Uva GEM R&D Update

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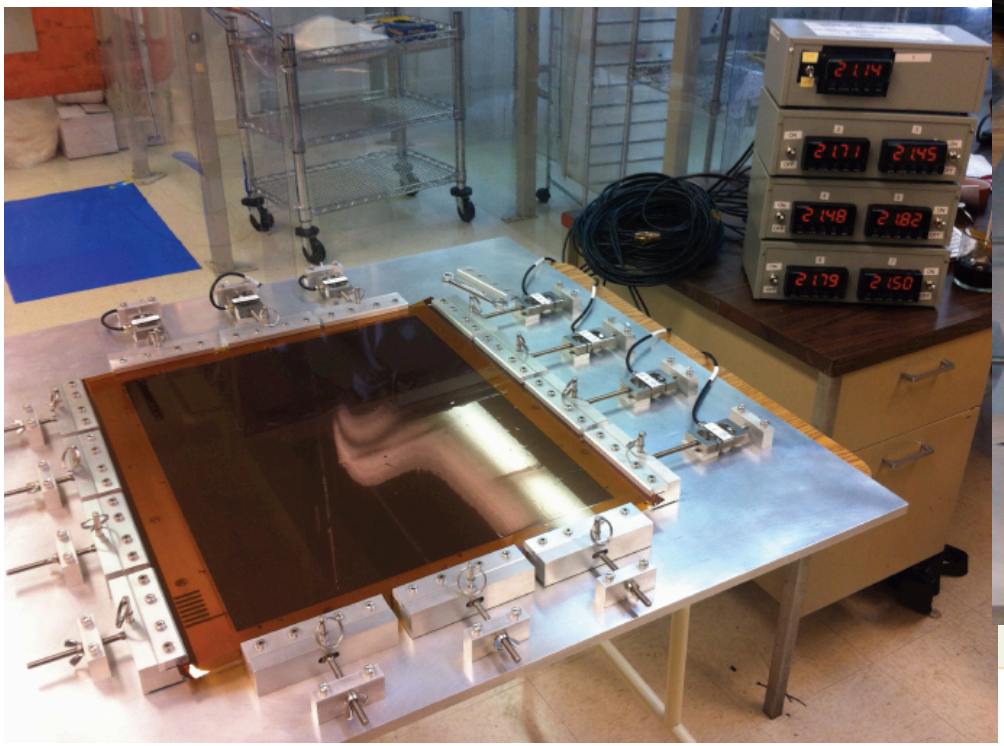
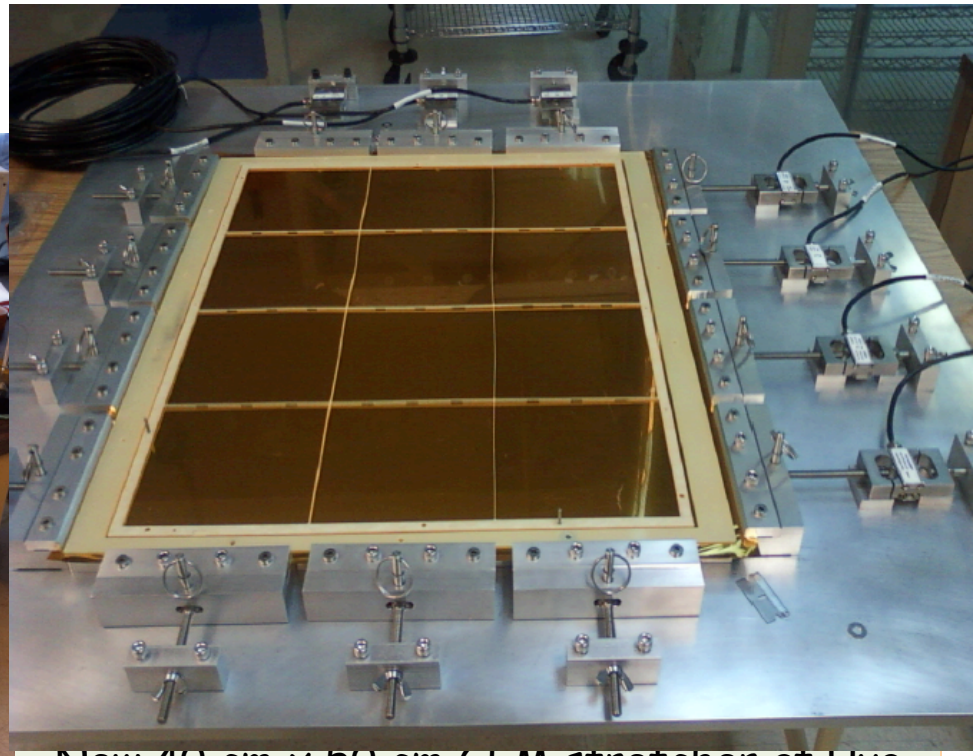
Status

- **Construction of the first SBS prototype GEM chamber (40 cm x 50 cm) is complete.**
- **It is working well and is under testing now.**
- **Italian APV readout system setup at UVa and is working well**
- **Construction of the second SBS chamber will be completed soon.**
- **The next set of SBS chambers will be 50 cm x 50 cm: we have finished the modified design; foils are ordered**
- **The design of the EIC R&D very large prototype chamber is complete – the size of this is similar to the largest SoLID chambers.**
- **The foils and frames for this chamber is ordered now; plan to construct by the end of the year.**
- **Xinzhan Bai from CIAE is now PhD student at Uva; already started contributing to GEM work**

