BigBite spectrometer for SBS experiments

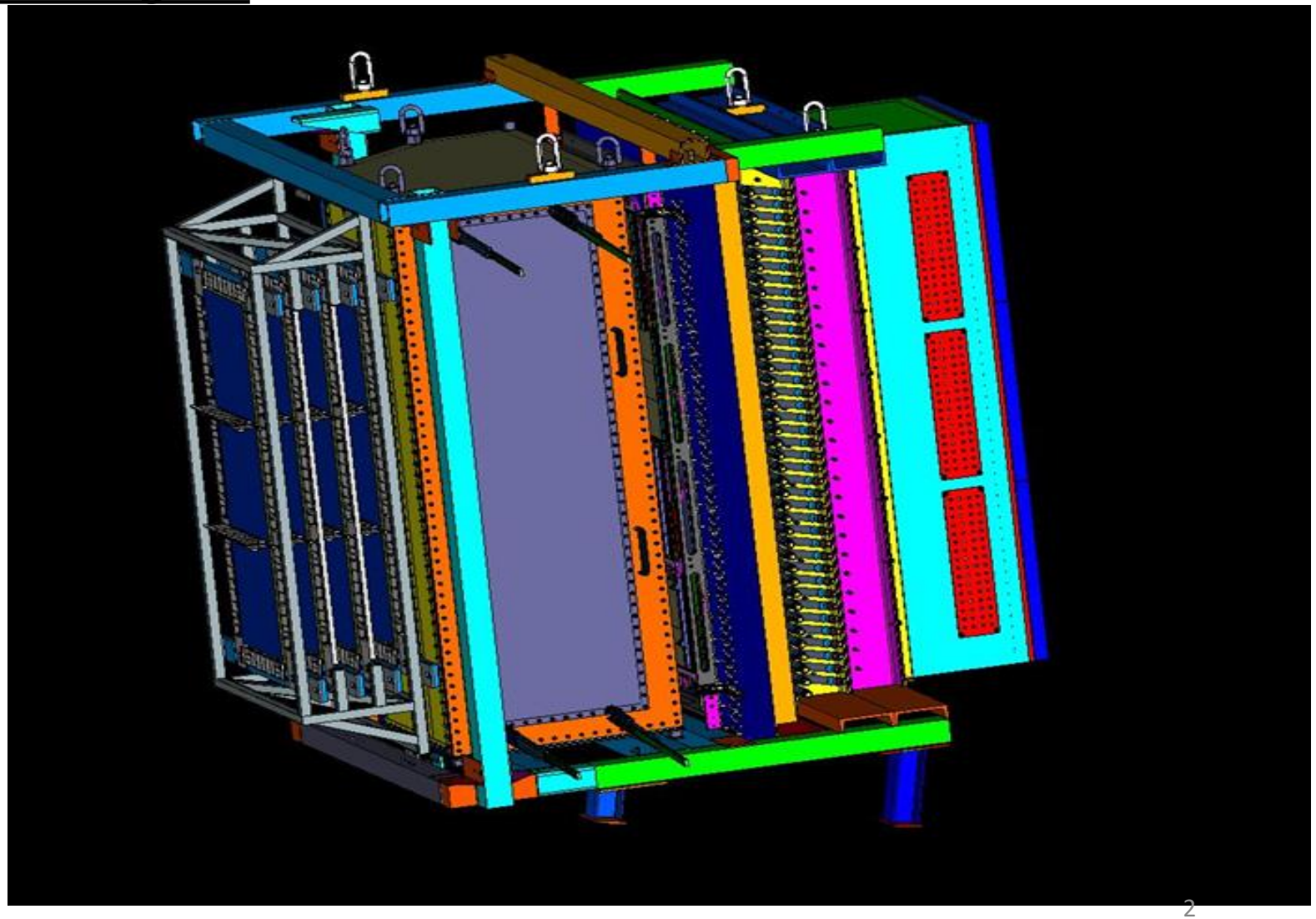
Mark Jones

Winter Hall A 2020 meeting

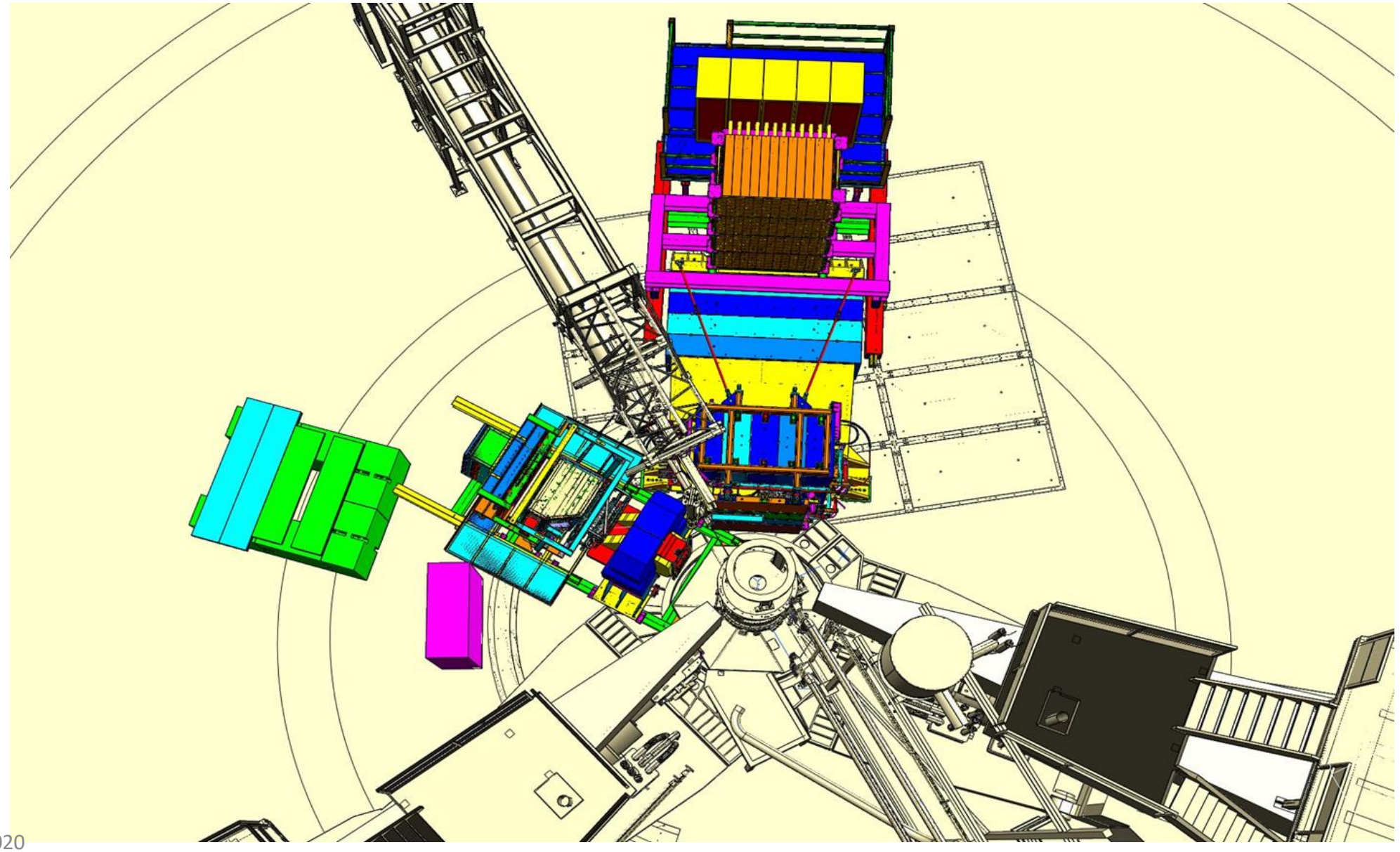
BigBite Spectrometer

Major upgrade to 6 GeV version of BigBite

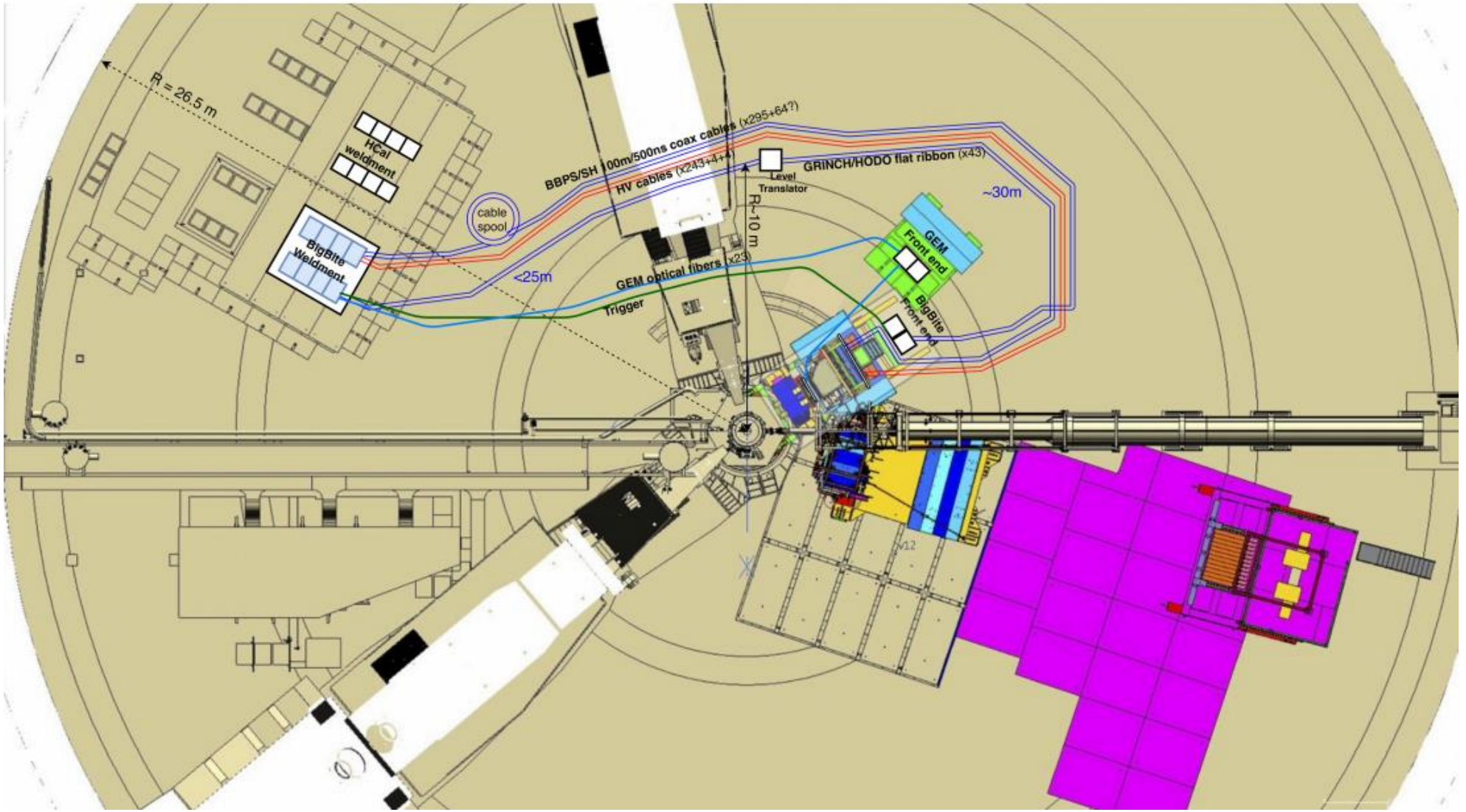
