Run 15 Readiness

Bill Christie

STAR Collaboration meeting

November 6, 2014

Outline

- RHIC Running plan for Run 15
- Current Status of new detector capabilities for Run 15
- STAR Schedule for period from now to Collider Cool down (January 20th)
- Shift staffing schedule for Run 15
- Data set goals/needs
- Summary

EXECUTIVE SUMMARY
(FROM 2014 PAC MTG)

Run	Energy	Duration	System	Goals	priority	sequence
15	$\sqrt{s_{NN}}$=200GeV	5-week	Transverse p+Au	saturation physics, ridge and reference, L=300 nb^{-1}	1	**3**
	$\sqrt{s}$=200GeV	12-week	1) p+p	1) HI reference L=90 pb^{-1}, 500M MB		
			2) transverse 6 weeks	2) Study transversity, Sivers effects L=40 pb^{-1}, 60% pol.	2	**2**
			3) longitudinal 6 weeks	3) Study Dg(x) L=50 pb^{-1}, 60% pol.	2	**1**
16	**$\sqrt{s_{NN}}$=200GeV**	**10-week**	**Au+Au**	**L_c, D v_2, R_{AA}, Υ 10nb^{-1}, 2billion MB**	**1**	**1**
	$\sqrt{s}$=510GeV	**7-week**	**Transverse p+p**	**A_N of W$^{\pm}$, g, Drell-Yan, L=400 pb^{-1}**	**2**	**2**

THIS IS WHAT STAR REQUESTED

(9 wks of pp and 5 wks of pA)

PAC Recommendation for Run 15 Collider Operation

For Run 15 the PAC recommends the following (in *order of priority):*

- 9 weeks of polarized p+p collisions at √s = 200 GeV, *and*
- 5 weeks of p+Au collisions at √s = 200 GeV with transverse polarization of the proton
- 2 weeks of p+Si (Al) collisions at √s = 200 GeV with transverse polarization of the proton

For Run 16 the PAC recommends the following:

- 10 weeks of Au+Au collisions at √s = 200 GeV
- 7 weeks of Au+Au and p+p collisions at √s = 62 GeV, *or*
- 7 weeks of polarized p+p collisions at 510 GeV

For Run 15, in a 22 cryo-weeks scenario, both p+p, p+Au and p+Si running are recommended. In the case of a shorter run, the p+p and p+Au programs would have higher priority.

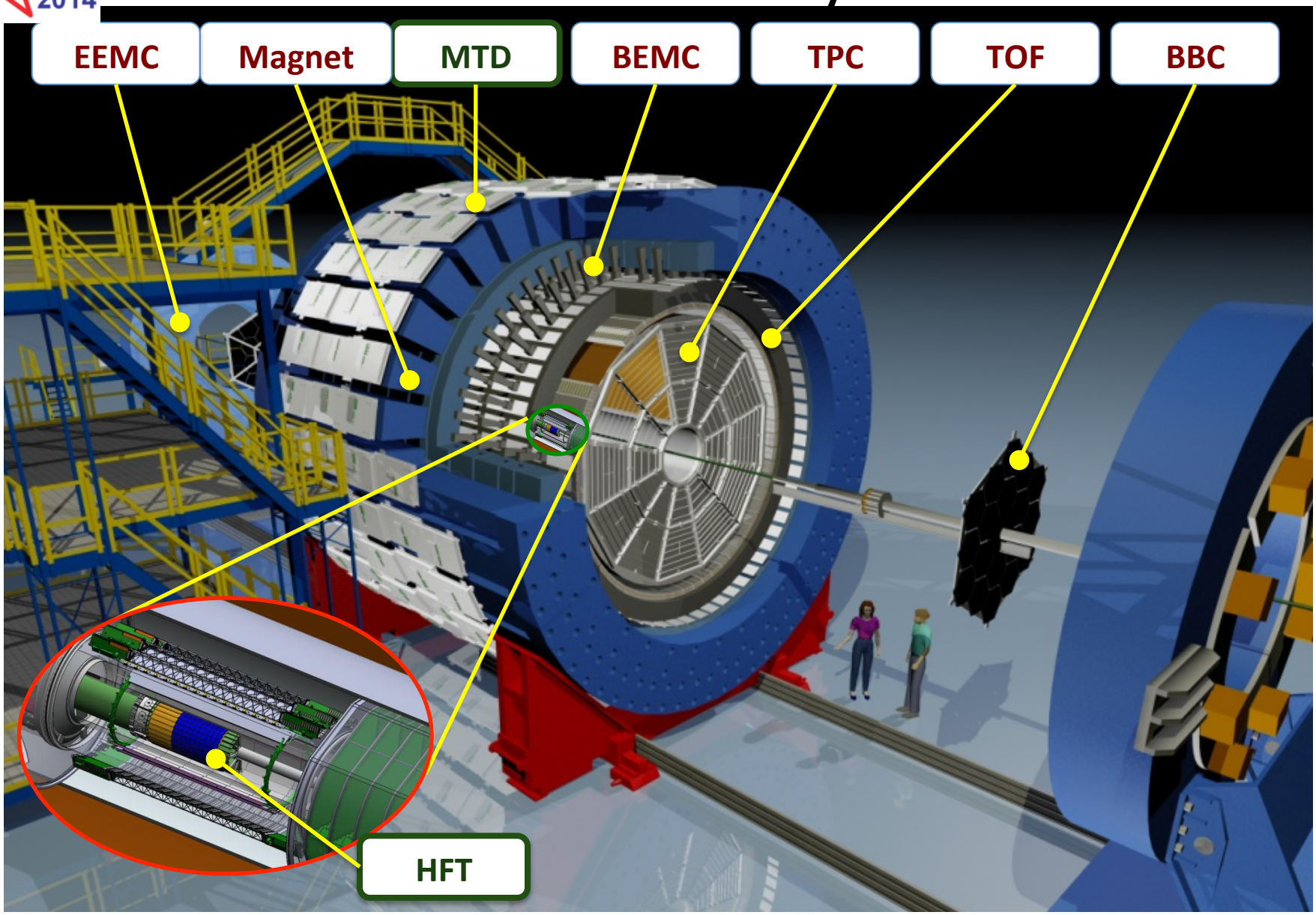
12 wks of pp requested drops to 9 wks
7 wks of pAu drops to 5 wks

STAR Plan for the pp running is to:

- start with 5 weeks of longitudinally polarized beams
- followed by 4 weeks of transversely polarized beams.

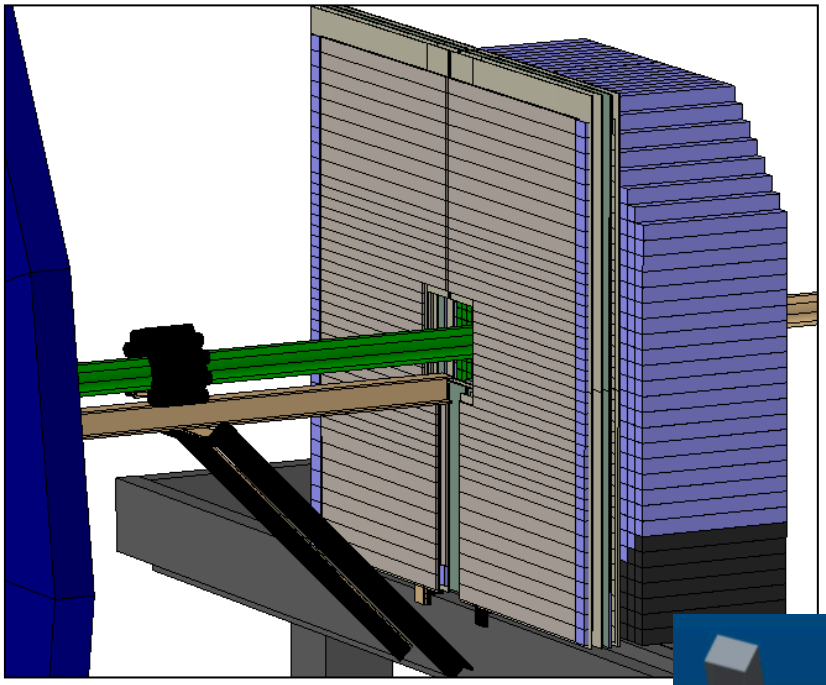
We'll use time, as/if needed, during the longitudinal running to complete commissioning of the FMSps, FMS, and pp2pp sub systems.

STAR Detector System

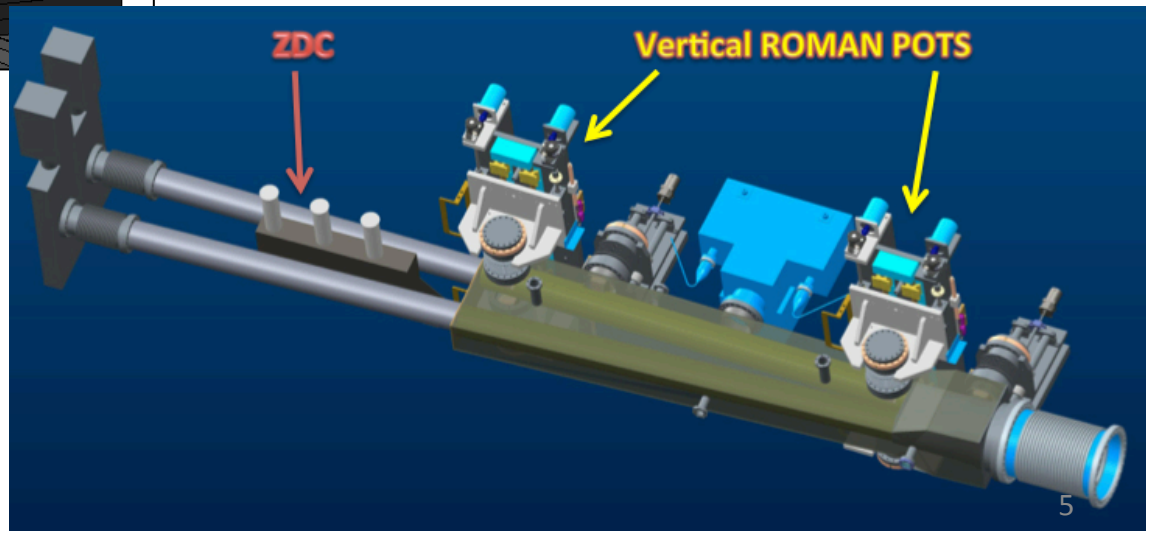


STAR stayed in the IR this year

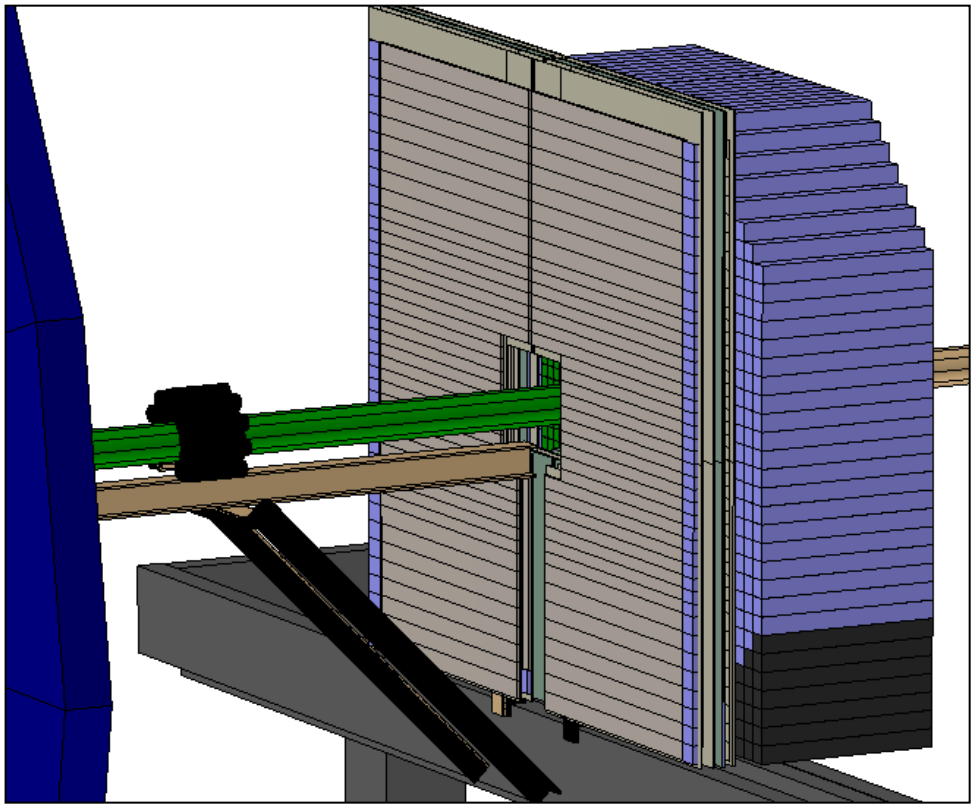
New Detector capabilities for Run 15.



