Preliminary Drawings of SBS FT GEMs with U-V Strips

SBS Weekly Meeting, Jan. 16, 2019

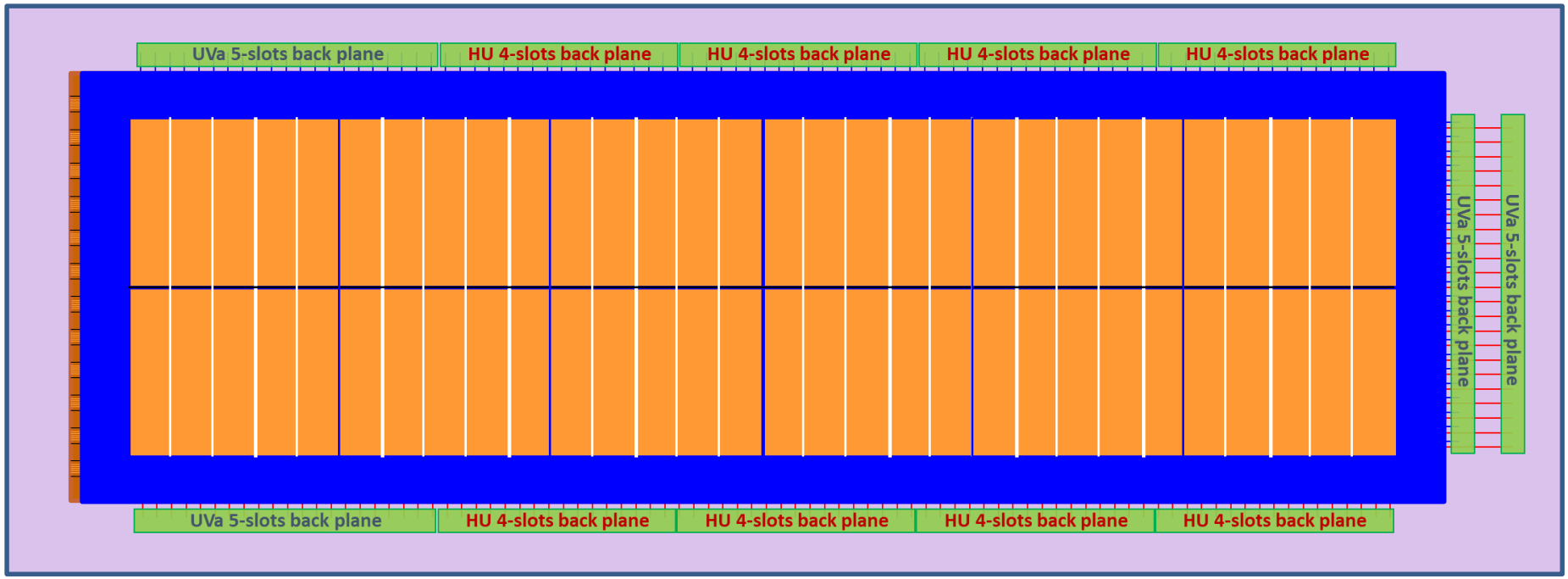
Kondo Gnanvo

Weekly meeting for the commissioning of the GEMs every Thursday at 9:00 am

Wiki: https://hallaweb.jlab.org/wiki/index.php/GMn_GEM_Commissioning_Meeting

Preliminary design of the new SBS FT GEM layers

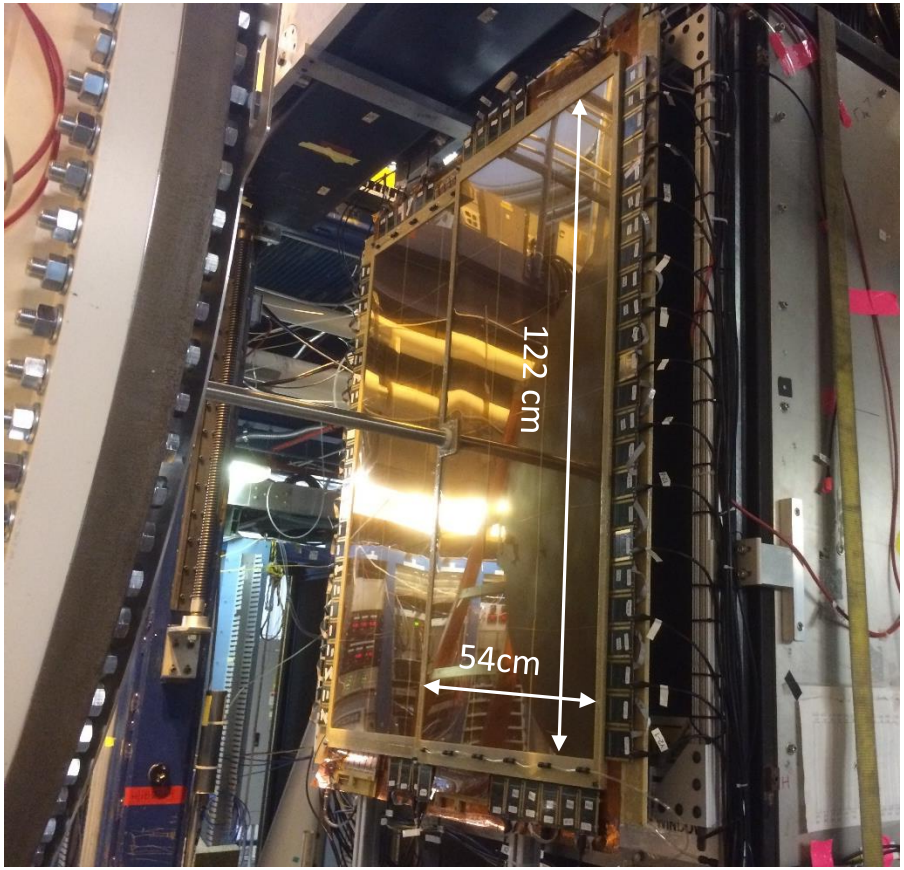
- ⇨ Investigation of two additional SBS Front Tracker GEM layers with U-V strips readout (90^{o} stereo angle)
- ⇨ Complement to the INFN Front Tracker GEM layers (with COMPASS 2D Cartesian strips readout)
  - ⇨ *Combination of U-V strips and X-Y strips will help the tracking in high particle rate environment*
- ⇨ New FT GEM layer will be one single large GEM (no dead area)
  - ⇨ *Unlike the current SBS GEMs layers based on the vertical stack of smaller modules*
  - ⇨ ***No dead area for frames or electronics*** *(other than spacers and HV sector boundaries)*
- ⇨ The GEM layer's active area is 150 cm × 40 cm
  - ⇨ *the exact size will be decided by the number of APV channels to cover*