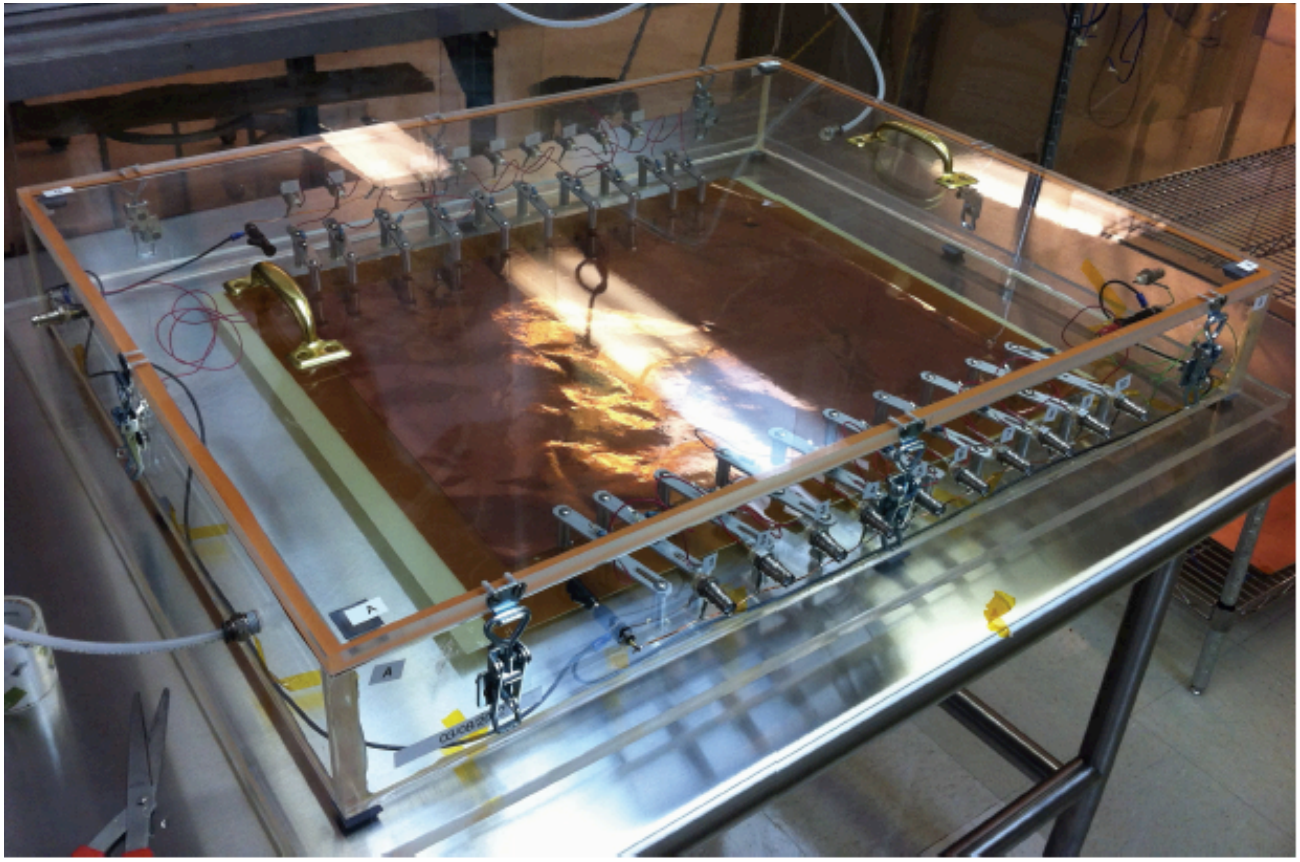
GEM R&D and assembly facility at UVa

- **The mechanical stretcher**
  - Use for stretching GEM foil and glue it to spacer frames to keep it flat
  - Stretch the foil to a tension bigger than ~ 0.3 kg/cm
  - Method developed by Bencivenni. Et al. (LNF Italy) for LHCb GEM chambers
  - Metal dust from bolts created problems in the clean-room: replacing with plastic parts.





New 40 cm x 50 cm GEM stretcher at Uva



GEM foil and Frame HV test box

•Test each sector of each new GEM foil by applying 500 V across the foil in dry Nitrogen

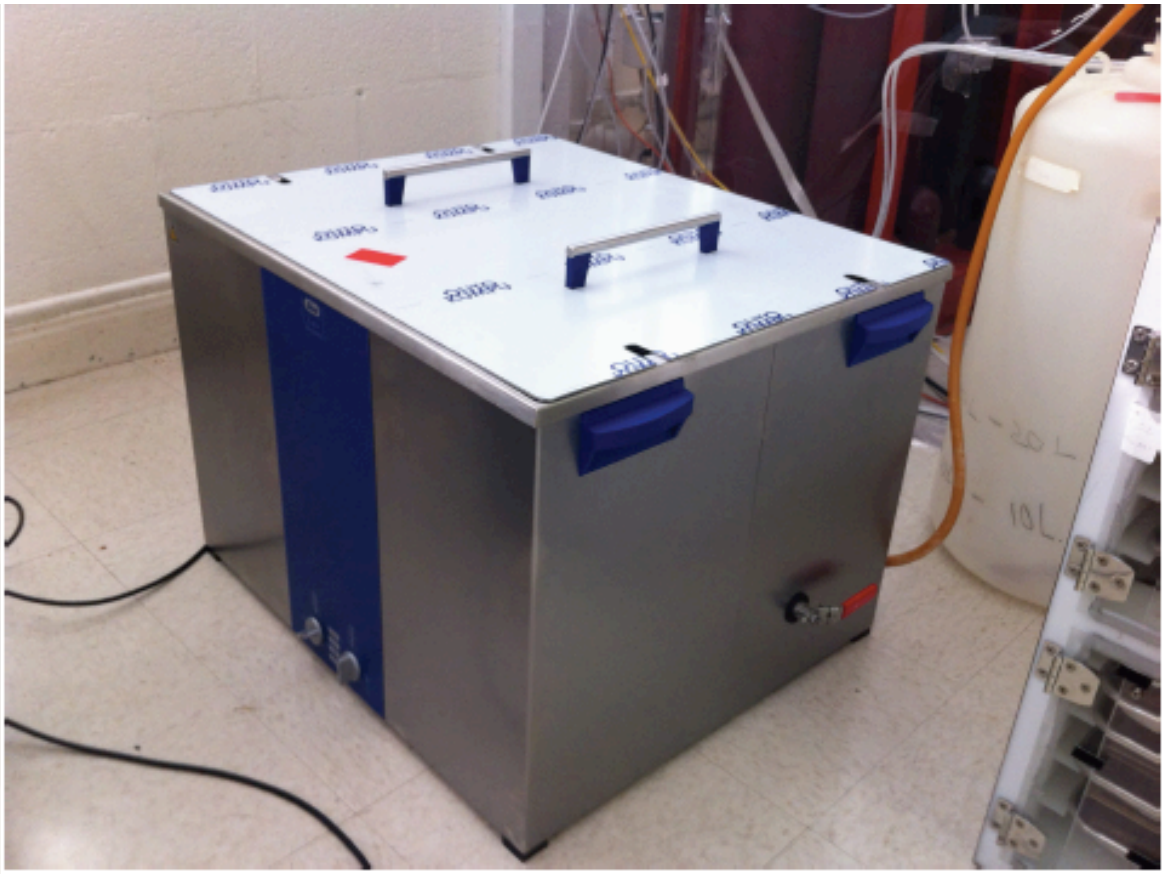
• Ensure that the current drawn by a sector is < 1 5 nA, and the current drawn by the whole foils < 20 nA