- FMS pre shower detector
- Refurbished FMS
- Pp2pp phase II



FMS WITH PRE-SHOWER FOR RUN15



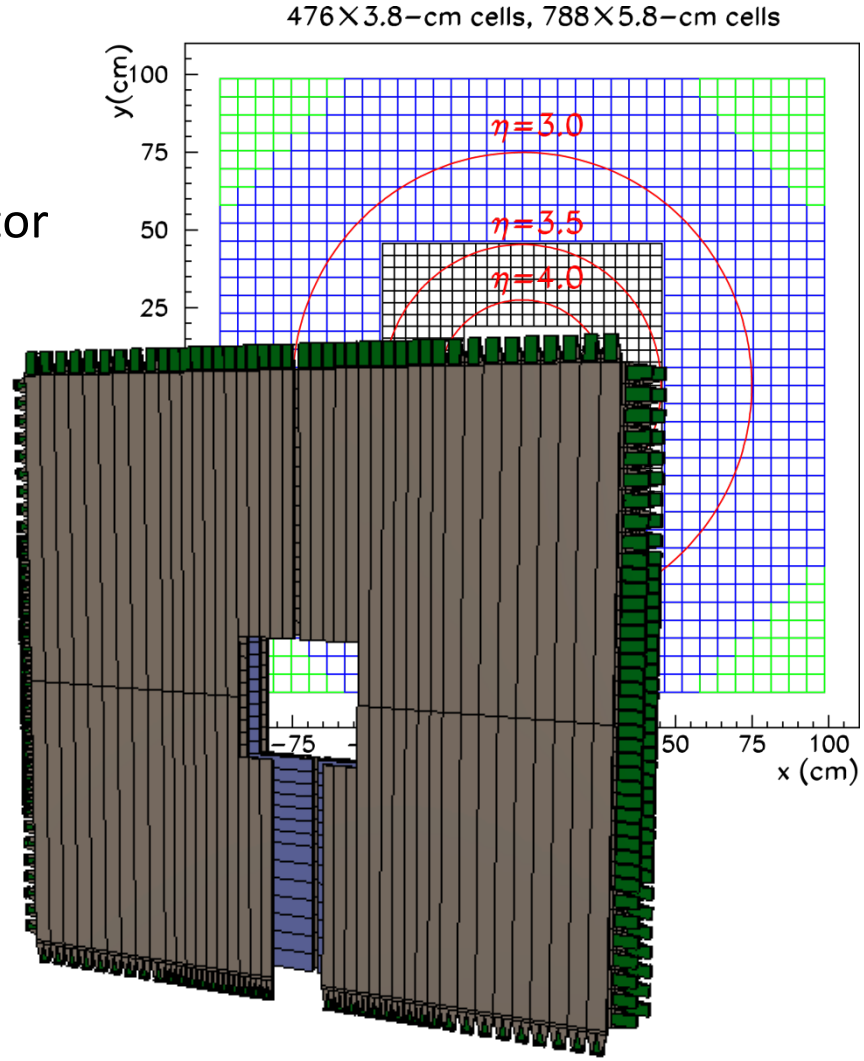
FMS pre-shower:
scintillators with Pb convertor and SiPM readout

- Physics aim
  - Direct photon measurements
- Forward Meson Spectrometer is being refurbished
- pre-shower added
- 3 layer hodoscope at 2.5 < η < 4.0

FMS pre-shower slides courtesy of Oleg Eyser's UIC talk.

Preshower Layout

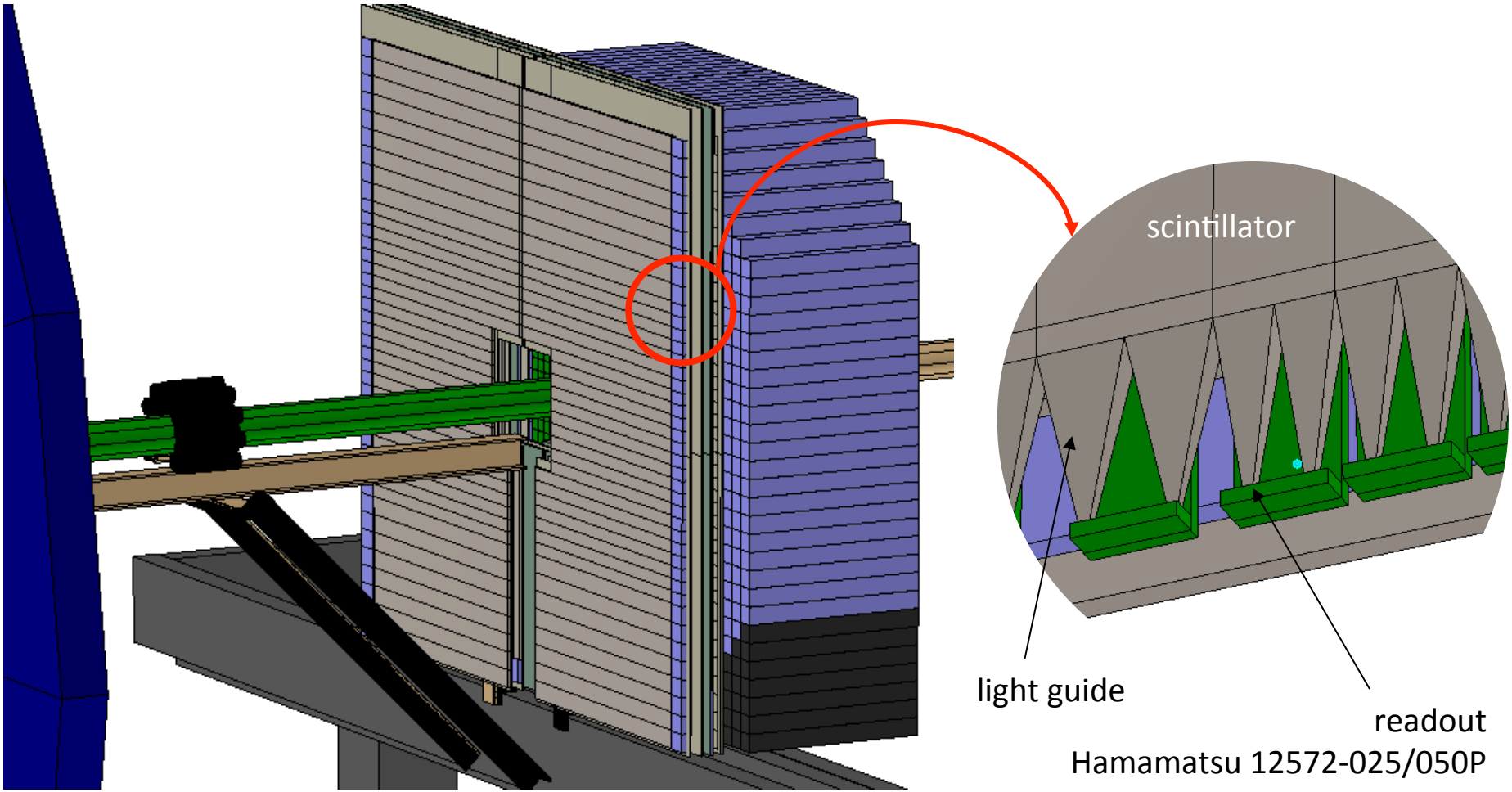
- Scintillator hodoscope
- Match FMS granularity
  - Two perpendicular layers of scintillator bars
- Photon identification
  - Reject minimum ionizing particles (charged hadrons/leptons)
- Electron identification
  - Converter with additional scintillator layer



Courtesy of Oleg Eyser

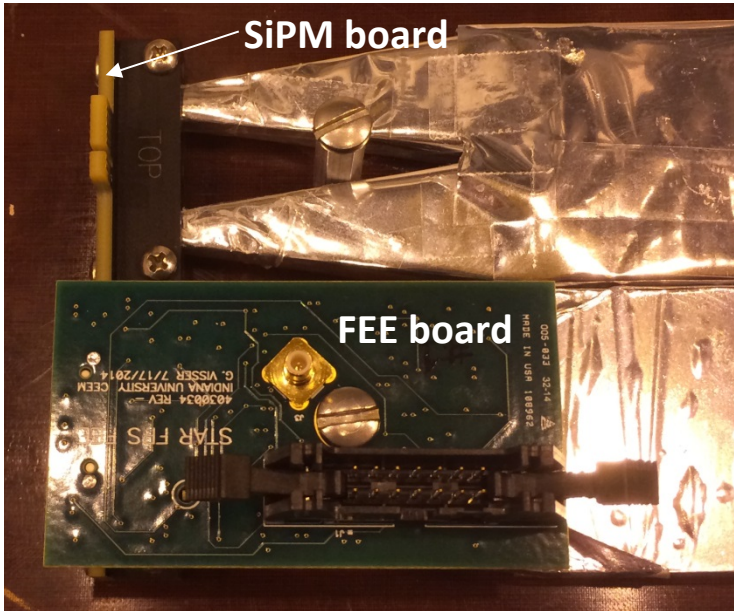
Preshower Layout

as in StarVMS/Geometry/FpdGeometry3.xml



Courtesy of Oleg Eyser

Light Guide Alignment



SiPM loading on board tolerance: $\Delta x, \Delta y < 3\ mil$ (x-ray measurement)

SiPM area: $3 \times 3\ mm^2$

Courtesy of Oleg Eyser

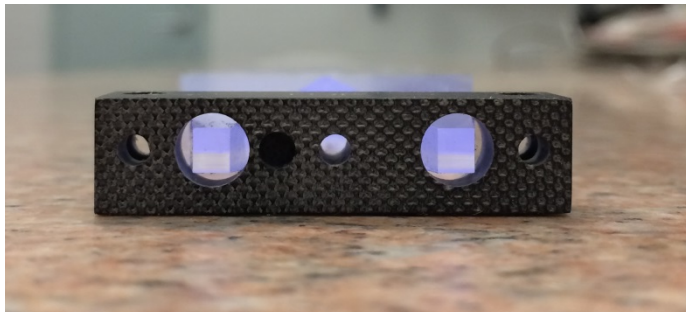
Scintillators & SiPM

Eljen:

We had our production meeting for the Brookhaven order. The main holdup is making the pyramids again. In order for us to keep the correct angles for each part, we will need to complete each size pyramid before starting the next. Very difficult to control the angles. Just the machining of all the pyramids will take 3 weeks. We will need a little more than a week per set for the gluing, cean-up and inspection. Here is the estimated ship dates per batch:

Set 1 Ships Nov. 10th
Set 2 Ships Nov. 17th
Set 3 Ships Nov. 24th
Set 4 Ships Dec. 8th
Set 5 Ships Dec 15th

(spares)



Procurement:

As the buyer on this PO I was just notified of the delay in shipment from my end user. At no time was I notified of this delay by your company. The November delivery date for ~1/4 of our order is very disappointing and unacceptable. Why was I not notified of this delay so I could have passed this information on to my requestor???? I would like to ask you to please EXPEDITE this order as it is crucial to our project. I would very much like to have an update on this order and if your able to improve the delivery status it would be greatly appreciated. Please advise ASAP to all.

