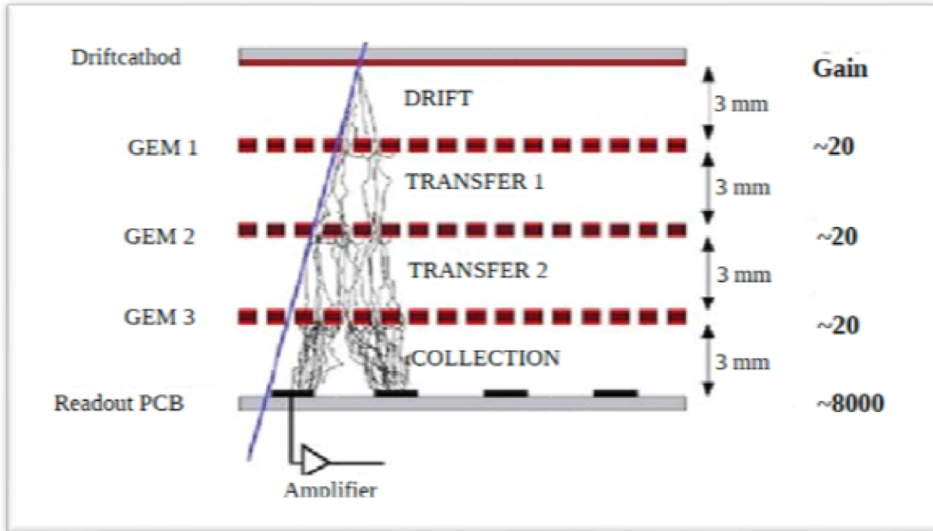


GEM System for upcoming SBS experiments

Holly Szumila-Vance
On behalf of the SBS GEM group
SBS Collaboration Meeting
17 July 2023

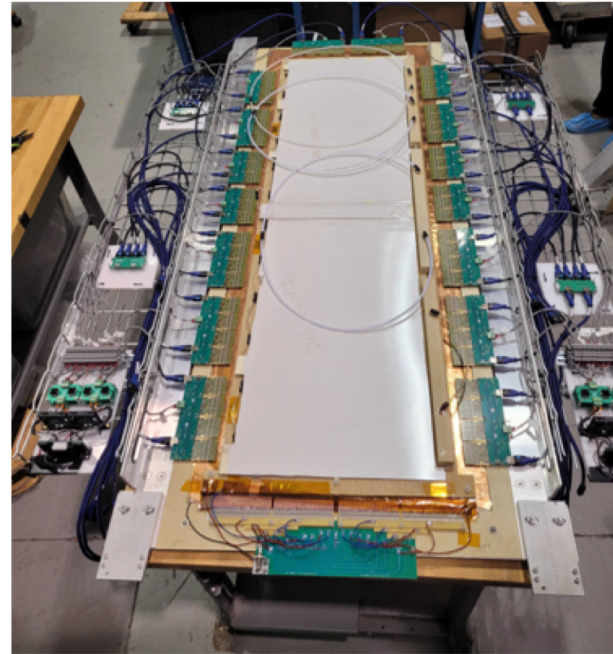
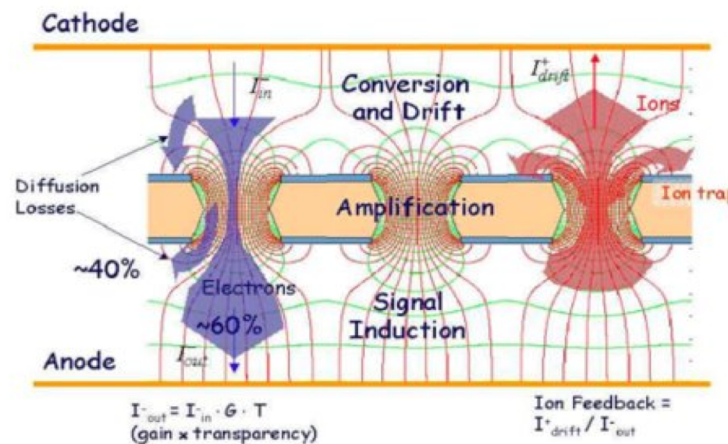
GEMs in our experiments