• Test the foils upon arrival from CERN, before gluing on to frame and, after framing and just before assembly into the chamber

• All 7 large foils we got from CERN passed the test.

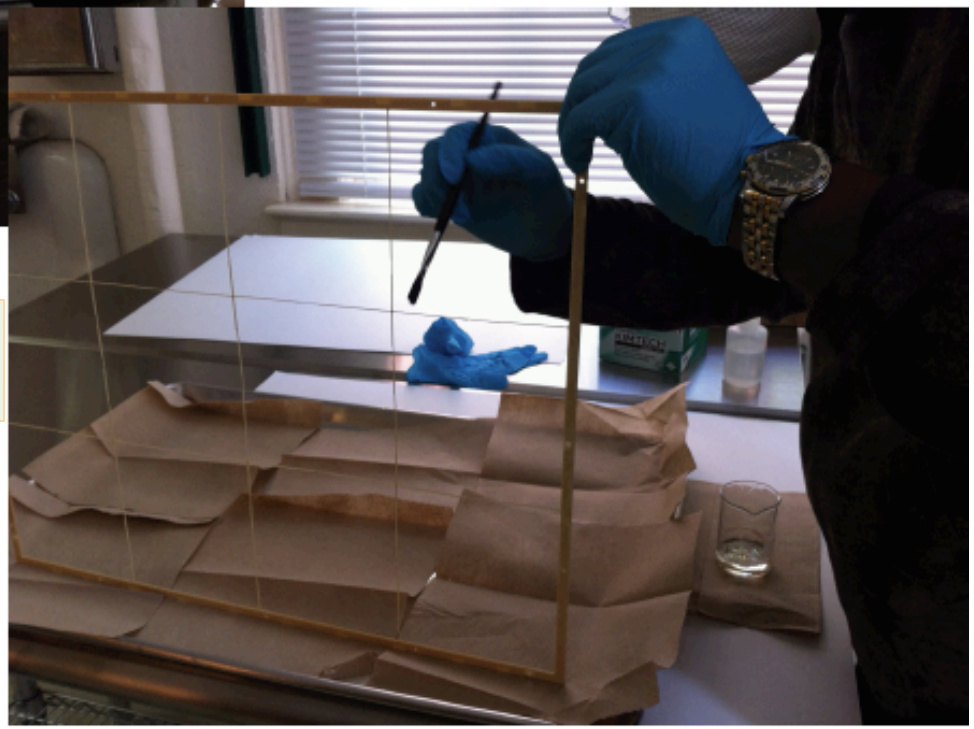
GEM R&D and assembly facility at UVa