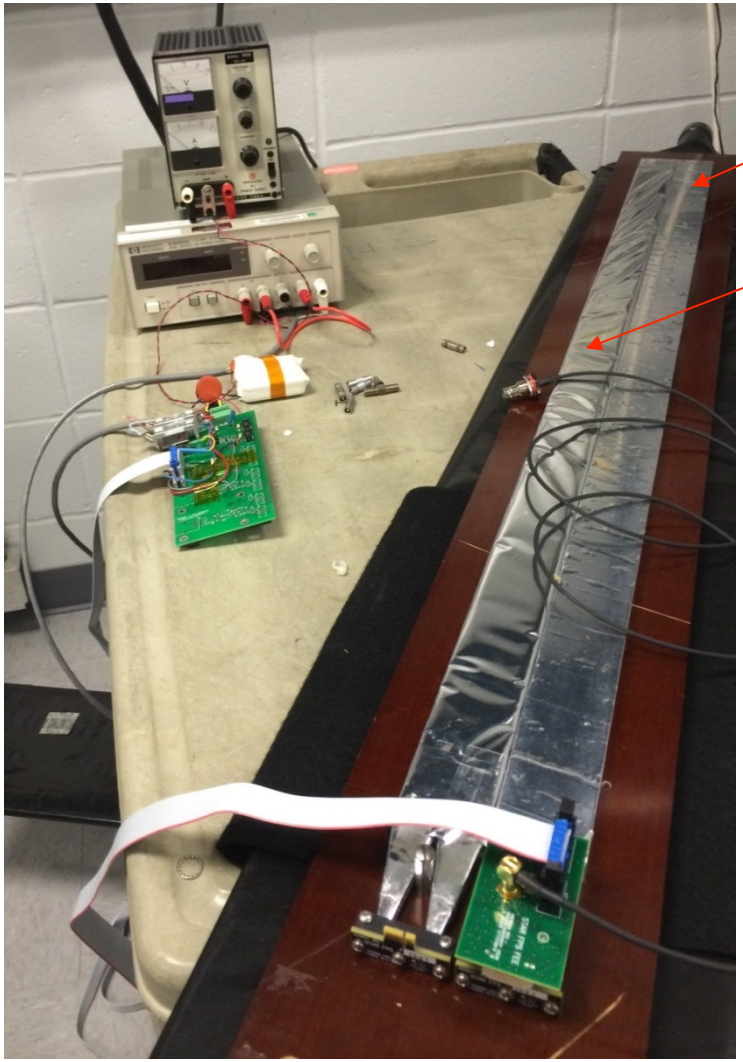
Hamamatsu:

Attached, please find our test data for remaining 55 units of S12572-050P.
You can expect to receive these parts in the week of 10/27.

- Scintillators are ~ 8 weeks late in getting delivered.

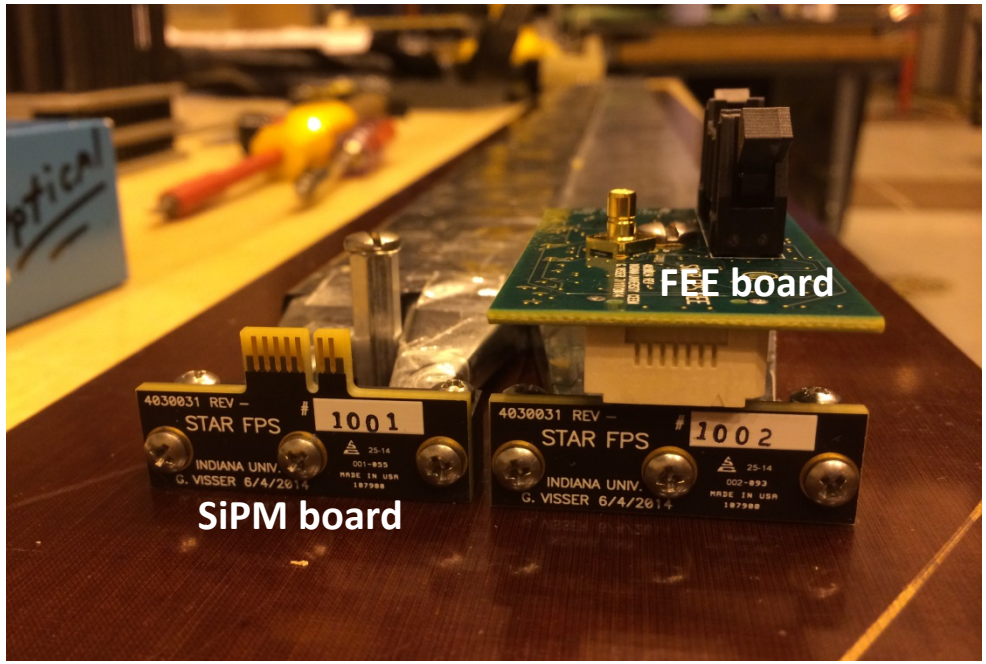
Courtesy of Oleg Eyser

Test Setup in Lab 1-231



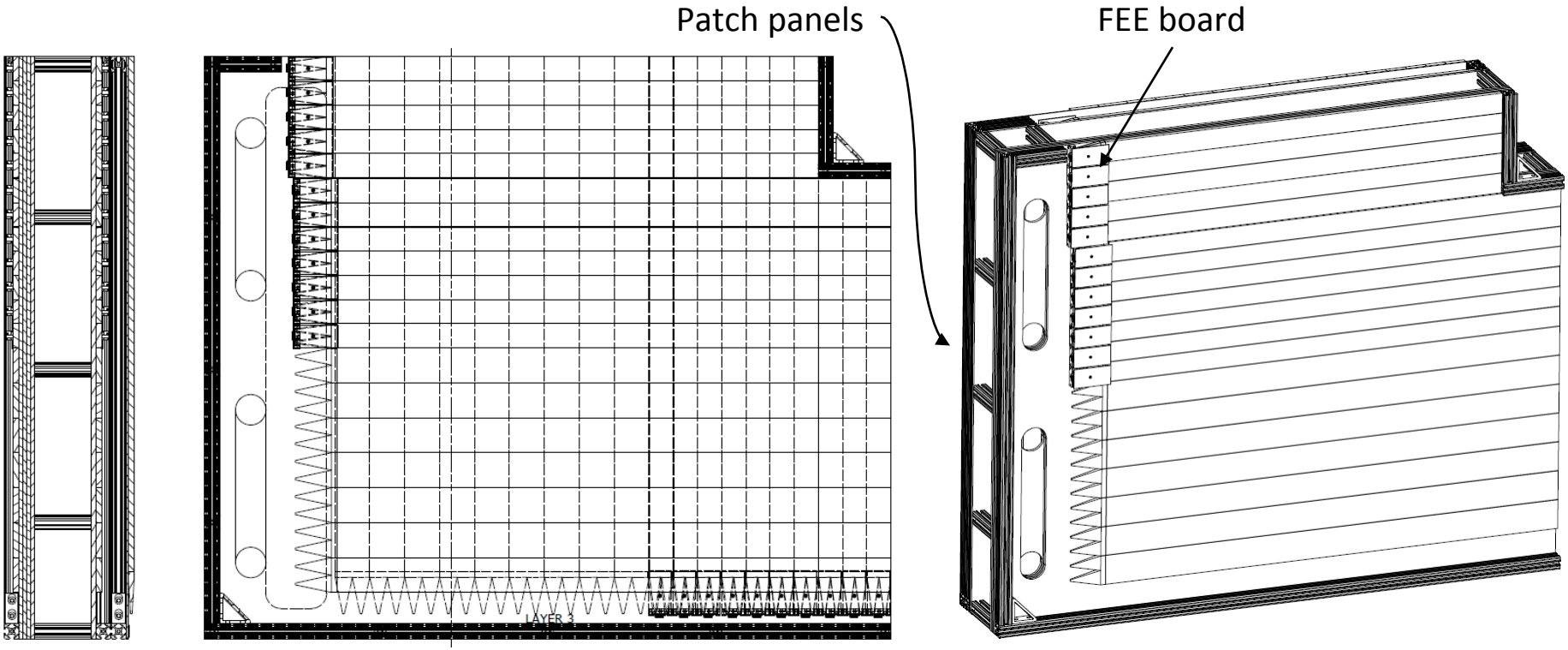
Previous: adhesive wrap
Glue may corrode the scintillator surface

Now: conventional wrap



Courtesy of Oleg Eyser

Quadrant Design



220 lbs each

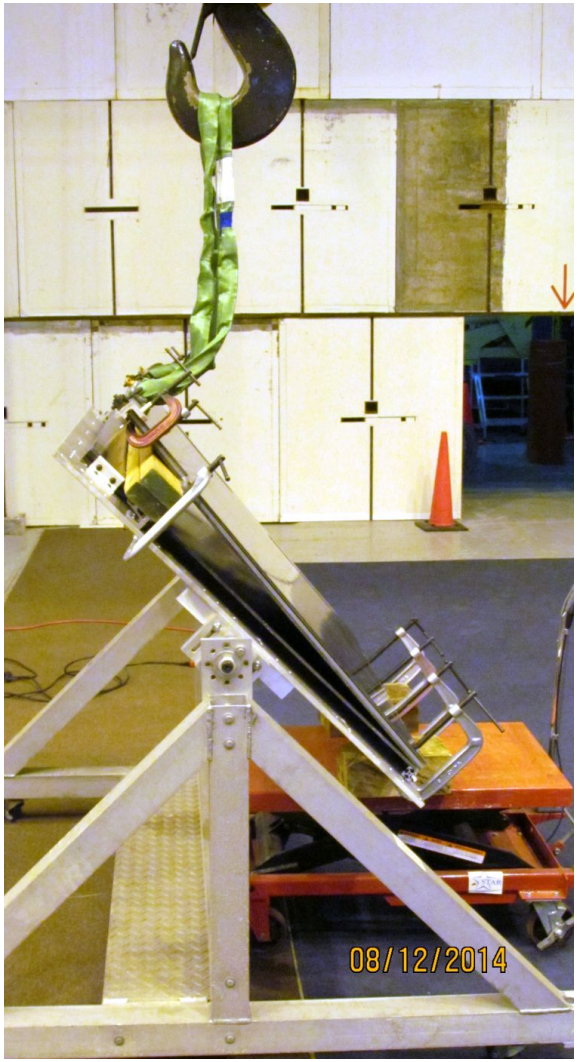
Scintillators will be glued to support plate