High rate environment
Large area coverage
Precise tracking



F. Sauli, NIM A386(1997)531

Triple foil GEM
increase gain and
reduce probability of
discharge



UV (shown)
Similar to XW
40 x 150 sq.cm
Single module



XY (shown)
60 x 200 sq.cm
4 modules

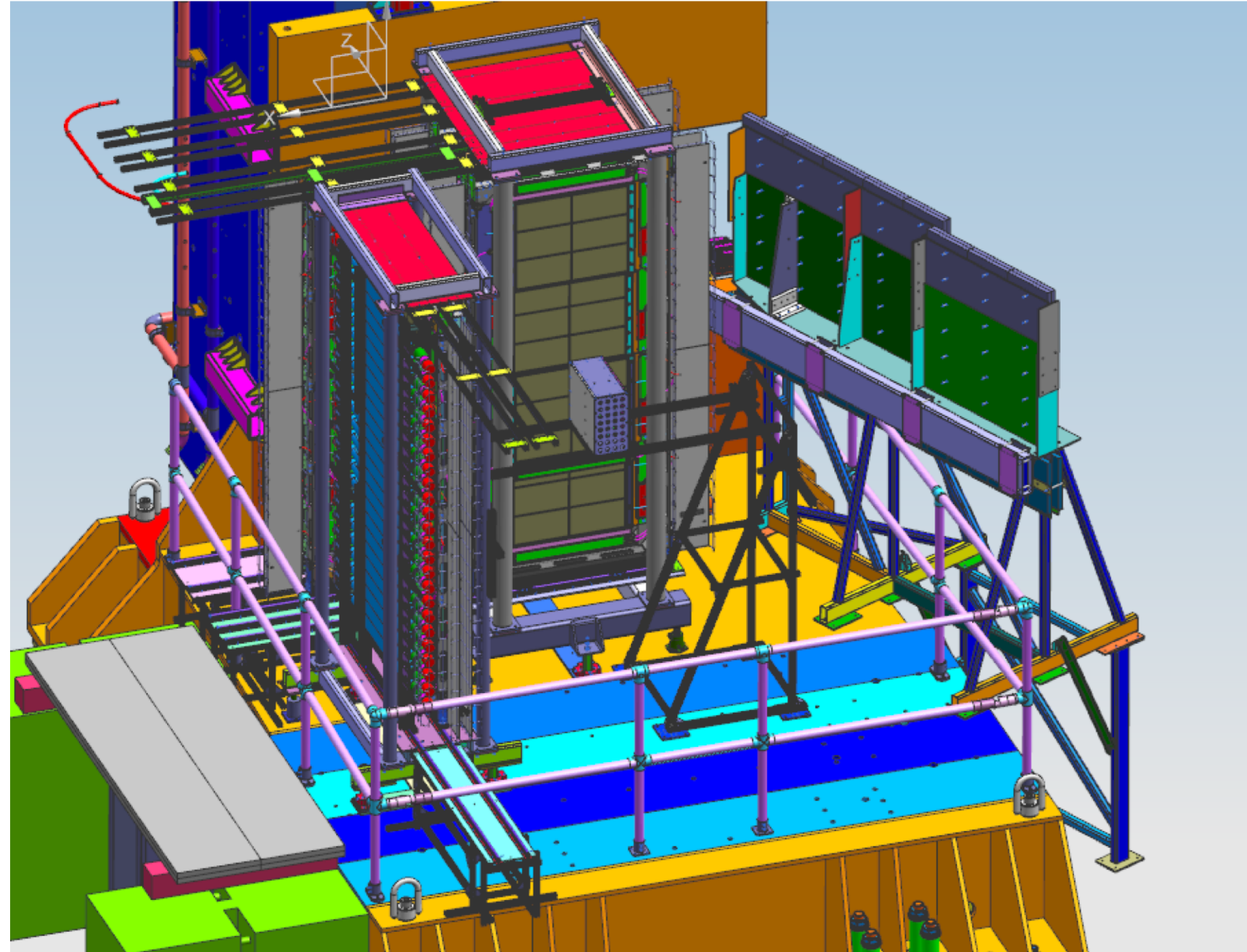
GEM setup for GEn-RP

BigBite:

- 4 UV layers, single module each
- 1 XY layer, 4 modules

SBS:

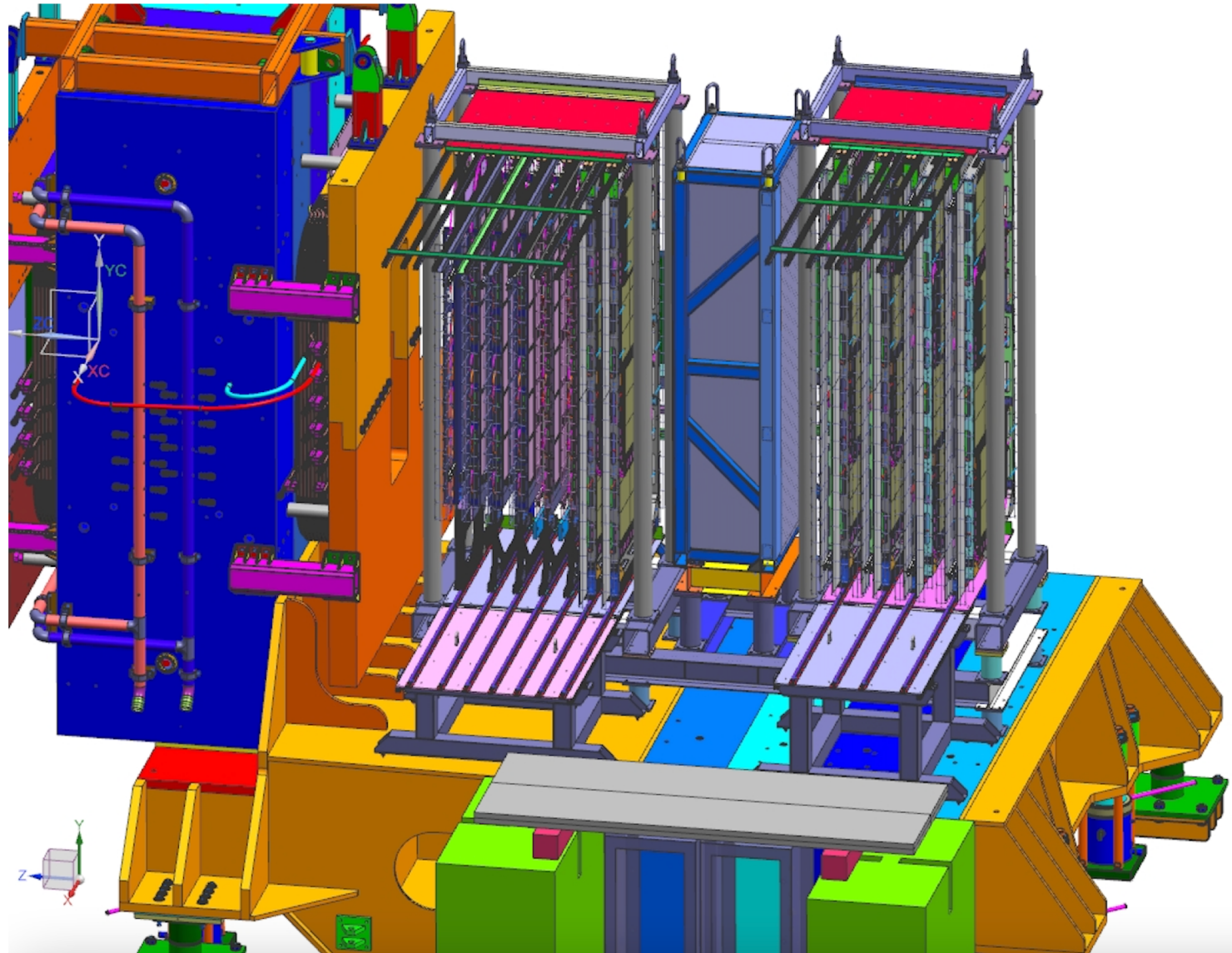
- 8 inline layers
 - 2 XW, single module each
 - 6 XY, 4 modules each
- 2RP layers (XY), 4 modules each



