SHMS Drift Chamber Status Update

Hall C Collaboration Meeting
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Outline of the talk

1. Basic Design
2. Tests at ESB
3. Hardware status
4. Software and analysis status
5. Per plane efficiency Tests
6. Documentation
7. Acknowledgement

Diagram of Super High Momentum Spectrometer and Drift Chambers

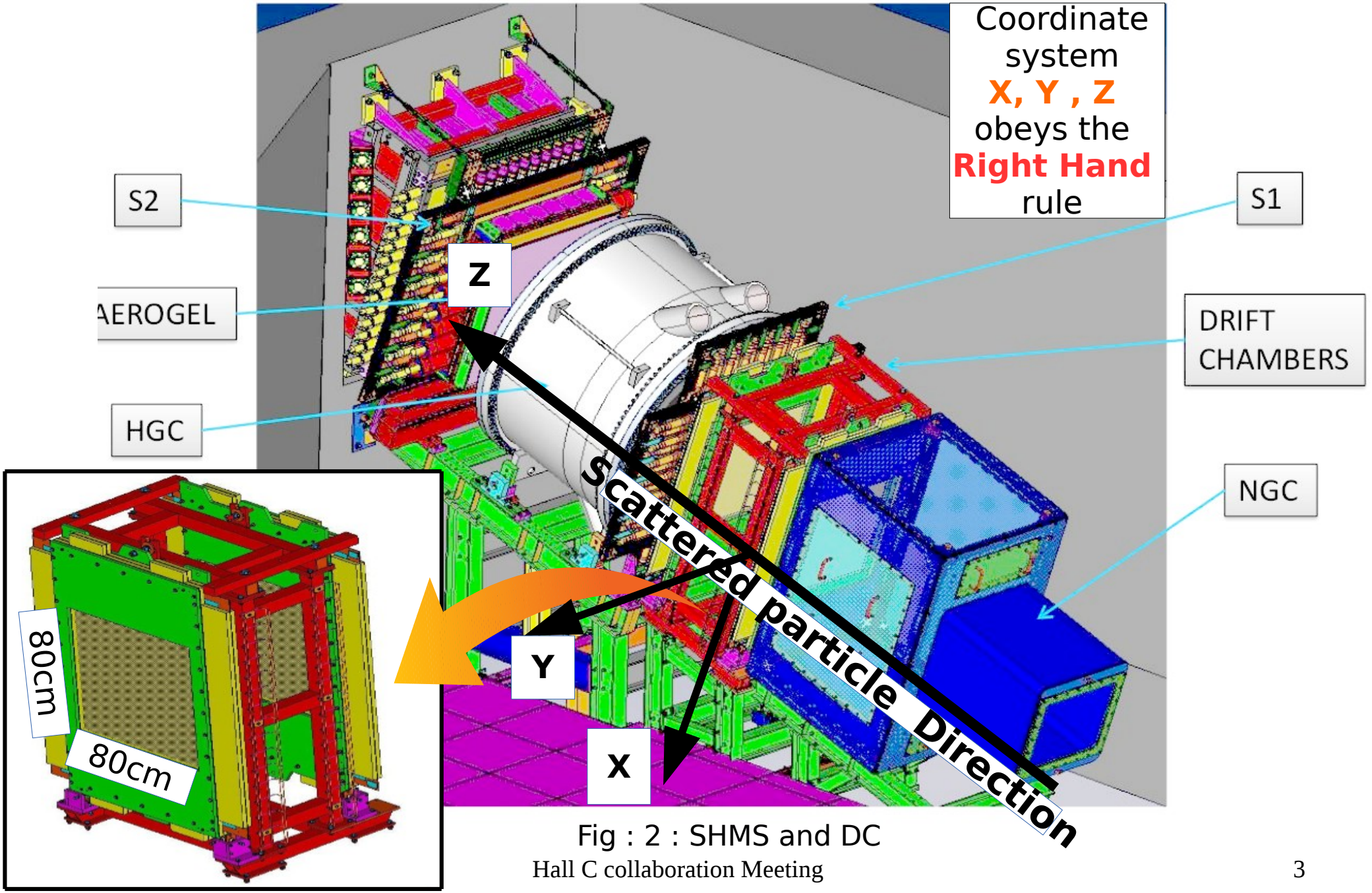


Fig : 2 : SHMS and DC

Two Drift Chambers

SHMS DC Requirements and General Design

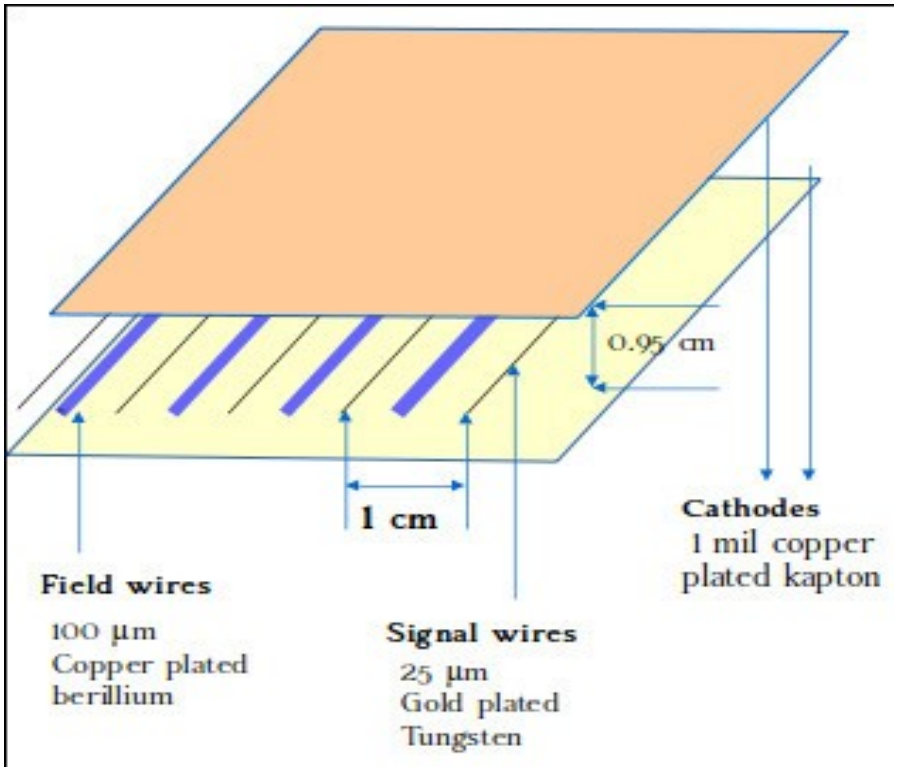
Requirements:

i) ~200 um position resolution per plane
ii) 5 MHz maximum flux
iii) Ability to utilize existing Nanometrics amp / disc cards outputting ECL logic signal.
iv) 80 cm x 80 cm active area

General Design:

→ Utilize *open plane* design with stacked PCBs for wire and Cathode planes Supported by rigid Aluminum plates. (same as previous SOS spectrometer)

→ Cell geometry same as HMS and SOS



SHMS Drift Chamber Design

→ 2 Chambers with ~1 m separation

→ 6 wire planes (1 cm cell) per chamber:

