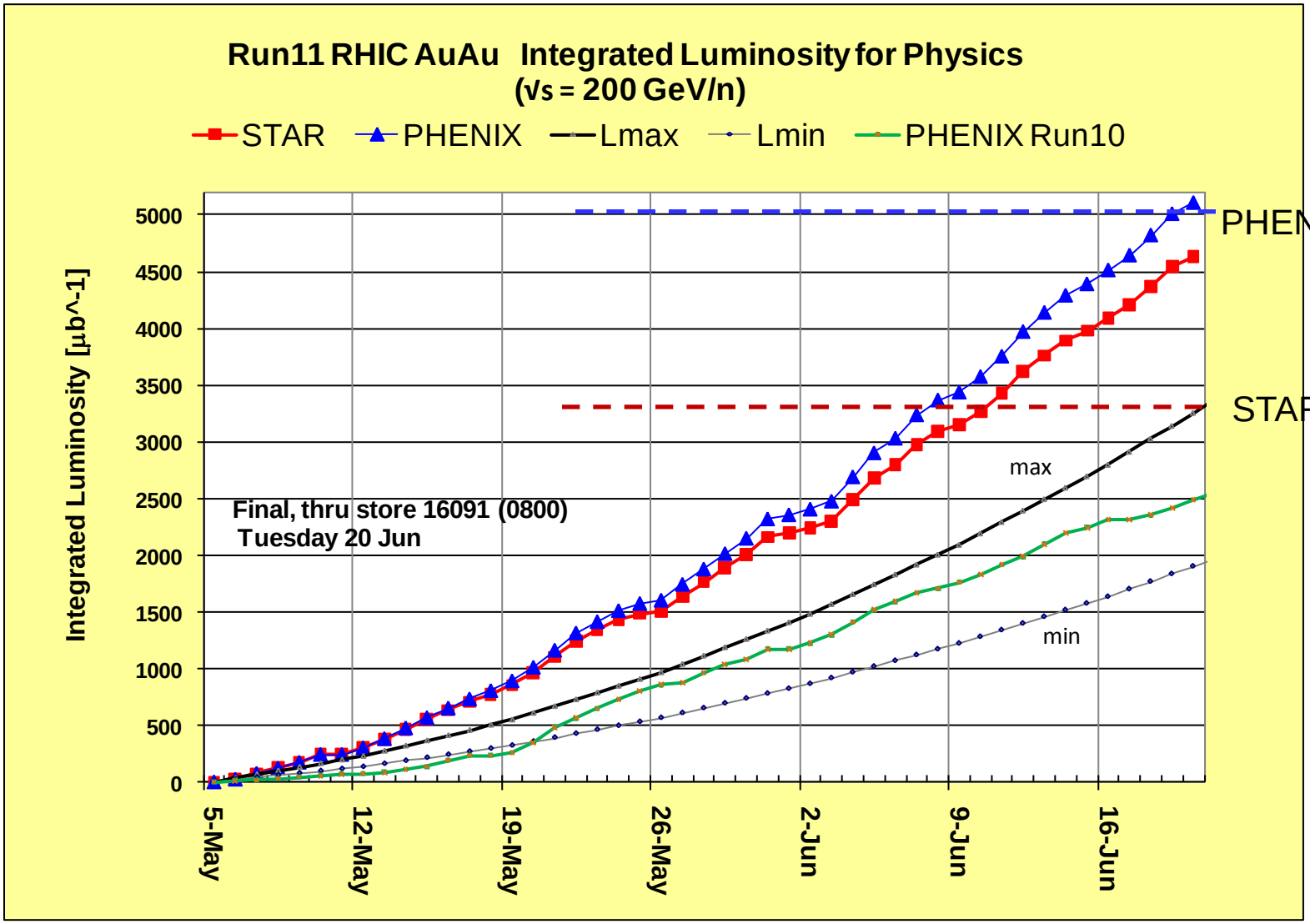
Agenda:

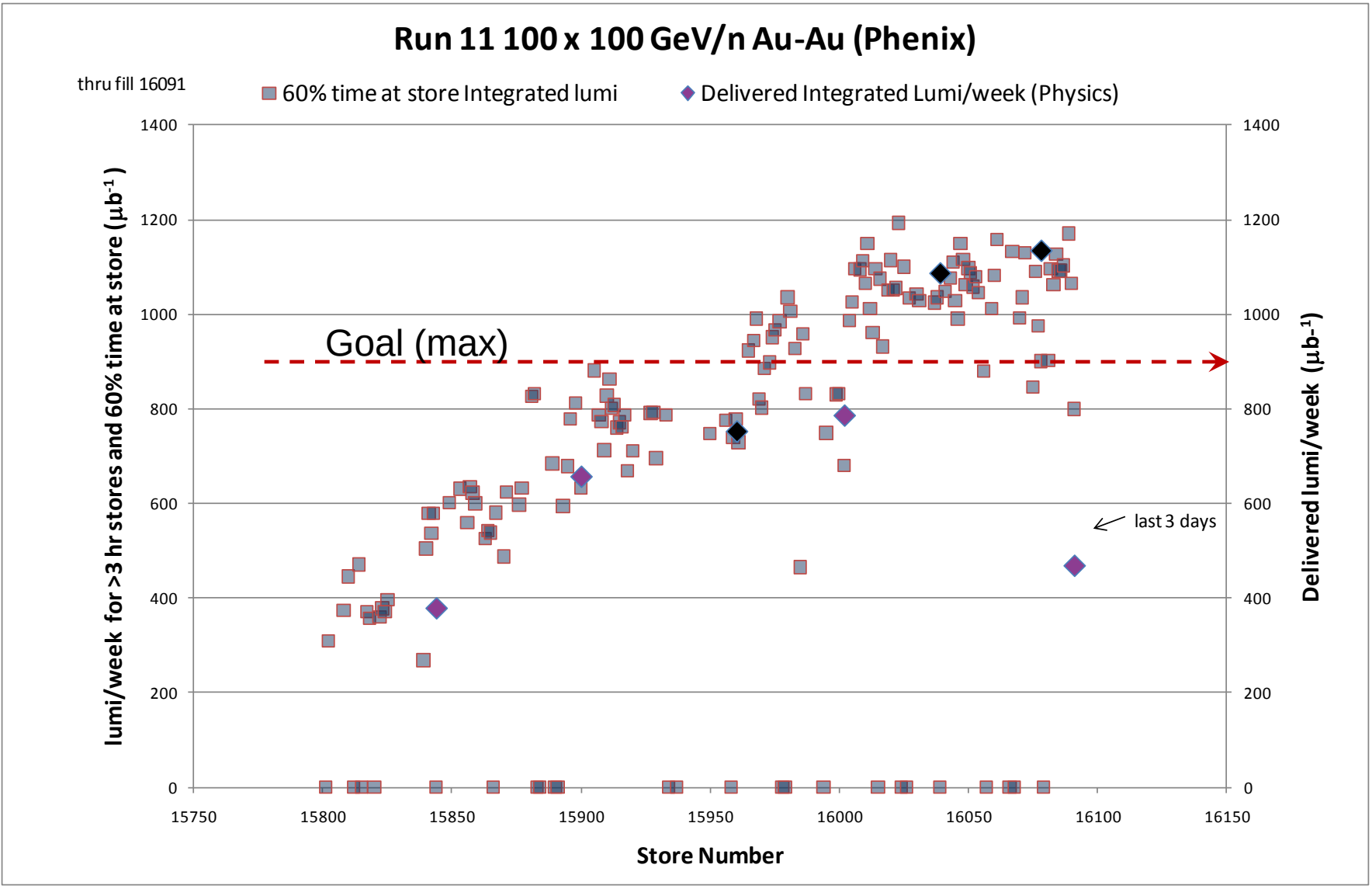
- √s = 200 GeV/n AuAu wrap-up
- √s = 27 GeV/n AuAu setup progress
- APEX request for final week
- Machine development requests
  - test RHIC dipoles and quads (+3.8%) for 100 GeV/n Uranium
  - high current test (+10%) of RHIC dipoles for eRHIC

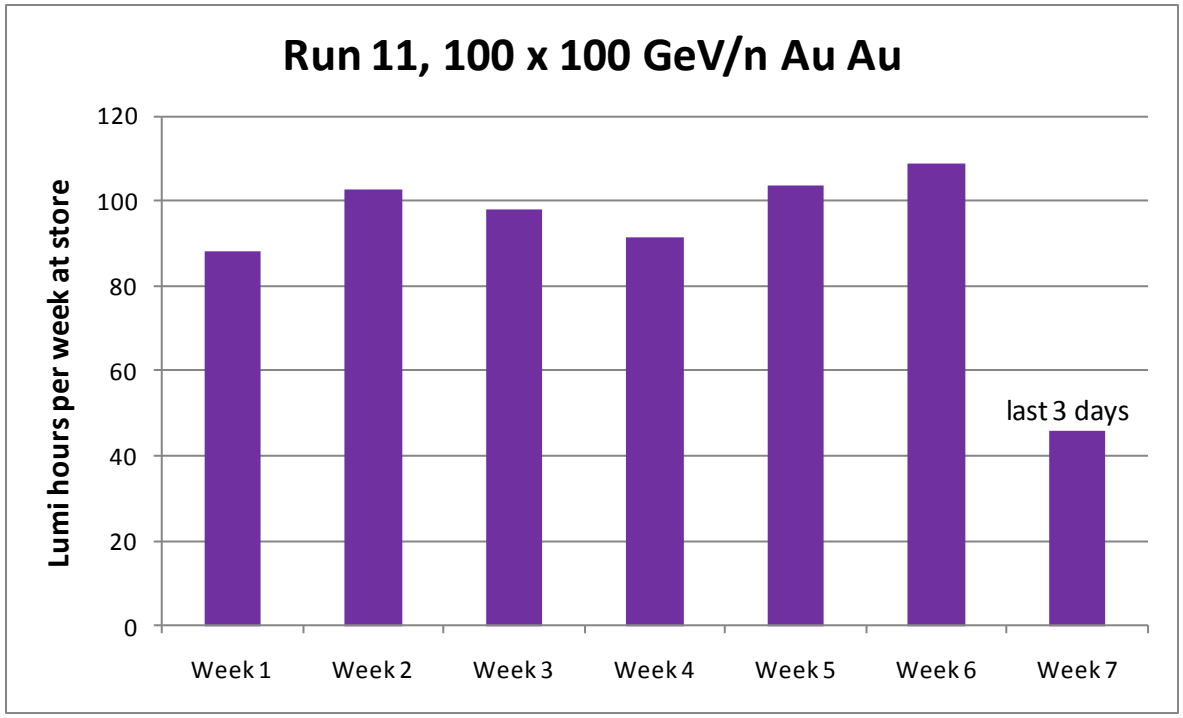
Run 11 Plan based on PAC recommendation/ALD Guidance and available funds
6/21/10 update

- 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 (√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 √s = 500 GeV**
- 18 Apr jet target polarization measurement at injection (<5%)
- 19 Apr, short maintenance followed by setup for √s = 18 GeV AuAu
- **23 Apr, begin ~1 week physics run (√s = 19.6 AuAu)**
- **2 May 08:00, end 1.3 week physics run at √s = 19.6 GeV**
- 2 May, begin setup for √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 (√s = 200 GeV/n AuAu)**
  20 June 08:00, end 6.4 wk AuAu physics run at √s = 200 GeV/n, 8 hr APEX
- **20 -21 June, setup for √s = 27 GeV/n**

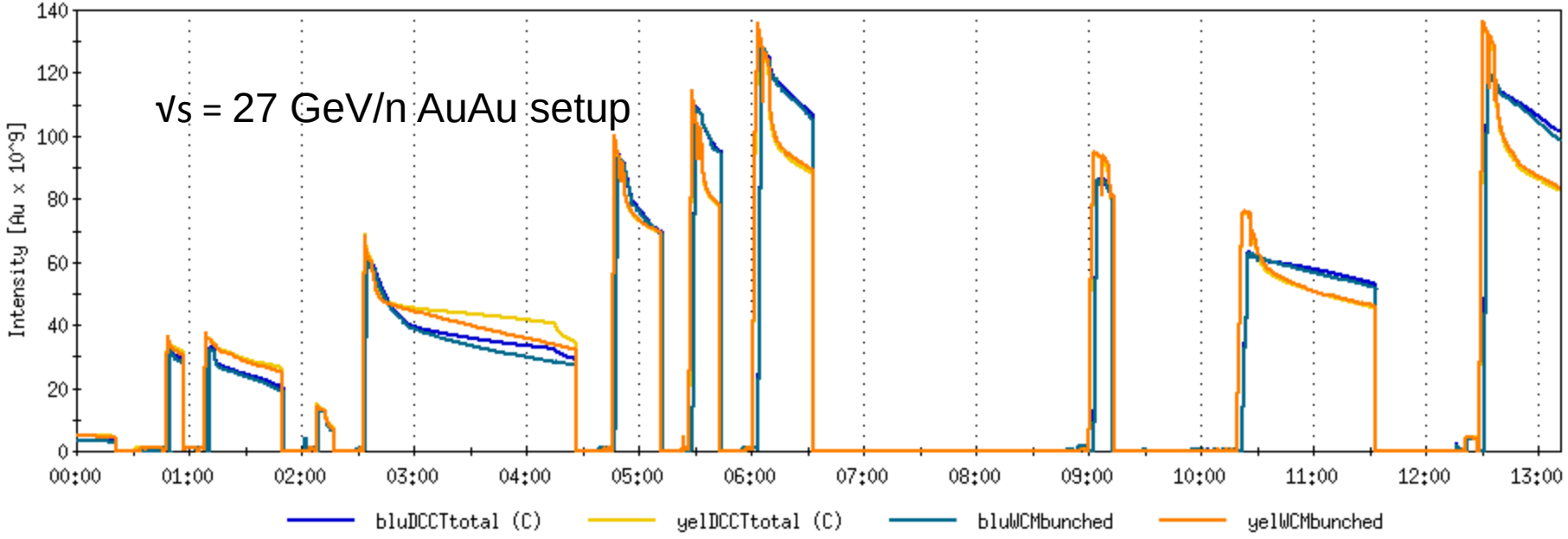
- ***21 Jun- TODAY***
- **22 June, begin 1 week √s = 27 GeV/n physics run**
- **29 June, end 1 week √s = 27 GeV/n physics run, begin warm-up**
- **30 June, cryo warm-up ~ complete, end 25.4 weeks cryo operation**

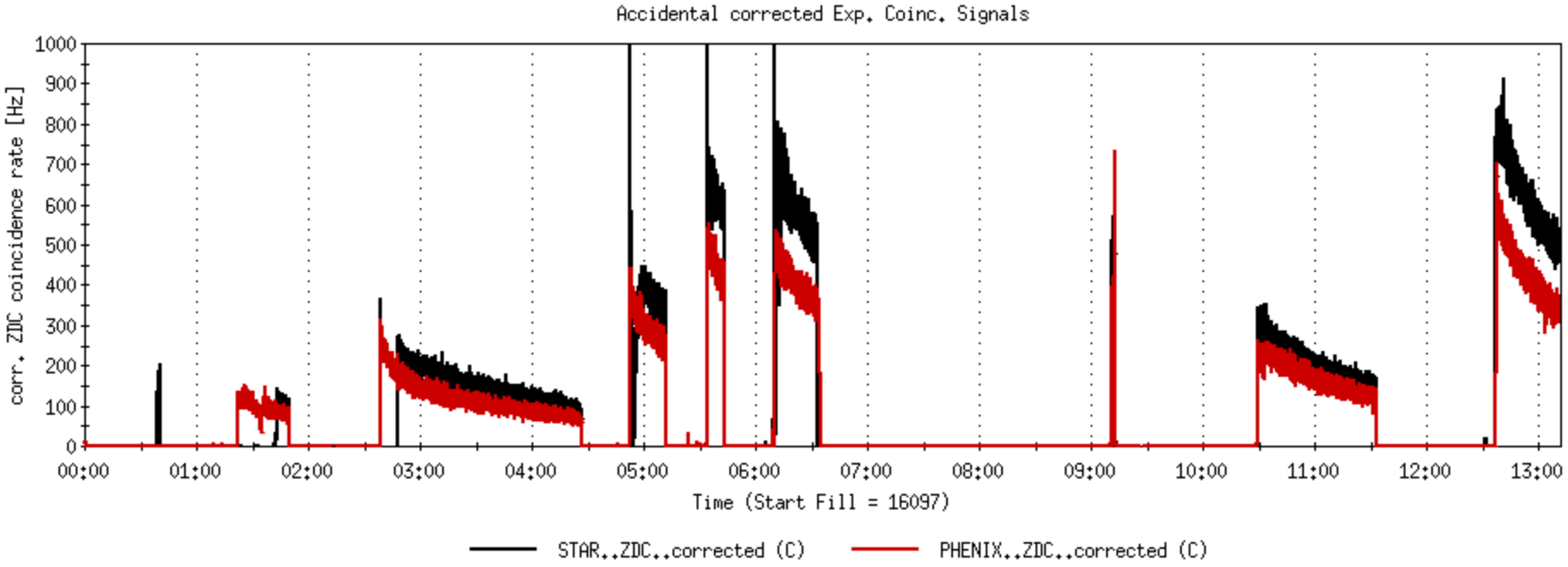

Run11 RHIC AuAu Integrated Luminosity for Physics
(√s = 200 GeV/n)
STAR
PHENIX
Lmax
Lmin
PHENIX Run10
Integrated Luminosity [μb^-1]
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
5-May
12-May
19-May
26-May
2-Jun
9-Jun
16-Jun
PHENIX Goal
STAR Goal
max
min
Final, thru store 16091 (0800)
Tuesday 20 Jun


Run 11 100 x 100 GeV/n Au-Au (Phenix)
thru fill 16091
60% time at store Integrated lumi
Delivered Integrated Lumi/week (Physics)
Goal (max)
last 3 days
lumi/week for >3 hr stores and 60% time at store (μb-1)
Delivered lumi/week (μb-1)
Store Number
0
200
400
600
800
1000
1200
1400
15750
15800
15850
15900
15950
16000
16050
16100
16150


Run 11, 100 x 100 GeV/n Au Au
Lumi hours per week at store
120
100
80
60
40
20
0
last 3 days
Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7

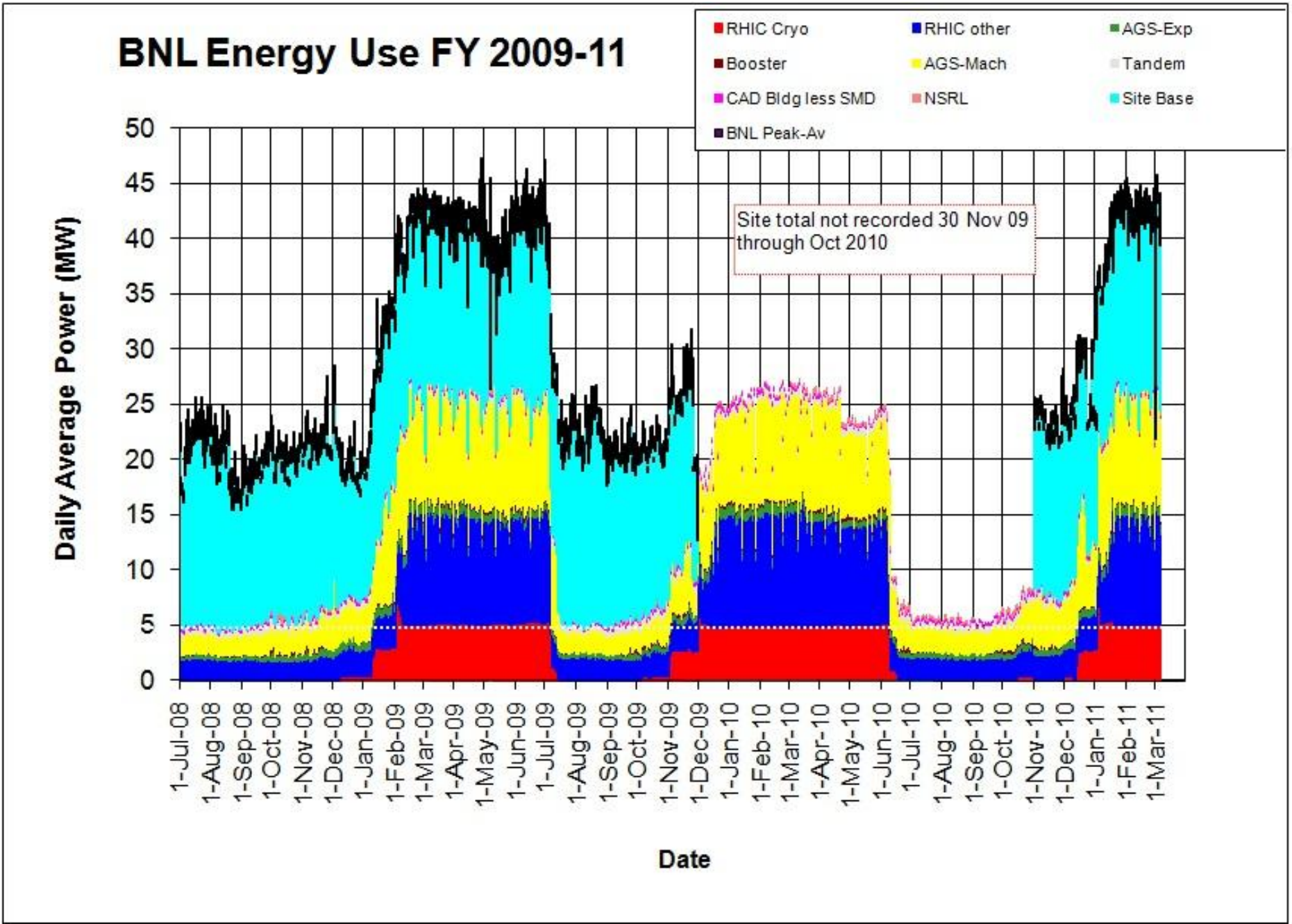
STAR Goal = 150M min-bias PHENIX Goal = 5.2 μb^{-1} sampled