GEM setup for GEp

SBS:

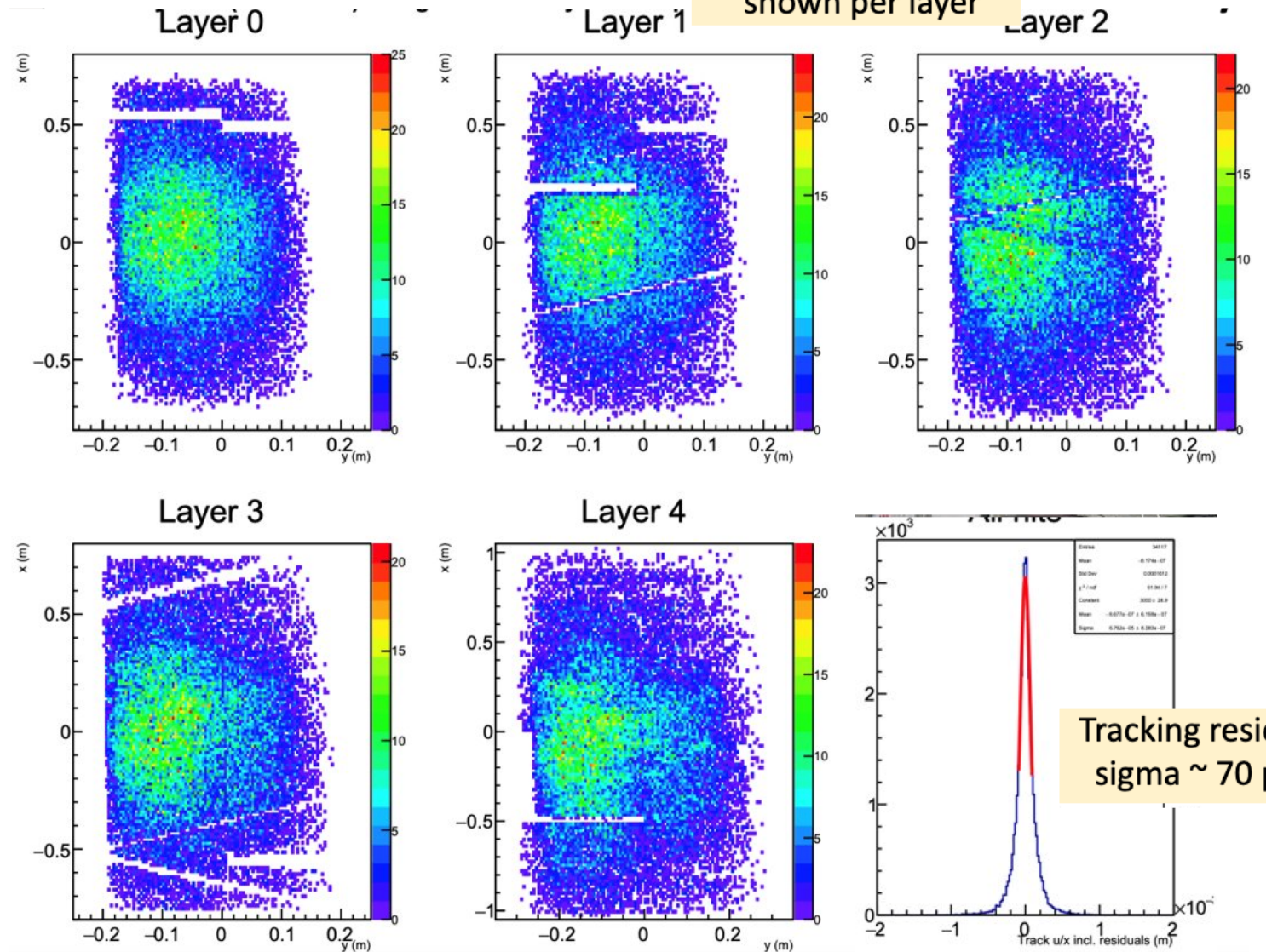
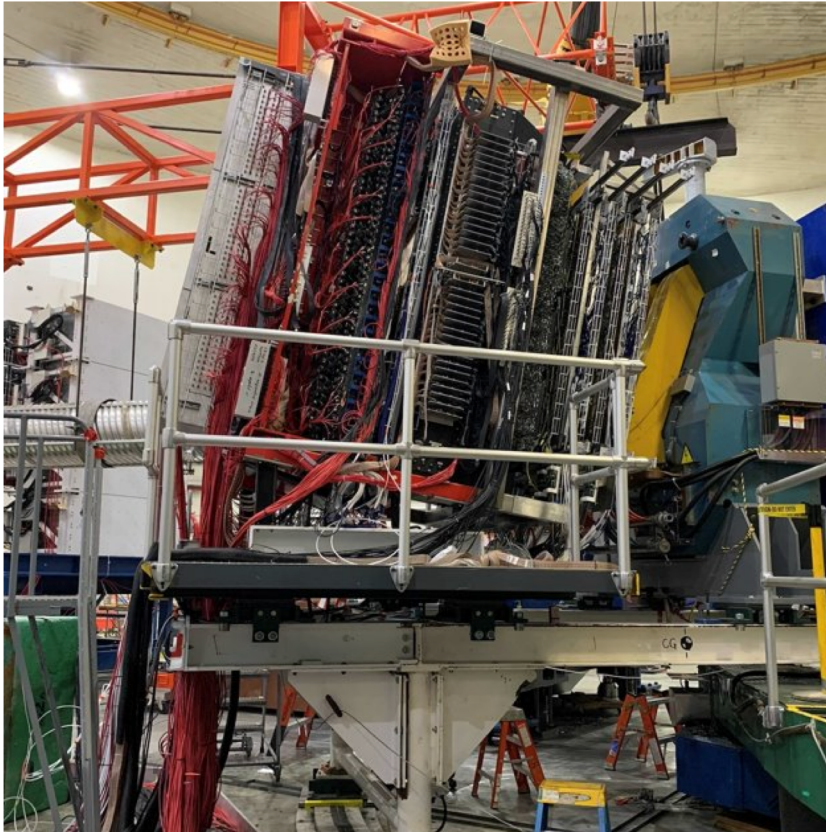
- 8 front tracker layers
 - 2 XW, single module
 - 4 UV, single module
 - 2 XY, 4 modules each
- 8 rear tracker layers
 - All XY, 4 modules each