- 4 GEM chambers
  - INFN
- GRINCH Cerenkov
  - W&M
- 1 GEM chamber
  - UVa
- Preshower
- Scintillator plane
  - Glasgow
- Shower



BigBite/SBS layout for GMn experiment



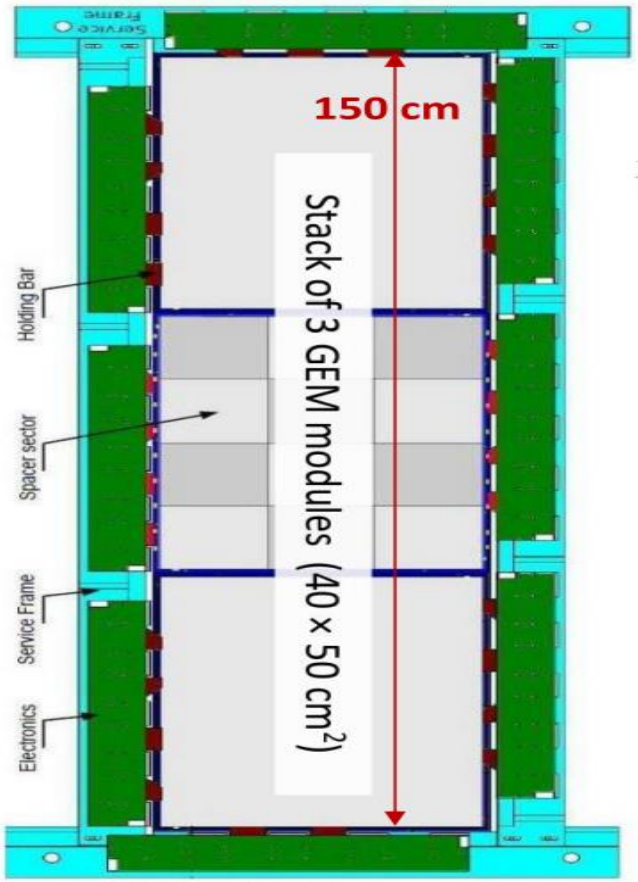
Electronics/cable layout for GMn experiment