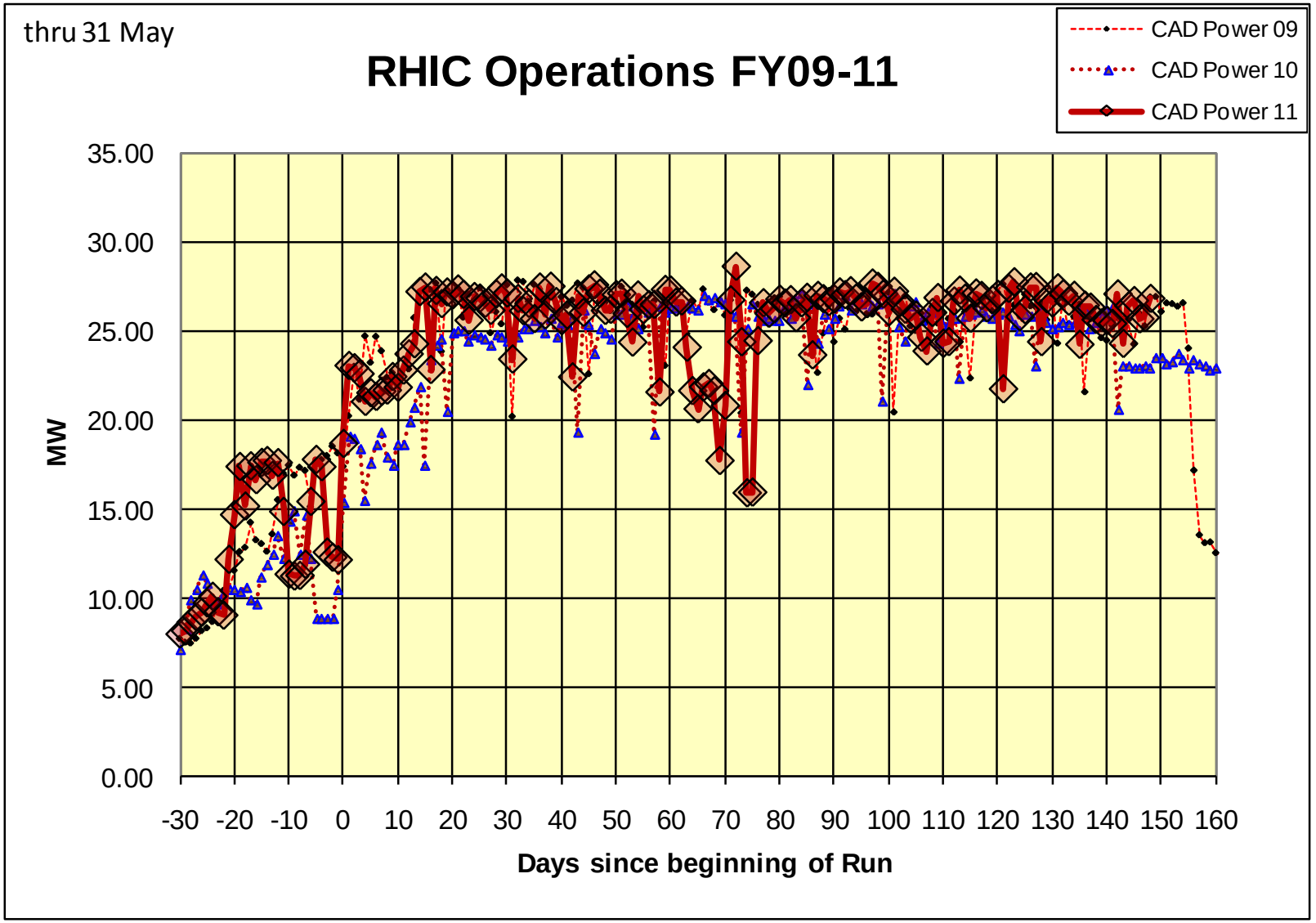


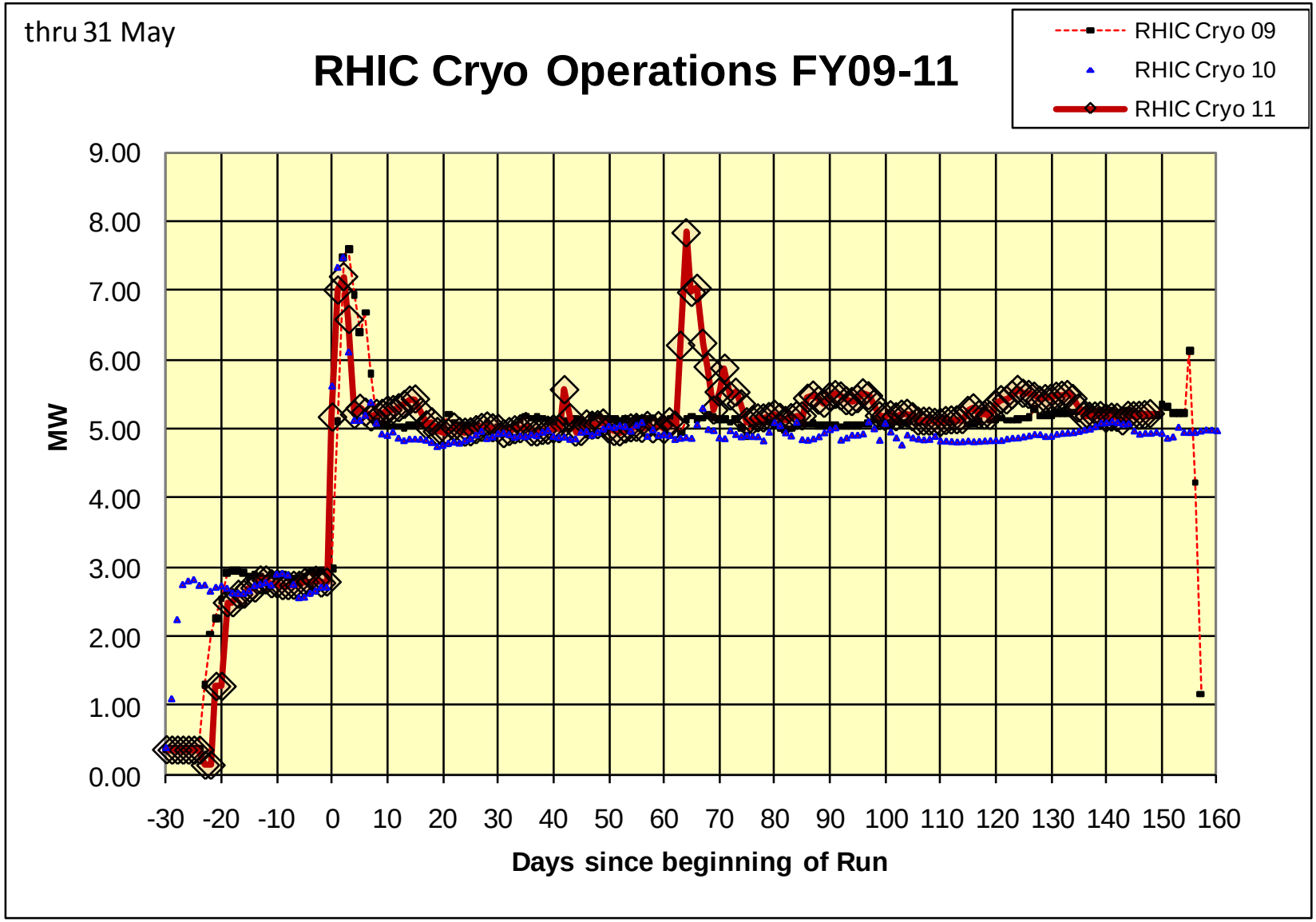


Old information

Through 31 May 2011

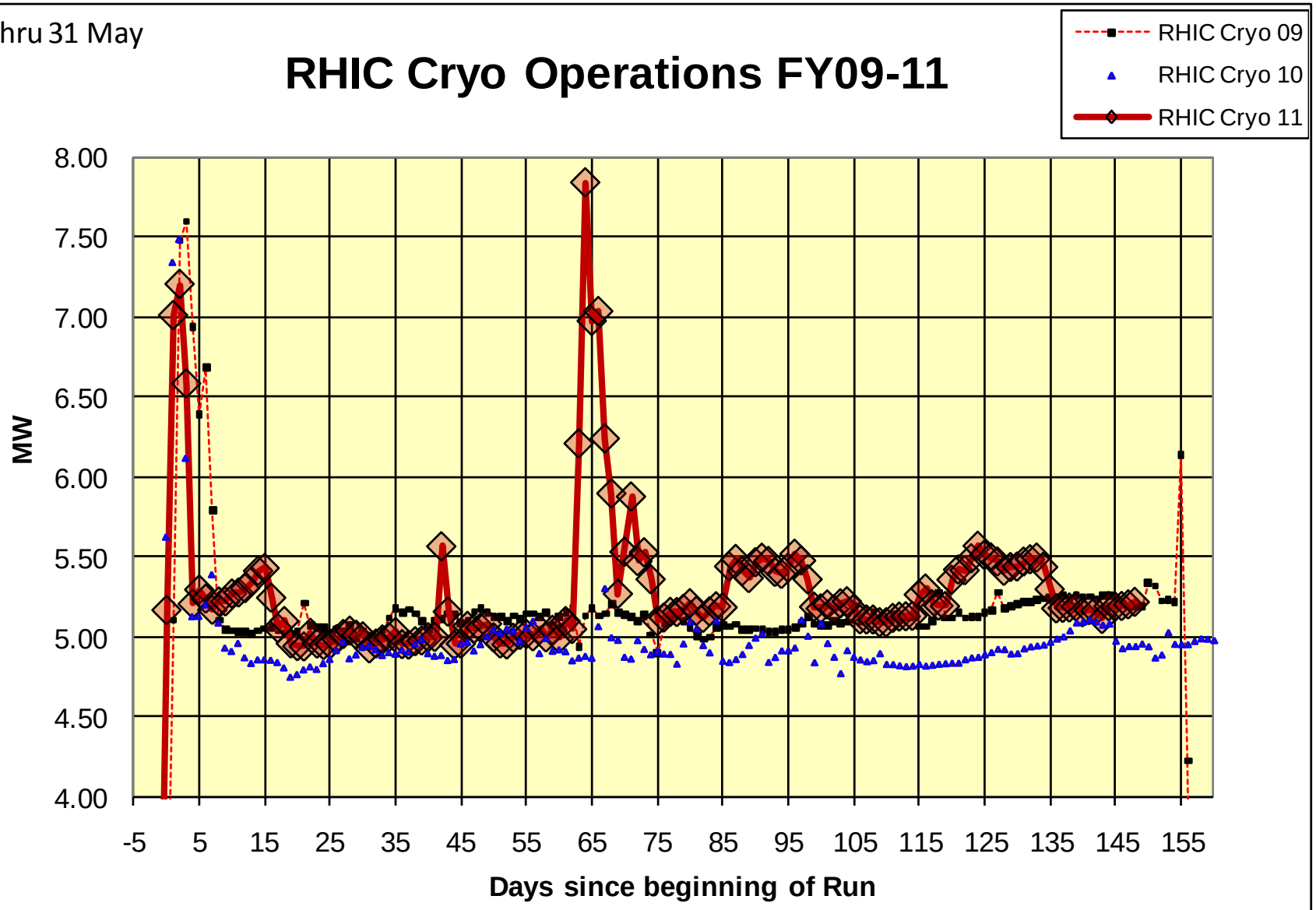



thru 31 May
RHIC Operations FY09-11
CAD Power 09
CAD Power 10
CAD Power 11
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
MW
-30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
Days since beginning of Run


thru 31 May
RHIC Cryo Operations FY09-11
RHIC Cryo 09
RHIC Cryo 10
RHIC Cryo 11
MW
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
Days since beginning of Run