Current status of the GEMs

BigBite:

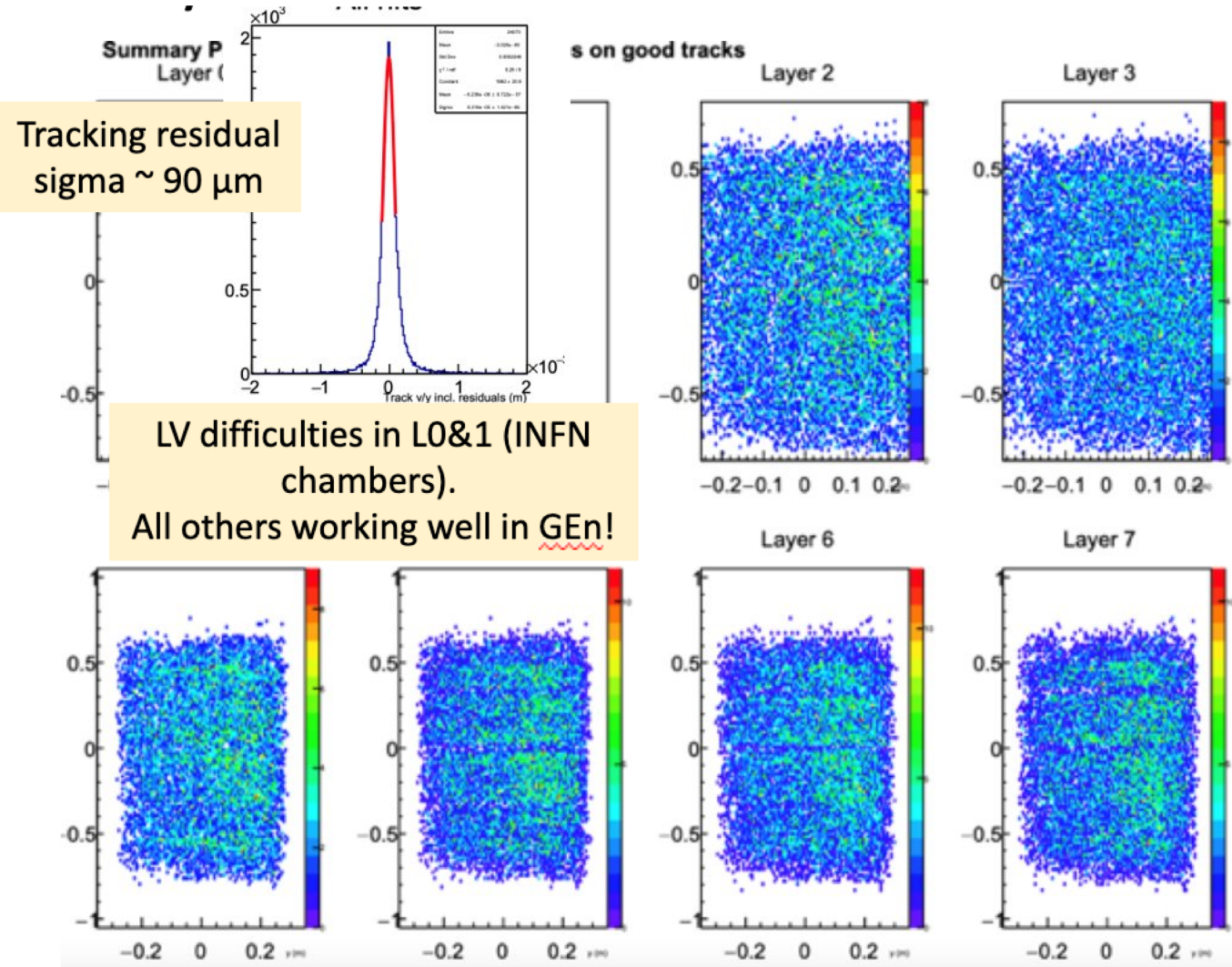
- Taking data since 2021
- Various HV distribution studies
- Requires some HV distribution upgrades prior to GEn-RP



