

# Electronics for GEM R&D at the University of Virginia

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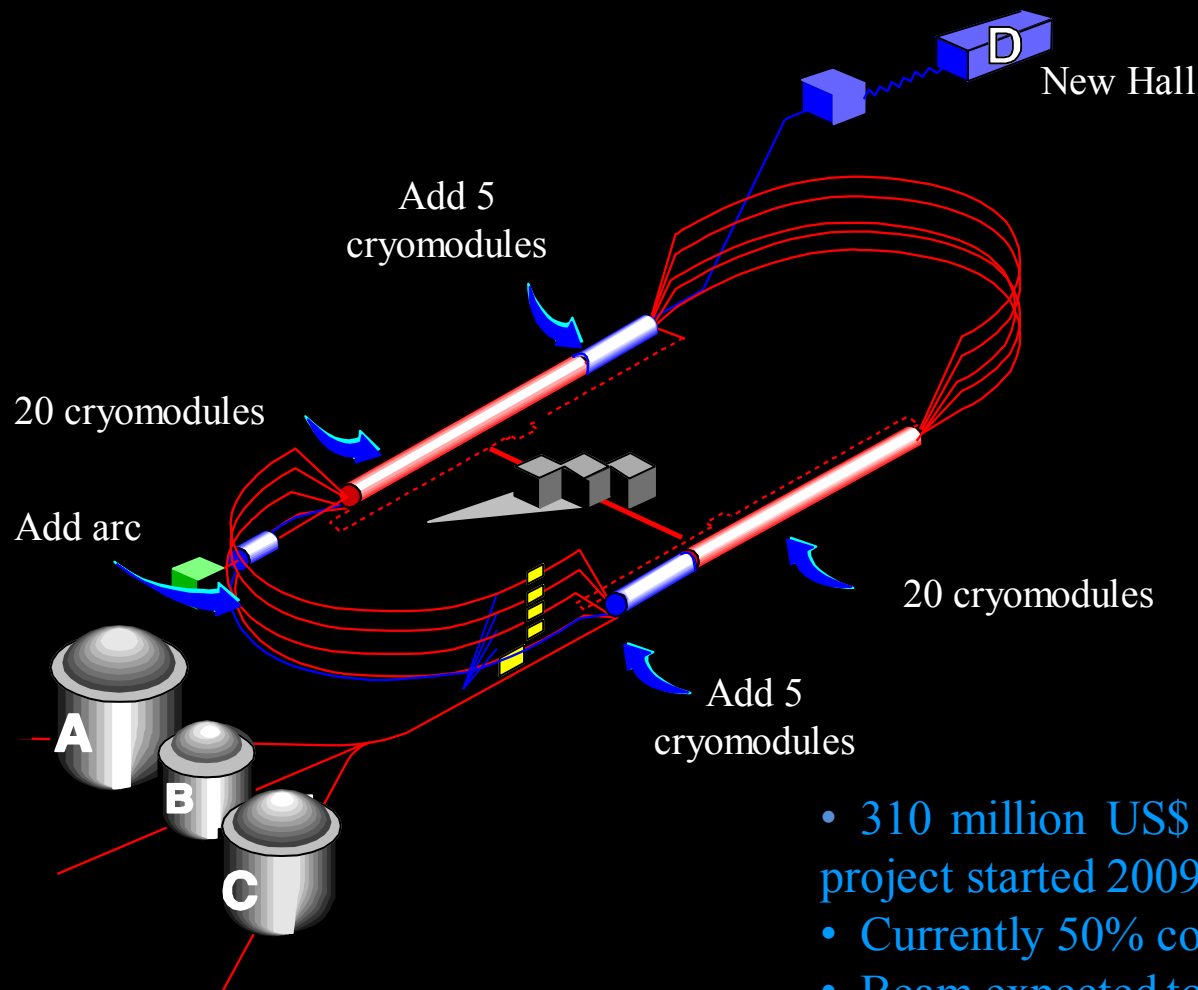
## Research Field in the Physics Department