thru 31 May

RHIC Cryo Operations FY09-11



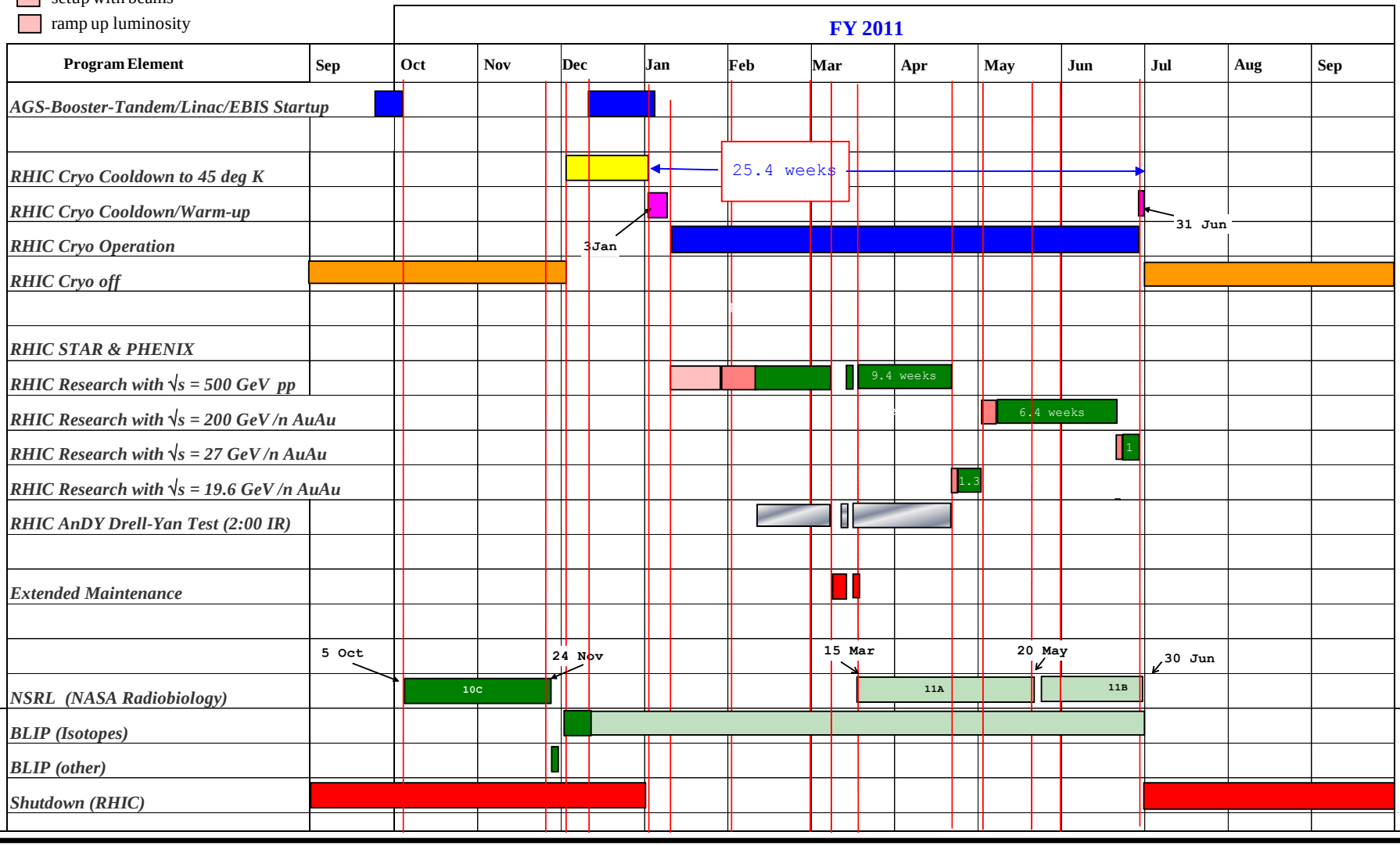
http://www.bnl.gov/cad/esfd

C-A Operations-FY11

13 Jun 11

as run/planned

concurrent with RHIC
setup with beams
ramp up luminosity

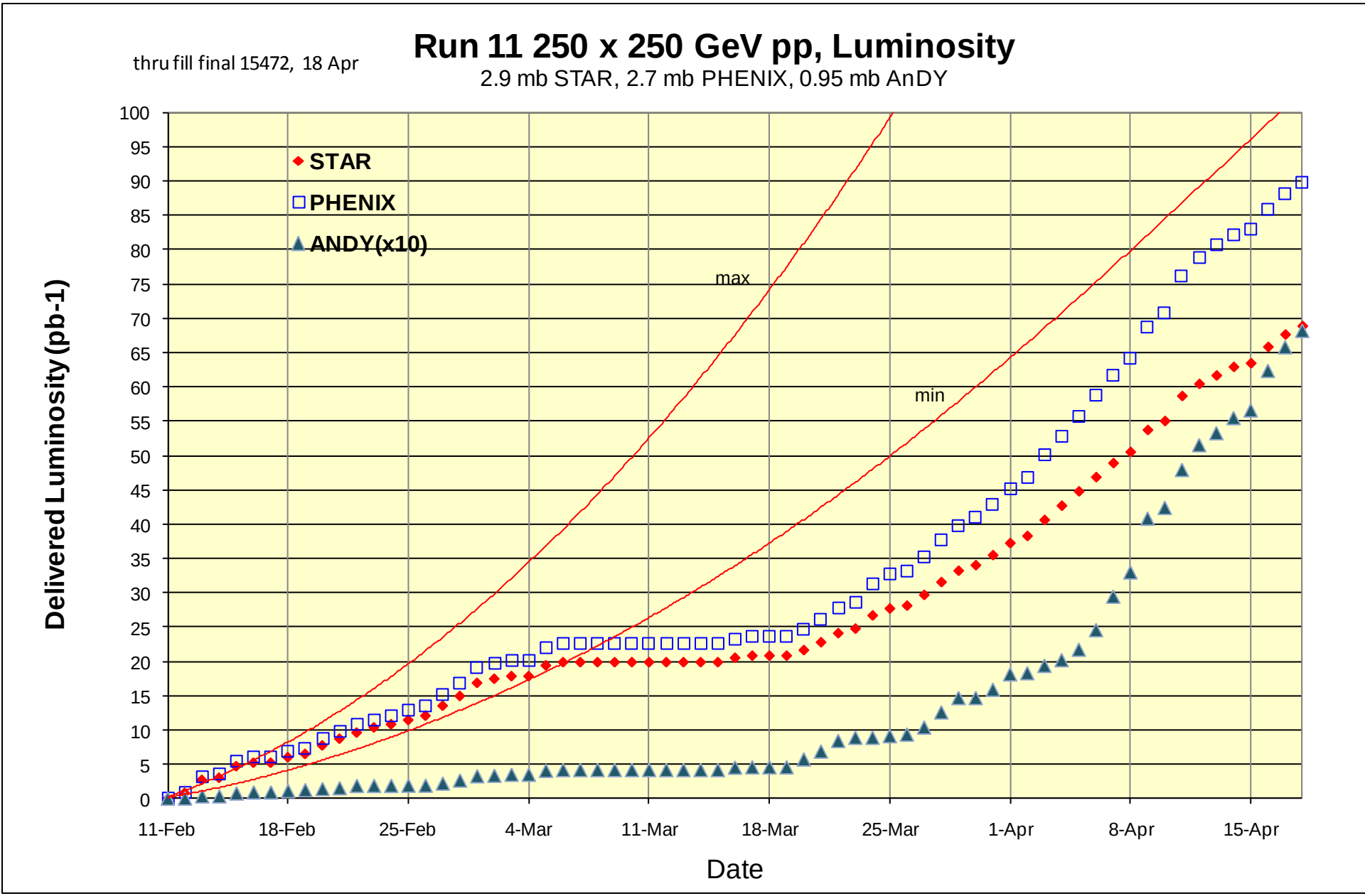


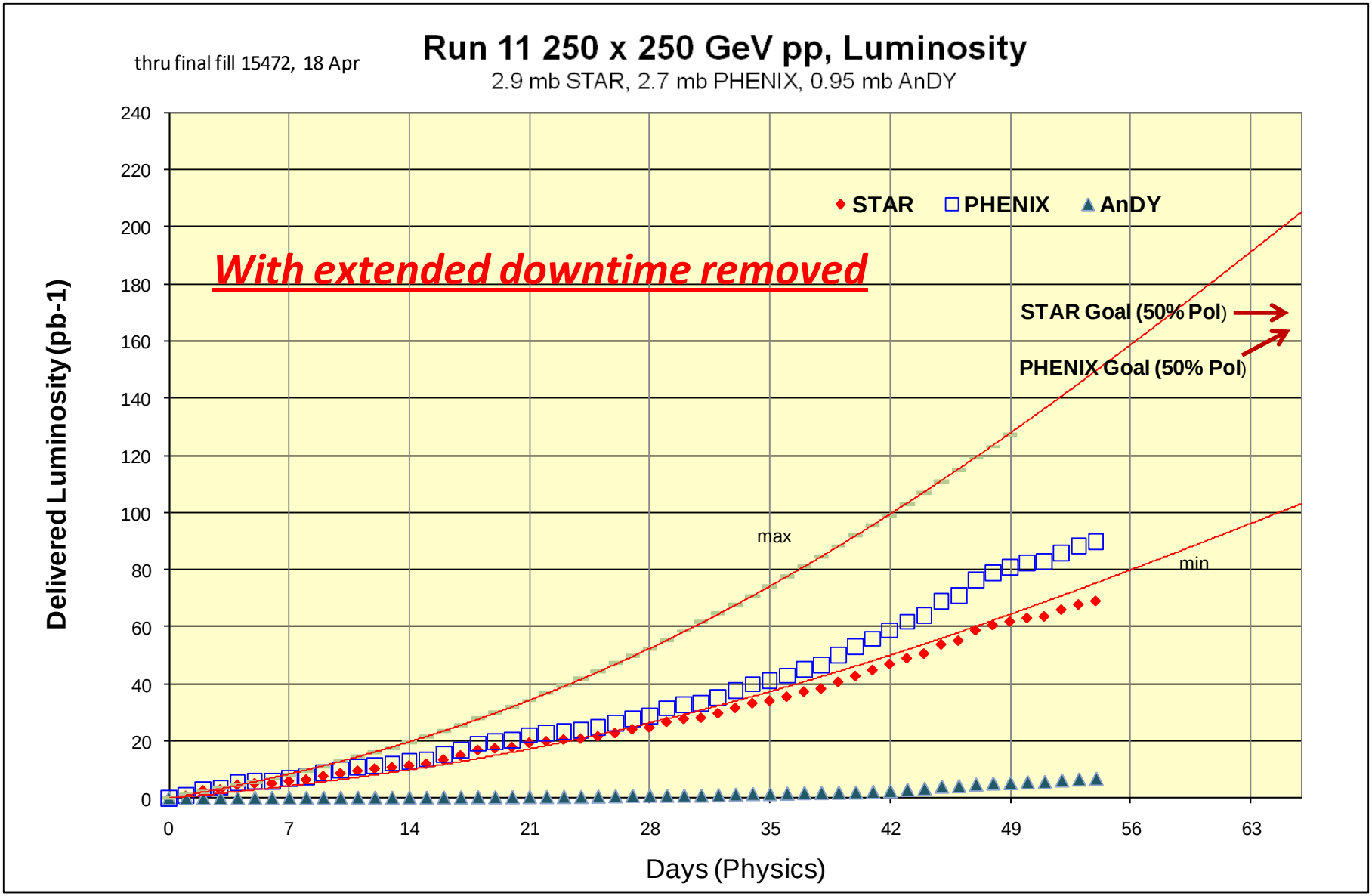
Run into July – an issue…

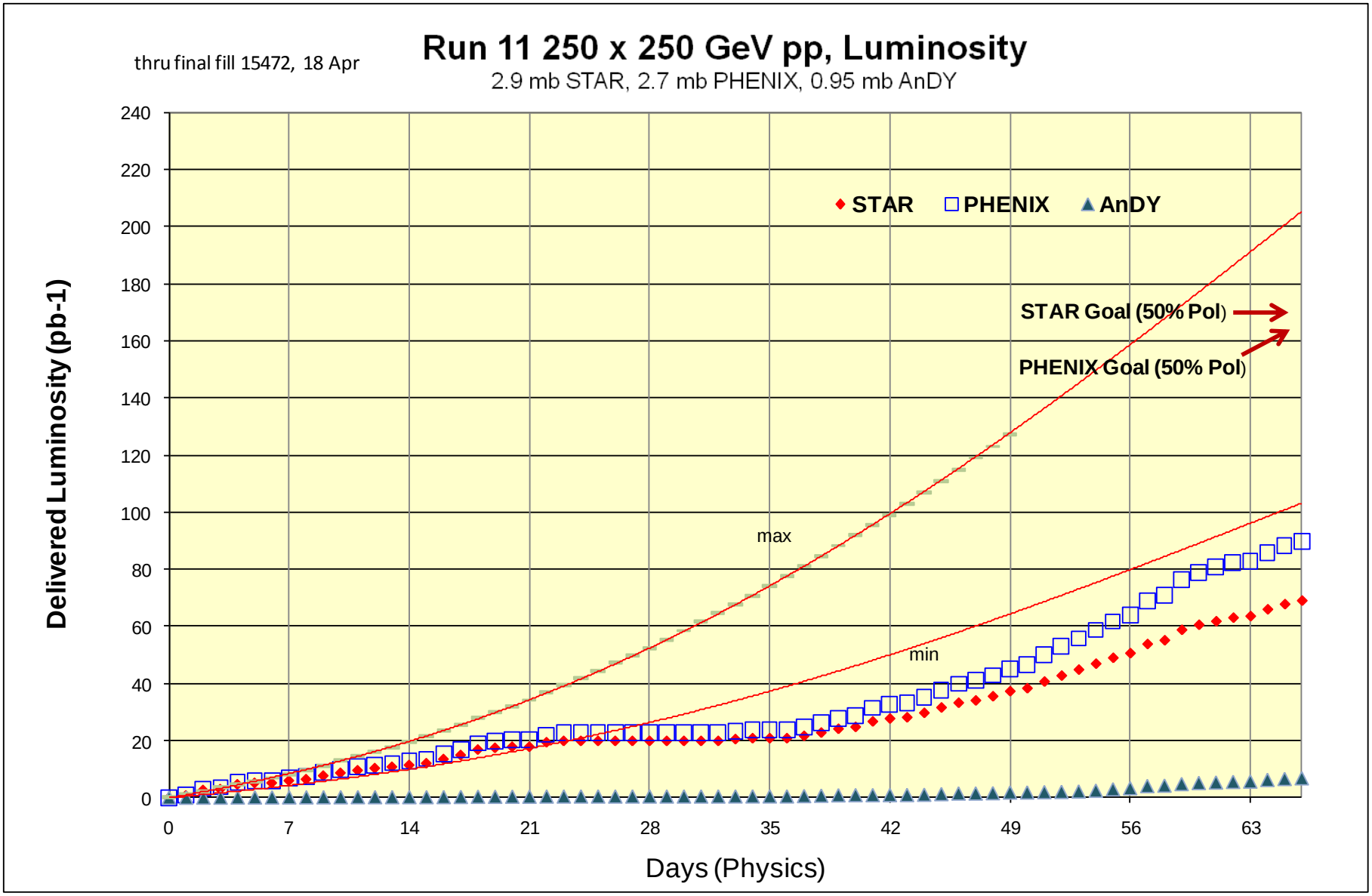
Power demand penalty (part 1)

- Transmission = $5,680/MW
- NYPA administrative = $190/MW
  - Total = $5,870/MW
  - RHIC ON/OFF difference ~ 20 MW
  - RHIC ON demand charge = 20x$5870 = $117,400
- LIPA “wheeling” charge
  - RHIC ON = $123,000
  - RHIC OFF = $63,550
  - Difference = $59,450
- **Total Demand Penalty = $117,400 + $59,450 = $176,850**

Singles Corrected (draft – another correction likely) AnDY Revised 6/3/2011




Run 11 250 x 250 GeV pp, Luminosity
2.9 mb STAR, 2.7 mb PHENIX, 0.95 mb AnDY
thru final fill 15472, 18 Apr
With extended downtime removed
STAR
PHENIX
AnDY
STAR Goal (50% Pol)
PHENIX Goal (50% Pol)
max
min
Delivered Luminosity (pb-1)
Days (Physics)
0
20
40
60
80
100
120
140
160
180
200
220
240
0
7
14
21
28
35
42
49
56
63


Run 11 250 x 250 GeV pp, Luminosity
2.9 mb STAR, 2.7 mb PHENIX, 0.95 mb AnDY
thru final fill 15472, 18 Apr
Delivered Luminosity (pb-1)
Days (Physics)
STAR
PHENIX
AnDY
STAR Goal (50% Pol)
PHENIX Goal (50% Pol)
max
min
0
20
40
60
80
100
120
140
160
180
200
220
240
0
7
14
21
28
35
42
49
56
63

√S = 200 GeV/n AuAu luminosity goals (24 May efficiencies)

STAR

2000 μb^{-1} sampled / 60% = 3300 μb^{-1} delivered

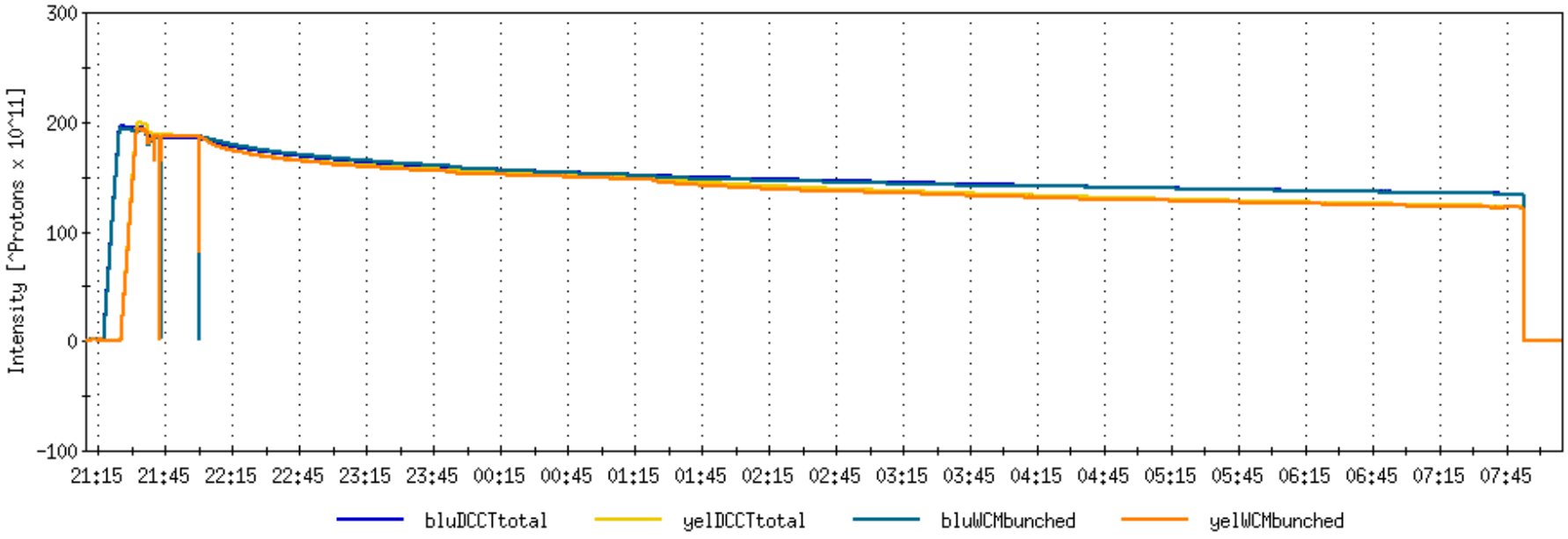
PHENIX

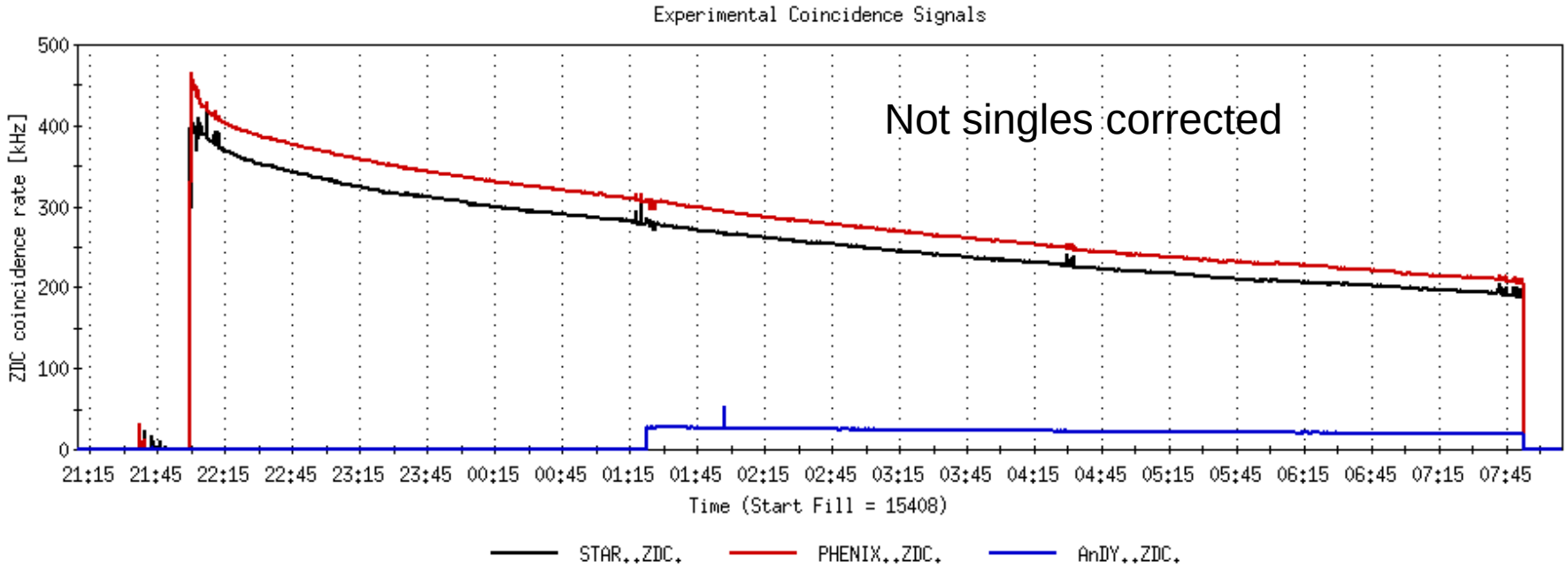
700 μb^{-1} sampled / 14% = 5000 μb^{-1} delivered

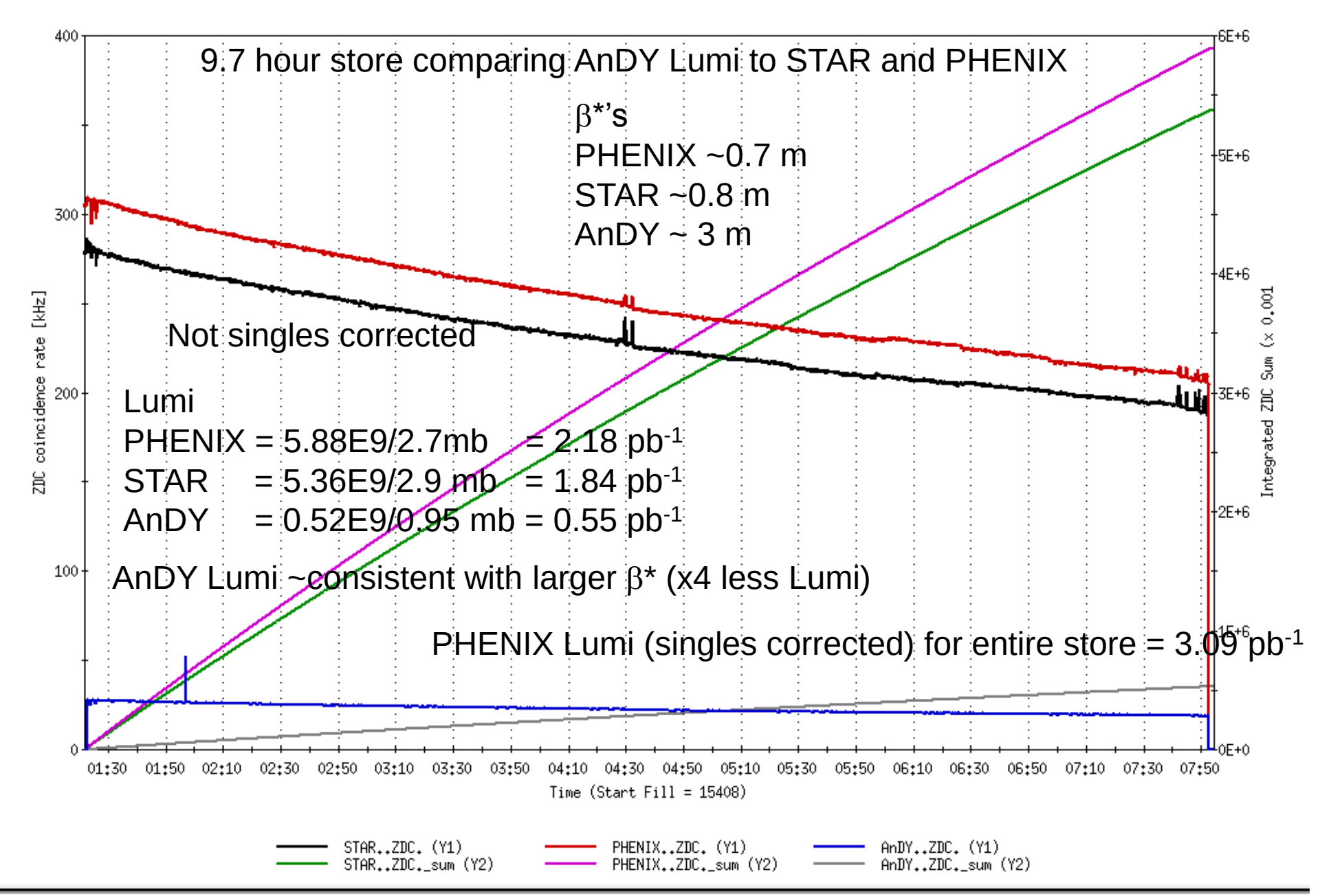
Estimate from PHENIX Beam Use Proposal – 15.8%