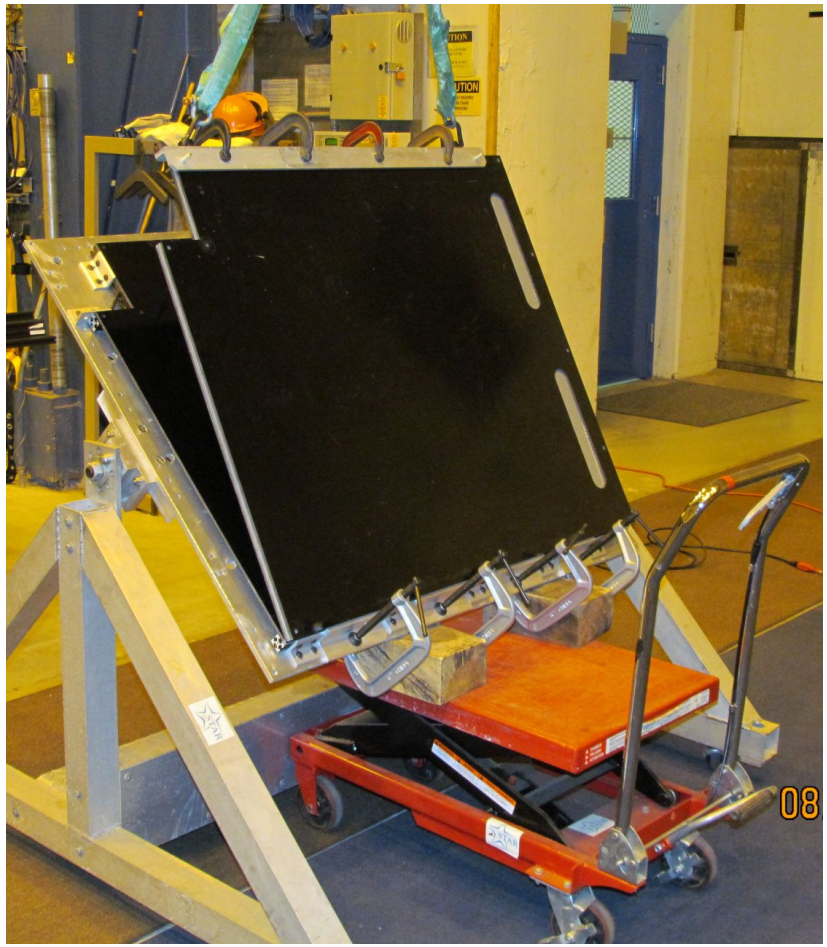
Installed from the STAR hall (crane)