- Experimental Atomic, Molecular & Optical
- Experimental Condensed Matter Physics
- Theoretical Condensed Matter Physics
- Experimental Nuclear Physics (20 Faculty members)
- Theoretical Nuclear Physics
- Experimental High Energy Physics
- Theoretical High energy Physics
- Medical & Biological Physics

## Our group

- Prof. Nilanga Liyanage
- Two senior research staff
  - Dr Vladimir Nelyubin
  - Dr Kondo Gnanvo
- 3 graduate students and many undergrad students
- GEM detectors R&D for SBS and SoLID spectrometers in Hall A @ JLab

## CEBAF: Continuous Electron Beam Accelerator Facility

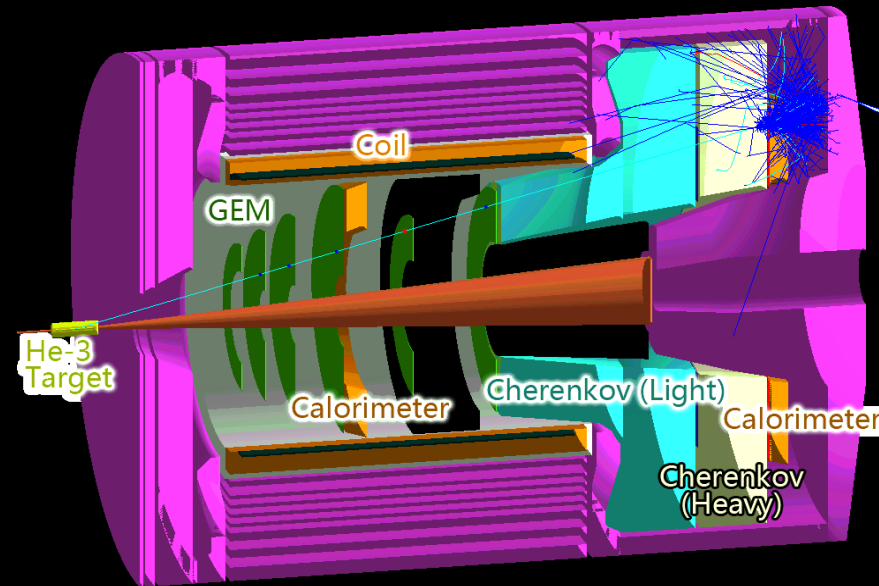
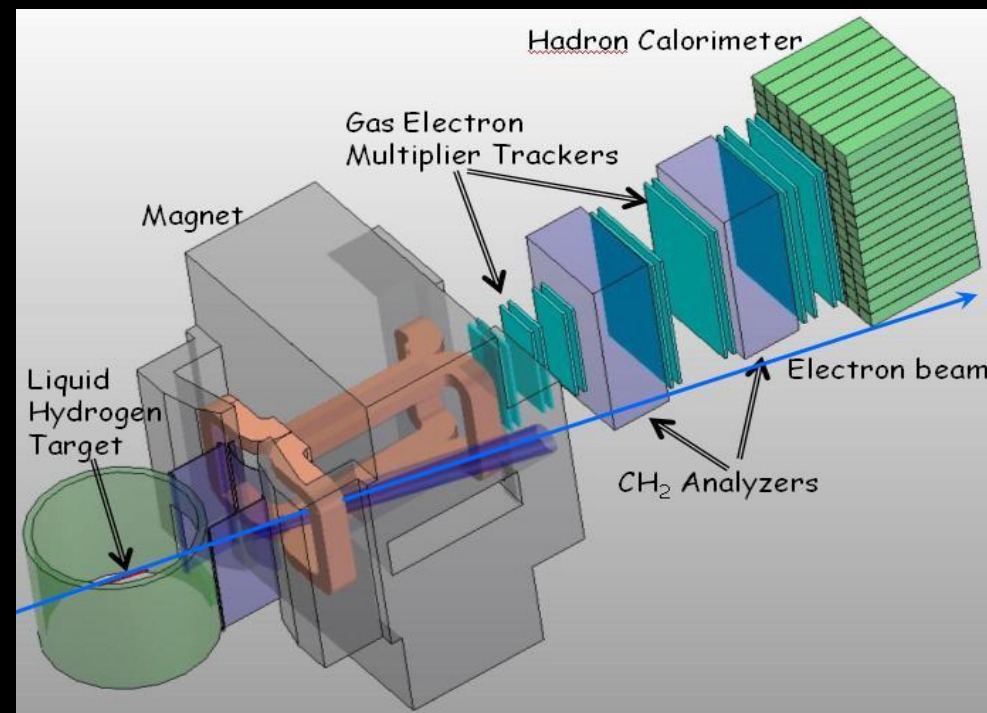