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

9.7 hour store comparing AnDY Lumi to STAR and PHENIX







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

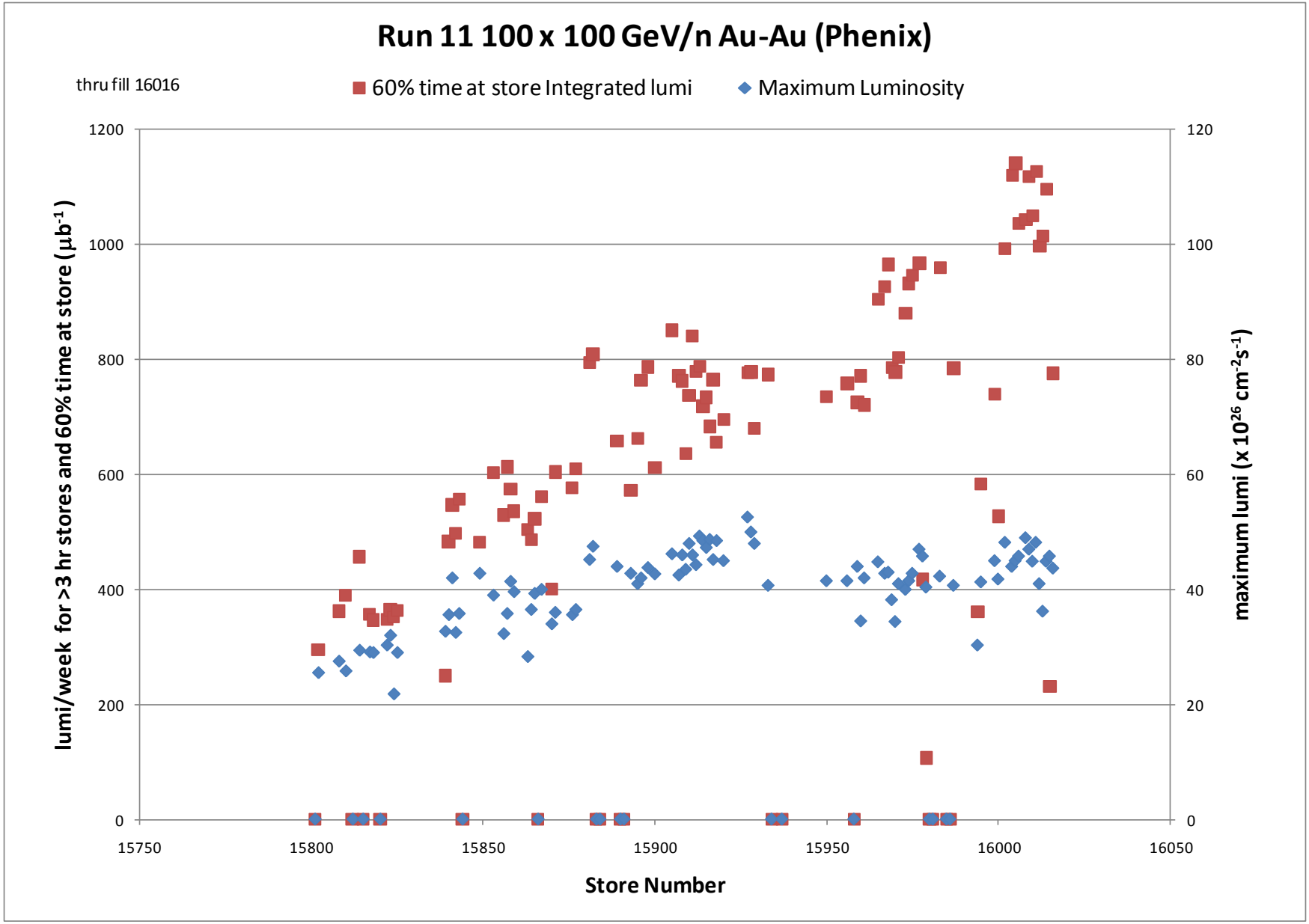
- 2:00 β^* = 3 meters
  - AnDY fraction of store 15408 = 0.55/3.09 = 18%

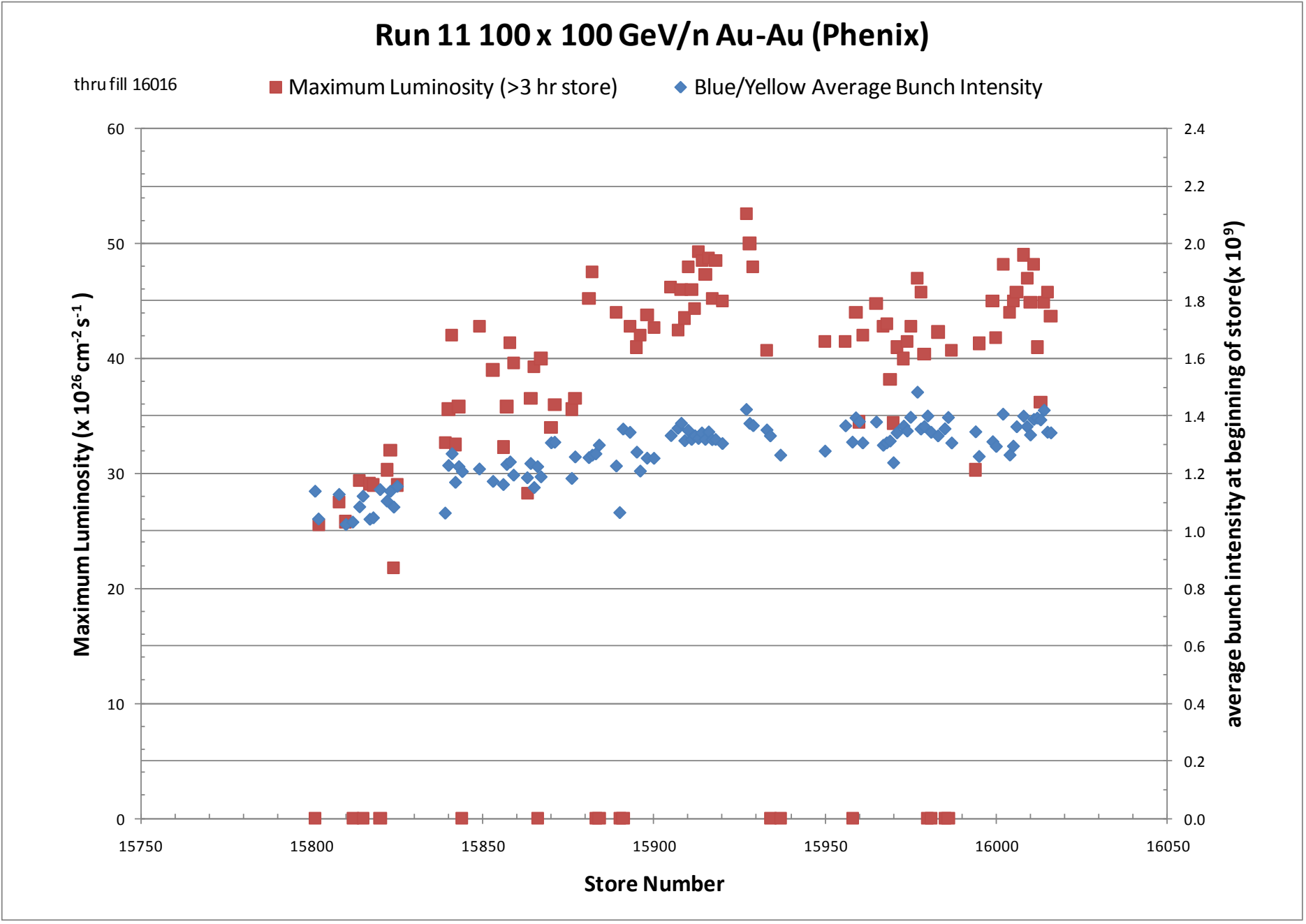
- With 2:00 β^* = 1.5 meters
  - AnDY fraction of store 15408 would have been 2x18%=36%

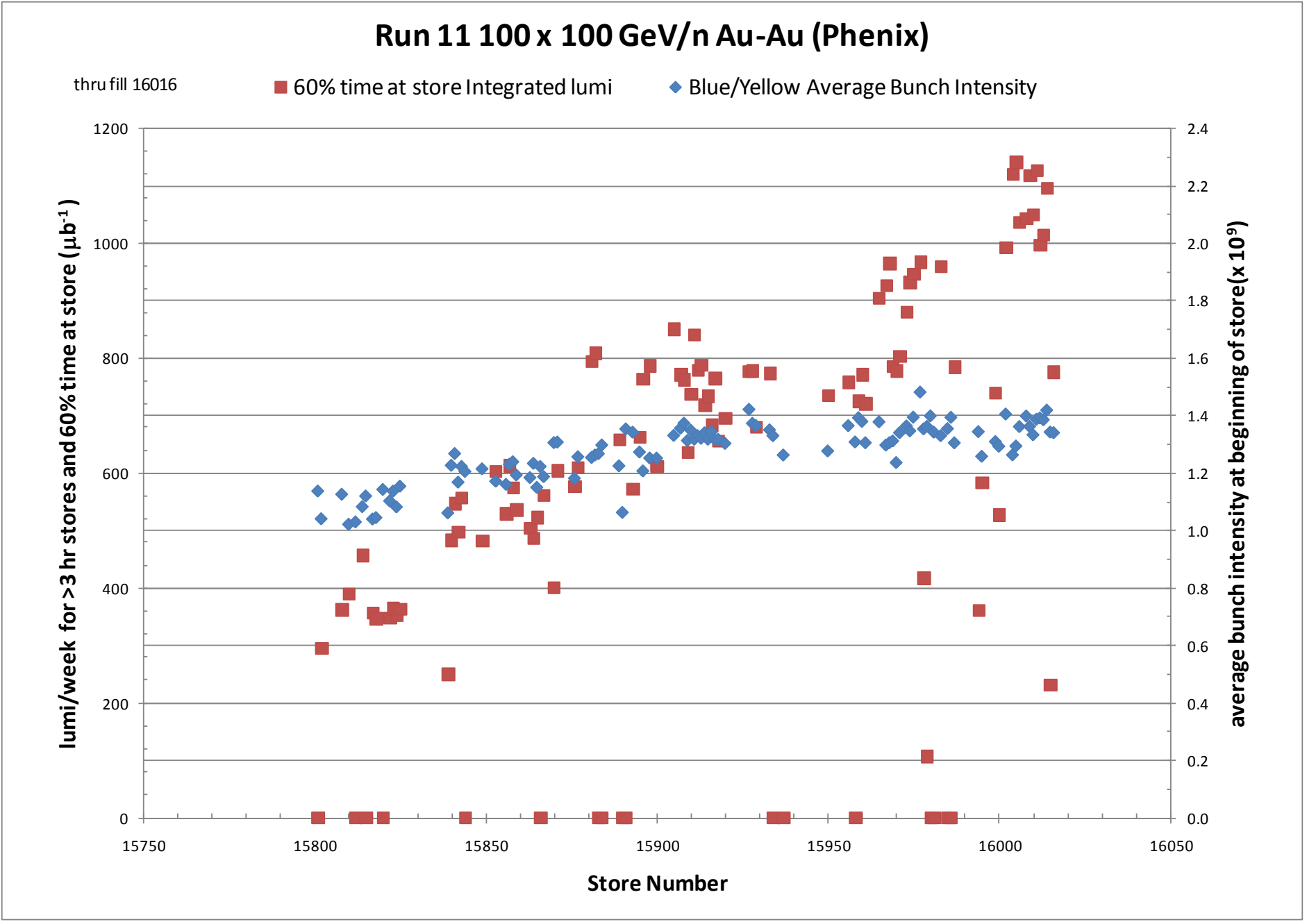
  - using Fischer et.al. 11 May 2010 Table 7 lumi projections for Run12

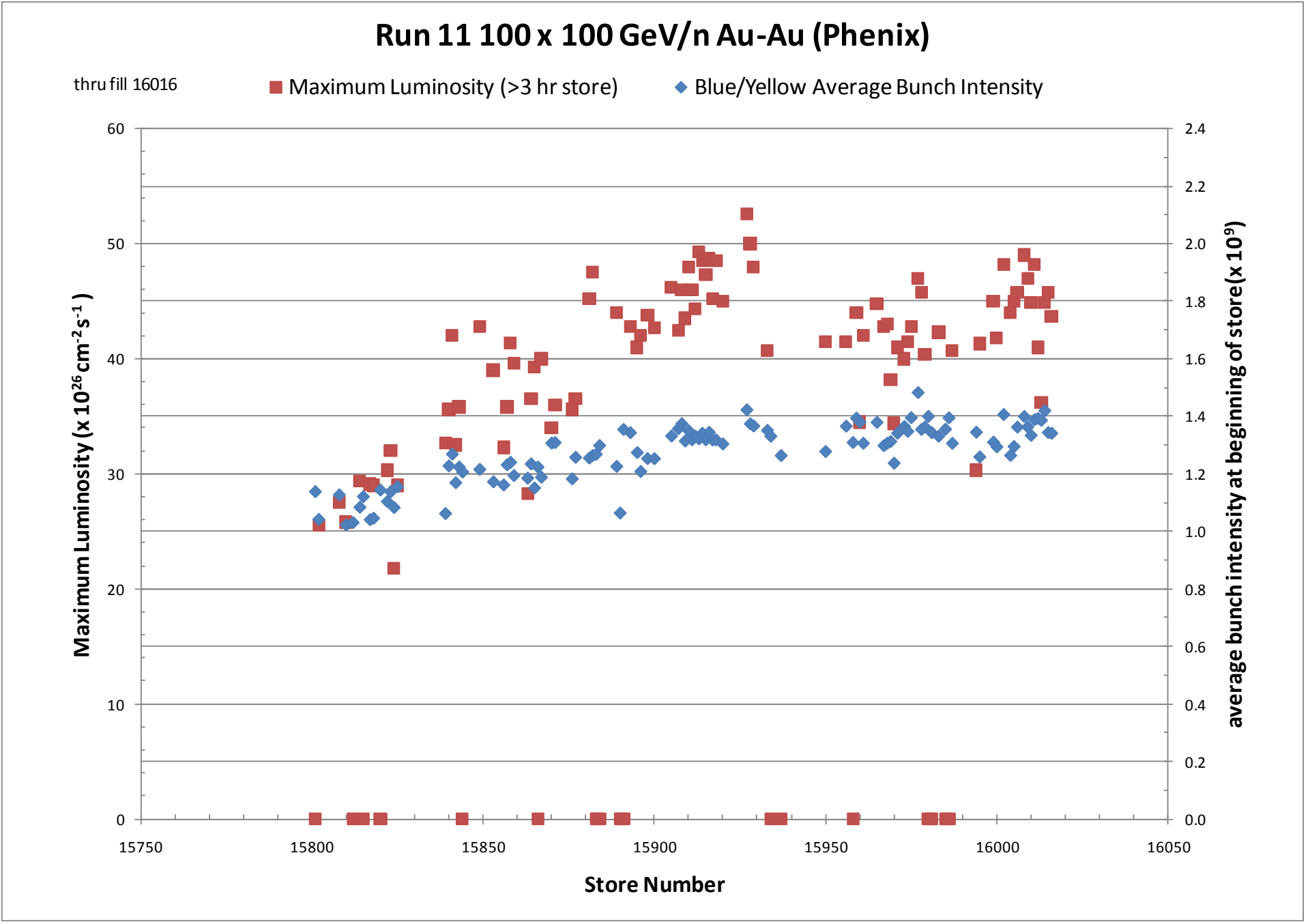
Physics Weeks	Max Lumi	Min Lumi	AnDY Est (1.5 m β^*)
8	276 pb^{-1}	98 pb^{-1}	35-99 pb^{-1}
10	388 pb^{-1}	134 pb^{-1}	48-140 pb^{-1}
12	500 pb^{-1}	170 pb^{-1}	61-180 pb^{-1}

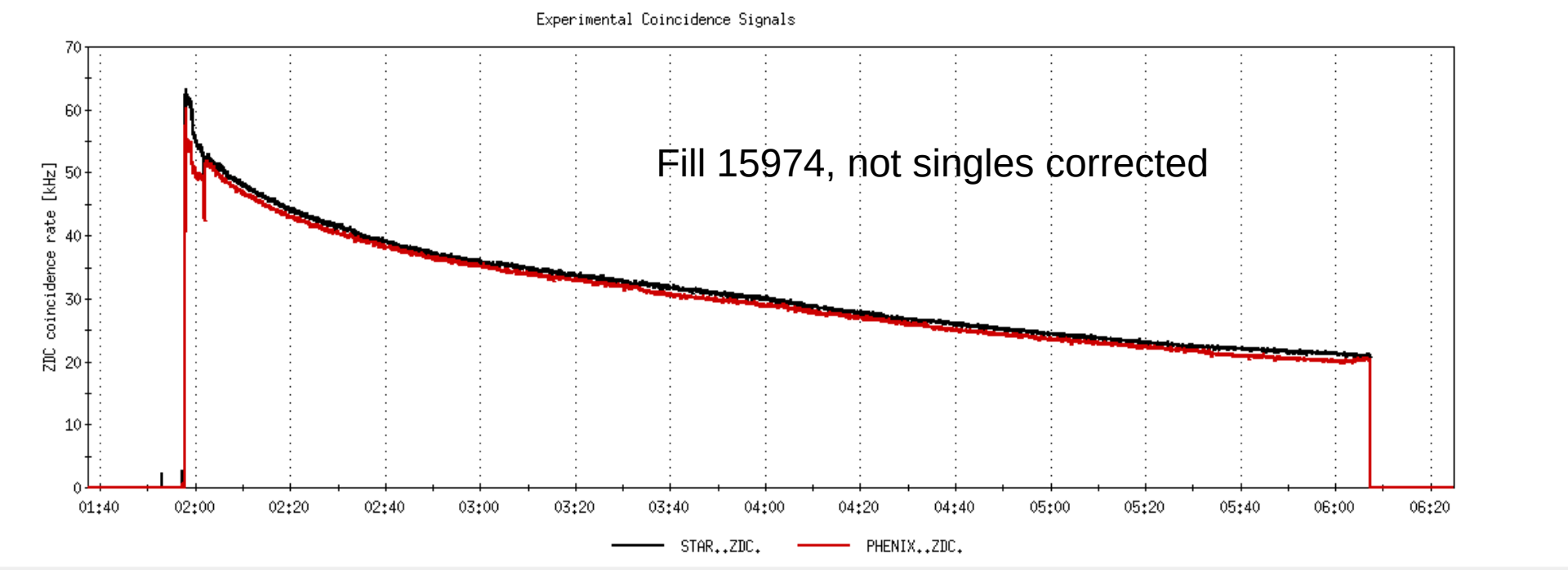
→ 100 pb^{-1} is not an unreasonable expectation for a 10-12 week run

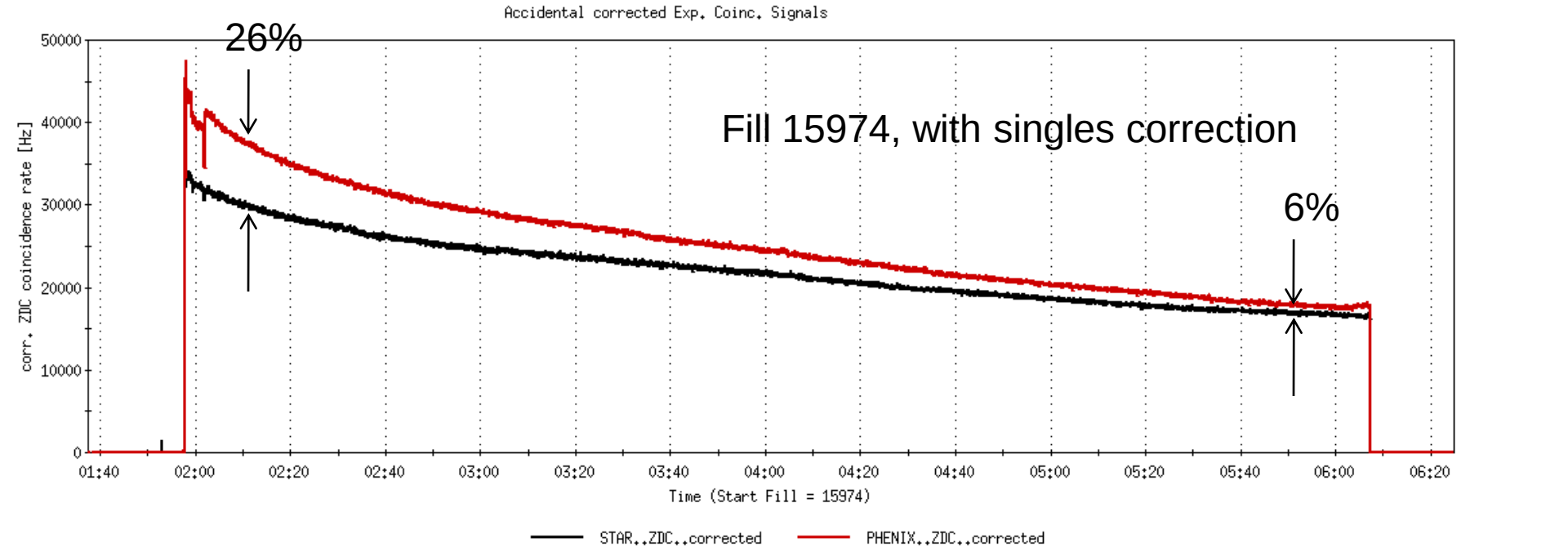

Run 11 100 x 100 GeV/n Au-Au (Phenix)
thru fill 16016
60% time at store Integrated lumi
Maximum Luminosity
lumi/week for >3 hr stores and 60% time at store (μb-1)
maximum lumi (x 10^26 cm-2s-1)
Store Number
0
200
400
600
800
1000
1200
0
20
40
60
80
100
120
15750
15800
15850
15900
15950
16000
16050