Quadrants will be bolted together and secured to overhead frame

Courtesy of Oleg Eyser

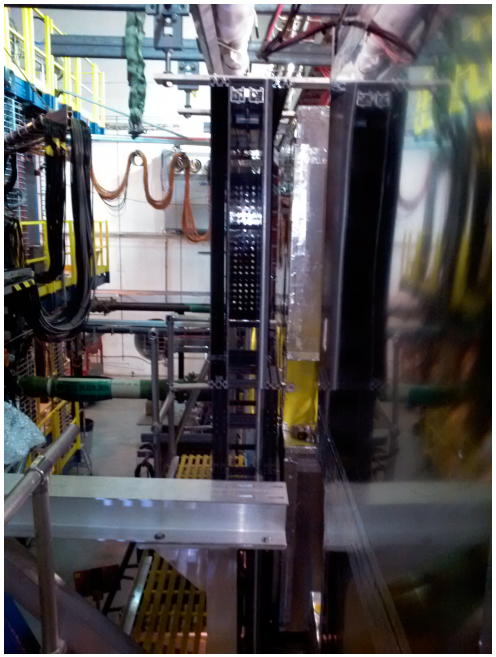
Frame Assembly



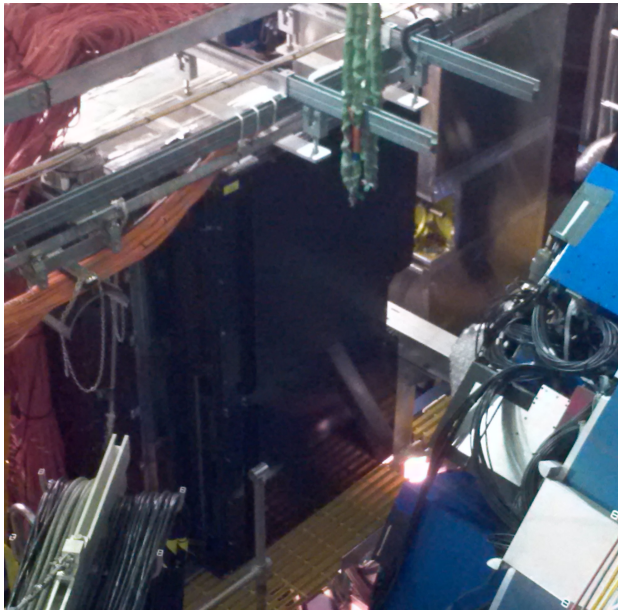


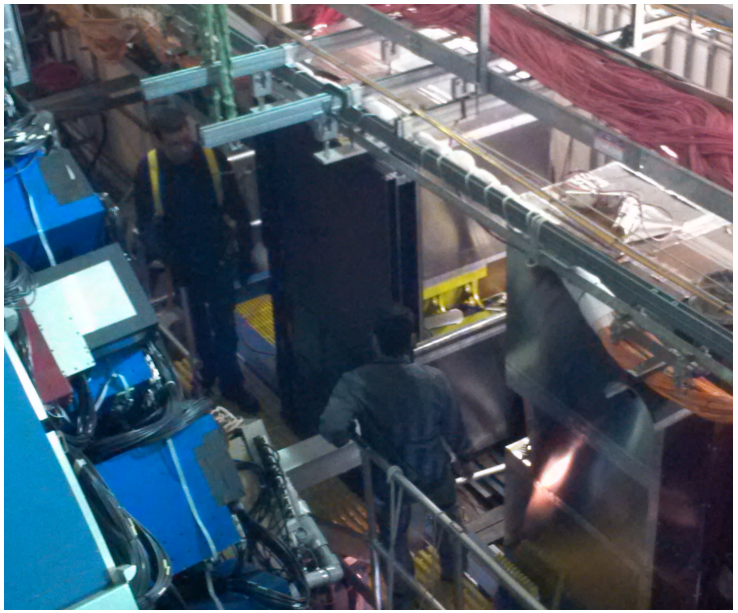
Courtesy of Oleg Eyser

Pictures of some test assembled FMS Pre Shower quadrants

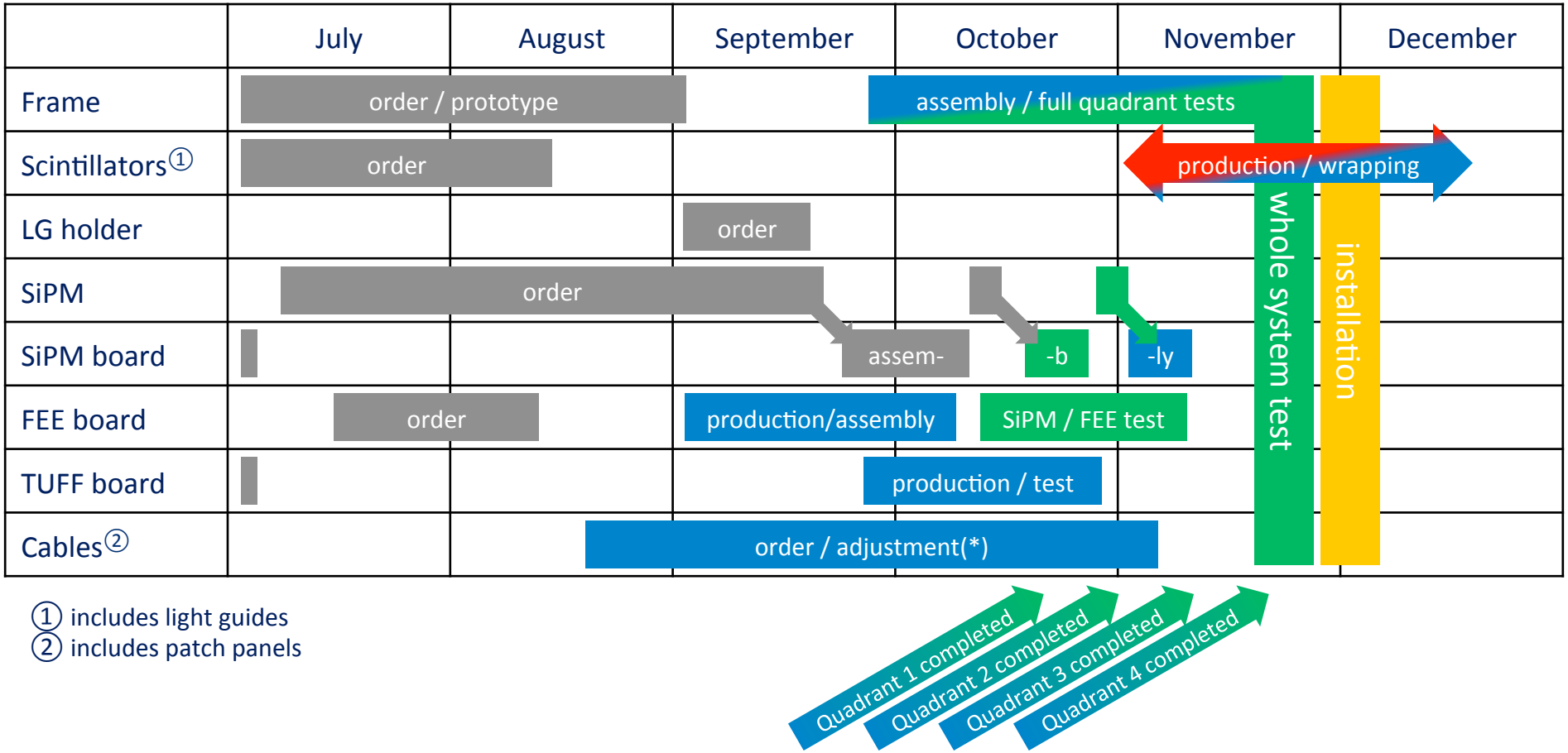


Test installation of two FMS ps Quadrants





Schedule

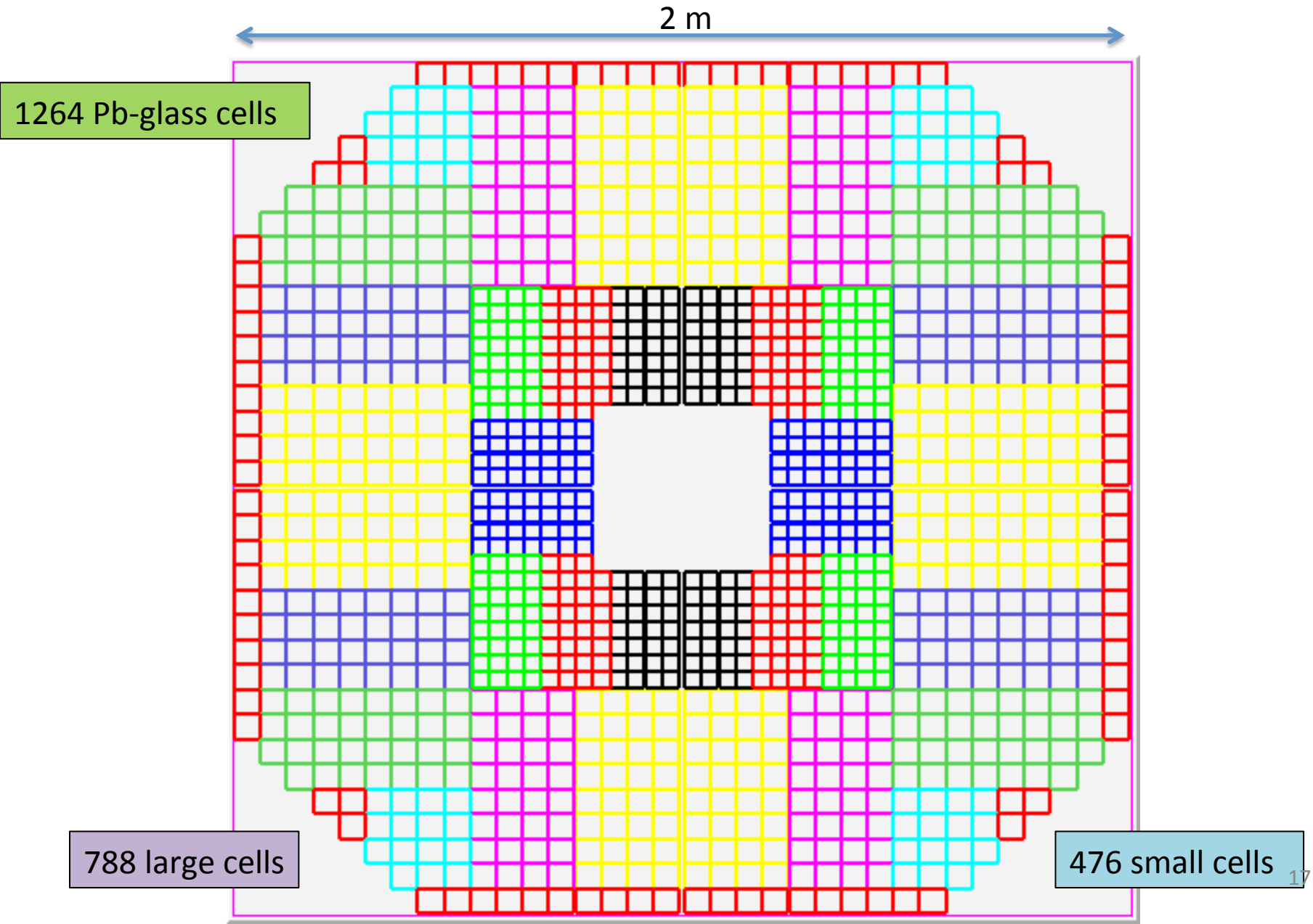


① includes light guides
② includes patch panels

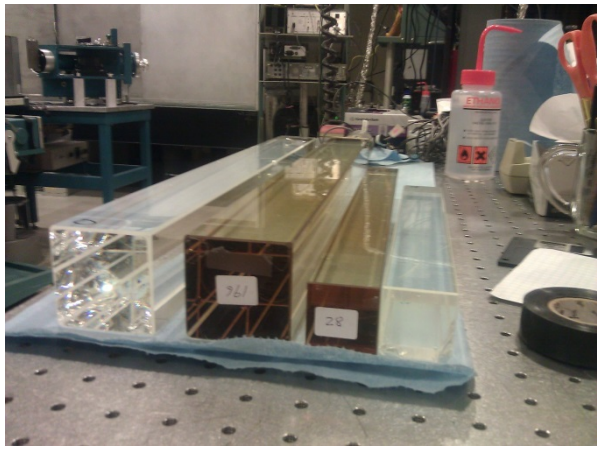
Courtesy of Oleg Eyser

The Forward Meson Spectrometer

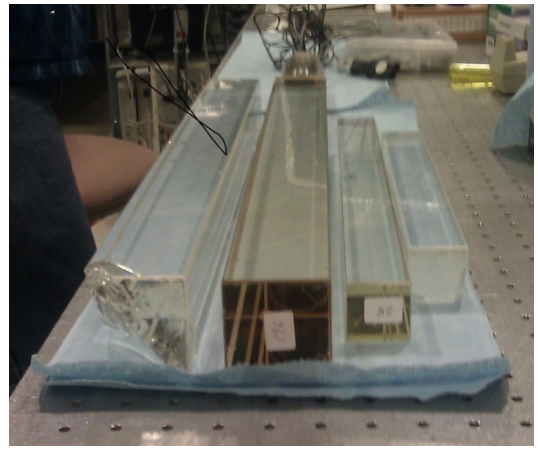
(FMS slides all courtesy of Grant Webb's UIC talk)



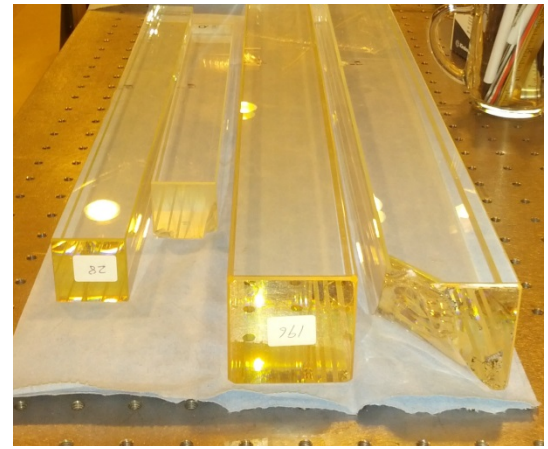
Radiation Damage/Exposure to Sunlight



0 hours



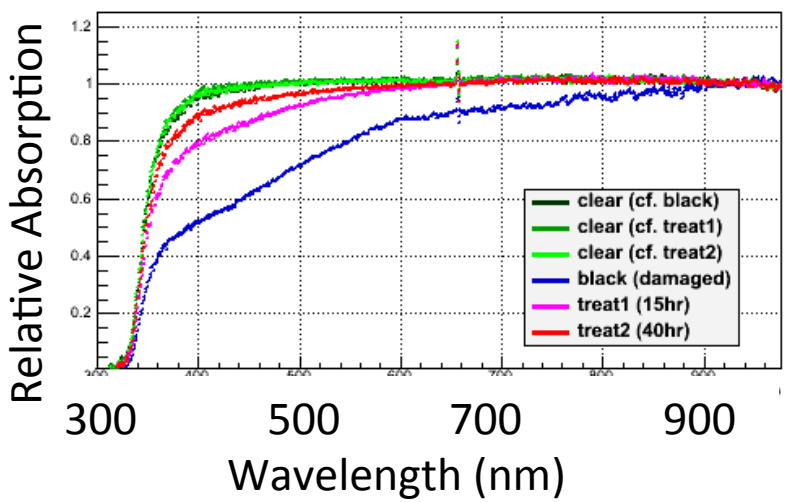
15 hours



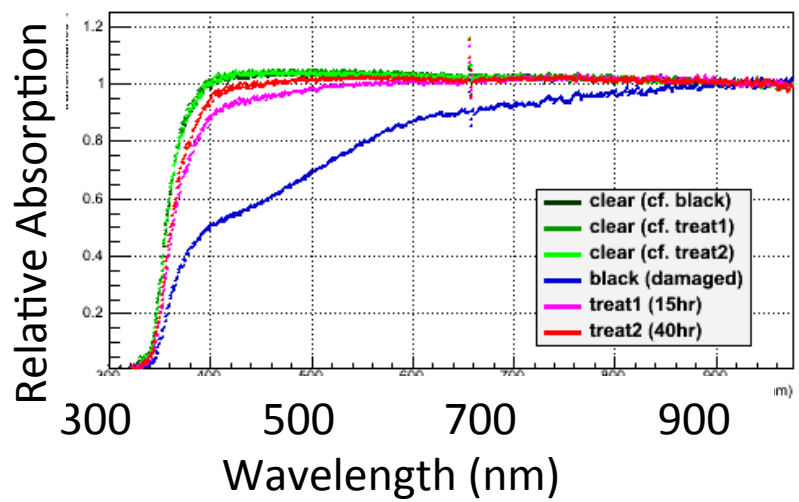
40 hours

Courtesy of Grant Webb

Large Cell



Small Cell



Stacking the FMS

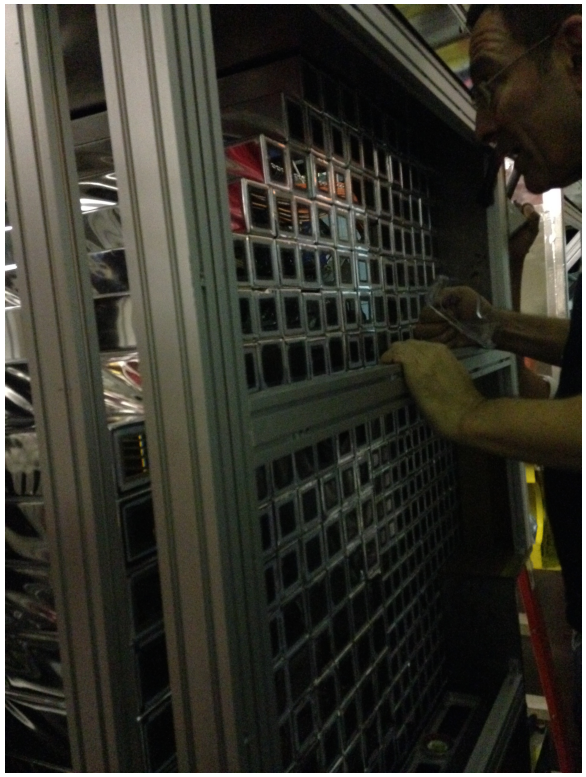
The first cell is stacked!

All the small cells are stacked

Courtesy of Grant Webb

Stacking the FMS

Survey of FMS location completed



The South Side is <u>Fully</u> Stacked

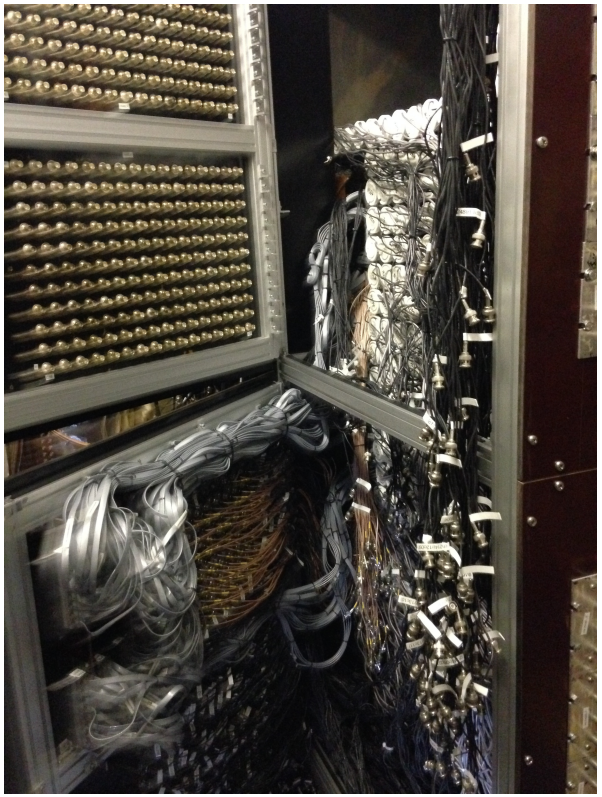
The North Side is 90% Stacked

Need the remaining 150 PMT bases from PSU.