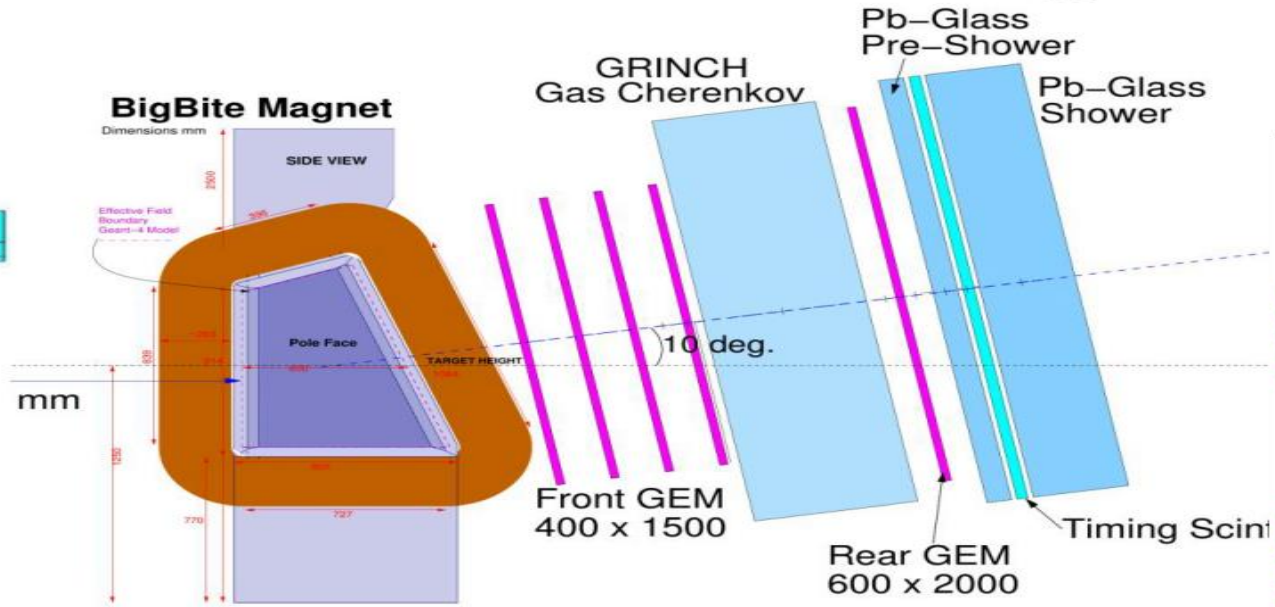


Slide from Eric Fuchey

GEMs tracker in BigBite

4 x Front-GEM

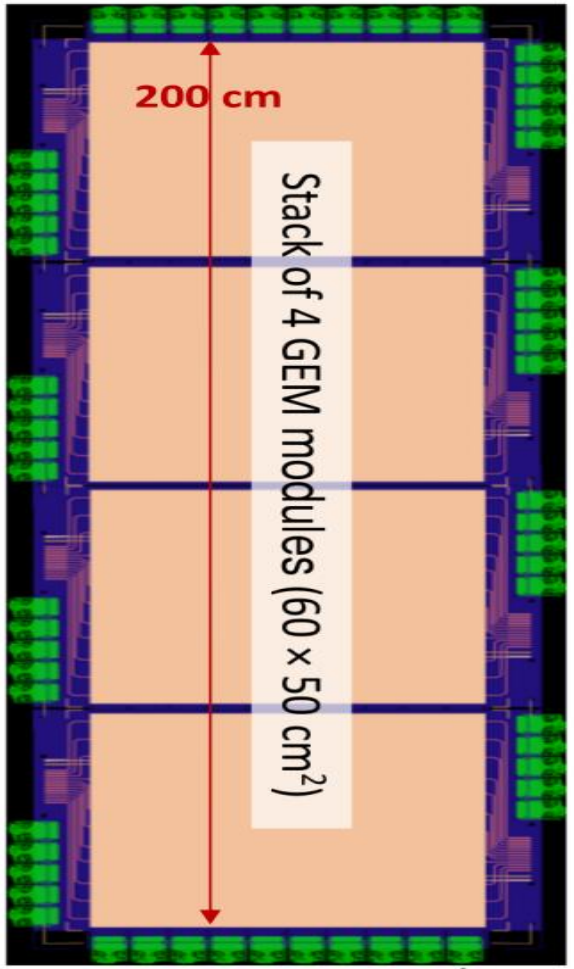




- **Similar design**
- **Almost identical electronics**
- **Same DAQ and analysis**
- **Same gas mixture**