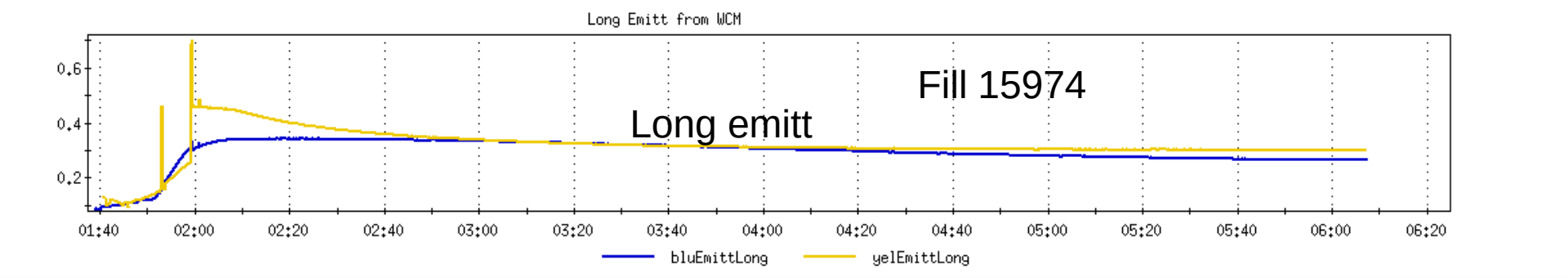

Run 11 100 x 100 GeV/n Au-Au (Phenix)
thru fill 16016
Maximum Luminosity (>3 hr store)
Blue/Yellow Average Bunch Intensity
Maximum Luminosity (x 10^26 cm^-2 s^-1)
average bunch intensity at beginning of store(x 10^9)
Store Number
0
10
20
30
40
50
60
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
15750
15800
15850
15900
15950
16000
16050

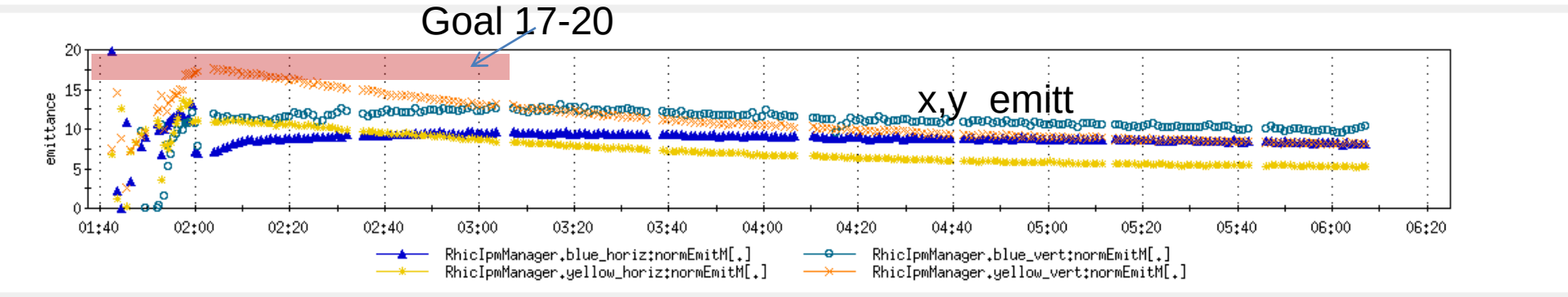

Run 11 100 x 100 GeV/n Au-Au (Phenix)
thru fill 16016
60% time at store Integrated lumi
Blue/Yellow Average Bunch Intensity
lumi/week for >3 hr stores and 60% time at store (μb-1)
average bunch intensity at beginning of store(x 10⁹)
Store Number
0
200
400
600
800
1000
1200
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
15750
15800
15850
15900
15950
16000
16050

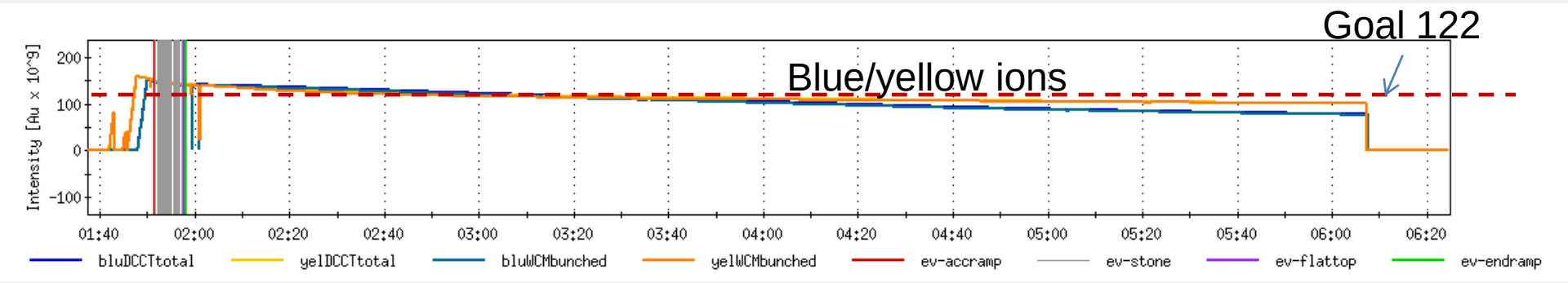

Run 11 100 x 100 GeV/n Au-Au (Phenix)
thru fill 16016
Maximum Luminosity (>3 hr store)
Blue/Yellow Average Bunch Intensity
Maximum Luminosity (x 10^26 cm^-2 s^-1)
average bunch intensity at beginning of store(x 10^9)
Store Number
0
10
20
30
40
50
60
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
15750
15800
15850
15900
15950
16000
16050

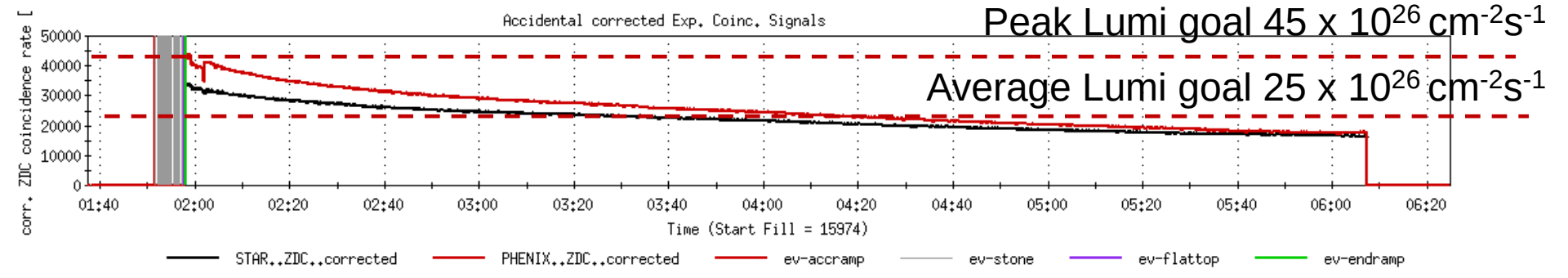

Experimental Coincidence Signals
ZDC coincidence rate [kHz]
Fill 15974, not singles corrected
STAR..ZDC.
PHENIX..ZDC.


Accidental corrected Exp. Coinc. Signals
corr. ZDC coincidence rate [Hz]
26%
Fill 15974, with singles correction
6%
Time (Start Fill = 15974)
STAR..ZDC..corrected
PHENIX..ZDC..corrected


Long Emitt from WCM
Fill 15974
Long emitt
0.6
0.4
0.2
01:40
02:00
02:20
02:40
03:00
03:20
03:40
04:00
04:20
04:40
05:00
05:20
05:40
06:00
06:20
bluEmittLong
yelEmittLong


Goal 17-20
x,y emitt
emittance
20
15
10
5
0
01:40
02:00
02:20
02:40
03:00
03:20
03:40
04:00
04:20
04:40
05:00
05:20
05:40
06:00
06:20
RhicIpmManager.blue_horiz:normEmitM[.]
RhicIpmManager.yellow_horiz:normEmitM[.]
RhicIpmManager.blue_vert:normEmitM[.]
RhicIpmManager.yellow_vert:normEmitM[.]


Goal 122
Blue/yellow ions
Intensity [Au x 10^9]
200
100
0
-100
01:40
02:00
02:20
02:40
03:00
03:20
03:40
04:00
04:20
04:40
05:00
05:20
05:40
06:00
06:20
bluDCCTtotal
yelDCCTtotal
bluWCMbunched
yelWCMbunched
ev-accramp
ev-stone
ev-flattop
ev-endramp


Accidental corrected Exp. Coinc. Signals
Peak Lumi goal 45 x 10^26 cm^-2s^-1
Average Lumi goal 25 x 10^26 cm^-2s^-1
corr. ZDC coincidence rate [
50000
40000
30000
20000
10000
0
01:40
02:00
02:20
02:40
03:00
03:20
03:40
04:00
04:20
04:40
05:00
05:20
05:40
06:00
06:20
Time (Start Fill = 15974)
STAR..ZDC..corrected
PHENIX..ZDC..corrected
ev-accramp
ev-stone
ev-flattop
ev-endramp

Store 15408 – AnDY projection

- 2:00 β^* = 3 meters
  - AnDY fraction of store 15408 = 0.55/3.09 = 18%

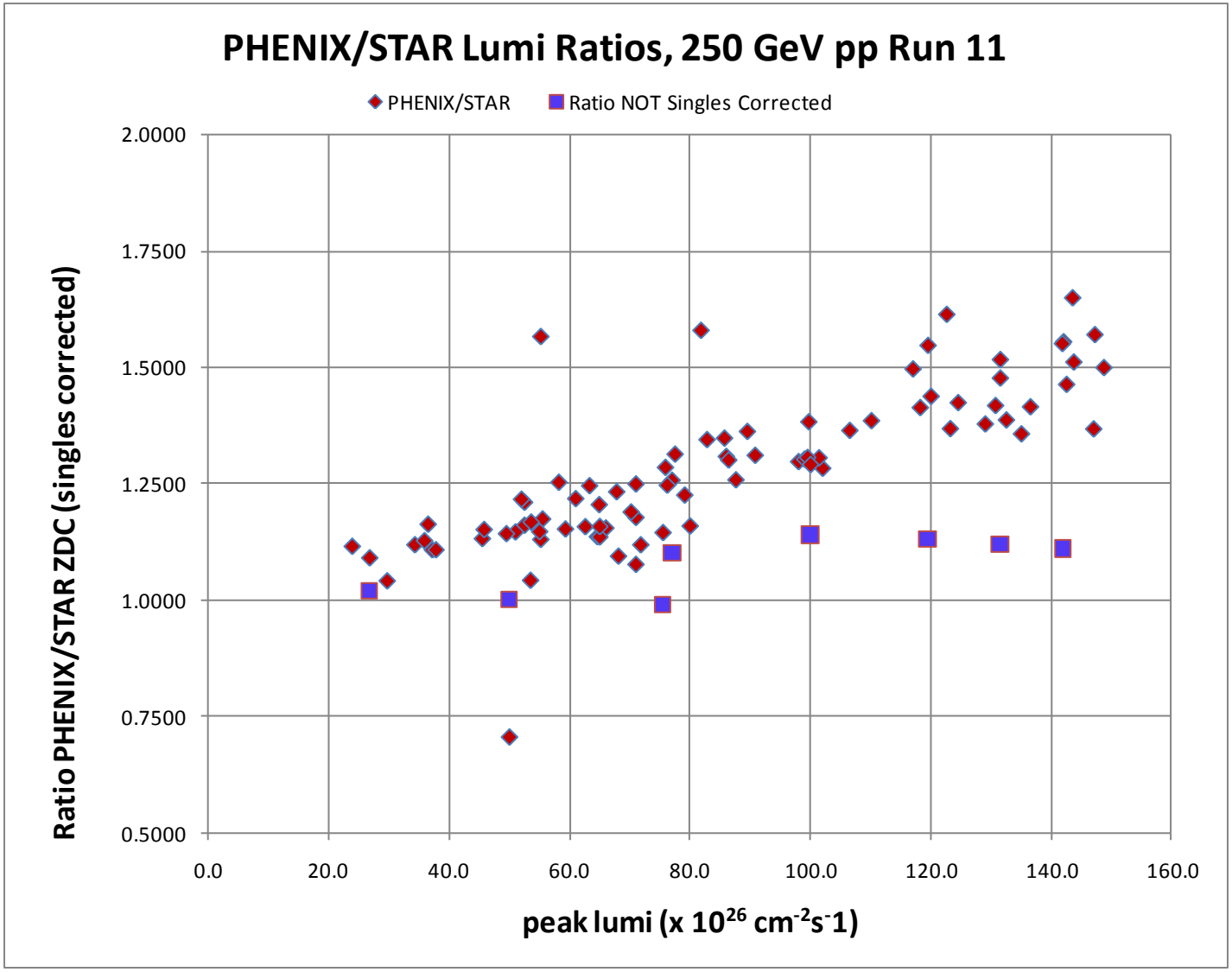
- With 2:00 β^* = 1.5 meters
  - AnDY fraction of store 15408 woulh have been 2x18%=36%

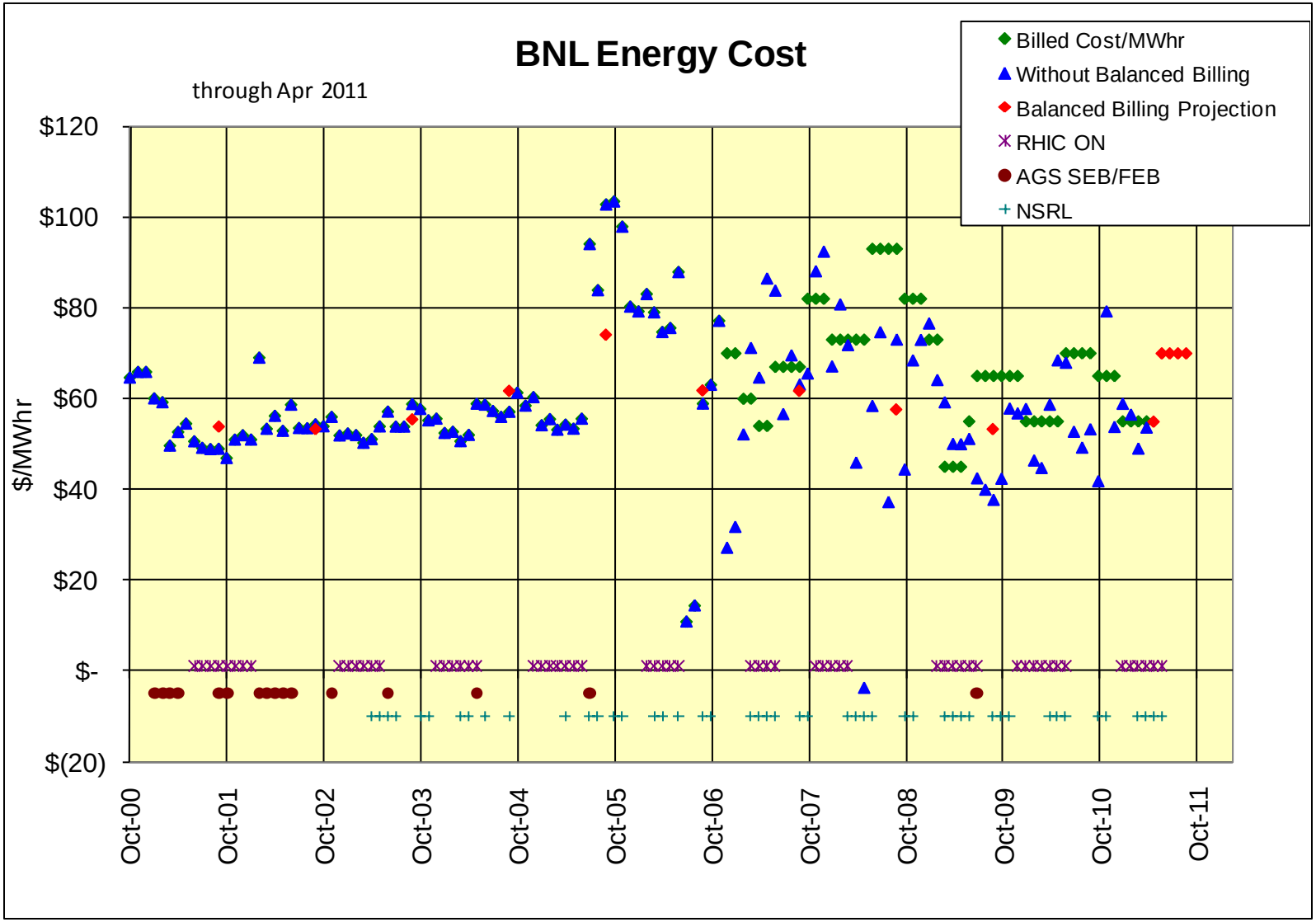
  - using Fischer et.al. 11 May 2010 Table 7 lumi projections for Run12

Physics Weeks	Max Lumi	Min Lumi	AnDY Est (1.5 m β^*)
8	276 pb^{-1}	98 pb^{-1}	35-99 pb^{-1}
10	388 pb^{-1}	134 pb^{-1}	48-140 pb^{-1}
12	500 pb^{-1}	170 pb^{-1}	61-180 pb^{-1}