Current status of the GEMs

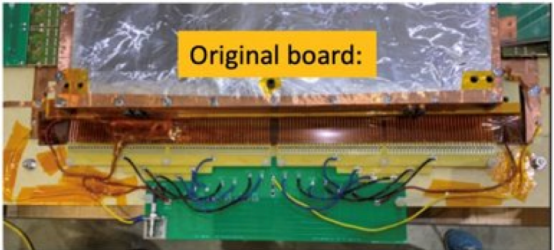
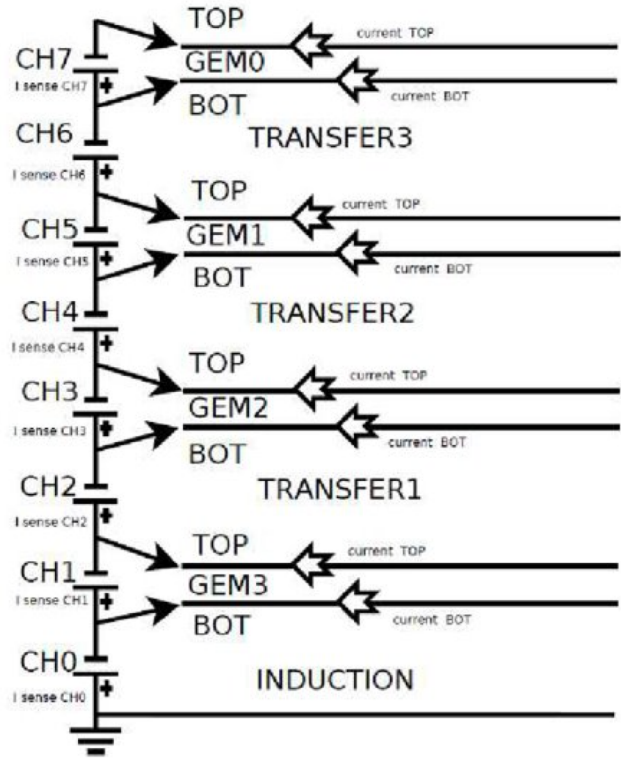
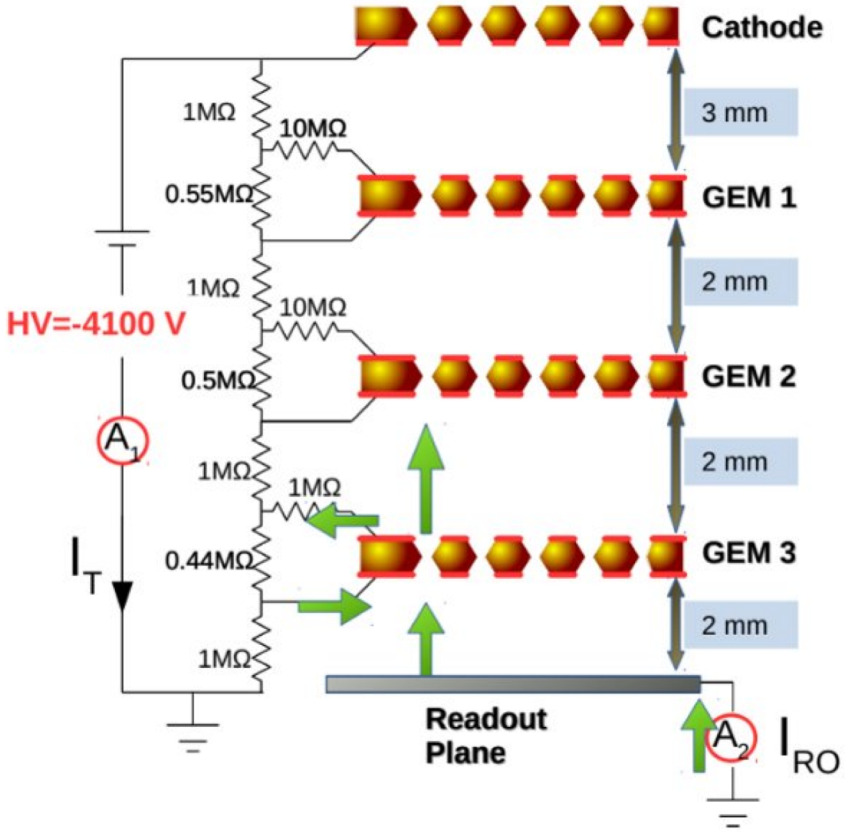
SBS:

- Taking some data during GEN
- XY GEM LV is nuisance, will be improved (post-GEN)
- 1st 2 INFN layers will be replaced by new XW layers for GEN-RP
- All layers running original HV divider

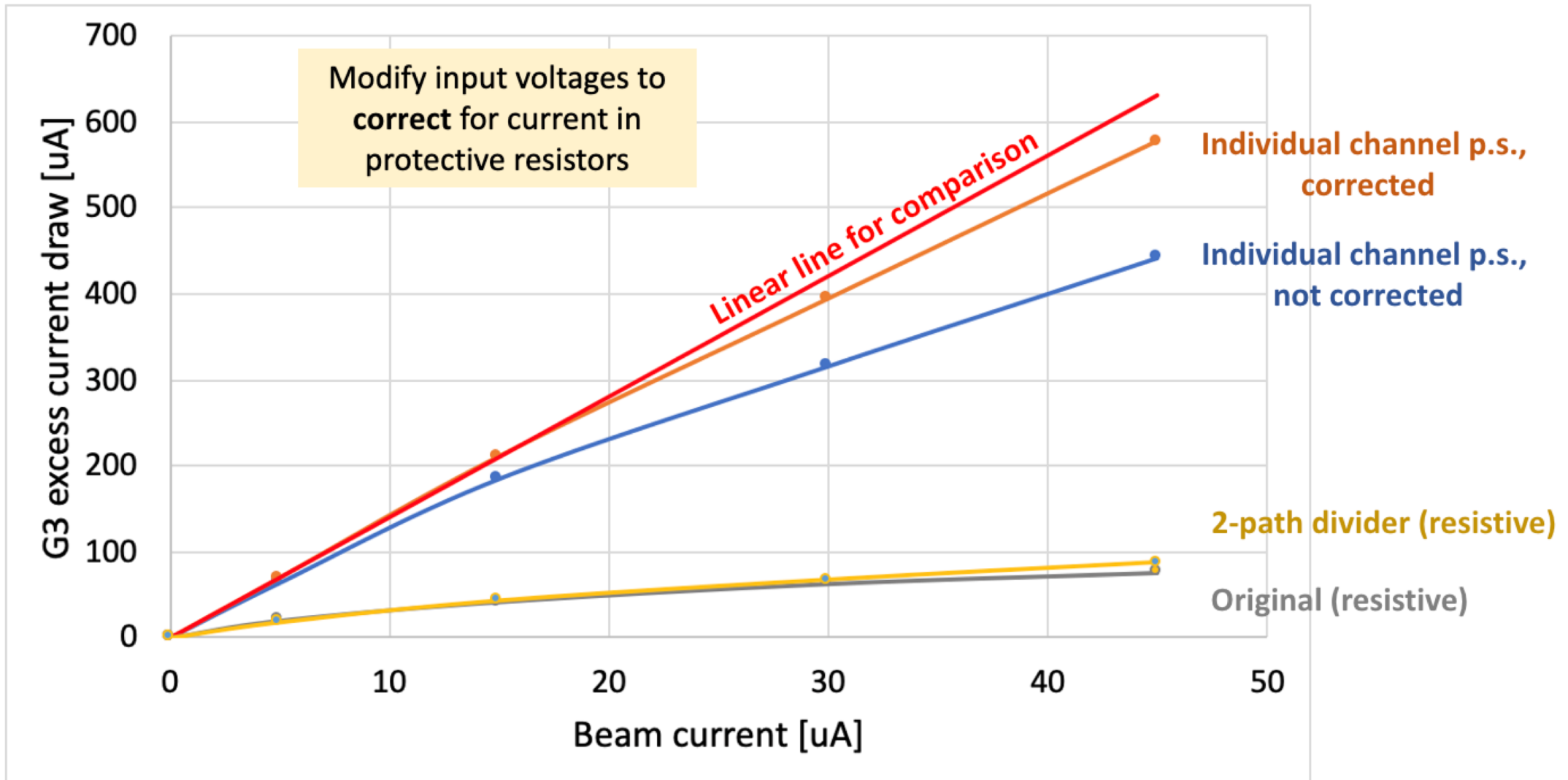


HV upgrades

Current equivalent to Hit rate x Gain x primary electrons x electron charge



Luminosity scan with different HV configurations during GEn (optics target)