- 310 million US\$ construction project started 2009
- Currently 50% complete
- Beam expected to start 2013

We are currently conducting large area GEM detector R&D for two proposed spectrometers at JLab

## Super BigBite Spectrometer @ JLab

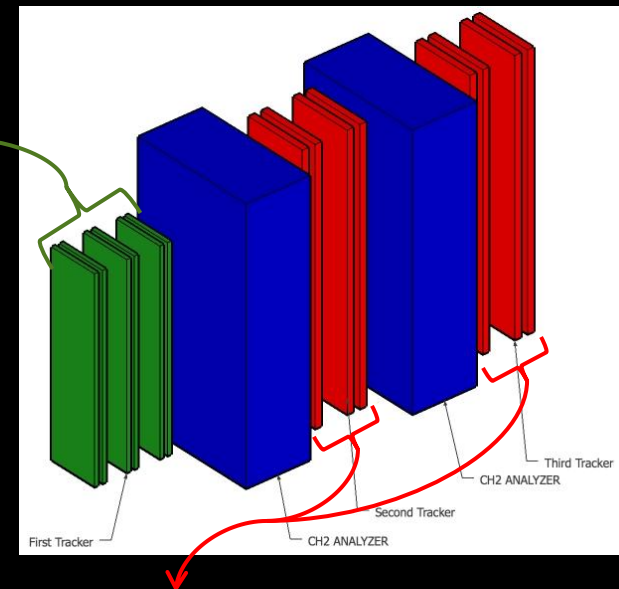
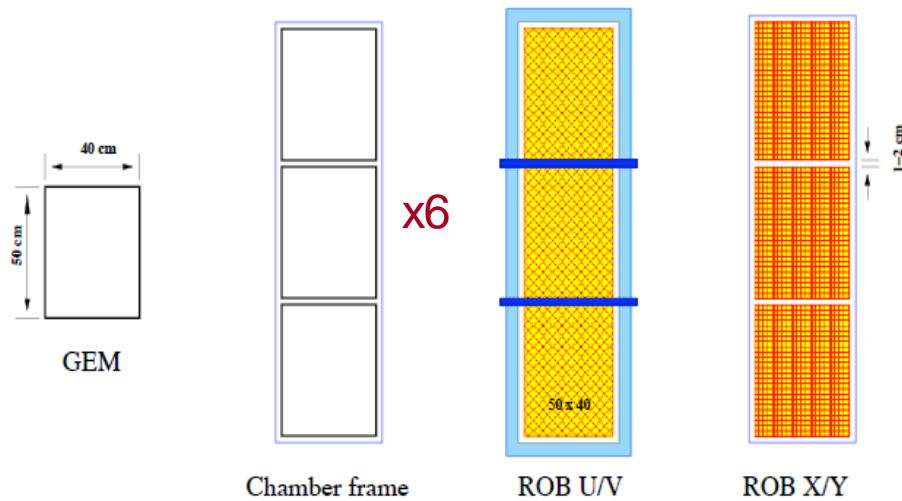
## SoLID Spectrometer @ JLab