Experience at UVa for Large GEM detector

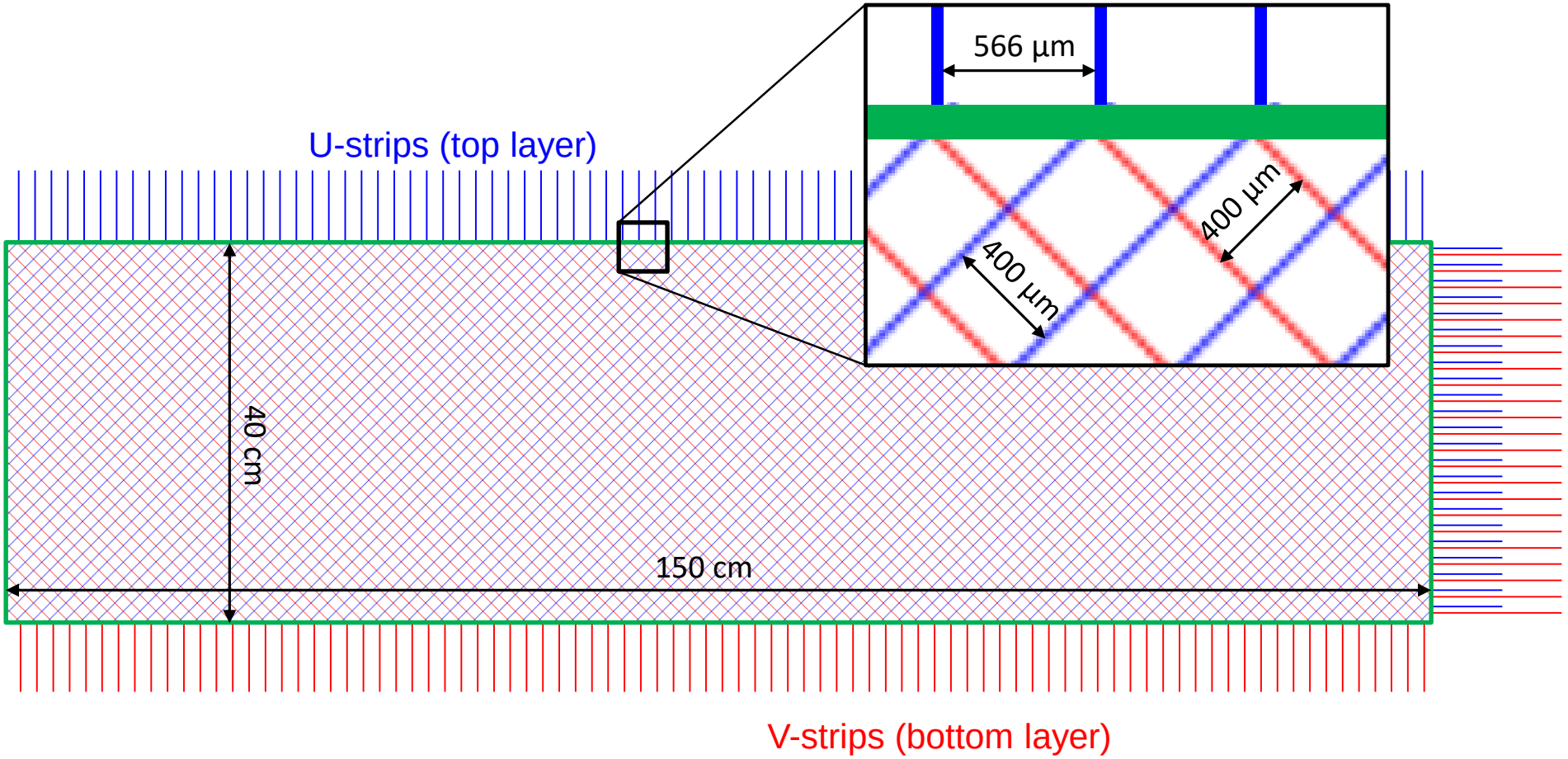
- **UVa has experience in the large area GEM**
  - Successfully built 2 large GEM chambers for the PRad Experiment that run in June 2016 in Hall B
- **PRad GEMs 122×54 cm² vs. FT GEMs 150×40 cm²**
  - similar active area: PRad larger in width but shorter in length
- **More challenges for production of PRad GEM and R/O foils because of the width**
  - Limitation of the raw material size (Kapton roll width)
- **Basic equipment for the stretching available at UVa,**
  - need some refurbishment work

PRad GEMs in Hall B (June 2016)