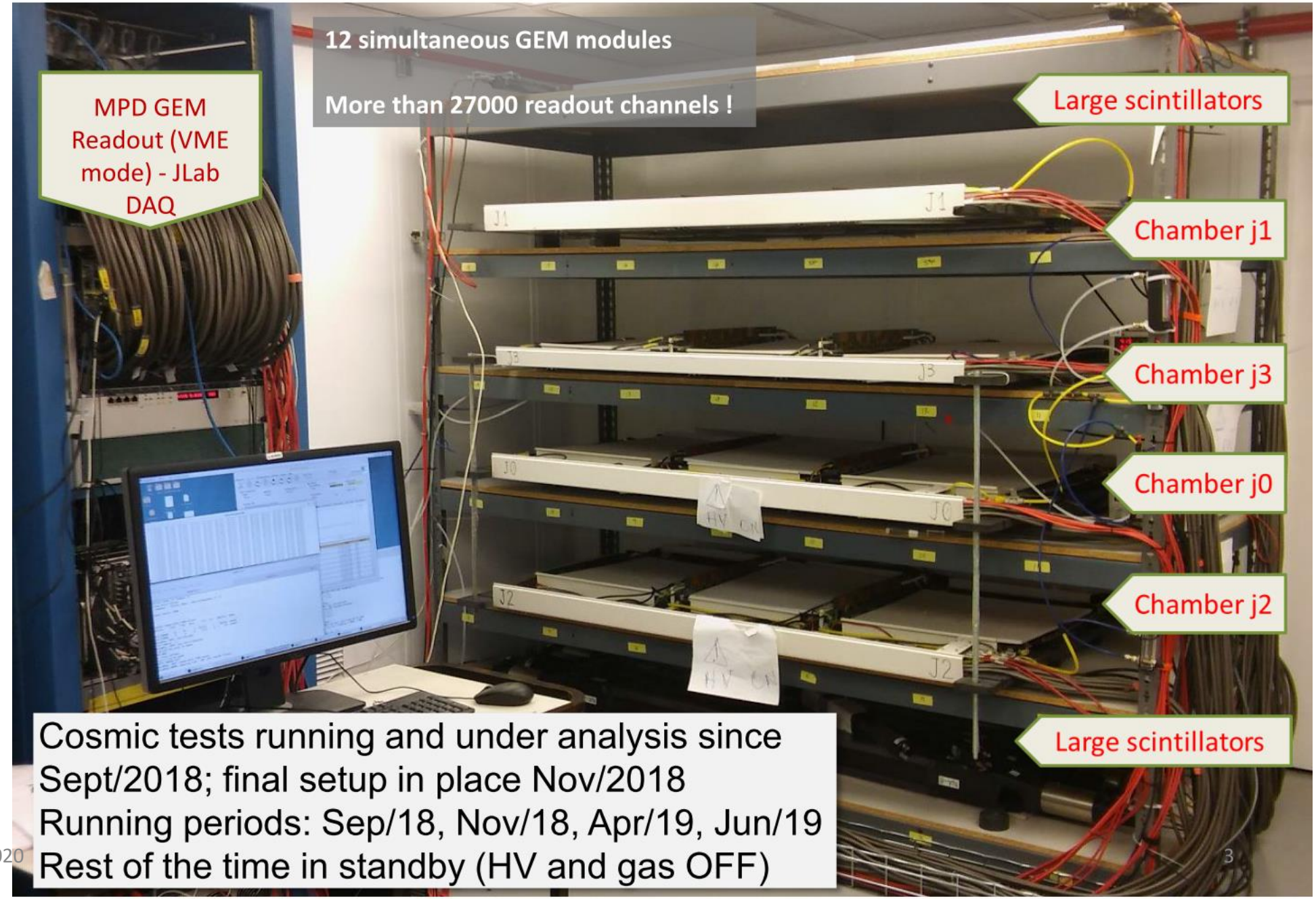
Expected Hit Spatial resolution < 100 um