Dry N2 cabinet for frame storage



Ultra-sonic cleaner for frames

GEM R&D and assembly facility at UVa



Sealing the frame surfaces with a special varnish

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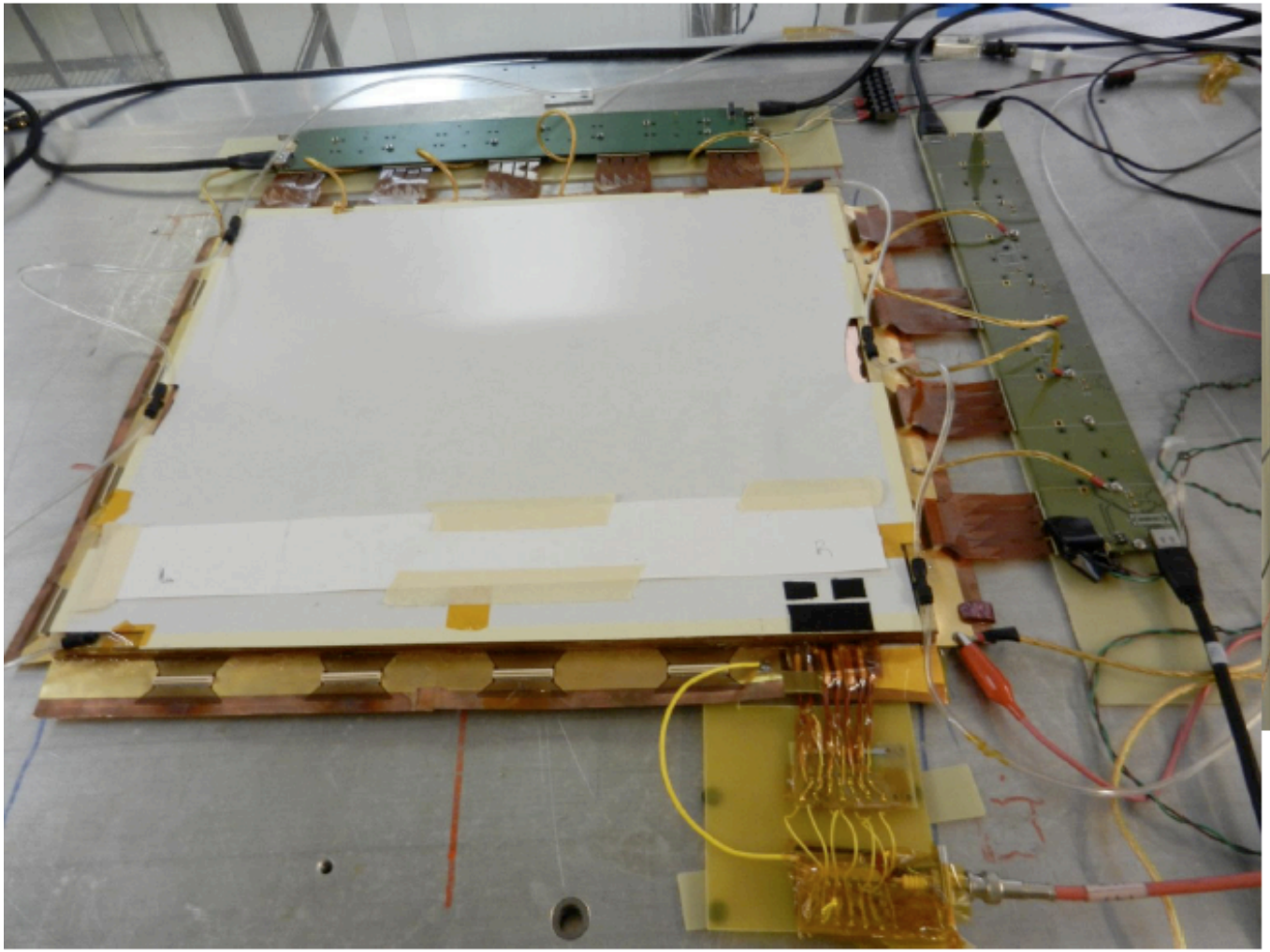
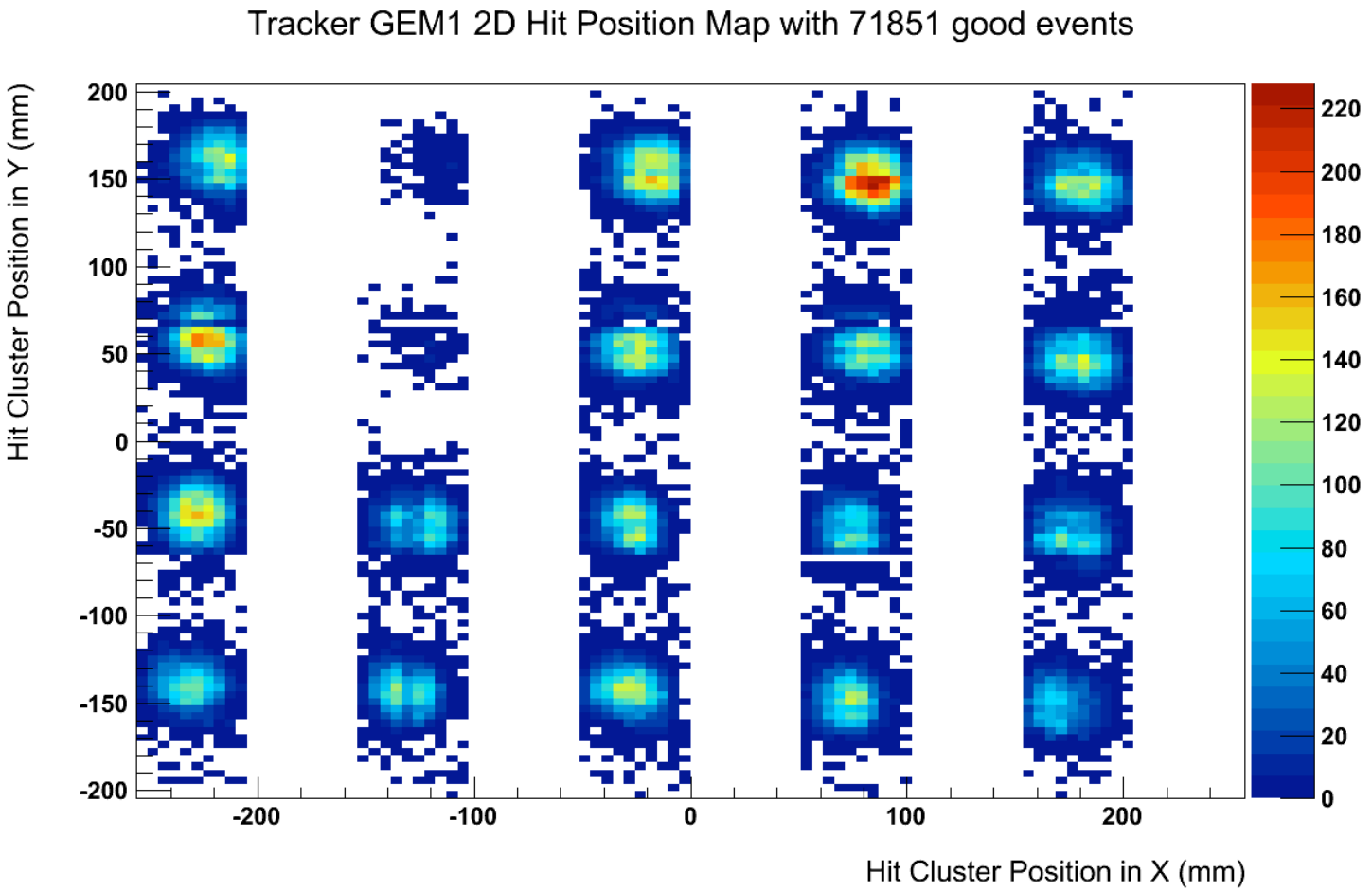
Lab