Courtesy of Grant Webb

Cabling the FMS

Attaching the HV Cables

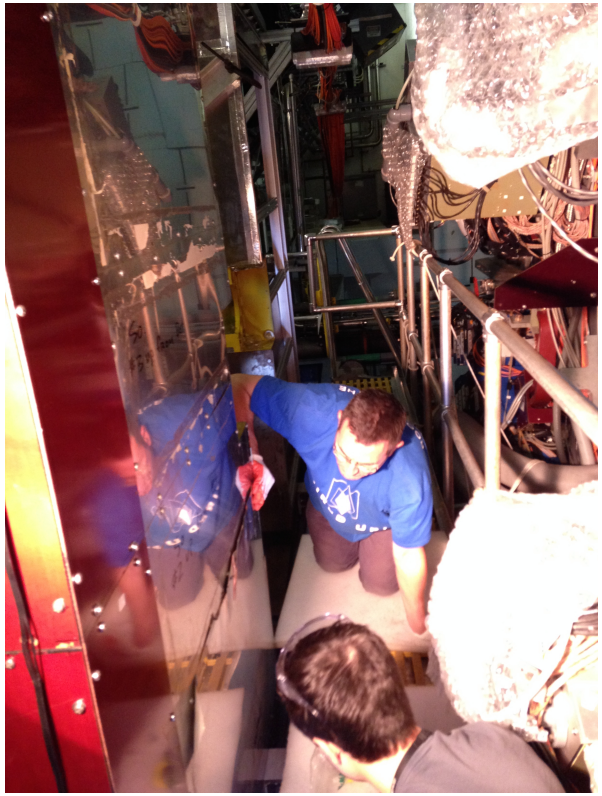


Attaching the Signal Cables

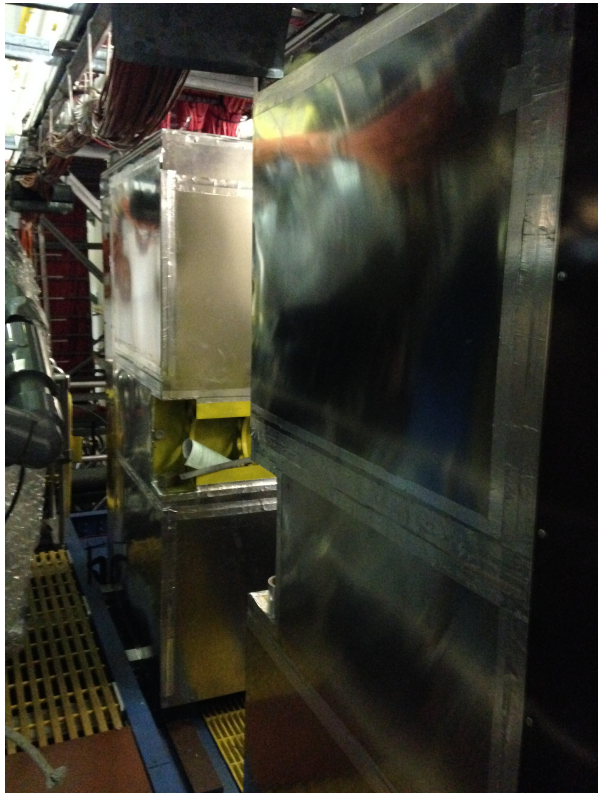
The FMS is 95% cabled

Courtesy of Grant Webb

Making it Light Tight



Stephen & Grant(?)

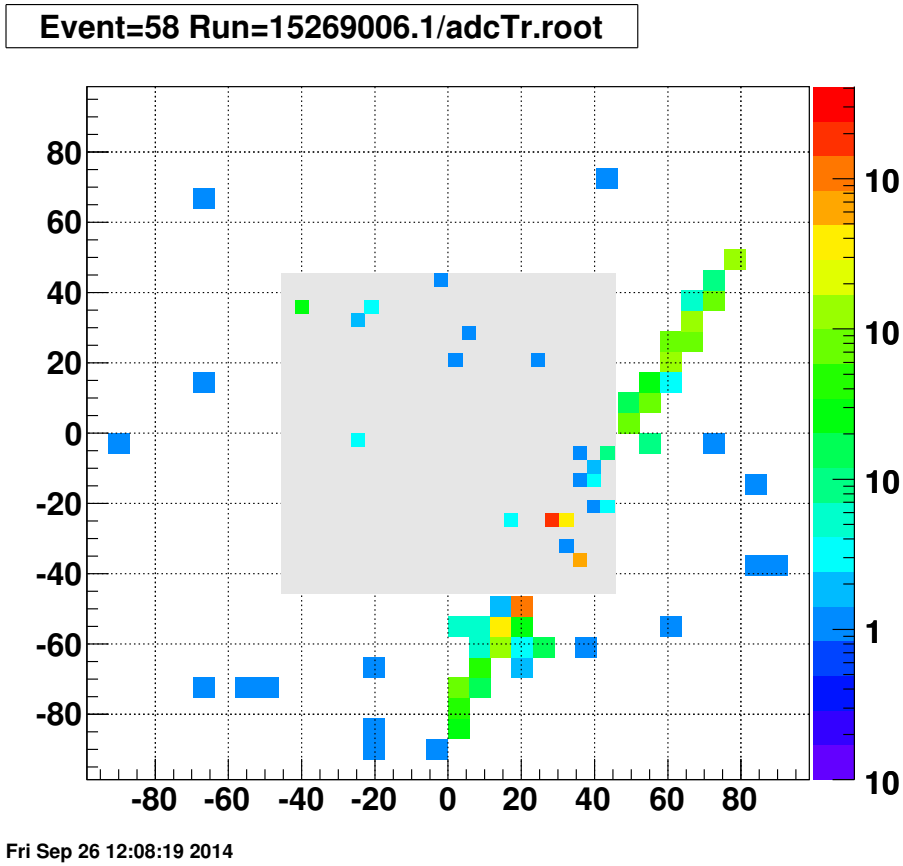


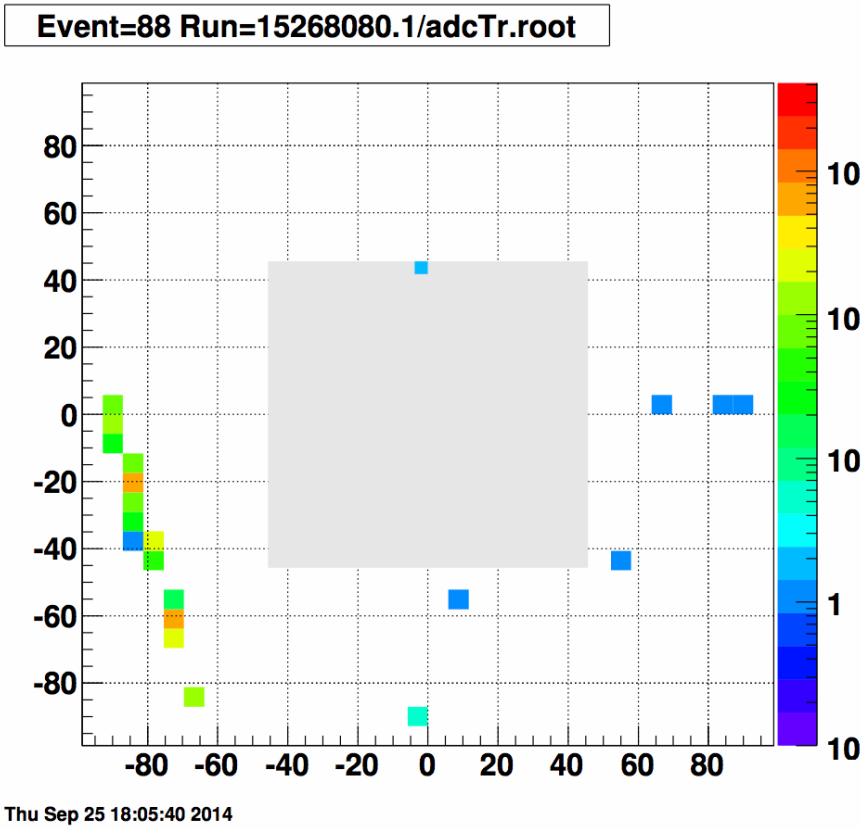
Reproducing the same shielding to make it light tight

2-3 layers of Mu metal

Courtesy of Grant Webb

Cosmic Rays Observed





Courtesy of Grant Webb

Summary (FMS)

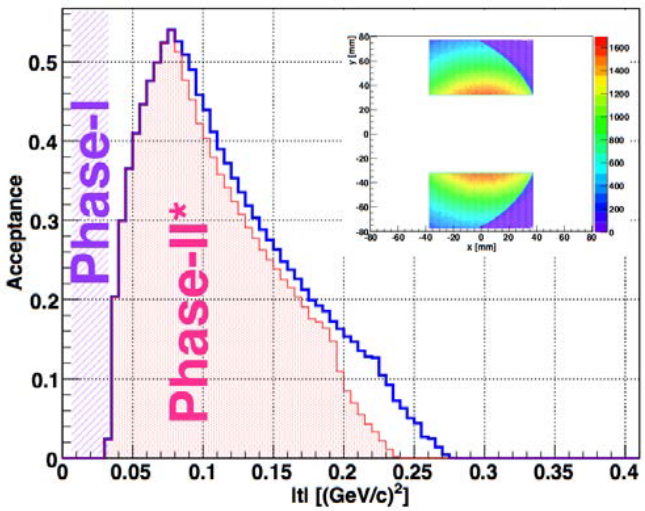
- A huge amount of progress has been made over the past few months
- Many Thanks to
  - Ivan Estaban Munoz
  - Dimitry Kalinkin
  - Samuel Heppelmann
  - Grant Webb
  - Mriganka Moulim Mondal
  - Stephen Trentalange
  - Elke Aschenauer
  - Stephen Heppelman
  - PSU graduate students
- Small Cell HV
- The North Side still needs to be fully stacked
- Large cell PMT installation

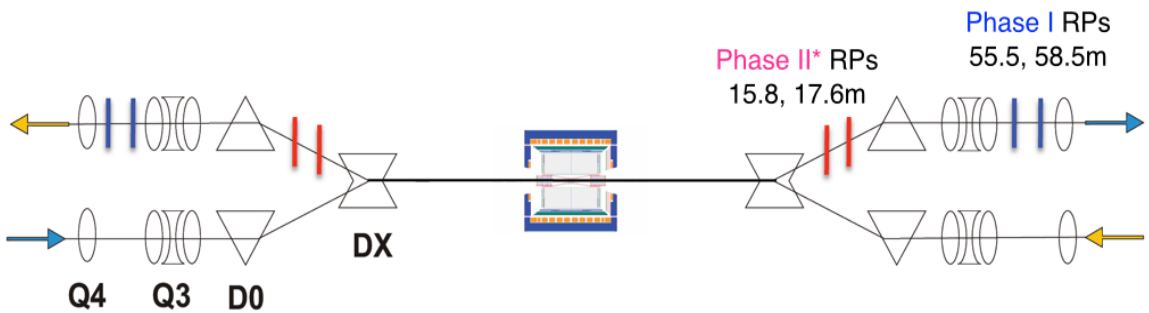
Polishing the PMT with attached CDF bases

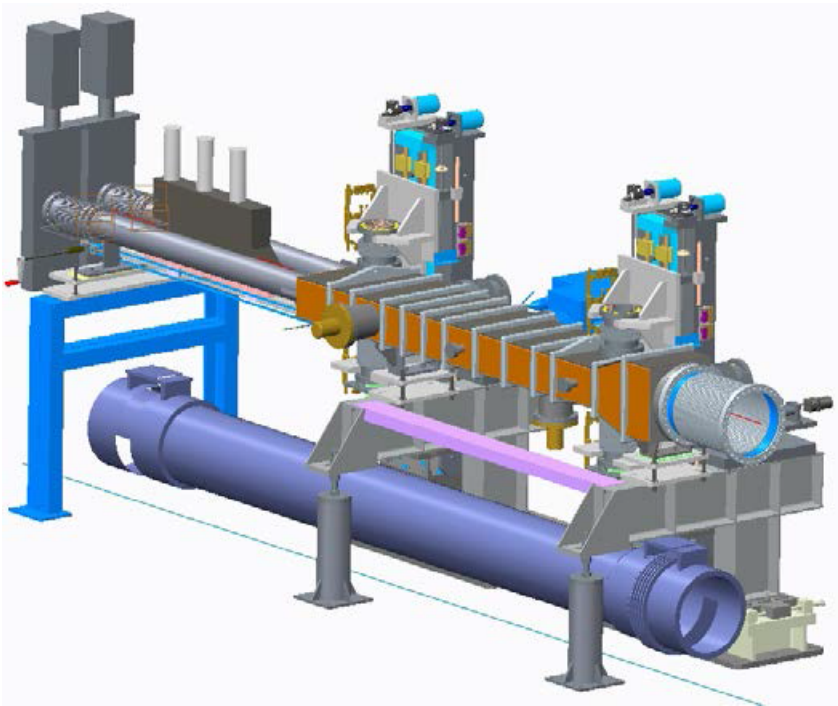
Courtesy of Grant Webb

ROMAN POT PHASE II* (RUN15)