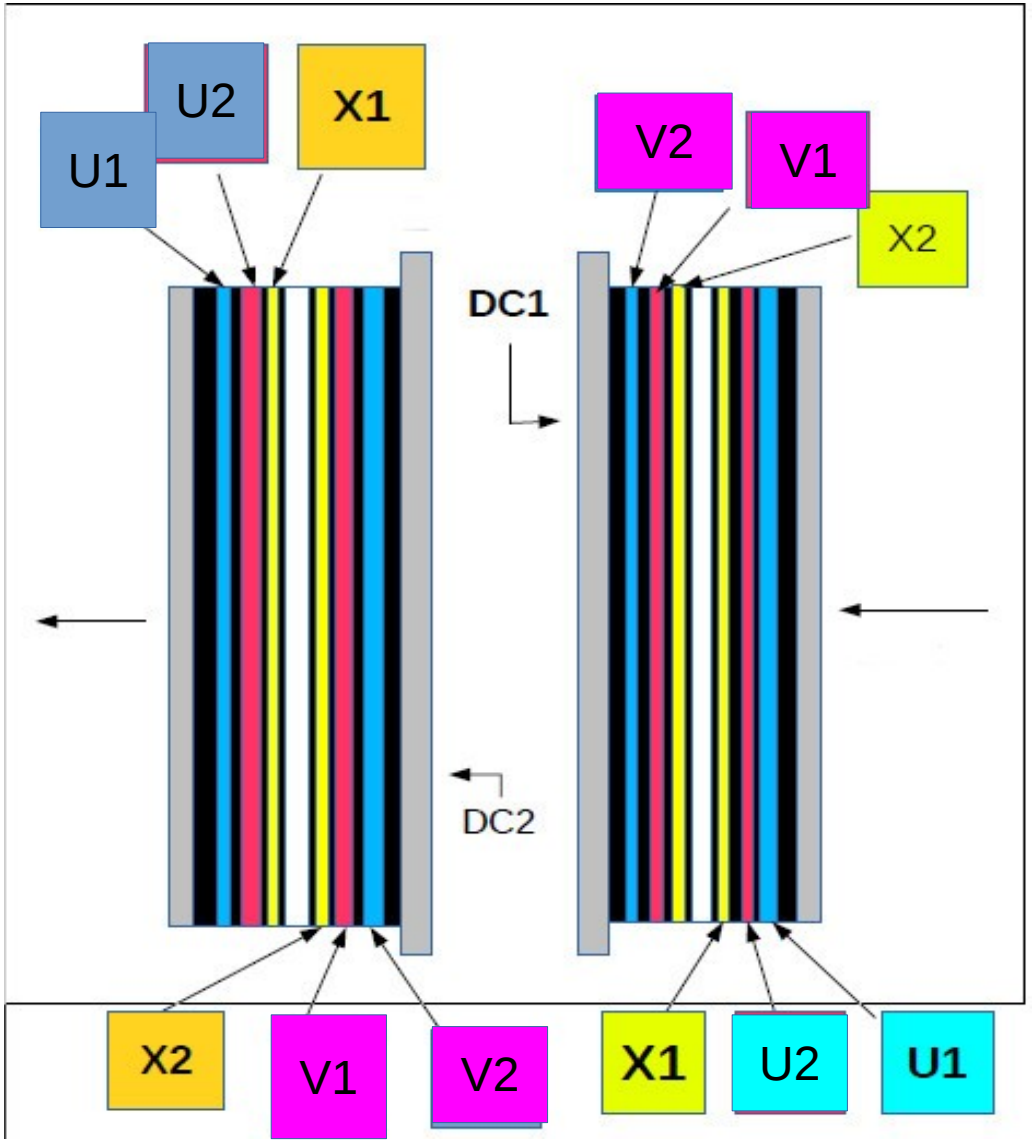
- 2 X-planes (dispersive position)
- 2 U-planes (+30 degrees to X)
- 2 V-planes (-30 degrees to X)

→ Each wire plane sandwiched between cathode planes (1 mil Cu plated Kapton)