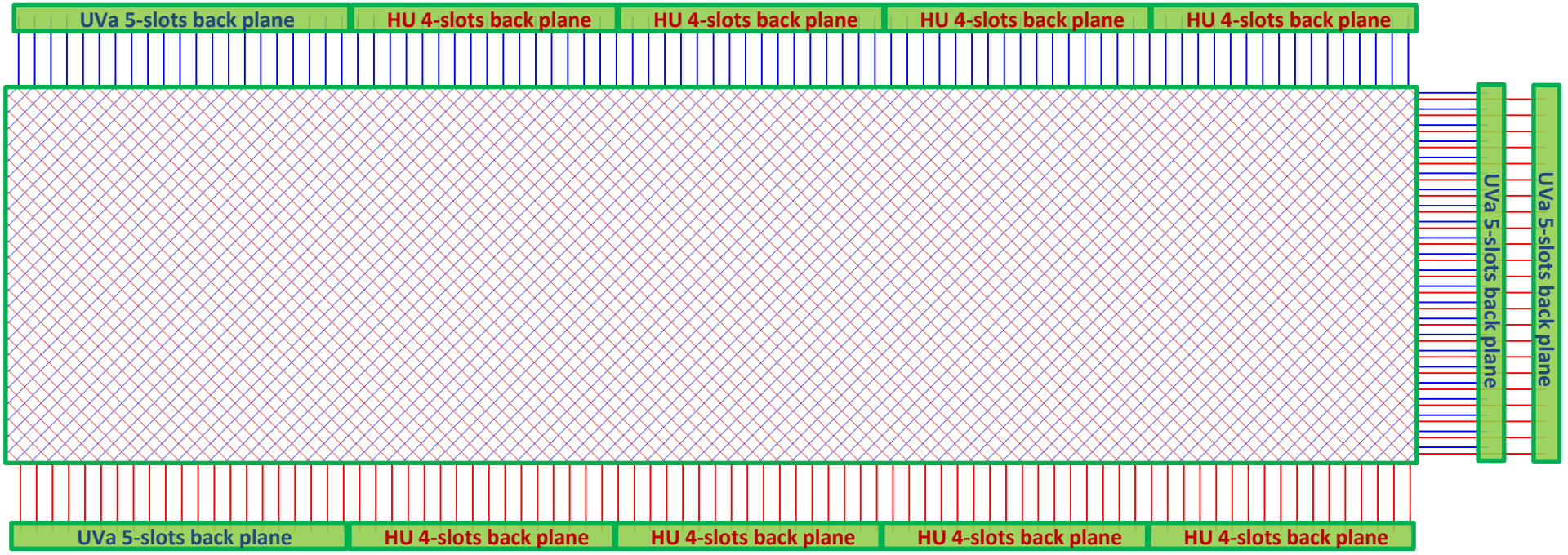
U-V strips readout layer (90º stereo angle)

- ⇨ 2D U-V strip readout with 90o angle between U and V strips
- ⇨ U-V Readout foil based on COMPASS 2D readout technology
  - ⇨ *top and bottom strips on same Kapton layer*
  - ⇨ *Pitch of 400 µm, top strip 80 µm, bottom strips 350 µm*
- ⇨ U-V strips successfully tested with EIC GEM prototype at UVa



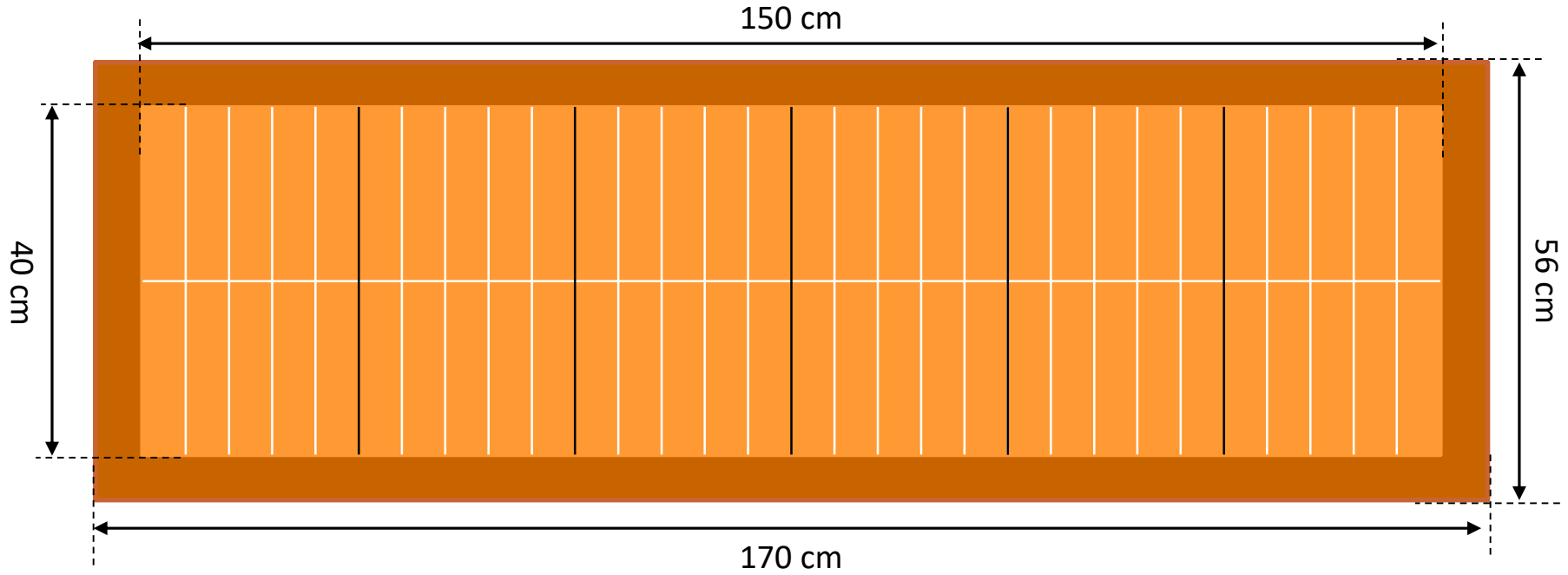
U-V strips readout layer (90º stereo angle)