The SBS prototype #1 connected to the Italian APV readout system

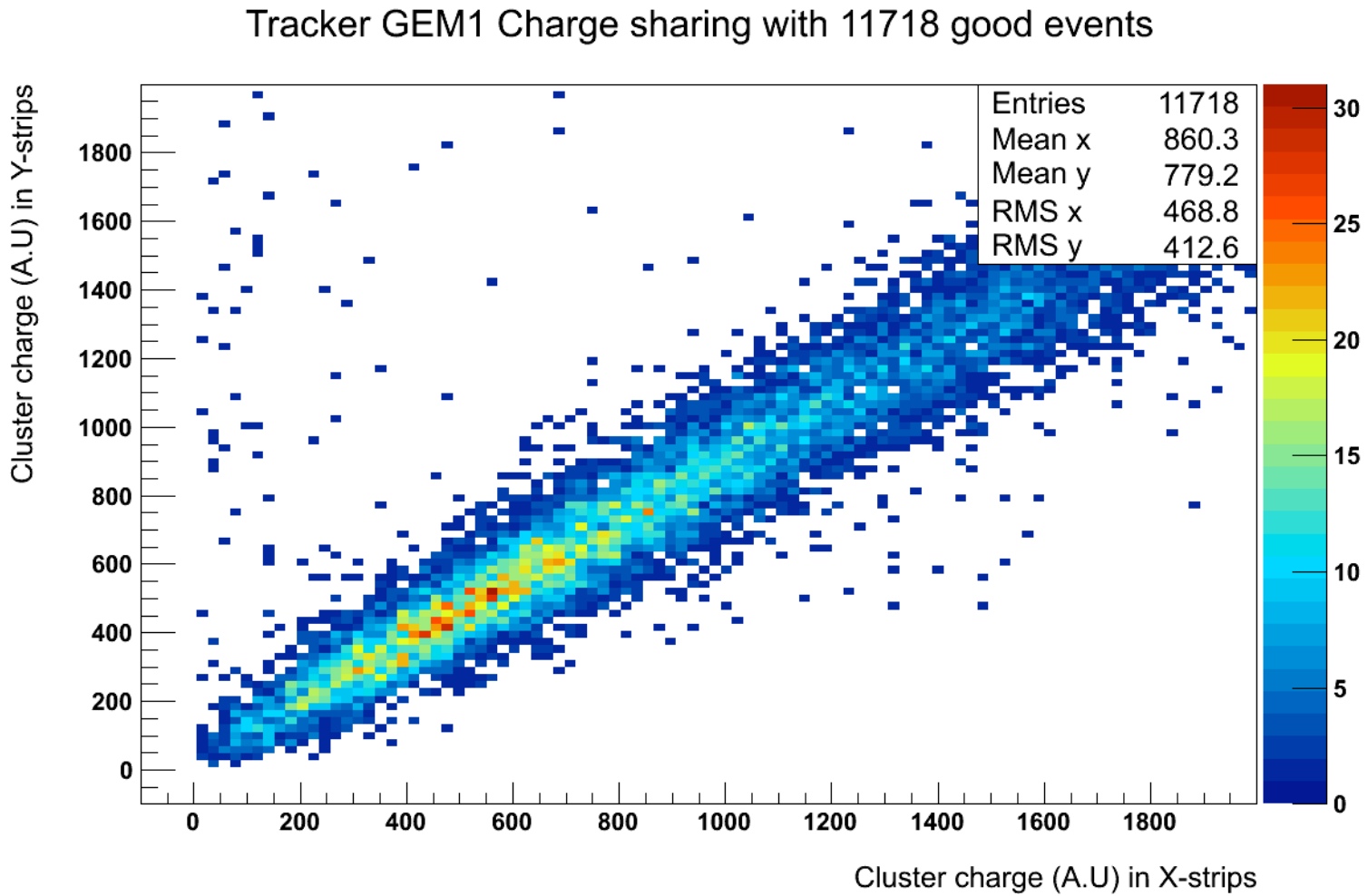
9 APV25 FE (5 on X and 4 on Y) cards on the chamber with the back plane, the Panasonic to ZIF connectors and the FE cards grounded directly to the GEM readout ground