1 x Rear-GEM

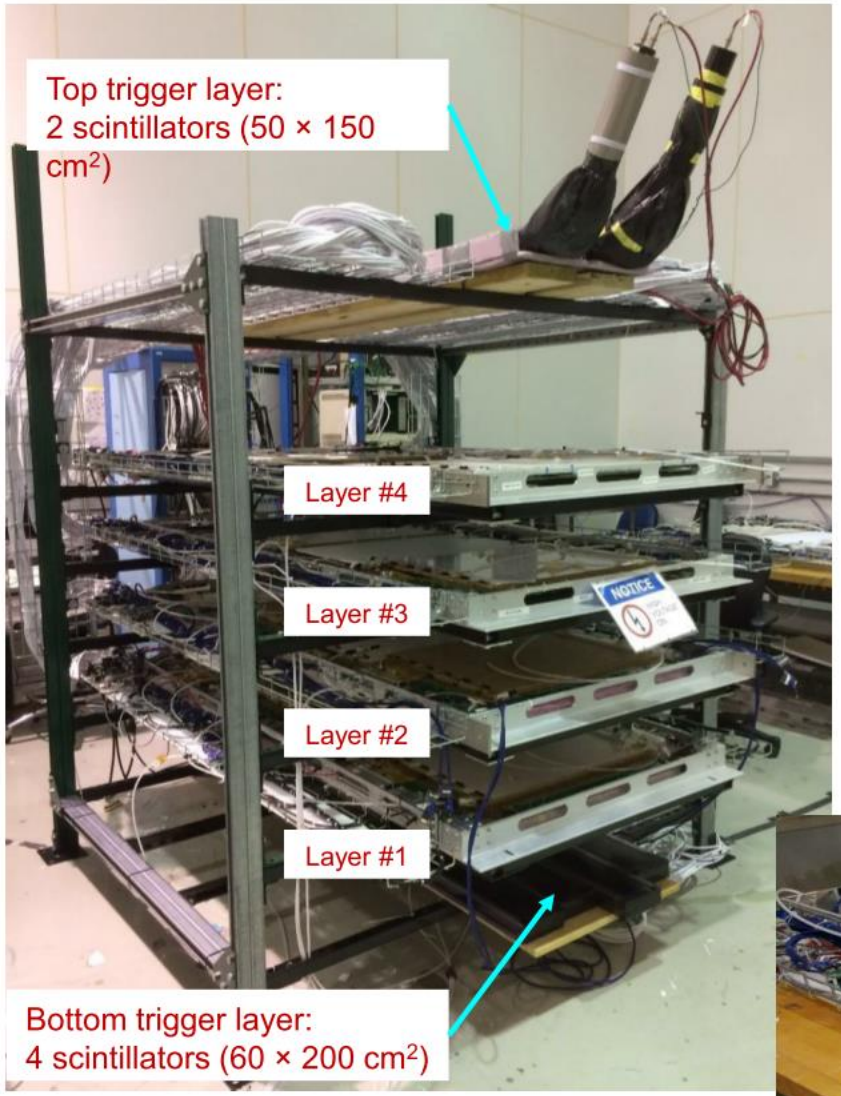


GEM Front Tracker / Cosmic Setup

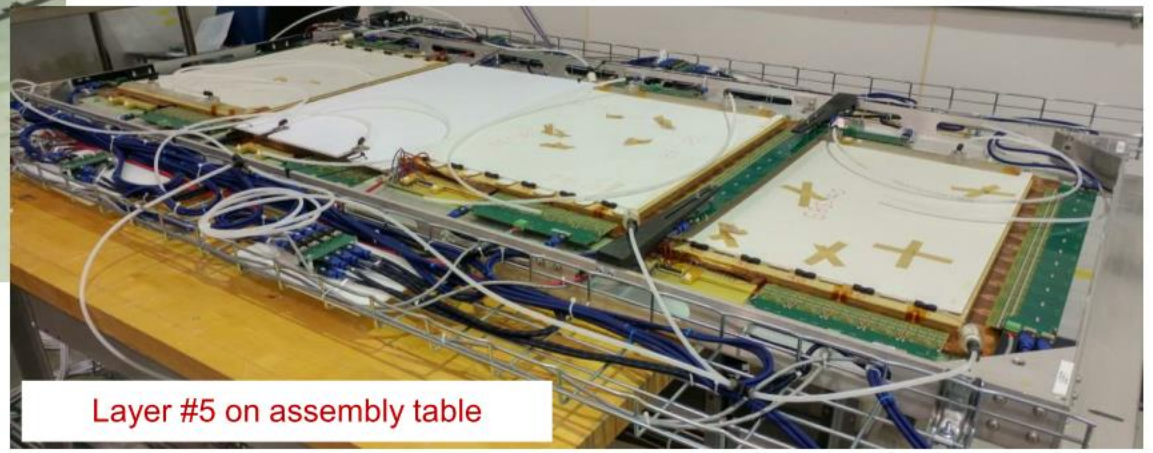
Nov/18 →



Status of UVa GEM layers assembly in EEL124



- ⇨ **5 of all 11 UVa GEM layers:** are assembled tested and validated.
- ⇨ **4 layers are on the cosmic stand:** They have been tested to be working perfectly. HV tests performed regularly (not problem so far with any of the 16 modules). We took some preliminary cosmic data
- ⇨ **layer #5 is completed:** sitting on the assembly table. It has passed the HV tests and readout electronics tests and ready to go to the cosmic stand when the "jacking system" is ready.
- ⇨ **Layer #3, #4, and #5 are assembly are final:** all equipped with the final low voltage power distribution for the APV25 electronics, mechanical support for the FE cards, final gas system, FE cards. All are ready for the experiment.
- ⇨ **Layer #1 and #2** are going to be taken out for some modifications.



Hampton University and UVa working on the cosmic data/ assembly of chamber onto frames

Monetary Contributions

- UVa
- JLab
- NCCU
- UConn
- Glasgow
- INFN Rome
- Saint Mary's

Front Trackers GEMs with U-V readout: designs

Motivation:

⇨ The U-V GEM: to complement the INFN GEM Layers which use COMPASS 2D straight strip.

⇨ The addition of U-V geometry enhances and complements the X-Y strips and will help with tracking in the high rate environment.

Key Features: active area: 150 × 40 cm^2, U-V strips readout (60^o) stereo angle

⇨ New GEM foil production allows for the FT U-V GEM layer to be **one single large module**

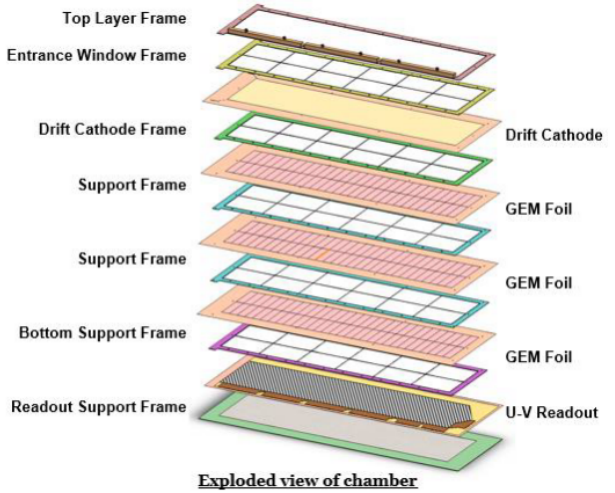
⇨ **No dead area** from support frames or electronics (Other than for spacers and HV sector)

⇨ The INFN-built MPD readouts for these GEMs will be the same as for all SBS GEMs

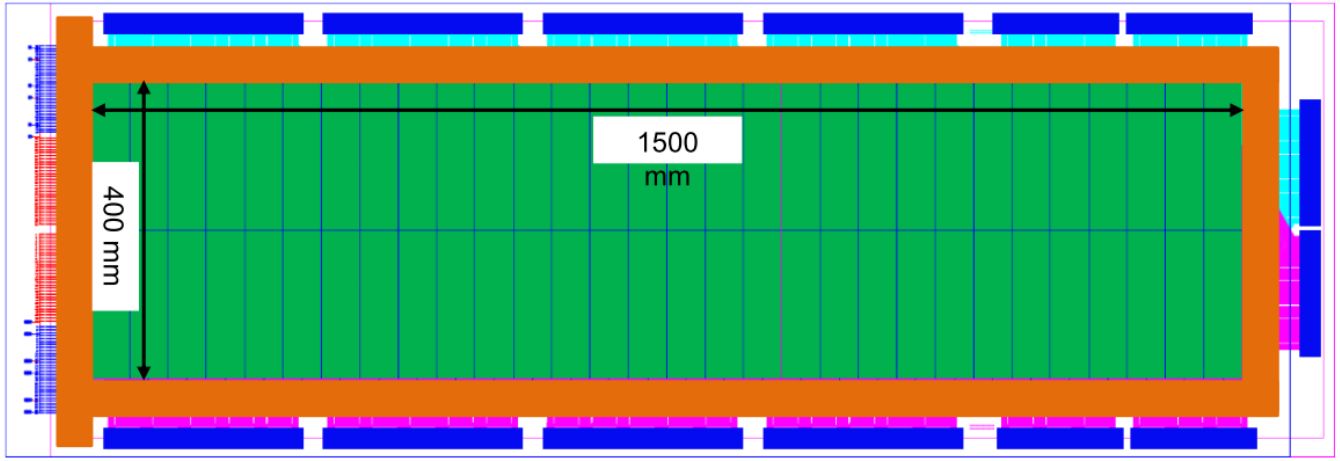
Our Experience: UVa has a successful track record with large area GEMs and U-V readout

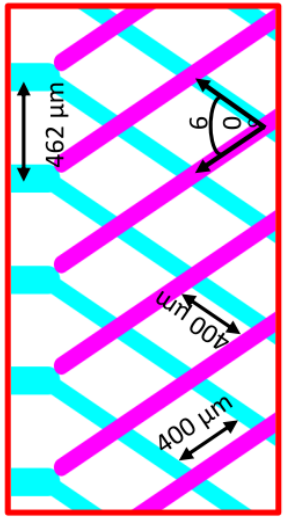
⇨ Large GEM with PRad Experiment (June 2016 in Hall B), similar size