- ⇨ MPD readout electronics requirements for on FT GEM layer
  - ⇨ *~ 6700 channels, 52 APV25 FE cards*
  - ⇨ *4 5-slots, 8 4-slots back planes and 3.5 MPDs*
- ⇨ Arrangement on the cartoon below.
  - ⇨ *Connection on the two long side and double layer connection on one short side*



GEM foil design

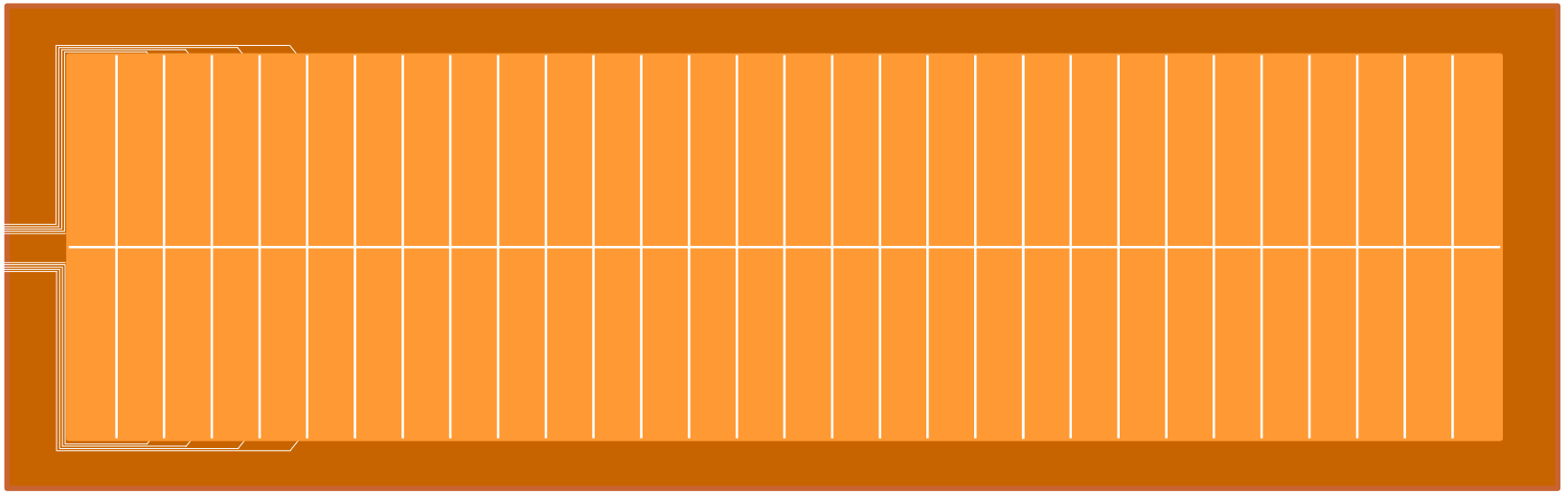
- FT GEM foil will be divided into:
  - *60 HV sectors (white strips) on the top side*
  - *12 HV sectors (black strips) or even up to 30 HV sectors on the bottom side*
- Segmented bottom electrode will help prevent from voltage drop on the divider in high rate
  - *We will discuss the optimal number of bottom HV sectors (6, 12, 30, 60) with CERN experts based on the fabrication challenges that this could cause*