→ 100 pb^{-1} is not an unreasonable expectation for a 10-12 week run

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

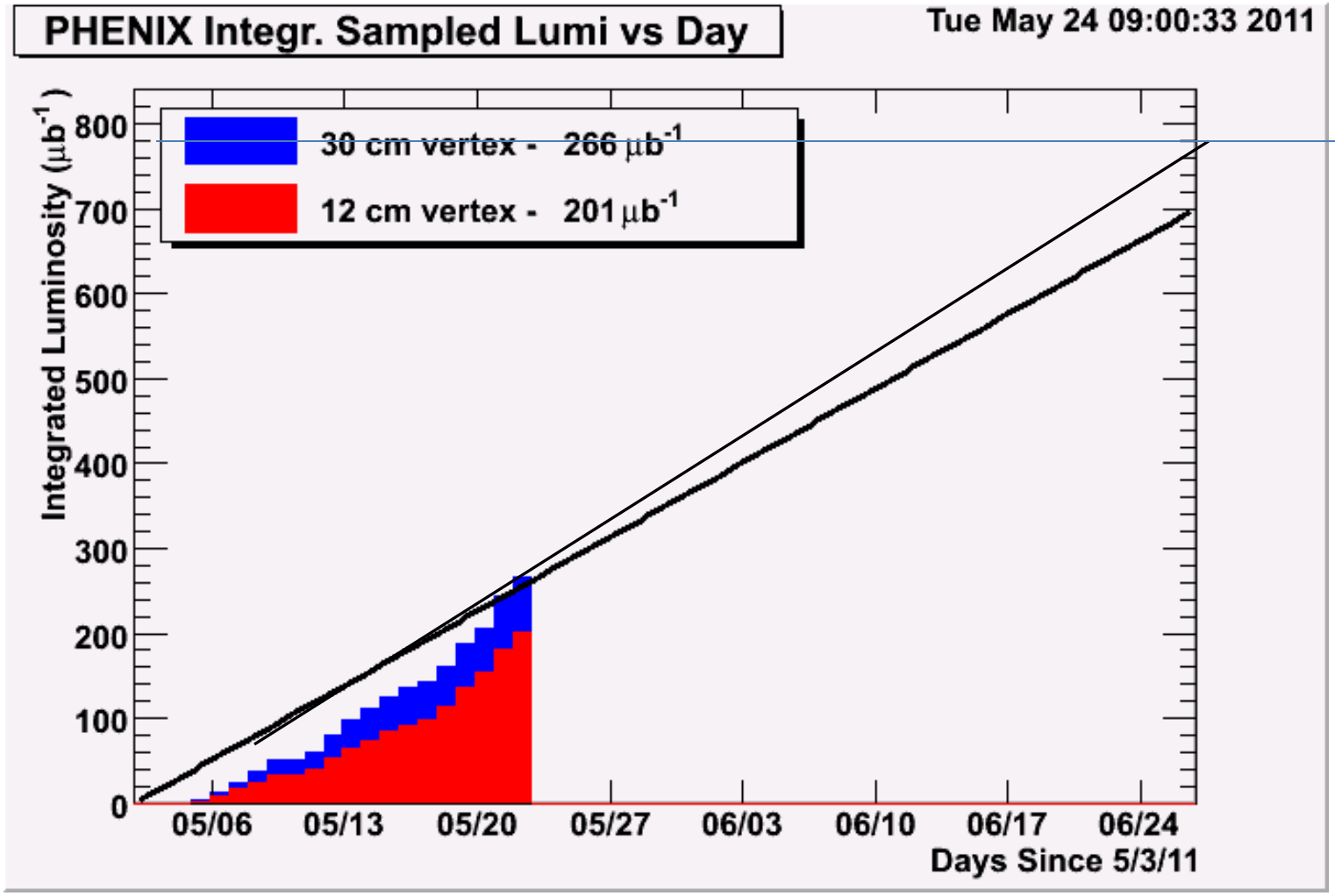



BNL Energy Cost
through Apr 2011
Billed Cost/MWhr
Without Balanced Billing
Balanced Billing Projection
RHIC ON
AGS SEB/FEB
NSRL
$120
$100
$80
$60
$40
$20
$-
$(20)
$/MWhr
Oct-00
Oct-01
Oct-02
Oct-03
Oct-04
Oct-05
Oct-06
Oct-07
Oct-08
Oct-09
Oct-10
Oct-11

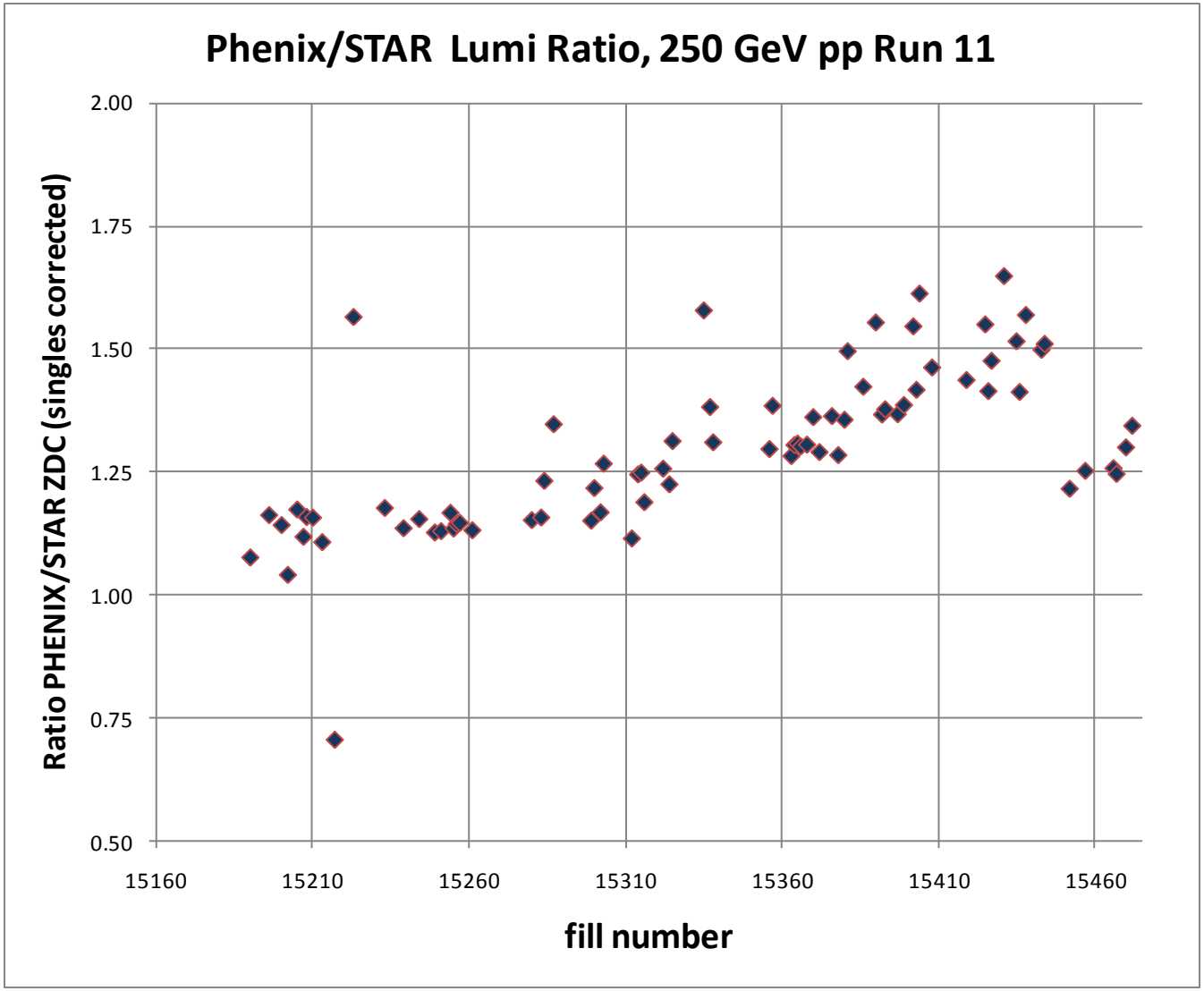
Through fill 15928 delivered 1474 μb^{-1}

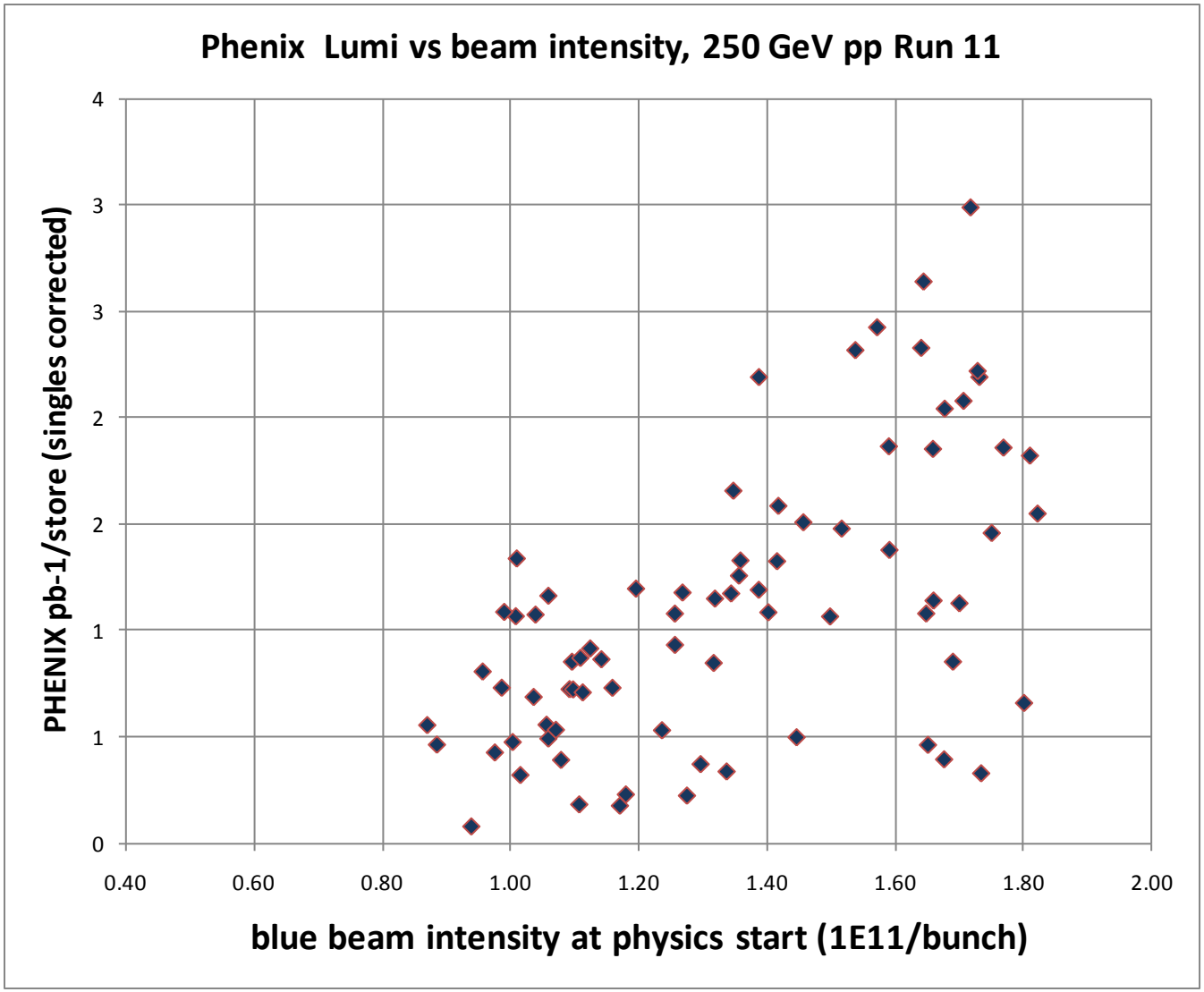
201 ub^-1 of 700 ub^-1 accumulated in 12cm vertex

→ *Efficiency = 201/1474 = 14%*



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

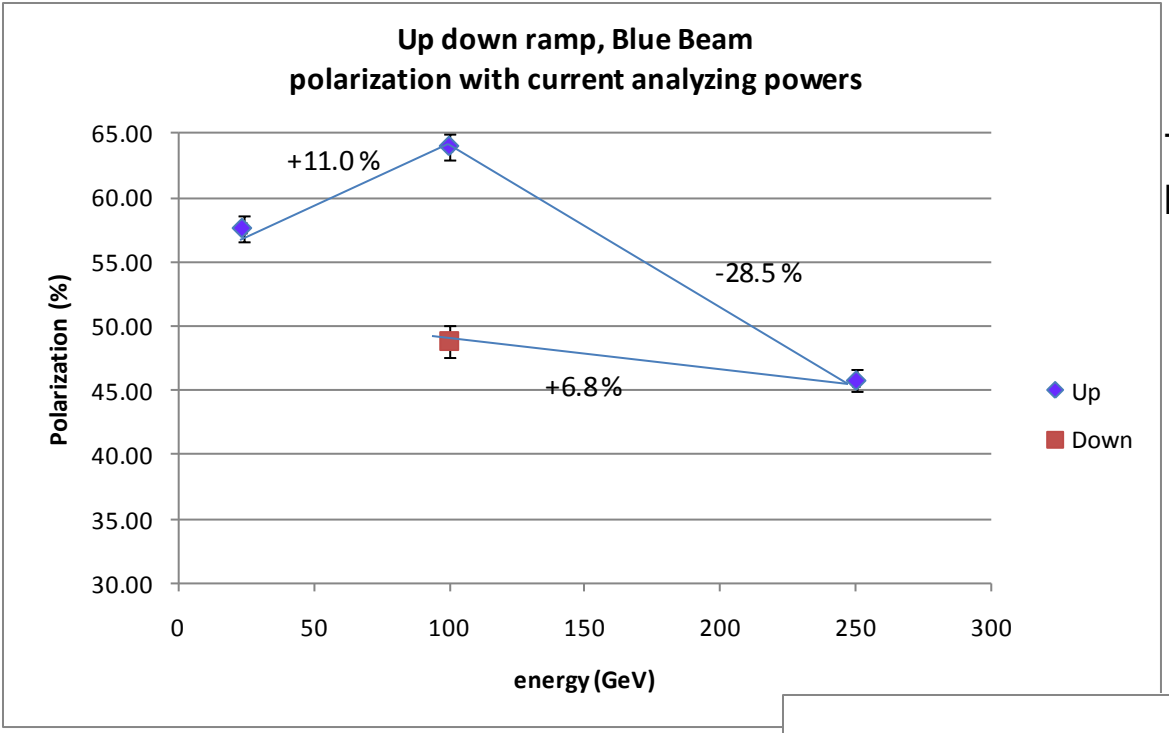



Phenix Lumi vs beam intensity, 250 GeV pp Run 11
PHENIX pb-1/store (singles corrected)
4
3
3
2
2
1
1
0
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
blue beam intensity at physics start (1E11/bunch)

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 √s = 500 GeV pp in RHIC begins.
- 15 Jan, power supply work/DX training complete
- 17 Jan, first successful ramp
- 19 Jan, 1st 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 (√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 √s = 500 GeV**
- 18 Apr jet target polarization measurement at injection (<5%)
- 19 Apr, short maintenance followed by setup for √s = 18 GeV AuAu
- **23 Apr, begin ~1 week physics run (√s = 19.6 AuAu)**

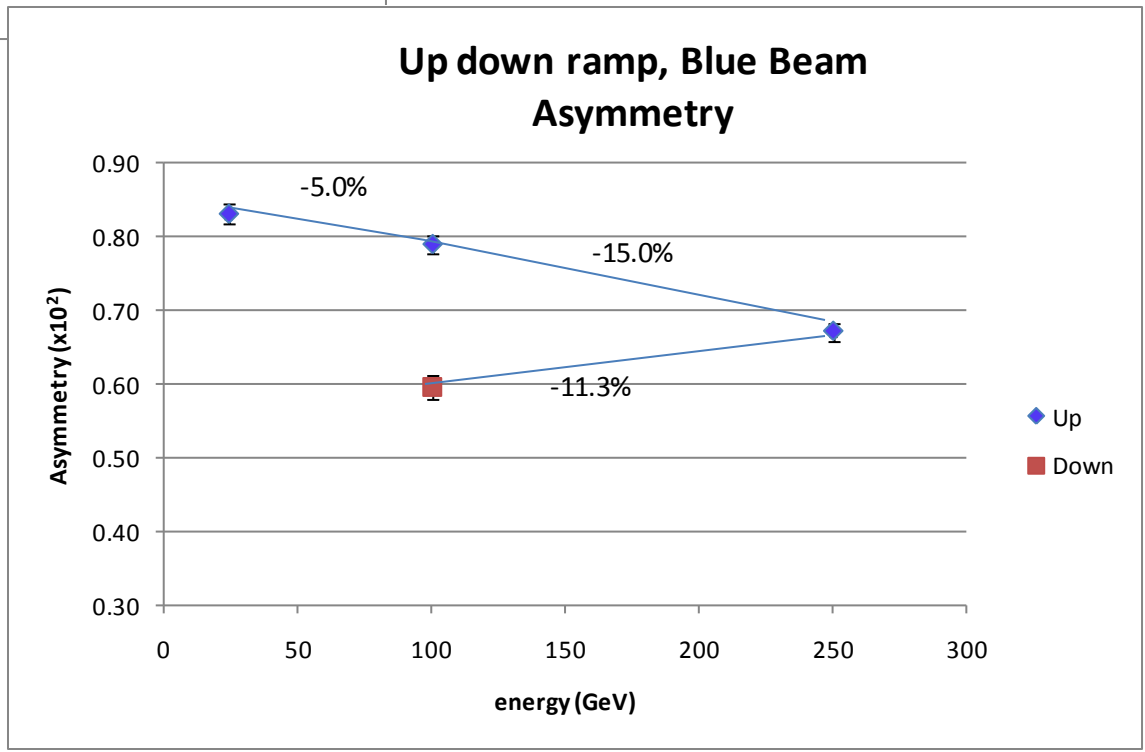
- **2 May, end 1.3 week physics run at √s = 19.6 GeV**

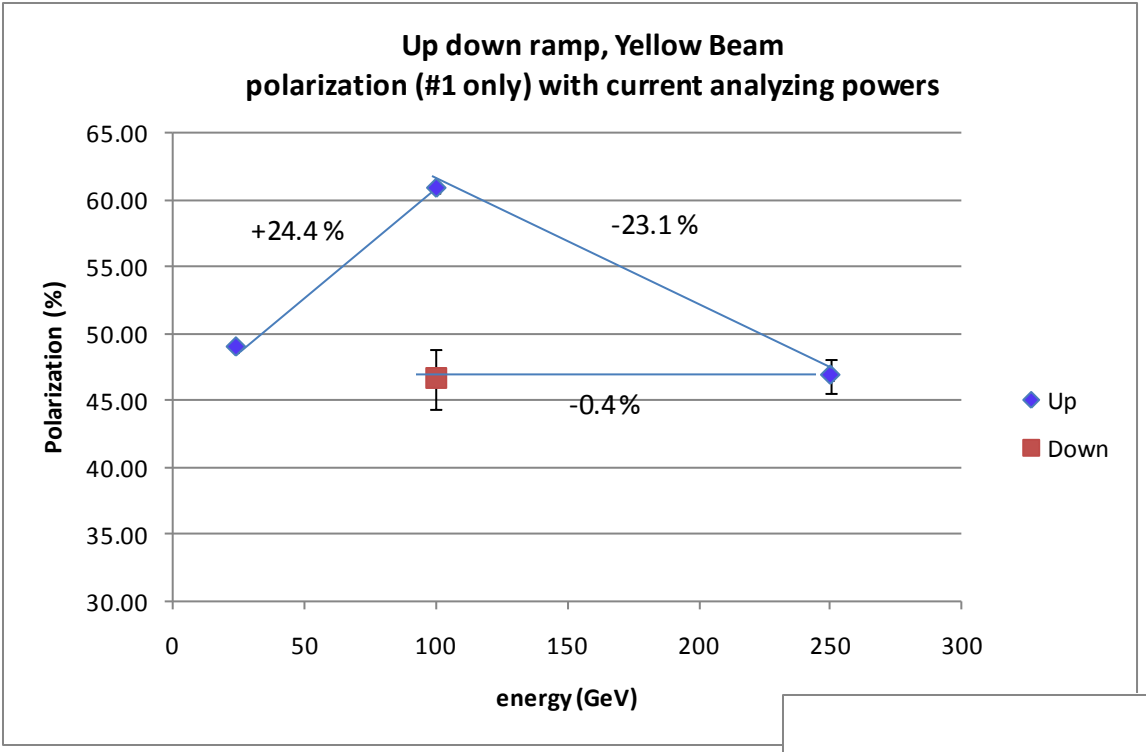


7 April Up-Down Ramp measurement Blue Beam

Current CNI average analyzing powers are:

Energy	A_N
24	0.0144
100	0.0122
250	0.0147

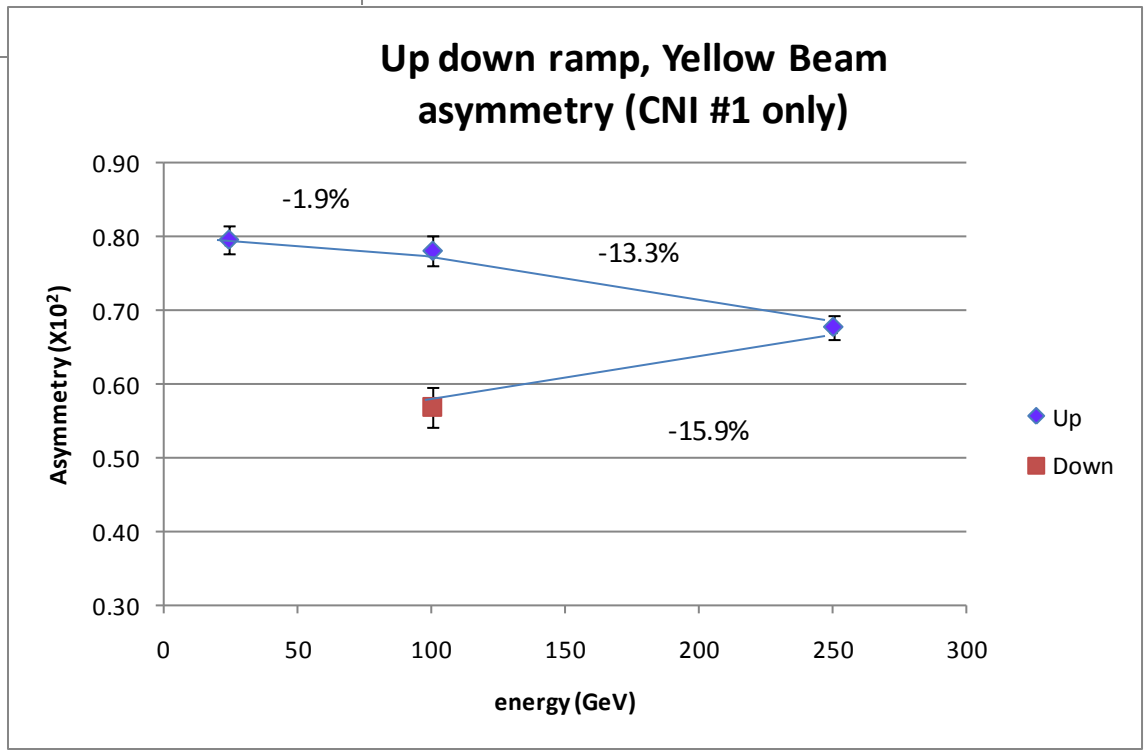


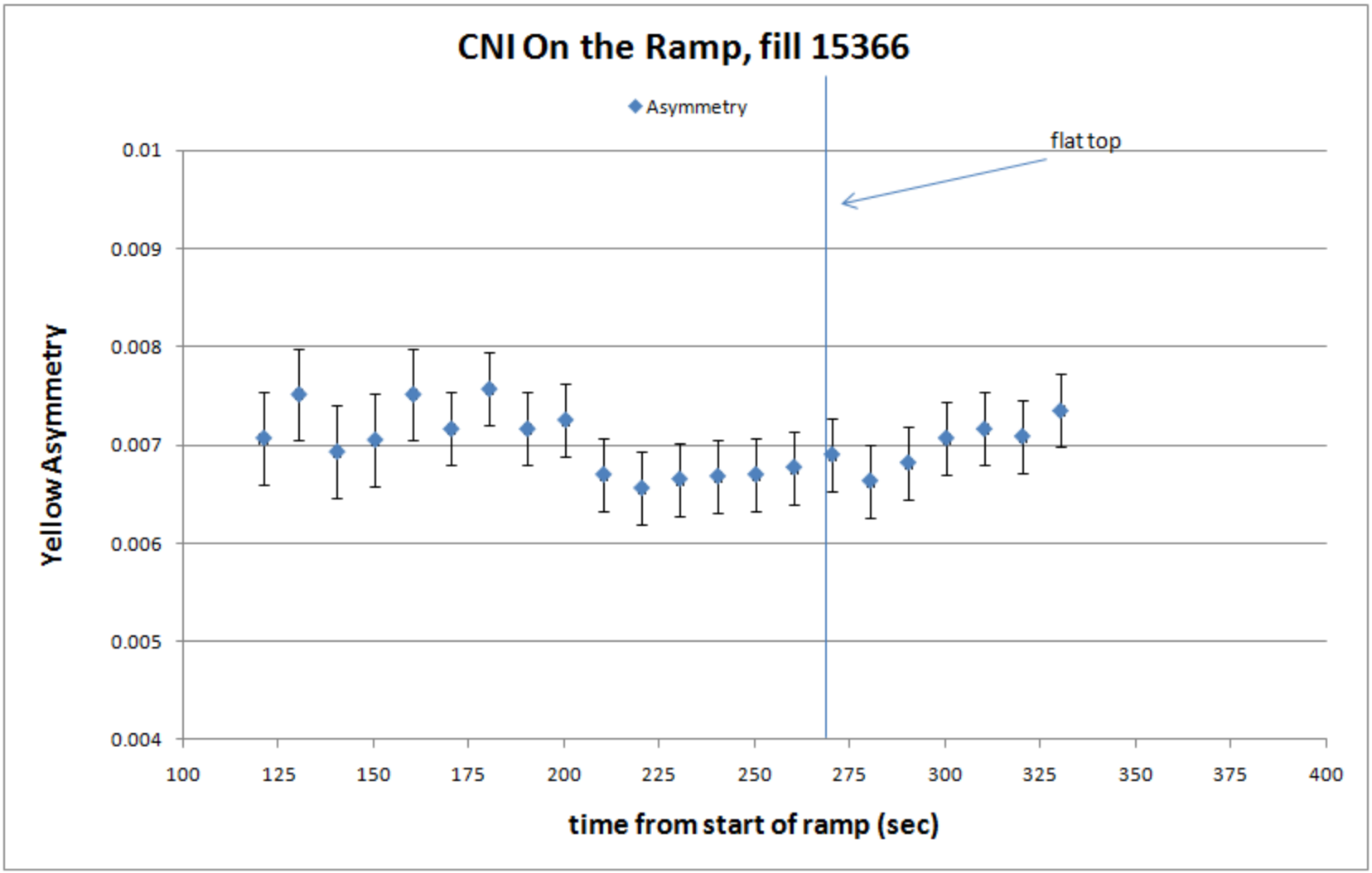


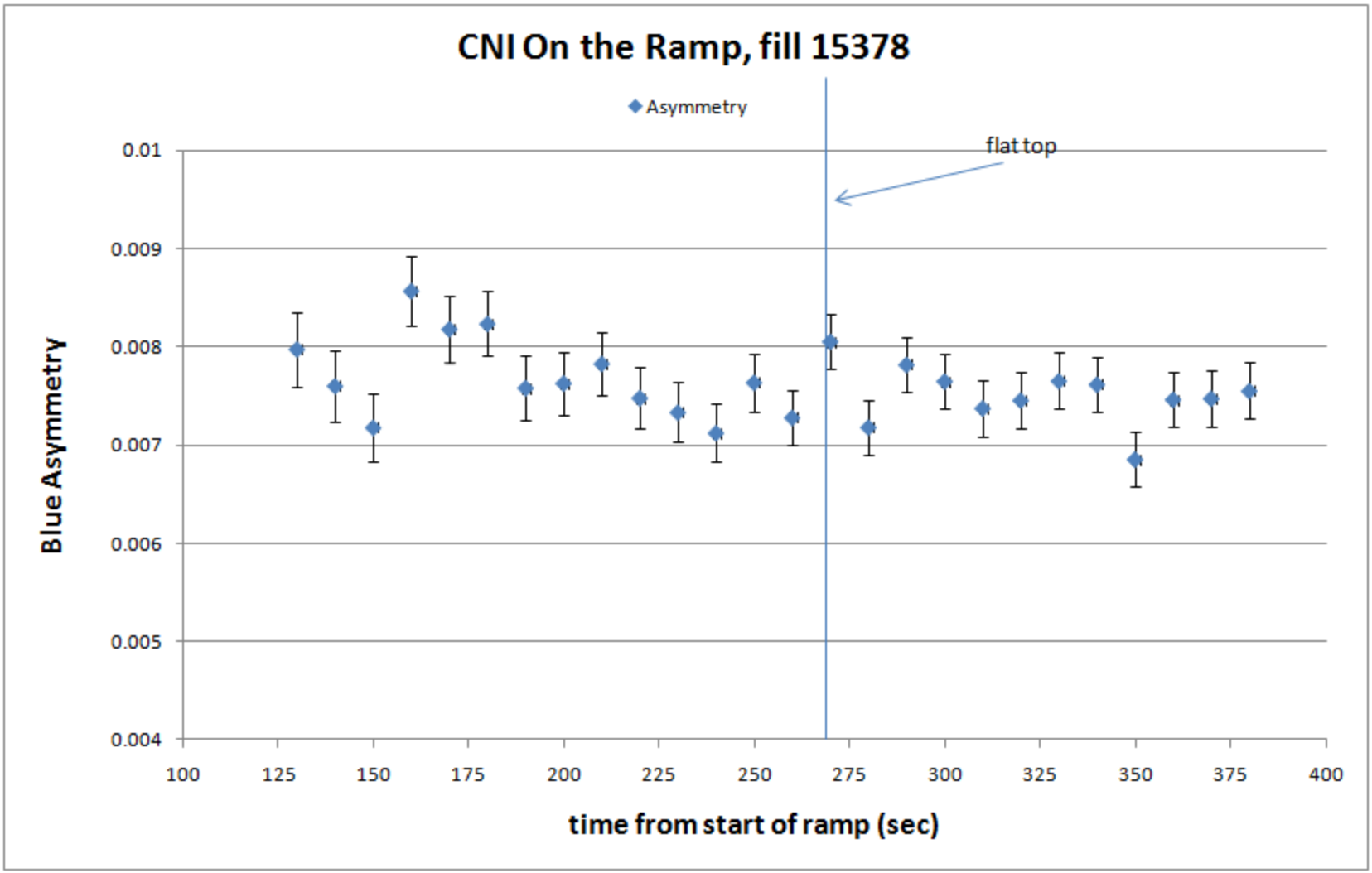
7 April Up-Down Ramp measurement Yellow Beam (only Yellow 1 was used as Yellow 2 was acting up)

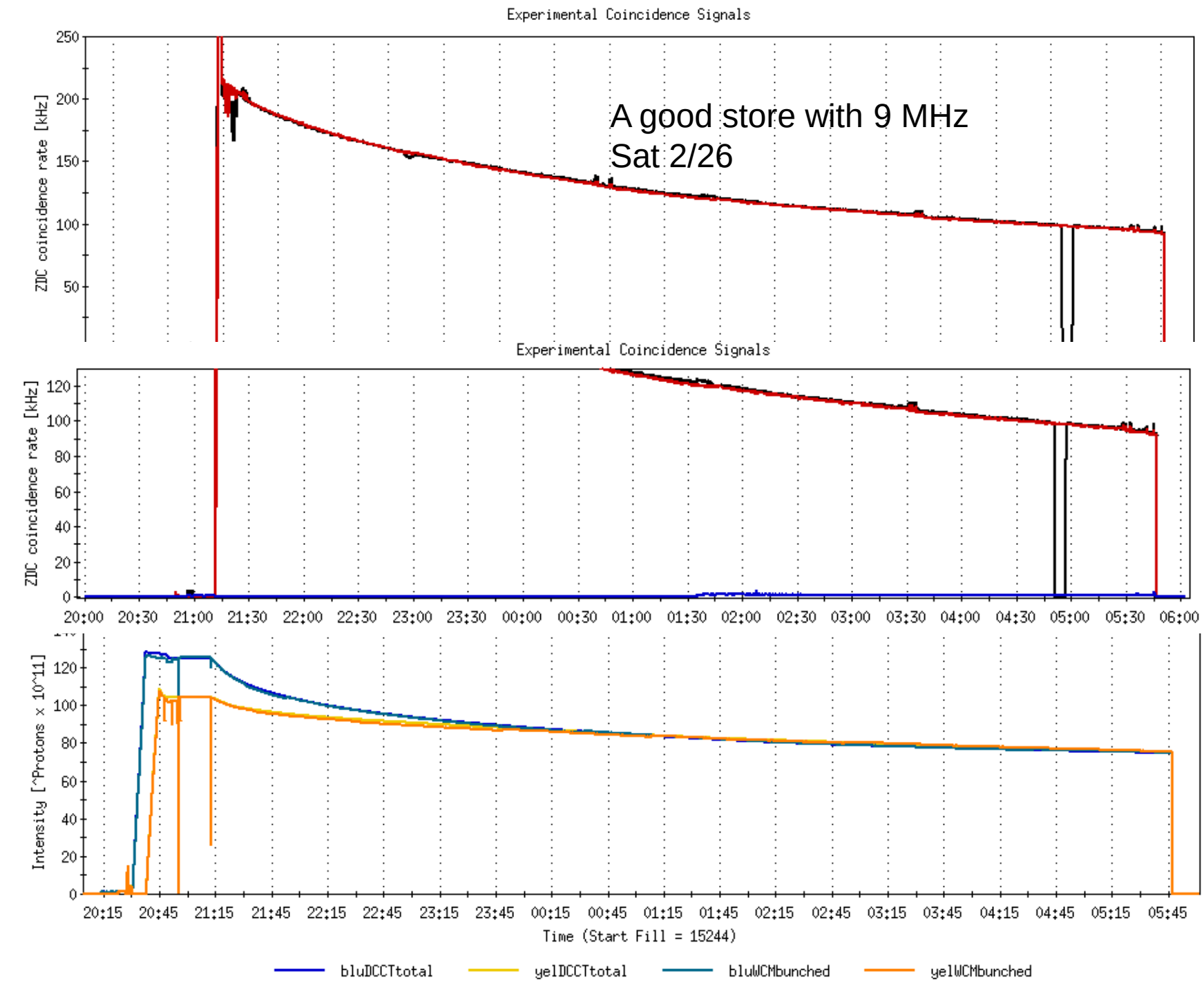
Current CNI average analyzing powers are:

Energy	A_N
24	0.0144
100	0.0122
250	0.0147




CNI On the Ramp, fill 15366
Asymmetry
flat top
Yellow Asymmetry
0.01
0.009
0.008
0.007
0.006
0.005
0.004
100
125
150
175
200
225
250
275
300
325
350
375
400
time from start of ramp (sec)

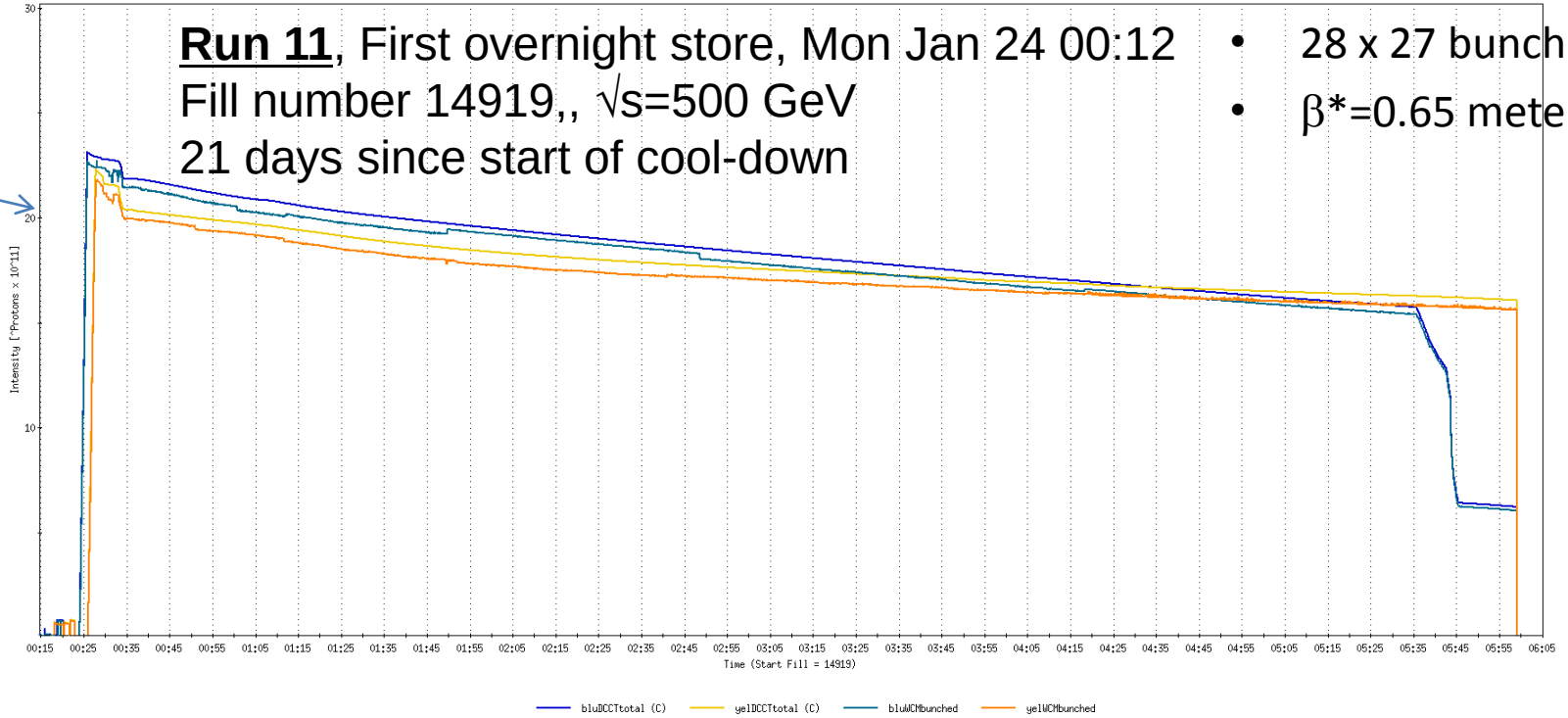

CNI On the Ramp, fill 15378
Asymmetry
flat top
0.01
0.009
0.008
0.007
0.006
0.005
0.004
Blue Asymmetry
100
125
150
175
200
225
250
275
300
325
350
375
400
time from start of ramp (sec)


Experimental Coincidence Signals
ZDC coincidence rate [kHz]
250
200
150
100
50
A good store with 9 MHz
Sat 2/26
Experimental Coincidence Signals
ZDC coincidence rate [kHz]
120
100
80
60
40
20
0
20:00
20:30
21:00
21:30
22:00
22:30
23:00
23:30
00:00
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
06:00
Intensity [^Protons x 10^11]
120
100
80
60
40
20
0
20:15
20:45
21:15
21:45
22:15
22:45
23:15
23:45
00:15
00:45
01:15
01:45
02:15
02:45
03:15
03:45
04:15
04:45
05:15
05:45
Time (Start Fill = 15244)
bluDCCTtotal
yelDCCTtotal
bluWCMbunched
yelWCMbunched

Run 11, First overnight store, Mon Jan 24 00:12
Fill number 14919,, √s=500 GeV
21 days since start of cool-down