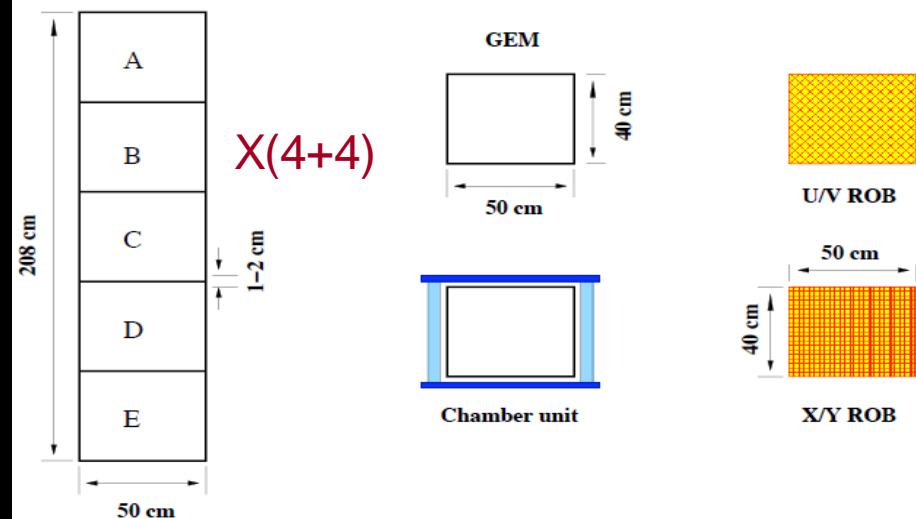
- Proton form factors ratio, GEp(5) (E12-07-109)
- Simple dipole for the large acceptance
- Field integral vs. detector resolution => GEM
- Forward angles vs. solid angle

- General Purpose Deep Inelastic Scattering for Parity Violation
- will be used in 12GeV PVDIS and SIDIS experiment with different configurations

## Front Tracker by INFN Roma, (E. Cisbani Group)



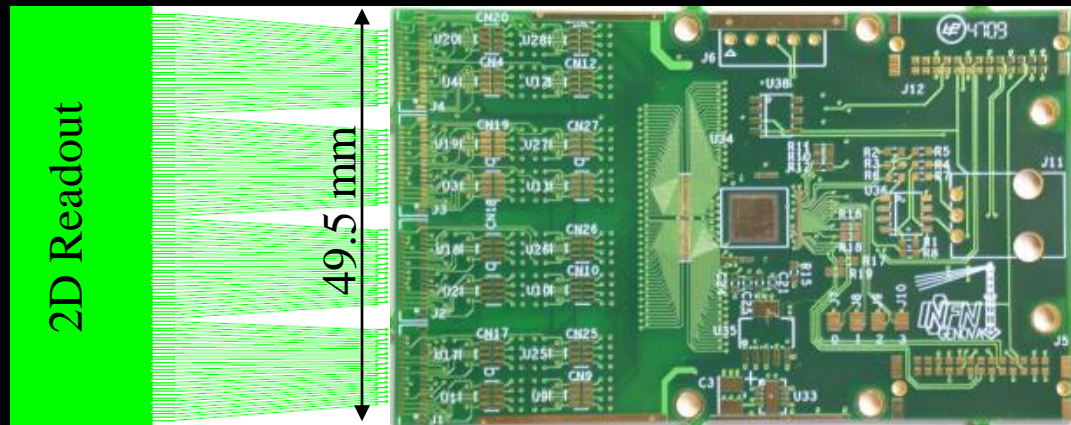
## Back Trackers by UVa (N. Liyanage Group)



- ✓ 3 large GEM trackers (100 K channels) in collaboration with INFN-Rome
- ✓ 40 modules by Univ. of Virginia for the back tracker and 18 modules by INFN Roma for the front trackers
- ✓ Modules are arranged into larger chambers with different sizes
- ✓ Electronics along the borders and behind the frame (at 90°) – cyan and blue in drawing