MPD VME64x board with the HDMI cables to communicate with the FE cards

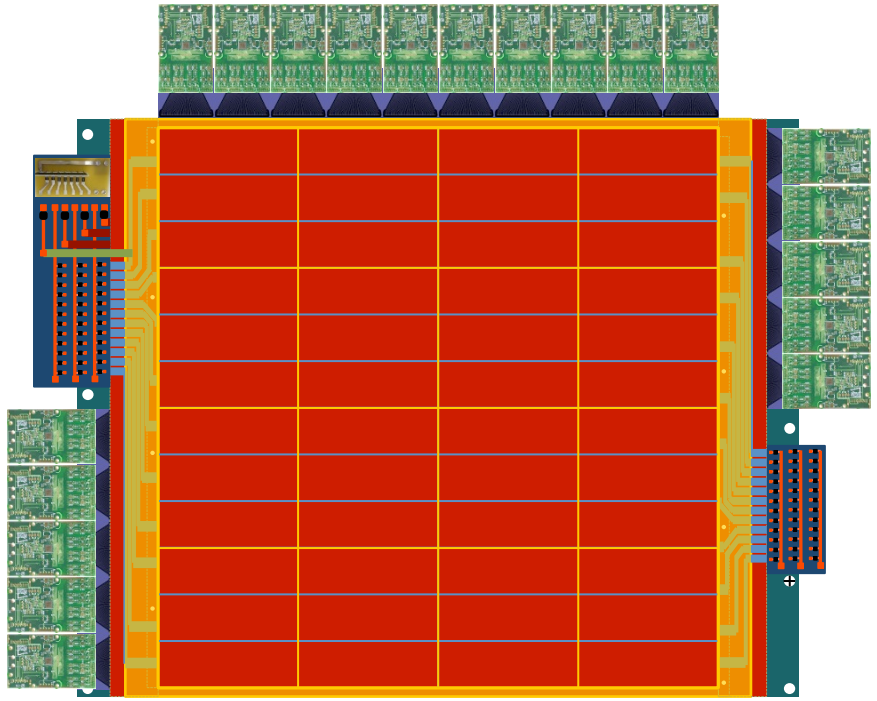


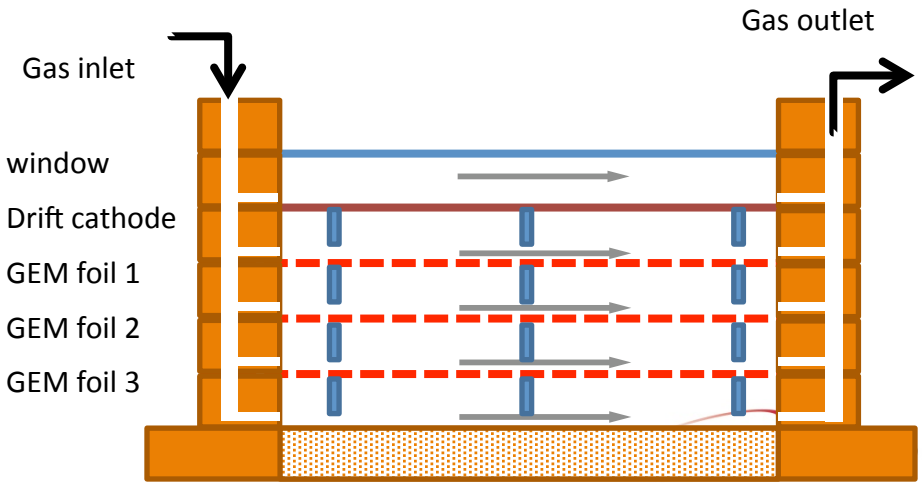
- First data from the 40 x 50 cm chamber – a powerful ^{90}Sr source was used for this test.
- One sector with very low efficiency; we are investigating the reason for this now.


Tracker GEM1 Charge sharing with 11718 good events
Entries 11718
Mean x 860.3
Mean y 779.2
RMS x 468.8
RMS y 412.6
Cluster charge (A.U) in Y-strips
Cluster charge (A.U) in X-strips
0
200
400
600
800
1000
1200
1400
1600
1800
5
10
15
20
25
30

Proposal for a new design for the SBS GEM polarimeter trackers by Kondo Gnanvo

- **Module of 50x50cm^2 to replace the 40x50cm^2**
  - 32 modules to be built instead of 40 for the 8 Polarimeter chambers
- **Wider GEM frames along x-axis**
  - Width of 30 mm instead of 8 mm
  - Better stretching
  - alignment holes away from active area
- **Wider readout support frame along x-axis (74 mm)**
  - Room for strips connectors and GEM HV sectors electrodes
- **No protective resistors on the GEM foils**
  - External resistor boards
- **Gas system same as in Evaristo design**





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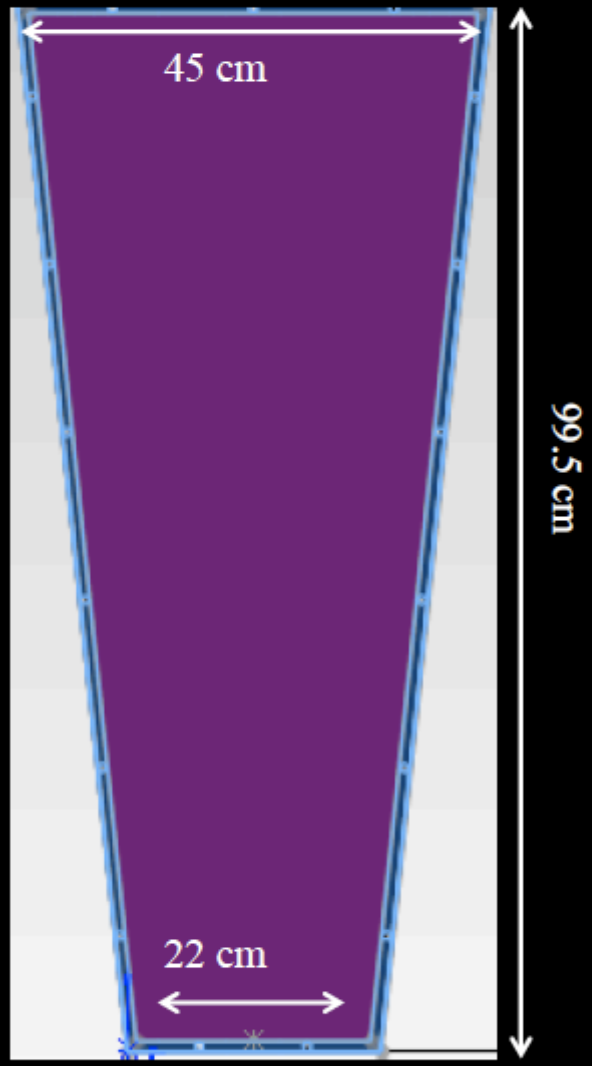
100 cm x (45 cm -22 cm) Prototype