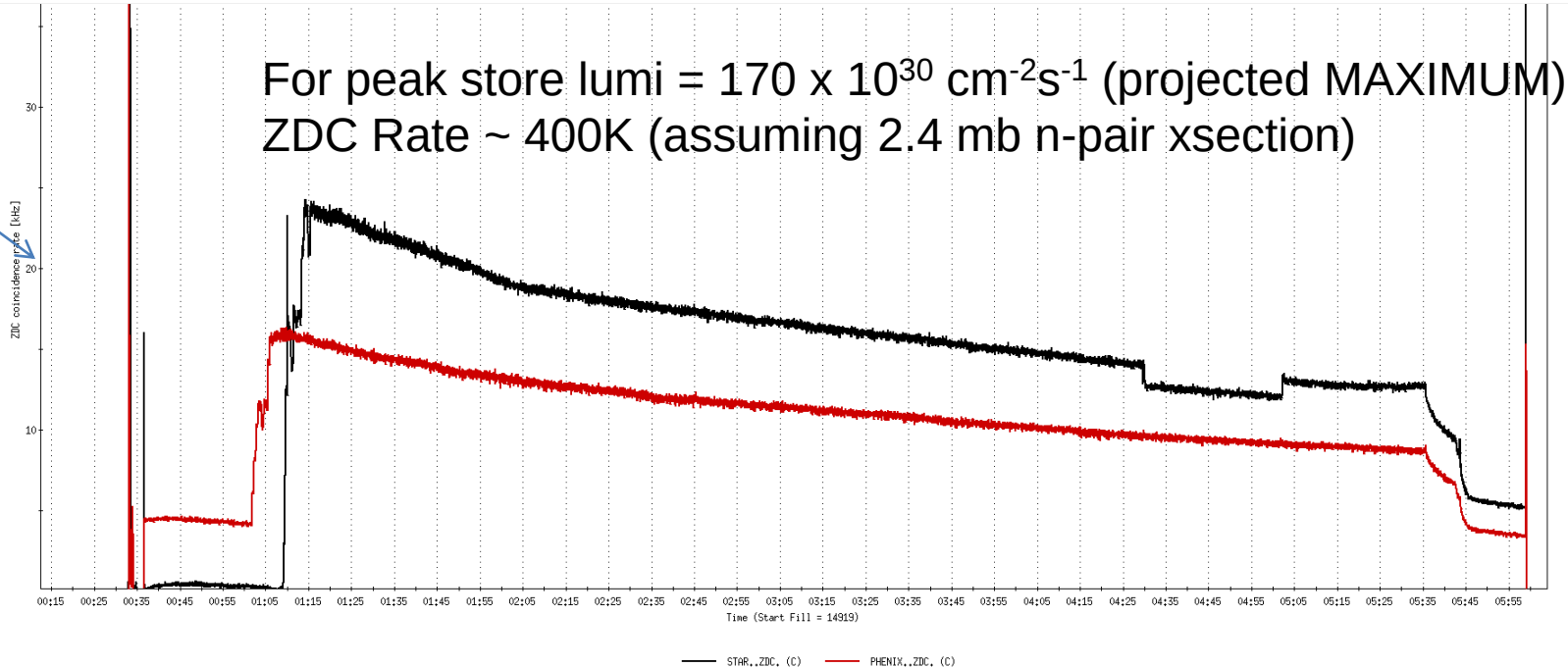
- 28 x 27 bunches
- β*=0.65 meters

20 x 10^{11}



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

20K

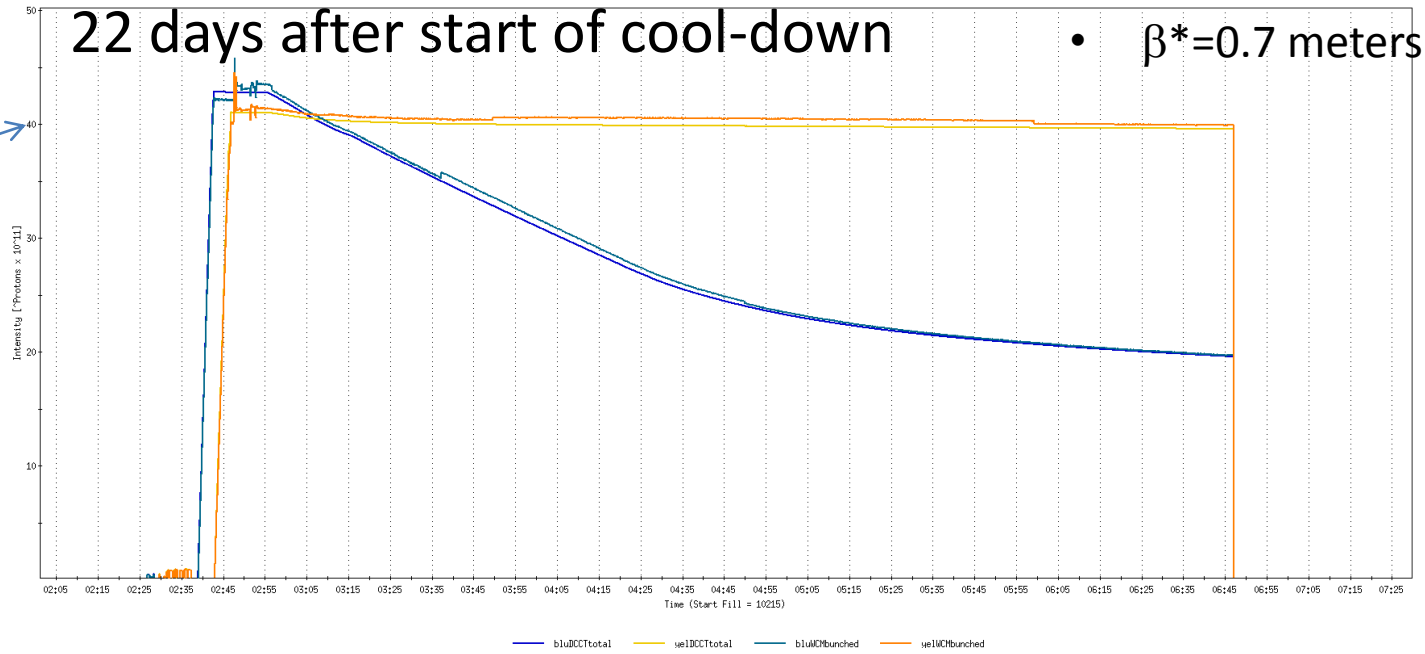


Run 9, First overnight store at √s=500 GeV

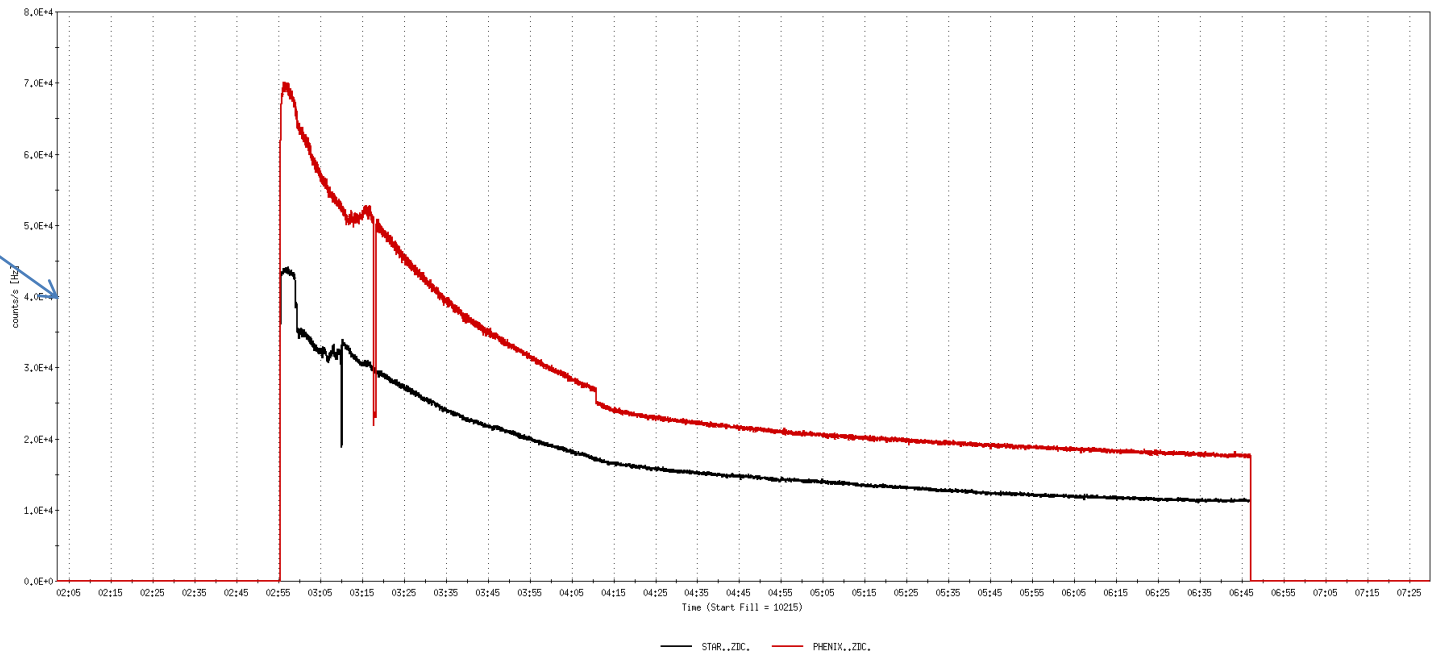
- 56 x 56 bunches
- β*=0.7 meters

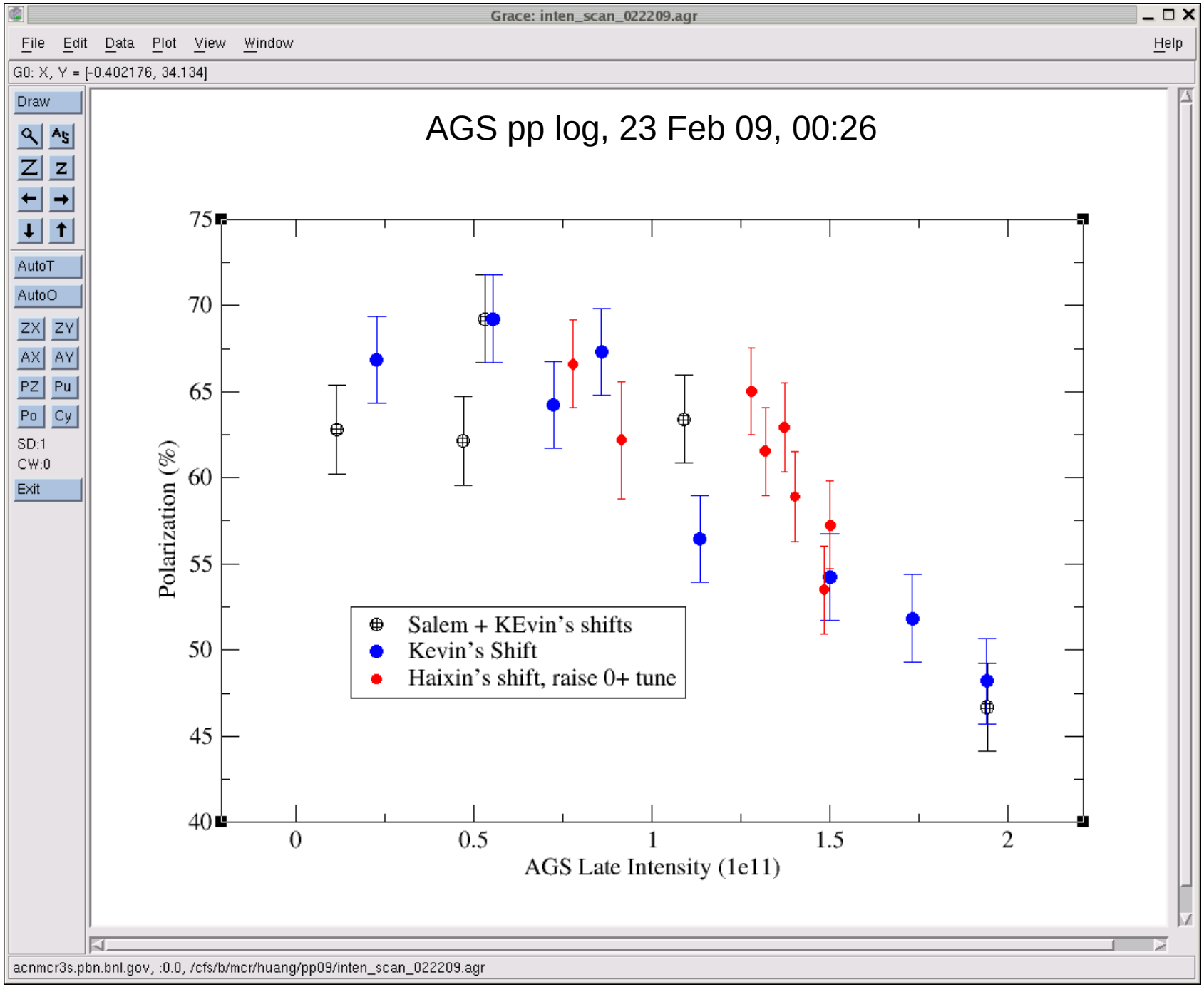
22 days after start of cool-down

40 x 10^{11}



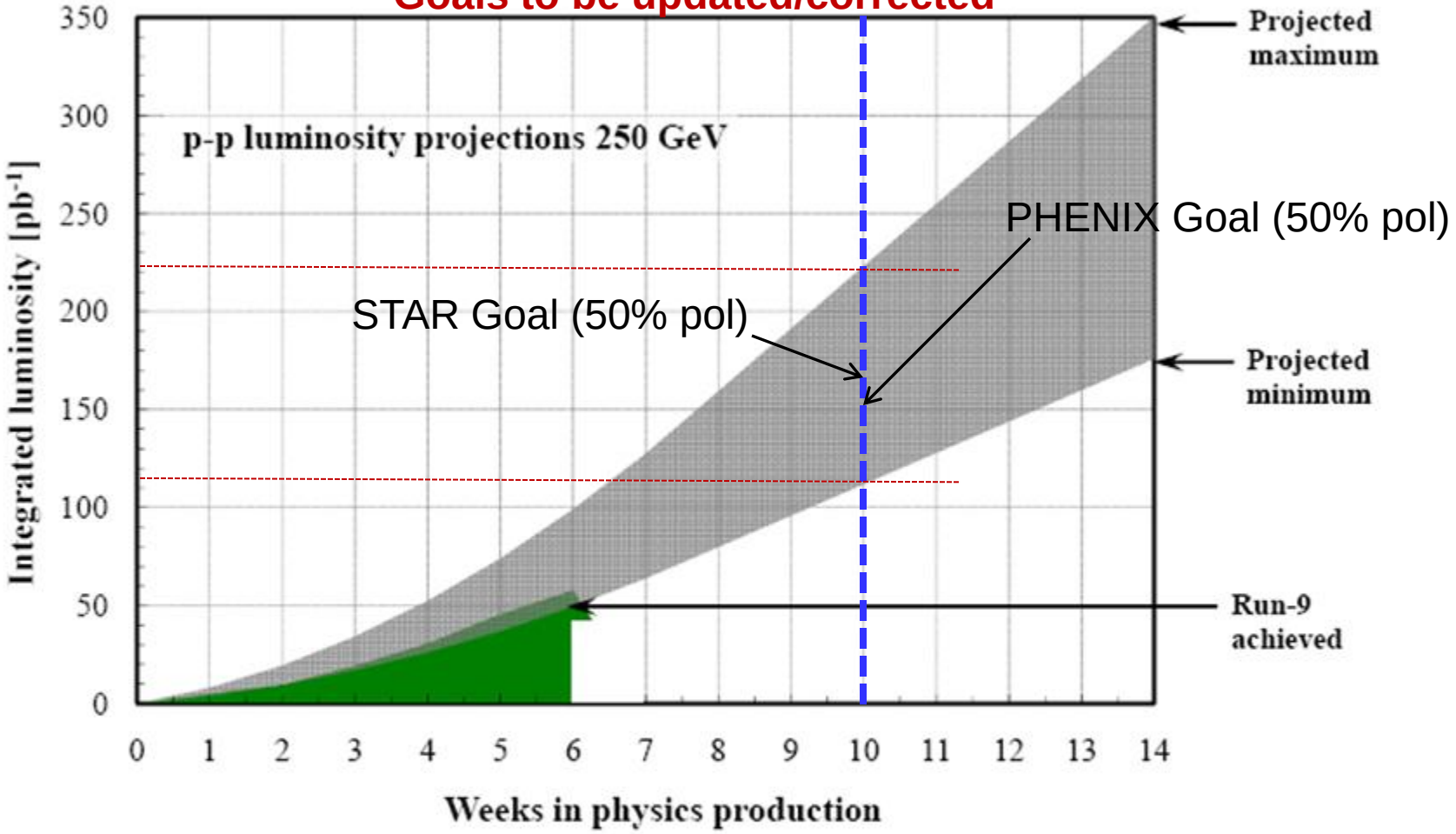
40K




Grace: inten_scan_022209.agr
File Edit Data Plot View Window Help
G0: X, Y = [-0.402176, 34.134]
Draw
AutoT
AutoO
ZX ZY
AX AY
PZ Pu
Po Cy
SD:1
CW:0
Exit
AGS pp log, 23 Feb 09, 00:26
Polarization (%)
AGS Late Intensity (1e11)
Salem + KEvin's shifts
Kevin's Shift
Haixin's shift, raise 0+ tune
acnmcr3s.pbn.bnl.gov, :0.0, /cfs/b/mcr/huang/pp09/inten_scan_022209.agr

Run-11 p↑-p↑ luminosity projections

Goals to be updated/corrected



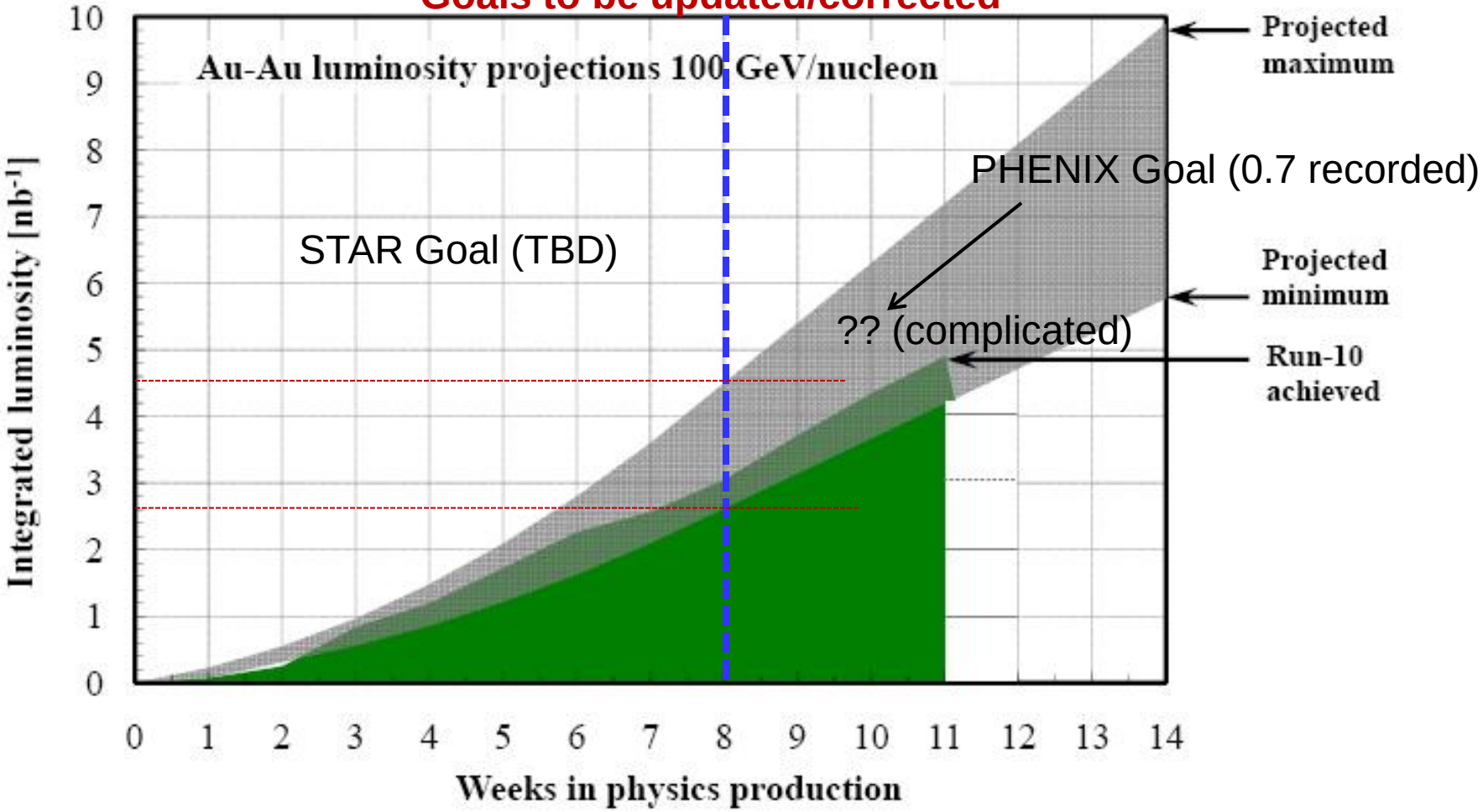
Assume 8 weeks to ramp-up for max.

Expect store P_{avg} = 35-50%, L_{avg} up to 100x10^{30}cm^{-2}s^{-1} (+80%).

[from Run-9 to max projection: β^* = 0.7 → 0.6 m, N_b = 1.1 → 1.4x10^{11}]

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

Goals to be updated/corrected



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

Expect L_{avg} up to 25x10^{26}cm^{-2}s^{-1} (+25%).

[from Run-10 to max: β^* = 0.75 ➔ 0.65 m, N_b = 1.1 ➔ 1.1x10^9, more cooling]