GEM

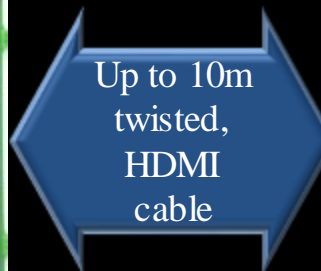
FEC



2D Readout

49.5 mm

75 mm



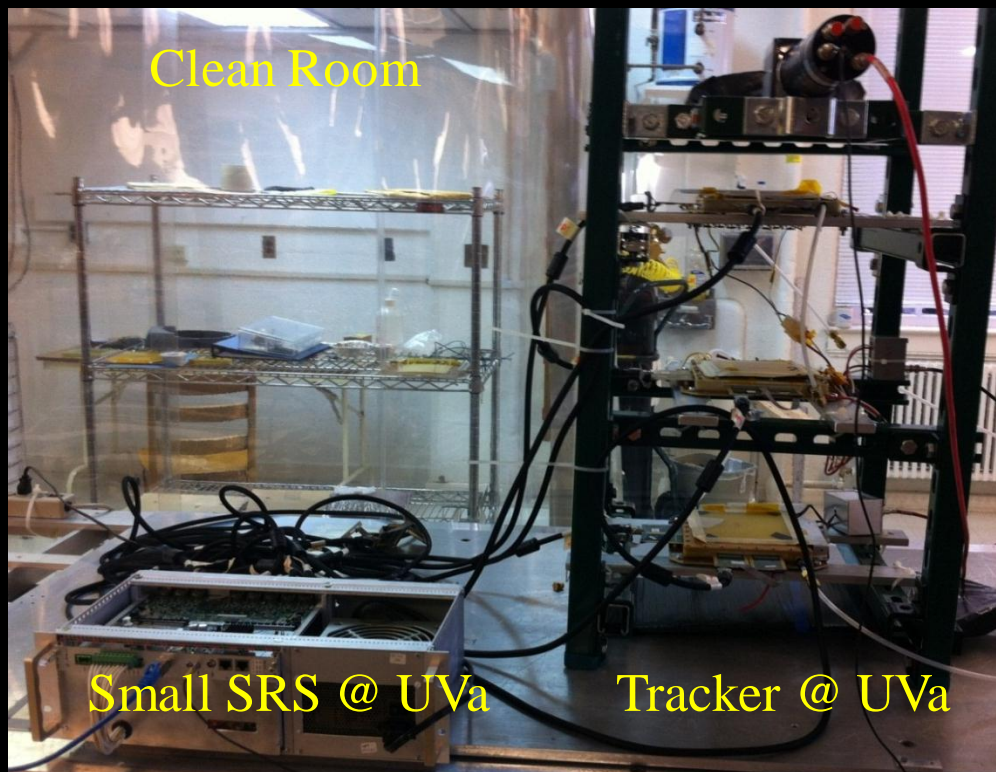
MPD



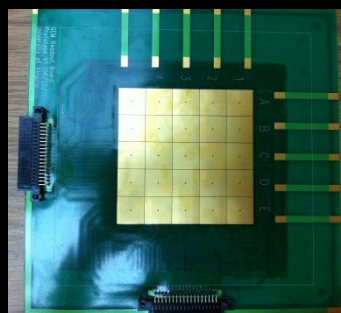
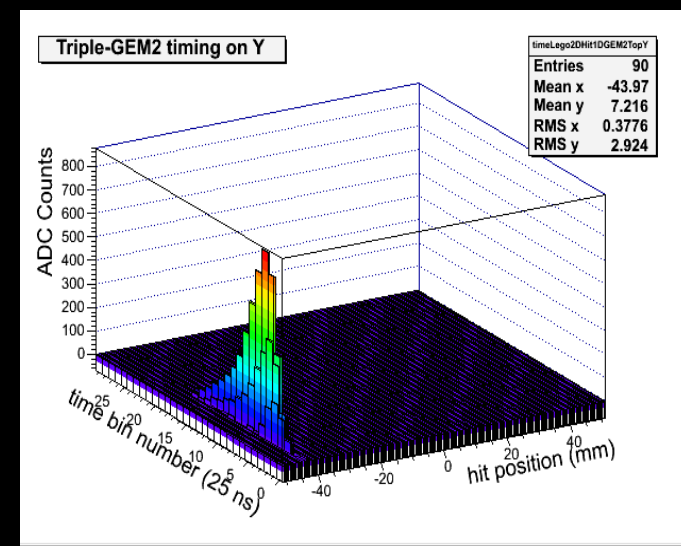
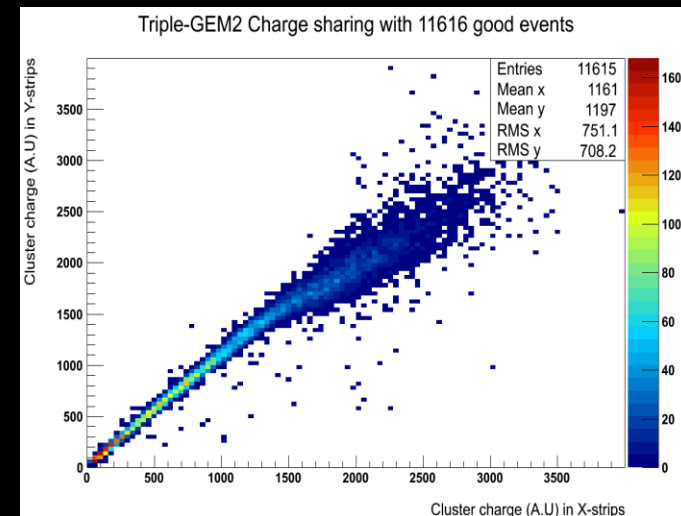
## Multi Purpose Digitizer

- VME64x controller hosts the digitization of the analog signals from the FEC.
- It handles all control signals required by the front end cards (up to 16 FE)
- Compliant to the JLab/12 VME64x VITA 41 (VXS) standard
- 2 HDMI-type A: digital lines + 2 analog lines (compatible with RD51/SRS hybrids connector), 2 HDMI-type B: 16 analog lines
- CODA (CEBAF Online Data Acquisition) based DAQ system

- $A_N$ DY : measurement di-electrons from the Drell Yan (DY) process at large rapidity, from  $\gamma^*$  with large longitudinal momentum,  $p_z$ .
- UVa recently joined the collaboration.
  - Providing the large GEM tracker + APV25 SRS Readout
  - The experiment would need at least 16 SBS triple-GEMs
  - 45K apv25/SRS readout channels (1 SRU, 23 FEC/ADC, ~360 hybrids)
- The APV25/SRS for  $A_N$ DY could constitute a dry run for the SoLID spectrometer readout system



## Some SRS Results





- We would like to have a system with 45K channels (ideally by early 2013)
  - 1 SRU, 23 FEC/ADC cards, ~360 apv25 hybrids
- Area we are interested in for the apv25/SRS
  - Re-design apv25 hybrid with proper HDMI mapping and improve the mechanical support of the HDM connector on the hybrid
    - understood that this is done with the upcoming apv25 hybrid v.4
  - We want to help test the zero suppression in the firmware
    - We can help for instance with the data format and the decoding
- We are also interested in the VFAT/SRS development
  - VFAT/SRS to equip a timing GEM for trigger application
- We would contemplate the possibility to have a UVa post-doctoral expert in electronic based at CERN to contribute to the SRS development.

- Large GEM detector R&D underway at University of Virginia for Experiment in Hall A at Jefferson Lab
- We are going to be involved in the SRS Electronics development by the RD51/WG5
- We are specially interested in large system SRS with apv25 hybrids as well as the VFAT/SRS
- We proposed to contribute to the development effort in our area of expertise