⇨ U-V strip readouts with large U-V GEM for the EIC Forward GEM Trackers Detector R&D



Exploded view of chamber





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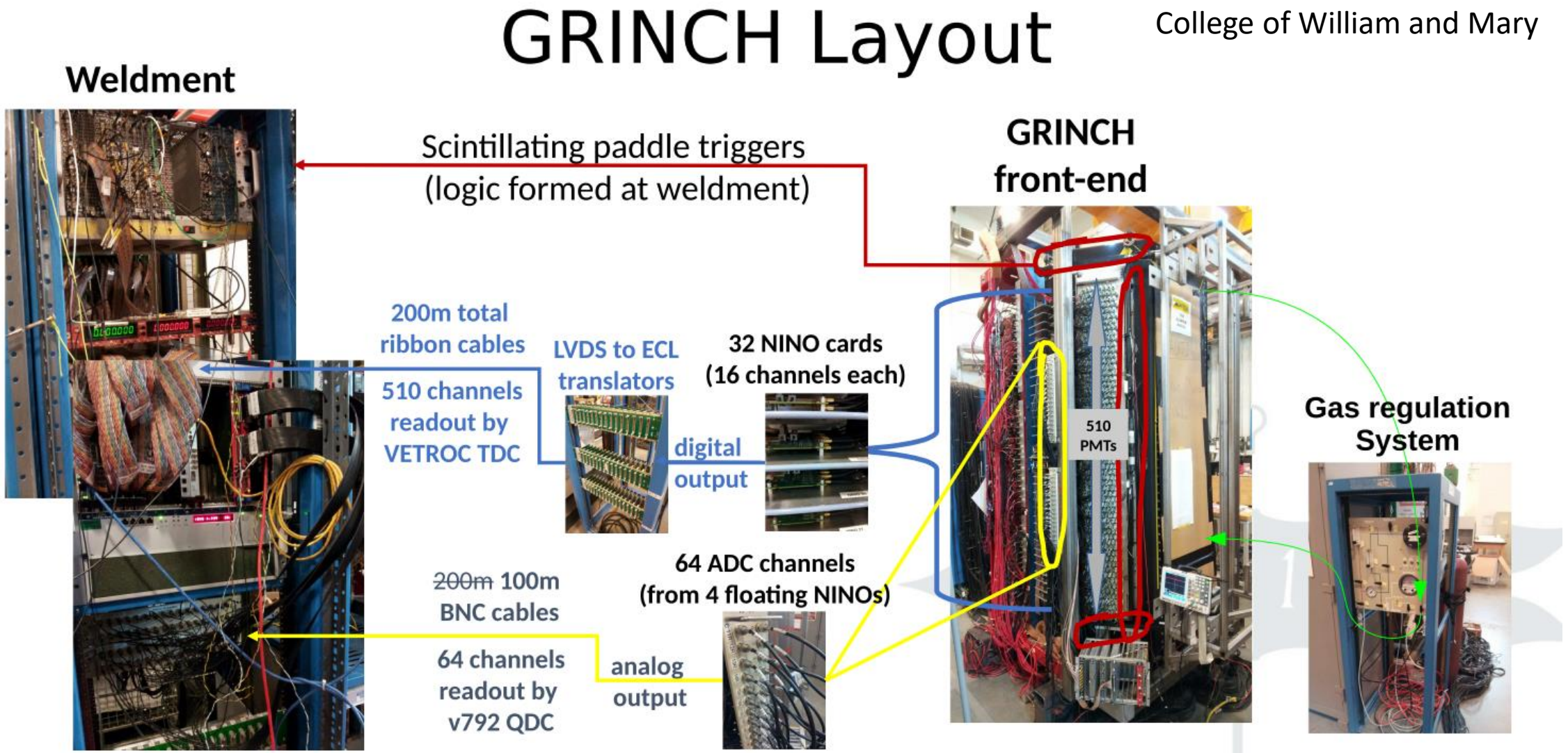
GRINCH

College of William and Mary



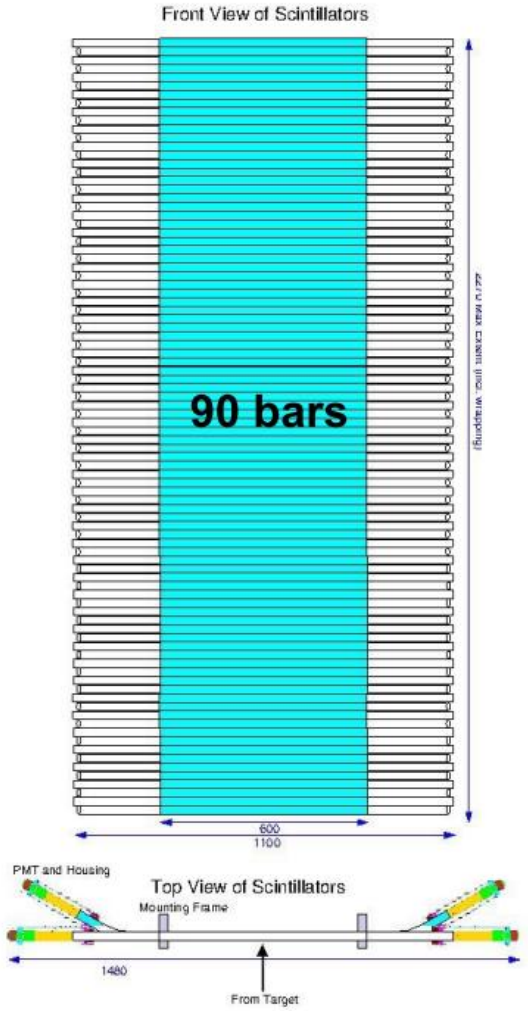
Grinch Status

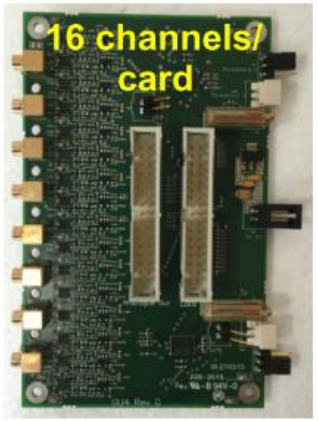
- The GRINCH is fully cabled, fully powered, and taking cosmic data
  - Cosmic tracks have been identified, using several trigger configurations
  - Some cable re-bundling is now in progress, to ease movement into the Hall
- ADC – ToT correlation has been established, PMTs are ready to be gain matched
  - Visualization tools have been developed to aid in this
- The gas system has been installed
  - After finding/repairing some major leaks, the leak rate will be determined
- Next: Simulate run conditions (sort of) by reflecting cosmic-produced photons straight into PMTs
  - An internal mechanism will be developed, which involves scintillating material and mirrors