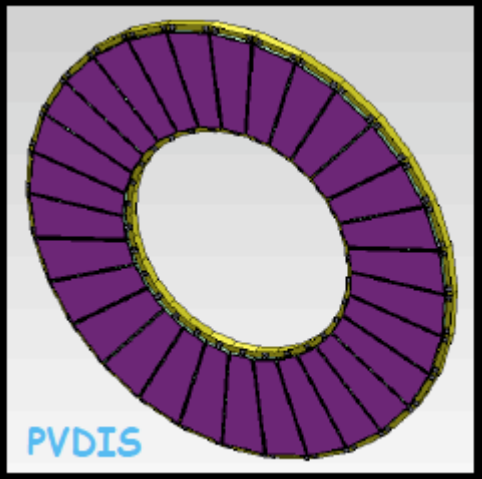
- **Funded by EIC R&D program**
- **Similar to the size of largest SoLID chambers**
- **The design is complete**
- **Kondo is going to CERN next week to finalize the design with Rui and order the foils.**

Large Area GEM R&D



Common R&D for various projects:

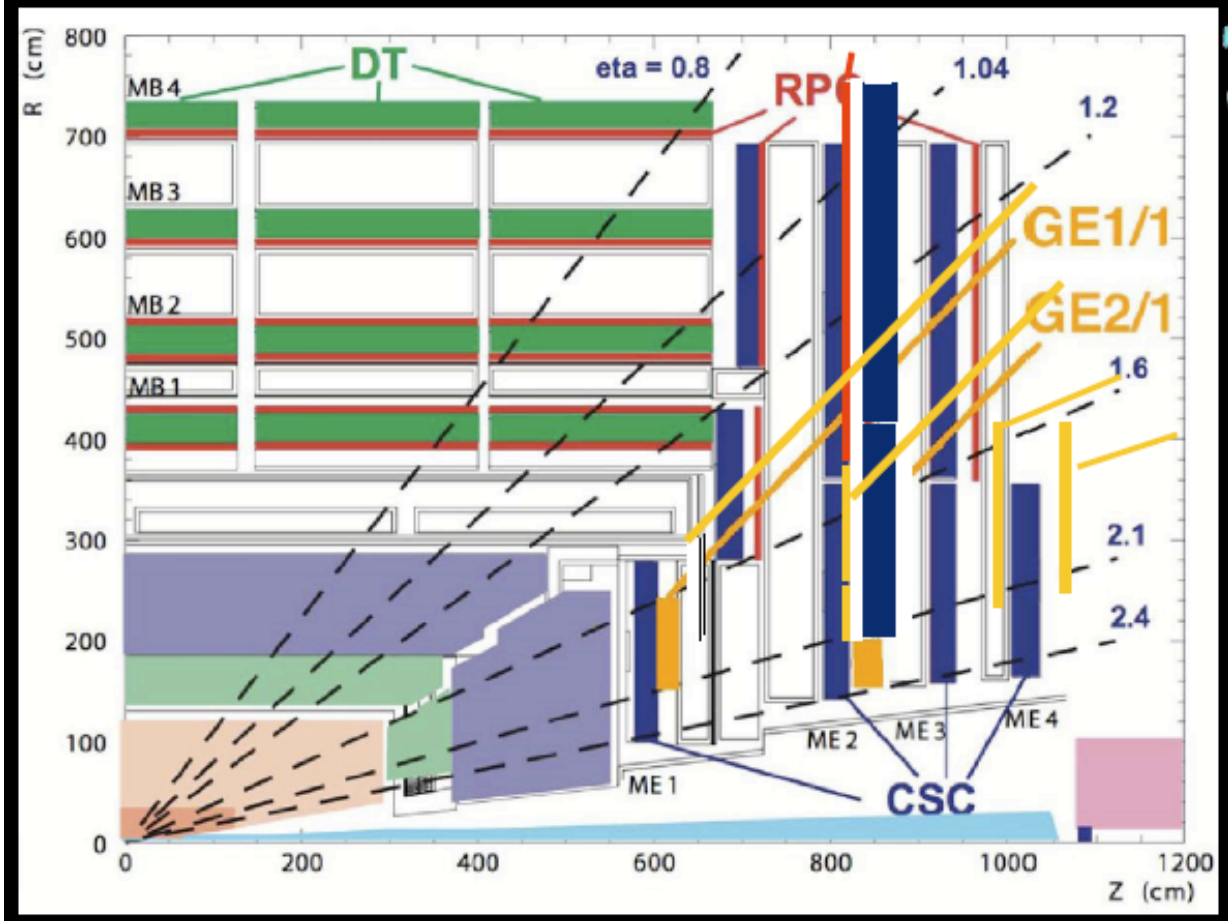
- EIC R&D funding at UVa for designing and prototyping a large area GEM for Forward Tracker
- Chamber size very similar to largest SoLID GEM and for CMS high Eta Muon Upgrade
- Seth Saher (UVa undergrad. student) is already working on the design



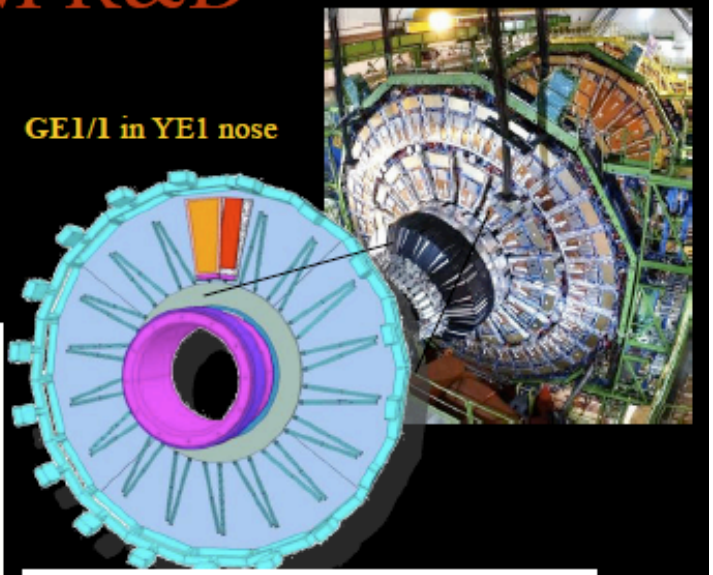
• Several chambers of this size have been built under the CMS upgrade program (see the next slides), but they are 1D readout; our chamber will be 2D readout.