→ Outer ¾" Aluminum plates

→ G10 frame with gas windows (1 mil Al plated Mylar) just inside plates

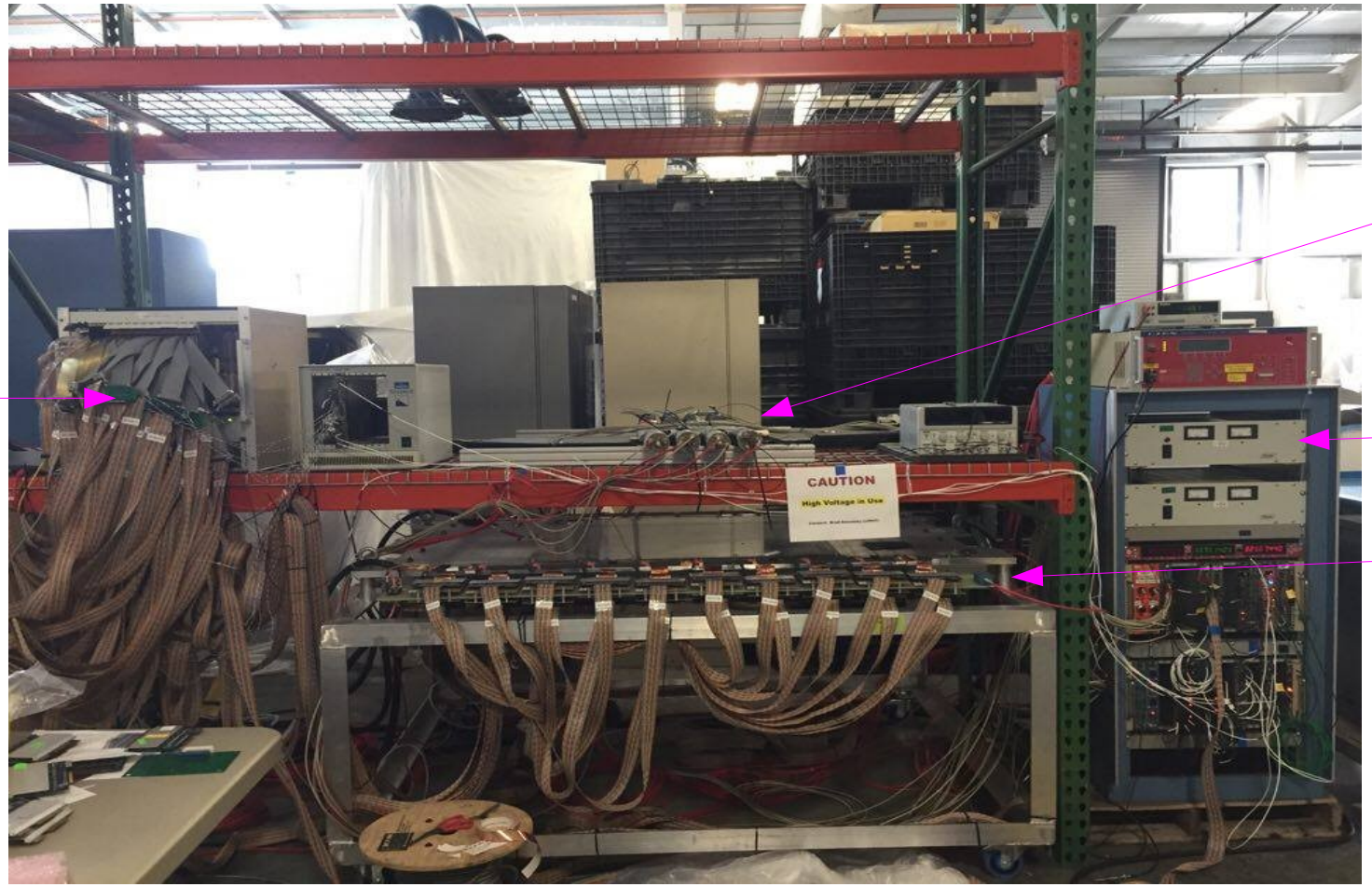
→ Nanometric cards plug into *card carriers* Mounted G10 midplane (protects wear and tear on chamber signal connectors).



- Complete construction of three chambers at Hampton University

- Moved to ESB building at Jefferson Lab

ESB test setup



TDC

scintillators

Power supply (HV & LV)