Provided by Bradley Yale (W&M)

Hodoscope design

University of Glasgow





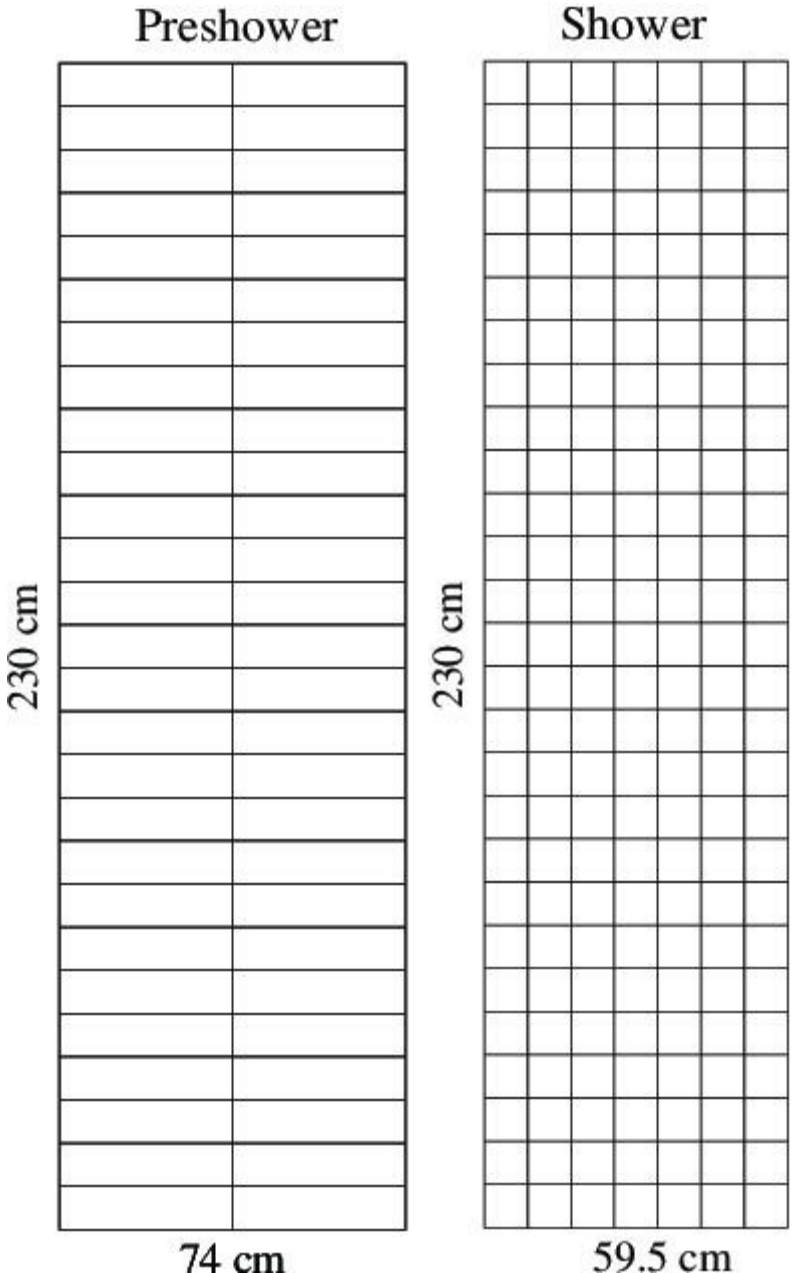
- Eljen EJ200 plastic scintillator (600x25x25mm)
- Straight/curved light guides
- Glued w/ UV curable cement
- ET9124 PMTs (2/bar) w/ custom bases
- Front end amplifier/discriminator cards (NINO)

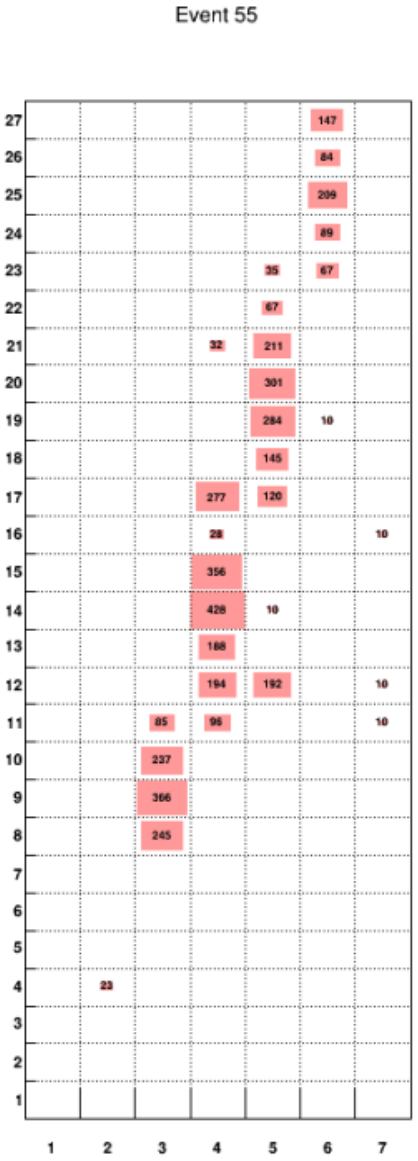
Hodoscope status

- Hodoscope plane is assembled in BigBite frame last summer.
- All NINO and HV cables and electronics are here.
- Unfortunately, about 14 paddles have broken light guide/scintillator glue joint.
- Designed new holding fixture for scintillator plane
- Found stronger epoxy.
- Need to unstack, fix paddles and restack.