Large area CMS GEM R&D

The currently un-instrumented high-η RPC region of the muon endcaps presents an opportunity for instrumentation with a detector technology that could **sustain the radiation environment long-term** and be suitable for operation at the LHC and its future upgrades into Phase II: **GEM Detectors**



GE1/1 in YE1 nose

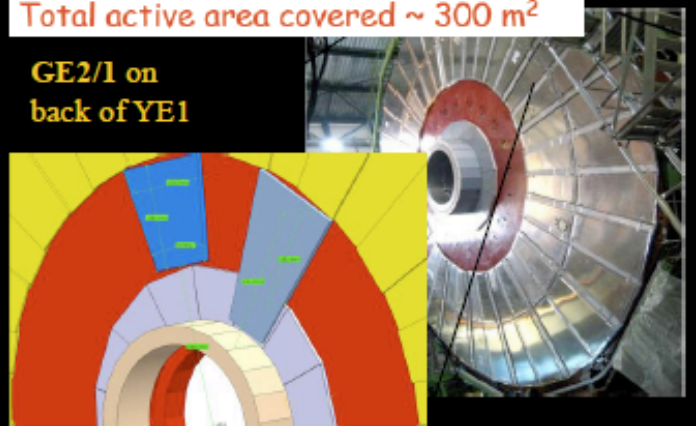


GEM s for triggering and tracking

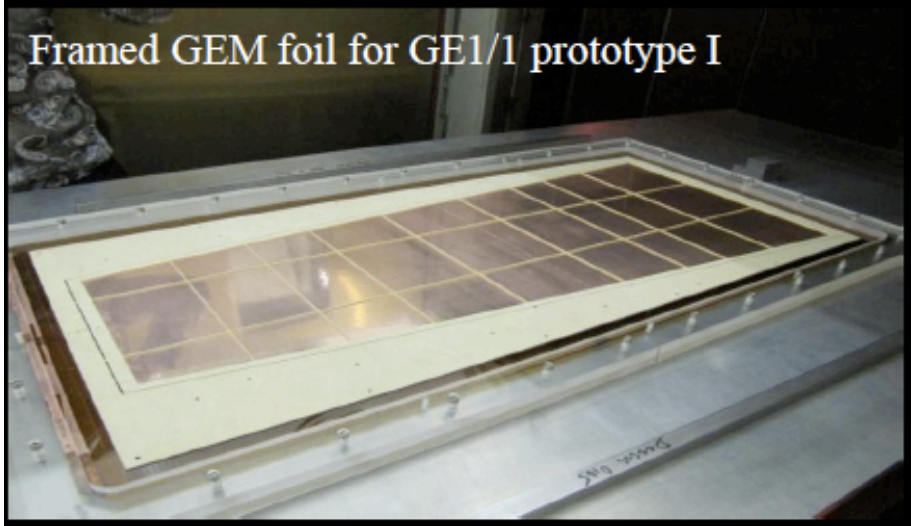
- Proposal to cover the $1.6 < |\eta| < 2.4$ region with GEMs.
- GEMs for
- 240 GEM chambers

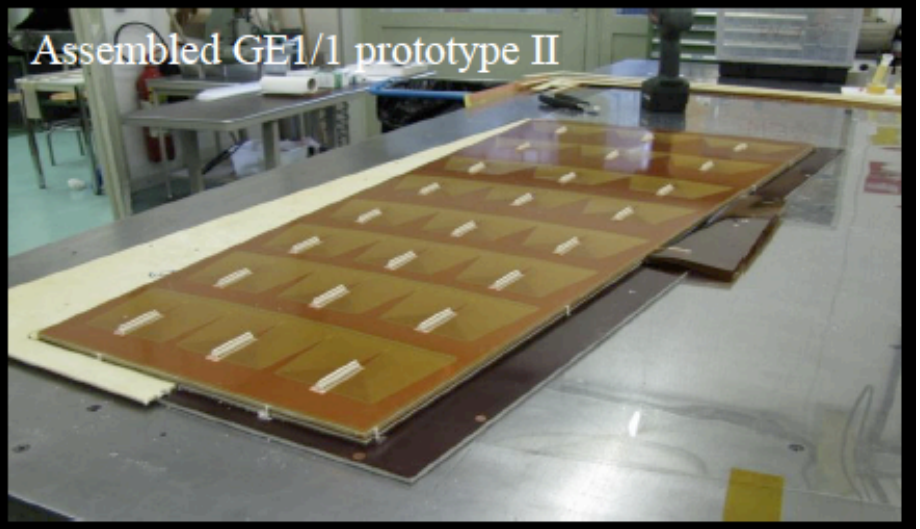
Total active area covered ~ 300 m^2

GE2/1 on back of YE1



Large area CMS GEM R&D





Extensive R&D by CMS Collaboration over many years:

- New Geometry (3-1-2-1) triple GEM with Ar/CO2/CF4 to achieve 4 ns timing resolution
- Participate in the development with RD51 Collaboration of the single mask technique for large area GEM
- NS2 technique for faster and spacer free GEM assembly
- Contributing in the development of the VFAT/SRS Electronics