Pp2pp slides courtesy of Wlodek Guryn via Robert Pak in UIC talk



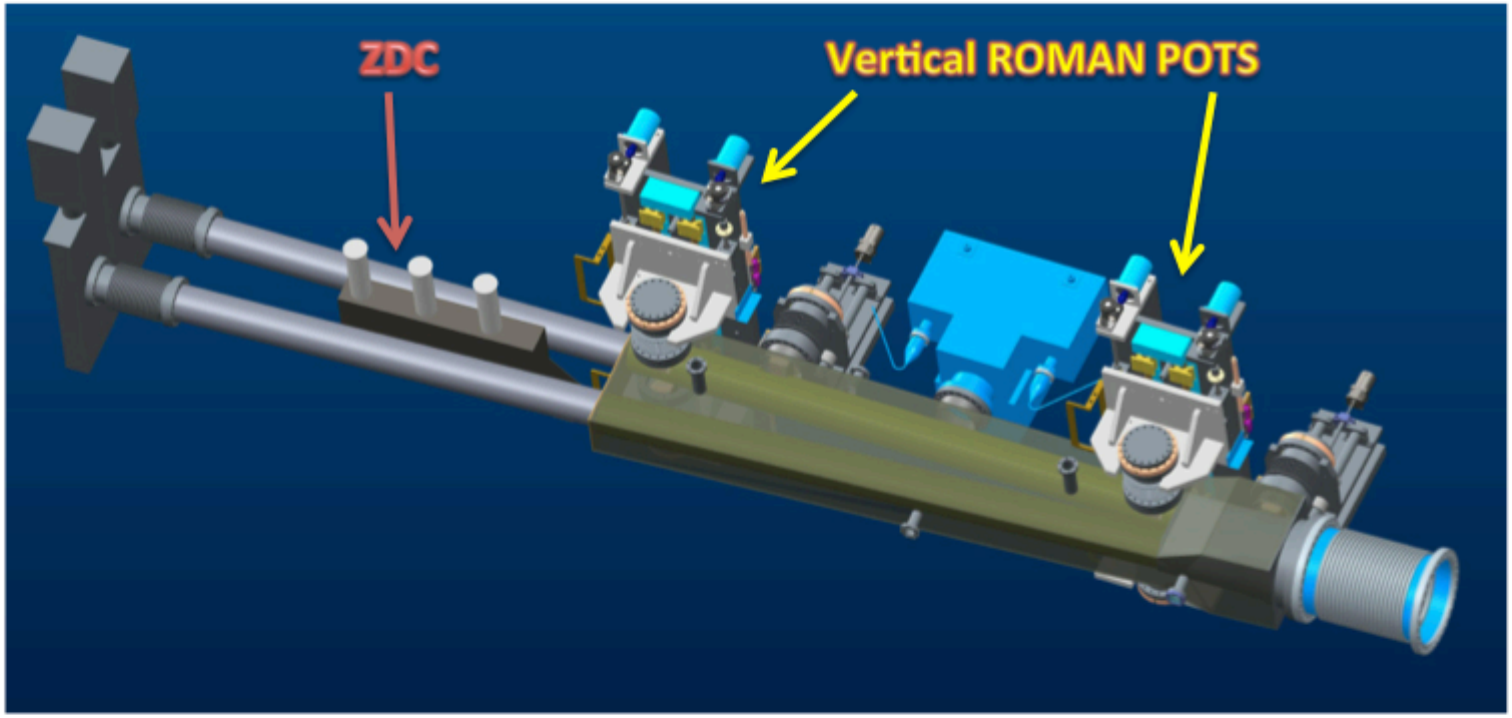




- Will allow taking data without special accelerator conditions,
- Requires new vacuum chamber in DX-D0 region
- Uses Roman Pot system and detectors of pp2pp
- A_N for diffractive processes
- Exotic states

Design accommodates horizontal RPs to allow spectator proton tagging for future p⇧D and p⇧He^3 collisions.

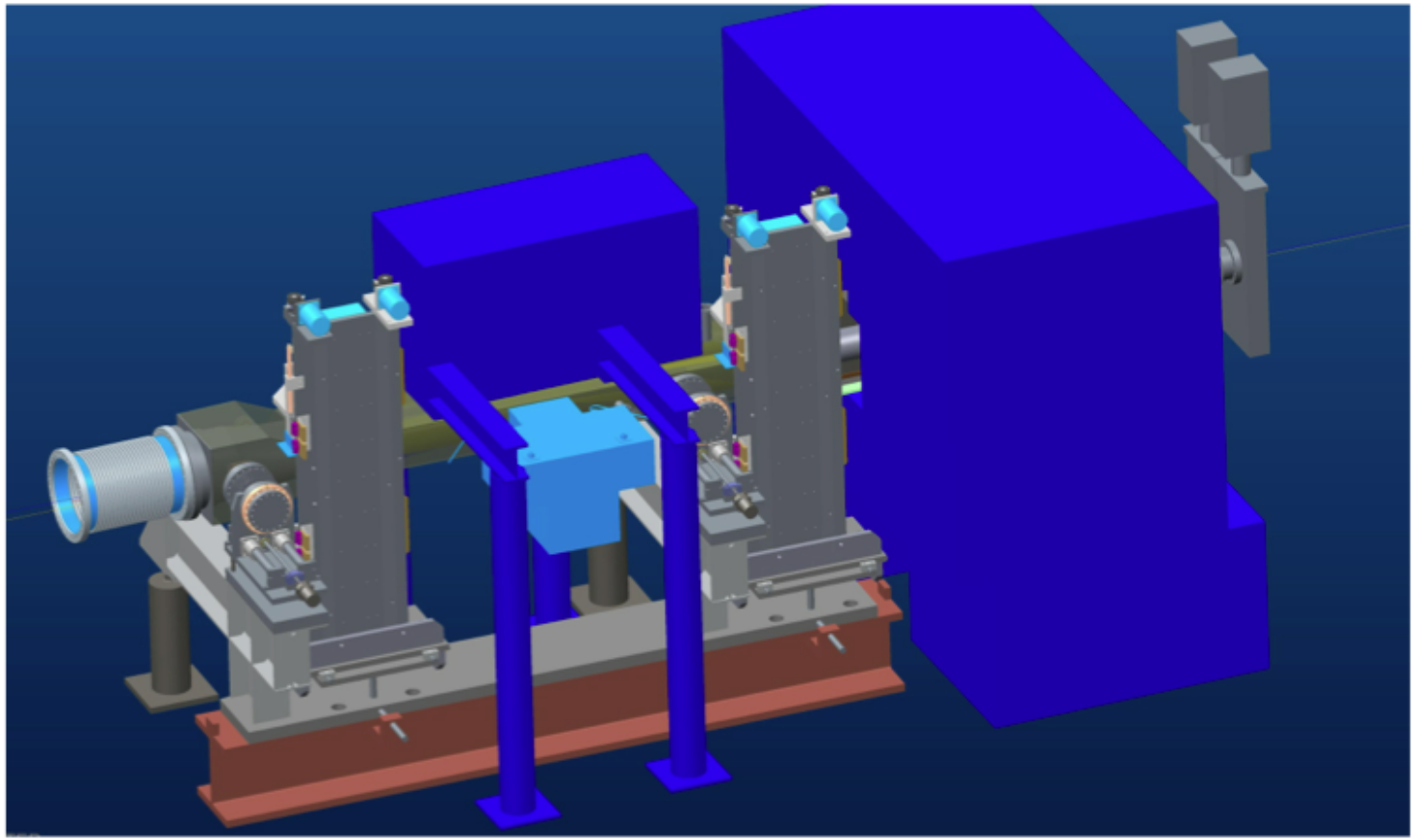
Roman Pot in DX-D0 Region



The Roman Pots of STAR are located on the outgoing beam 5 o'clock and 6 o'clock
Two vertical station allow approach of the beam from above and below
to about 15 - 20 mm from the beam axis

Roman Pot in DX-D0 Region with shielding

To STAR



Note change of shielding configuration

Courtesy of Wlodek Guryn

First DX-D0 chamber is ready for installation

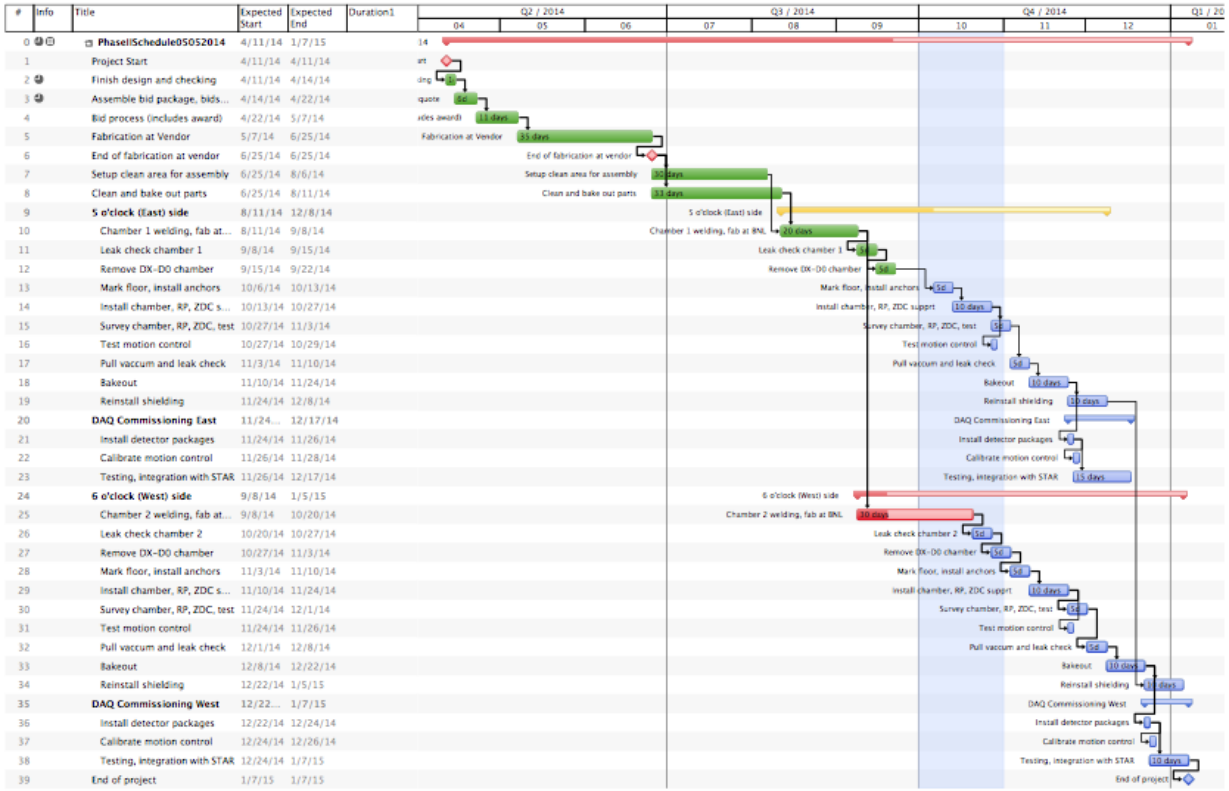
The new vacuum chambers are now installed on both sides of STAR