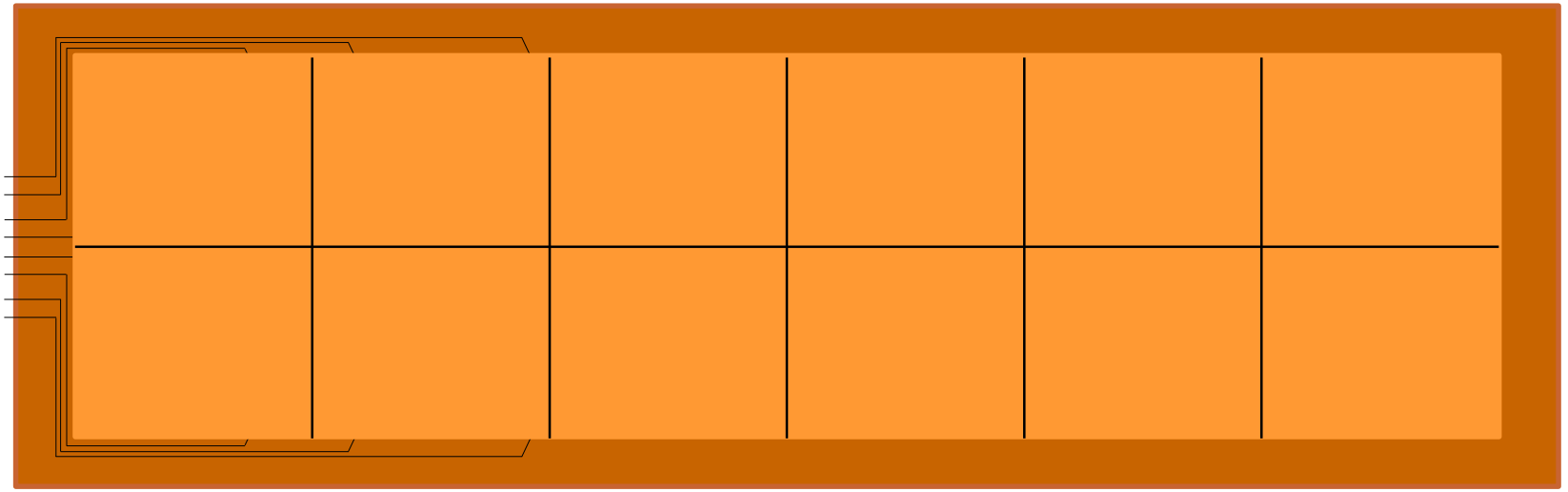
GEM foil design

⇨ All the HV sectors traces will be connected to one the HV divider on the short side of the foil (opposite to the side of the FE electrodes