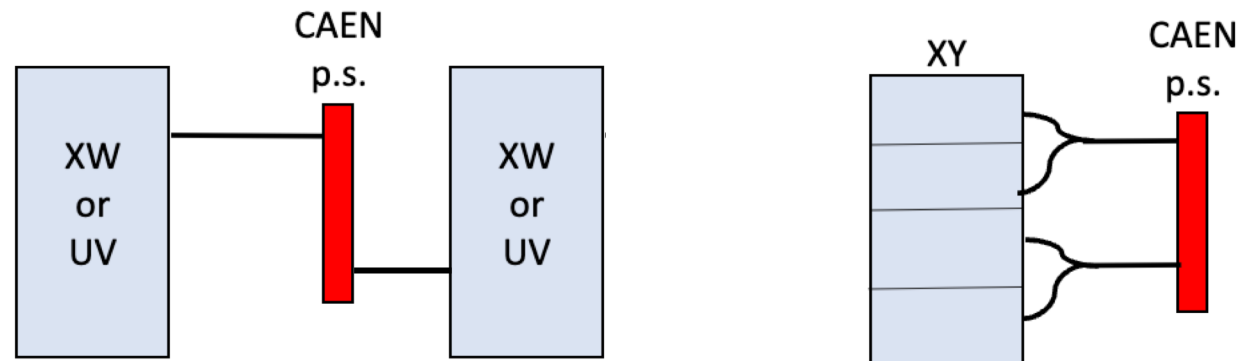
Install individual channel HV supply on every GEM

CAEN A1515BTG designed for triple GEMs:

- 2 channels with 7 outputs each
- 1 mA max per output, HP versions have 3 mA max per output
- Floating ground
- Can trip together
- 6 HV modules (of either type) in SY5527 mainframe



Configurations per GEM type:



HV tracker

	GEp config					
	GEM Layer	RO Type	Modification	HV module	HV mod status	CAEN crate
Front Tracker	Layer 0	XW	Parallel Supply	A1515BTGHP-3mA	purchased-JLab	CNU, on hand
	Layer 1	XW	Parallel Supply			
	Layer 2	UV	Parallel Supply	A1515BTGHP-3mA	purchased-INFN	
	Layer 3	UV	Parallel Supply			
	Layer 4	UV	Parallel Supply	A1515BTGHP-3mA	purchased-INFN	
	Layer 5	UV	Parallel Supply			
	Layer 6	XY	Parallel Supply	A1515BTGHP-3mA	purchased-JLab	
	Layer 7	XY	Parallel Supply	2xA1515BTG	on hand-JLab	
Back Tracker	Layer 8	XY	Parallel Supply	A1515BTG	on hand-JLab	Glasgow-will order
	Layer 9	XY	Parallel Supply	A1515BTG	on hand-JLab	
	Layer 10	XY	Parallel Supply	A1515BTG	on hand-JLab	
	Layer 11	XY	Parallel Supply	A1515BTG	purchased-JLab	
	Layer 12	XY	Parallel Supply	A1515BTG	on hand-UVa	
	Layer 13	XY	Parallel Supply	A1515BTG	on hand-INFN	
	Layer 14	XY	Parallel Supply	A1515BTG	on hand-INFN	Glasgow-will order
	Layer 15	XY	Parallel Supply	A1515BTG	on hand-INFN	
(not in GEp)	Layer 16	XY	Parallel Supply			

Other components:

MPDs	Needed	Total
Hall A (currently), GEn	50 in SBS, 24 in BB	74
GEn-RP	+14 in RP arm (+ 6? new XW)	88 (94?)
GEp	+7	95 (101?)

We have 105 (sufficient) for SBS experiments

APVs	On hand	Needed
Spares	3	
New XW layers		112 (2 x 56)
Borrowed from LAD		14
Spare XY layer	88	
Borrowed from DarkLight		26

APV accounting is tricky since we use a lot of borrowed APVs from other setups and Moller.

With new GEn-RP configuration, burden is reduced to 61.