BigBite PreShower & Shower

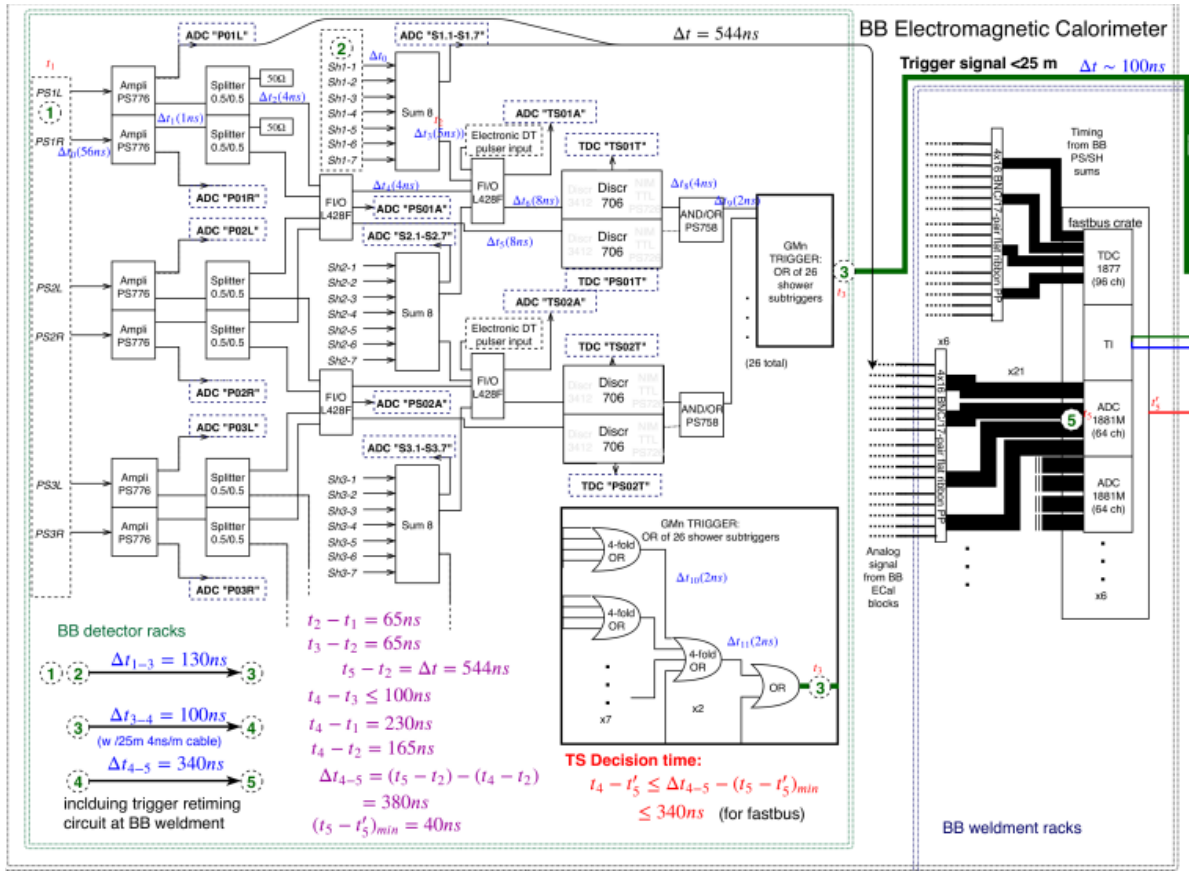
- Preshower is 2x27 blocks
- Shower is 7x27 blocks.
- Last summer, postdocs and students worked to cable signals and HV.
- Cosmic data at various HV was taken in Fall 2019.
- Ashley Yoon (CNU) and Nandhu Sridhar (Saint Mary's) are working on analyzing data.
- Example of event display by Nandhu.
- In Jan 2020, restacked the shower and inserted mu-metal shielding.
- Investigating replacing the Preshower blocks with available rad-hard blocks.

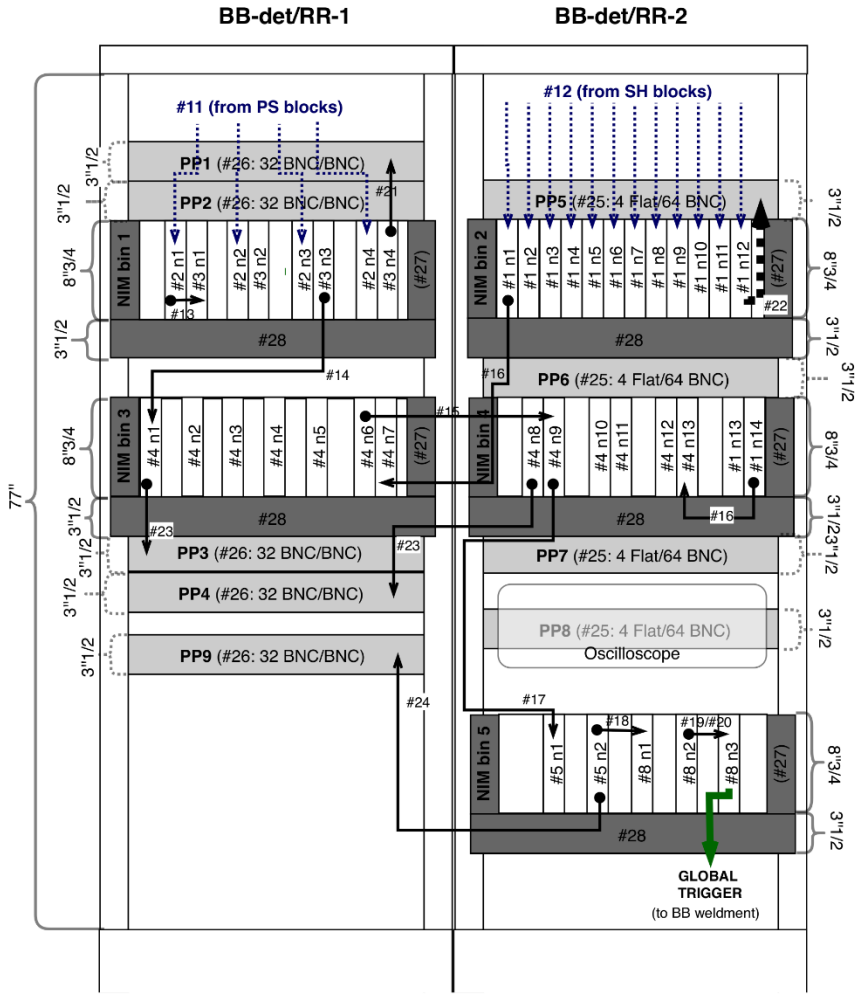




Preshower/Shower Trigger

- Eric Fuchey (UConn) with students have set-up the preshower/shower trigger.





Conclusion

- Major changes to BigBite detector package.
- Each of the detectors in at JLab.
- Assembly and testing is ongoing in the TEDF.