Courtesy of Wlodek Guryn

Summary for pp2pp

Schedule of Phase II*

10/02/2014



#	Info	Title	Expected Start	Expected End	Duration1
0		PhaseIISchedule05052014	4/11/14	1/7/15	
1		Project Start	4/11/14	4/11/14	
2		Finish design and checking	4/11/14	4/14/14	
3		Assemble bid package, bids...	4/14/14	4/22/14	
4		Bid process (includes award)	4/22/14	5/7/14	
5		Fabrication at Vendor	5/7/14	6/25/14	
6		End of fabrication at vendor	6/25/14	6/25/14	
7		Setup clean area for assembly	6/25/14	8/6/14	
8		Clean and bake out parts	6/25/14	8/11/14	
9		5 o'clock (East) side	8/11/14	12/8/14	
10		Chamber 1 welding, fab at...	8/11/14	9/8/14	
11		Leak check chamber 1	9/8/14	9/15/14	
12		Remove DX-D0 chamber	9/15/14	9/22/14	
13		Mark floor, install anchors	10/6/14	10/13/14	
14		Install chamber, RP, ZDC s...	10/13/14	10/27/14	
15		Survey chamber, RP, ZDC, test	10/27/14	11/3/14	
16		Test motion control	10/27/14	10/29/14	
17		Pull vaccum and leak check	11/3/14	11/10/14	
18		Bakeout	11/10/14	11/24/14	
19		Reinstall shielding	11/24/14	12/8/14	
20		DAQ Commissioning East	11/24...	12/17/14	
21		Install detector packages	11/24/14	11/26/14	
22		Calibrate motion control	11/26/14	11/28/14	
23		Testing, integration with STAR	11/26/14	12/17/14	
24		6 o'clock (West) side	9/8/14	1/5/15	
25		Chamber 2 welding, fab at...	9/8/14	10/20/14	
26		Leak check chamber 2	10/20/14	10/27/14	
27		Remove DX-D0 chamber	10/27/14	11/3/14	
28		Mark floor, install anchors	11/3/14	11/10/14	
29		Install chamber, RP, ZDC s...	11/10/14	11/24/14	
30		Survey chamber, RP, ZDC, test	11/24/14	12/1/14	
31		Test motion control	11/24/14	11/26/14	
32		Pull vaccum and leak check	12/1/14	12/8/14	
33		Bakeout	12/8/14	12/22/14	
34		Reinstall shielding	12/22/14	1/5/15	
35		DAQ Commissioning West	12/22...	1/7/15	
36		Install detector packages	12/22/14	12/24/14	
37		Calibrate motion control	12/24/14	12/26/14	
38		Testing, integration with STAR	12/24/14	1/7/15	
39		End of project	1/7/15	1/7/15	

Progress on the pp2pp effort has been very good since this last schedule update above (Oct. 2nd). Looks to be on a path where it will be ready for the start of the RHIC cool down.

Courtesy of Wlodek Guryn

November

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

East D0/DX chamber, RP, Bakeout

West D0/DX chamber, RP pull vacuum and leak check

Reinstall, pump down, & survey West beam pipe. Prep. For bake out

Reinstall East Shielding

West D0/DX chamber, RP, Bakeout

Bake out pipe and remove bake out blankets and equipment

Reinstall East Shielding

West D0/DX chamber, RP, Bakeout

FMSps cabling (includes rack)

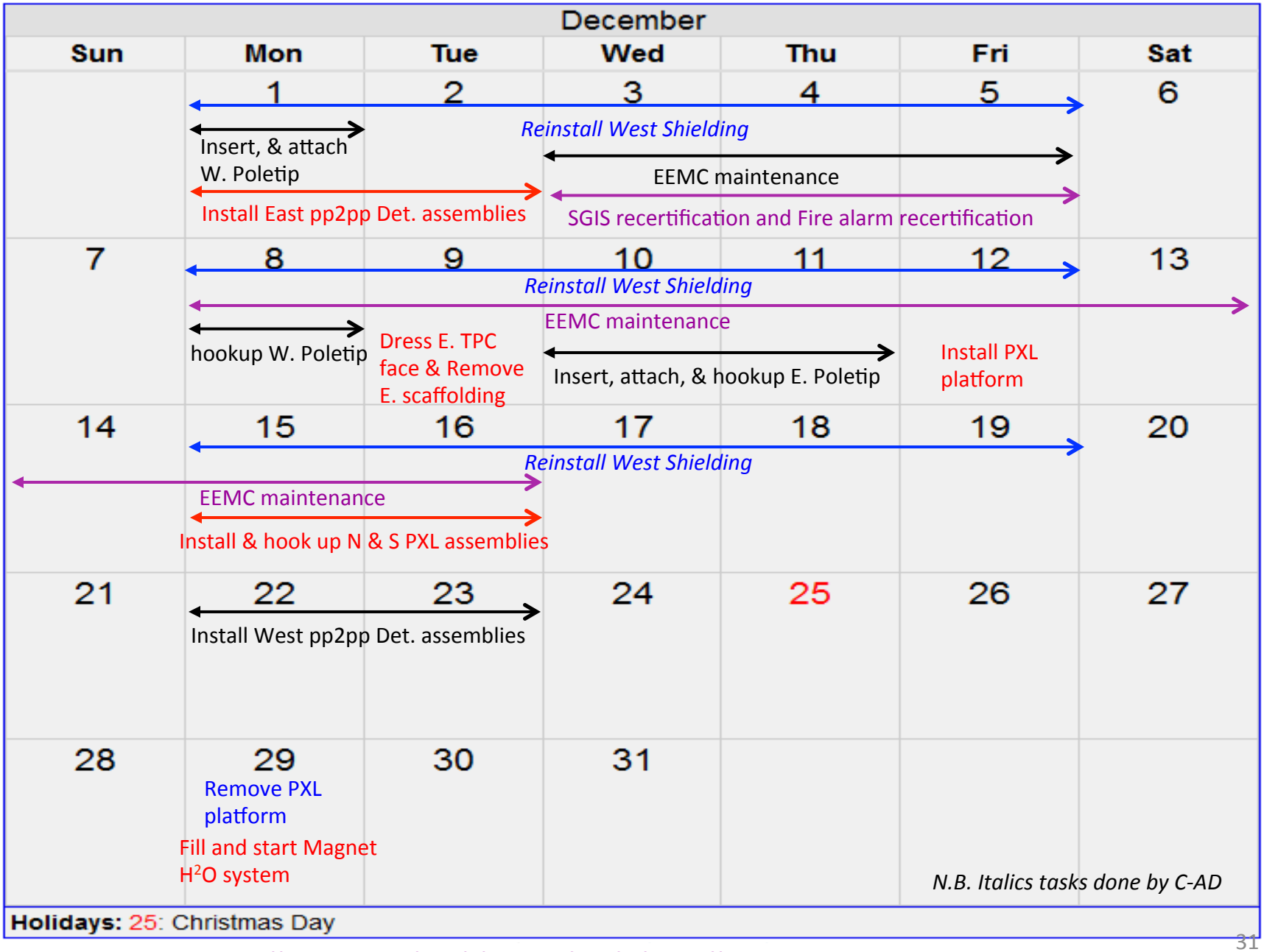
Remove and replace TPC FEEs and RDOs as necessary

Dress W. TPC face &
Remove W. scaffolding

Reinstall East Shielding

N.B. Italics tasks done by C-AD

Holidays: 11: Veterans Day, 27: Thanksgiving Day



FMSps Installation and cabling schedule still TBD

January						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2 Start Magnet checkout	3
4	5	6	7	8	9	10
	Magnet checkout & Heat run, TPC HV check			Install & light check BBCs		
11	12	13 Start 2 person STAR Shifts	14	15 STAR ready for Cosmic Ray testing	16	17
18	19	20 **RHIC Cool down begins**	21	22	23	24
25	26	27	28	29	30	31

Holidays: 1: New Year's Day, 19: Martin Luther King Day

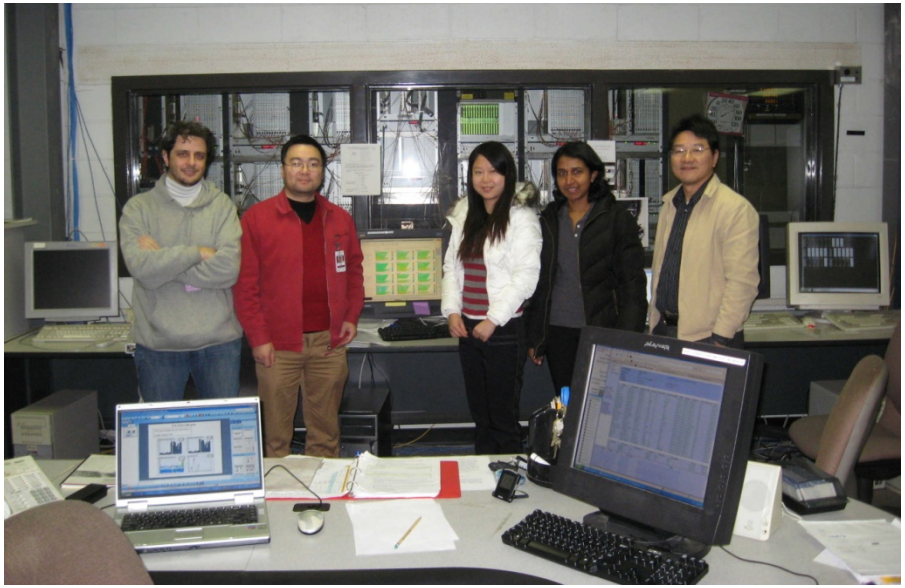
Current Schedule for STAR Shifts

- RHIC Cool Down starts Tuesday January 20th
- Plan for Run 15 is 22 Cryo weeks

STAR Shift Plan:

- 2 person shifts start on Tuesday, January 13, 2015.
- Introduce P-10 into TPC, start adding Isobutane to TOF and MTD
  - Check out systems and take cosmic ray data until beam operation begin (~ Jan. 24th or so)

- Start full 4 person shifts on Tuesday February 3rd.
- Shifts continue until Tuesday June 23rd.



STAR Data set goals and priorities for RHIC Run 15

As has become the norm, we (STAR) are looking to accumulate data sets for multiple physics programs this year.

- HFT pp comparison data set
- Longitudinal pp gluon polarization data set
- MTD Upsilon, J/Psi, and e-muon data sets
- Transverse pp forward single spin asymmetry data sets
- Transverse pAu mid rapidity data sets
- Transverse pAu forward single spin asymmetry data sets

- The Trigger Board will start meeting soon (next week?) and work to understand/ quantify all of the various data set needs (#'s of evts or int. lumi.), convert these needs to bandwidth needs, and work out the optimal balance.
- With the shortened pp running this will likely be a challenge.

Summary

- The bulk of the annual sub system maintenance has been completed. Still to come is the EEMC maintenance effort in early December.
- FMS pre shower effort is getting tighter due to delay in delivery of scintillators. Once we get delivery and fabricate first quadrant we'll know where we stand.
- FMS refurbishment has gone very well. System testing is in progress.
- Pp2pp installation is progressing well. At this point appears to be well on track to be ready for RHIC cool down and physics run.

- Plan is to start 2 person shifts on January 13th, "ring out" the STAR system, and accumulate a large cosmic ray data set prior to the start of beam operations.
- RHIC cool down scheduled to start on January 20th.
- The 22 Cryo week RHIC run 15 should end on June 23rd.