Top side

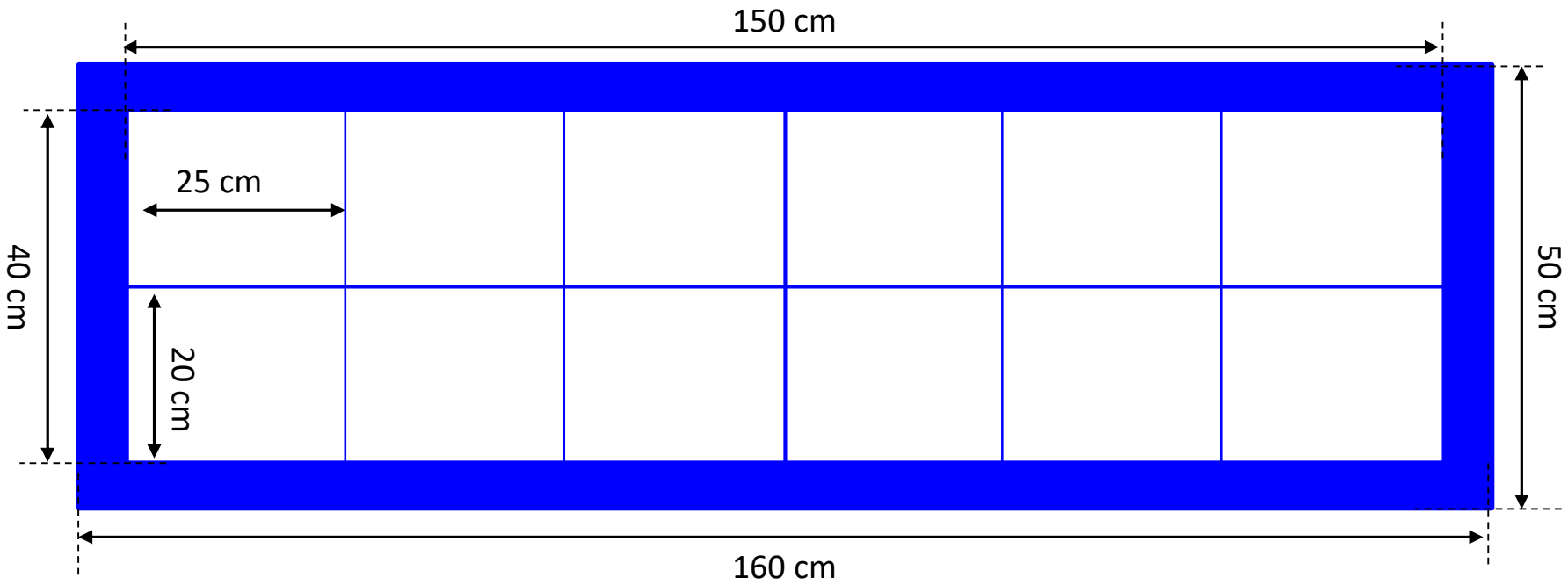


Bottom side



Support frames

- GEM support frame (width of 5 cm):
  - We can afford this because there is no frame material to minimize in the active area to minimize
- Spacers 5 (or 9) vertical and 1 horizontal one spacers in the active area.
  - Width 500 µm spacers
  - Minimize the number of spacers (5) but ensure a safe detector operation (9?)
- Produced by our usual vendor RESARM company in Belgium
  - Need to check with RESARM that there is no limitation in the size of the frames they can provide



Timeline for building 2 chambers

⇨ **Already discuss with Rui at CERN about the feasibility of the GEMs and R/O**

- He does not see any technical difficulty for producing

⇨ **Based on past experience, we should plan for 1 full year to have the two chamber delivered to JLab**

- Most of the time from GEM and R/O foils production at CERN: 6 months is the absolute minimum we could dream of
- We should try to make get the R/O and GEMs in Rui's schedule before end of March 2019: avoid summer shutdown delay
- Production of frames at RESARM (Belgium) is generally faster a few months

⇨ **Before GEM and R/O foils production start at CERN, in this order we would need to complete**

- GEM support frame design (CAD drawings) needs to be completed: Grad student at UVa
- GEM foil and R/O final design by me with the support of CERN expert: require a trip at CERN mid to end February

Update on UVa GEMs Cosmic Stand in EEL Clean Room 124

- **Assembly of the UVa GEM Cosmic stand is almost completed**
  - A few fixes
- **Plan to move the first GEM layer on the stand this week**
- **Meeting this afternoon with Chris Cuevas to discuss the LV power supply for the APV25 electronics**

Cosmic Stand with GEM layers