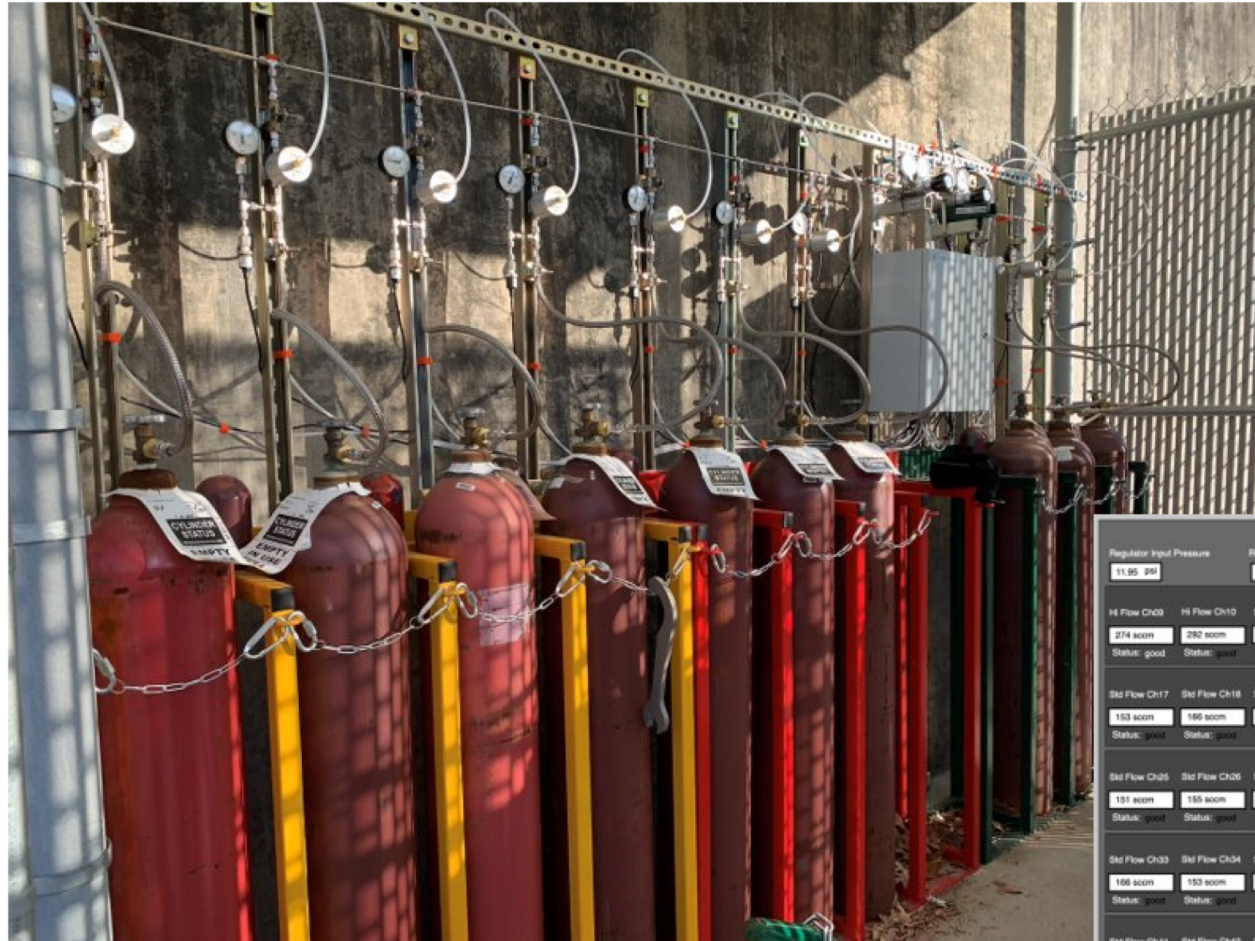
Order with EES is being established.

Misc	Needed	On hand
A996 connectors	14	6 ordered (INFN), 6 on site
HV patches and cables		

Still need to order 2 x A996 connectors.

HV cables/patch schema TBD soon.

GEM gas system



Biggest gas challenge is coordinating deliveries from vendor with randomly/constantly changing lead times

Hall A SBS GEM Flow Readout								Software Heartbeat: ●
Regulator Input Pressure		Regulator Output Pressure		Argon % of mix				
11.95 psf		7.78 psf		108.31%				
H Flow Ch09	H Flow Ch10	Std Flow Ch11	Std Flow Ch12	Std Flow Ch13	Std Flow Ch14	Std Flow Ch15	Std Flow Ch16	
274 sccm	292 sccm	162 sccm	135 sccm	162 sccm	159 sccm	163 sccm	161 sccm	
Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	
Std Flow Ch17	Std Flow Ch18	Std Flow Ch19	Std Flow Ch20	Std Flow Ch21	Std Flow Ch22	Std Flow Ch23	Std Flow Ch24	
153 sccm	186 sccm	154 sccm	135 sccm	149 sccm	161 sccm	148 sccm	152 sccm	
Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	
Std Flow Ch25	Std Flow Ch26	Std Flow Ch27	Std Flow Ch28	Std Flow Ch29	Std Flow Ch30	Std Flow Ch31	Std Flow Ch32	
151 sccm	155 sccm	163 sccm	184 sccm	145 sccm	167 sccm	162 sccm	151 sccm	
Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	
Std Flow Ch33	Std Flow Ch34	Std Flow Ch35	Std Flow Ch36	Std Flow Ch37	Std Flow Ch38	Std Flow Ch39	Std Flow Ch40	
166 sccm	133 sccm	0 sccm	0 sccm	0 sccm	0 sccm	0 sccm	0 sccm	
Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	
Std Flow Ch41	Std Flow Ch42	Std Flow Ch43	Std Flow Ch44	Std Flow Ch45	Std Flow Ch46	Std Flow Ch47	Std Flow Ch48	
0 sccm	1 sccm	0 sccm	3 sccm	0 sccm	0 sccm	0 sccm	2 sccm	
Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	
Std Flow Ch49	Std Flow Ch50	Spare Ch1	Spare Ch2	Spare Ch3	Spare Ch4	Spare Ch5	Spare Ch6	
0 sccm	75 sccm	1 sccm	0 sccm	0 sccm	1 sccm	0 sccm	1 sccm	
Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	Status: good	



Task/timeline for upcoming experiments

GEnIIb:

- Re-install layer 0 in BigBite
- Re-establish the low voltage supply for SBS
- Could add individual channel power supply to more UV layers, if time

GEn-RP:

- Install individual channel power supplies on remaining BB layers (XY?)
- Install individual channel power supplies on SBS inline stack (remove stack with crane and install)
- Install RP and individual channel power supplies
- Install new low voltage supply in Hall A with output to inline GEM stack
- Install new XW layers

GEp:

- Arrange GEM layers in new frames with front and back tracker on SBS side

Summary

- Detectors are commissioned and performing well
- Plan to upgrade HV input to all detectors prior to GEn-RP
- Will need to remove detectors and reconfigure prior to GEn-RP and GEp
- Details on HV distribution from crates needs determined
- LV supply upgrade will happen after GEn