Chamber

Circuit arrangements for the determination of operating voltage at ESB

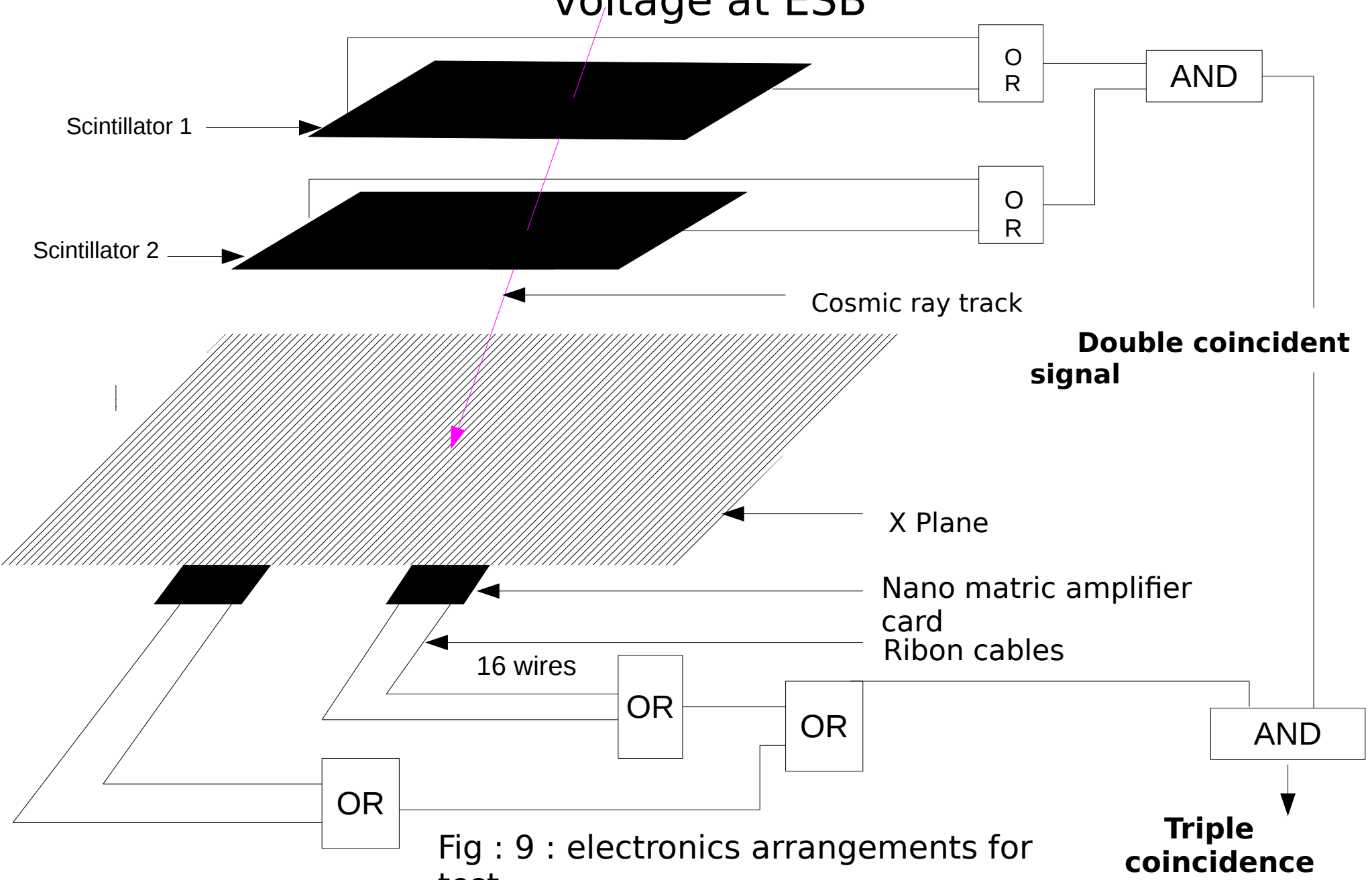
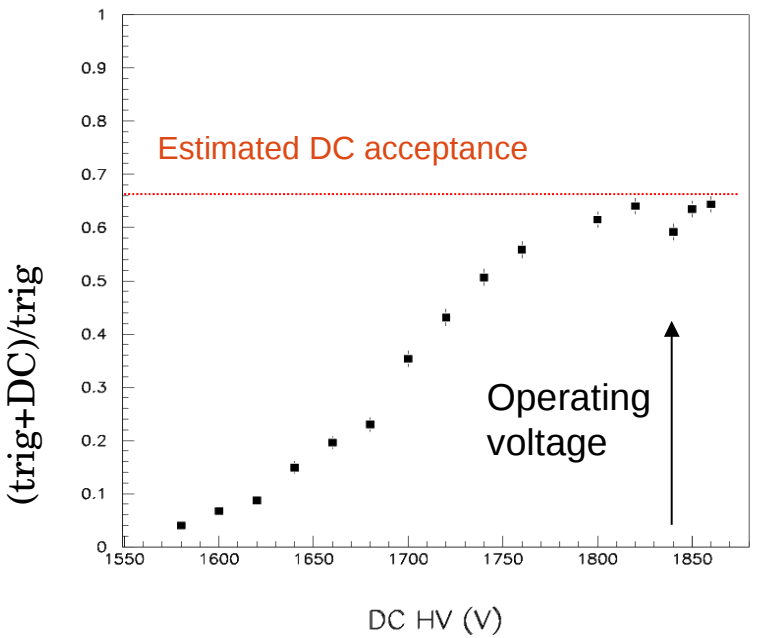


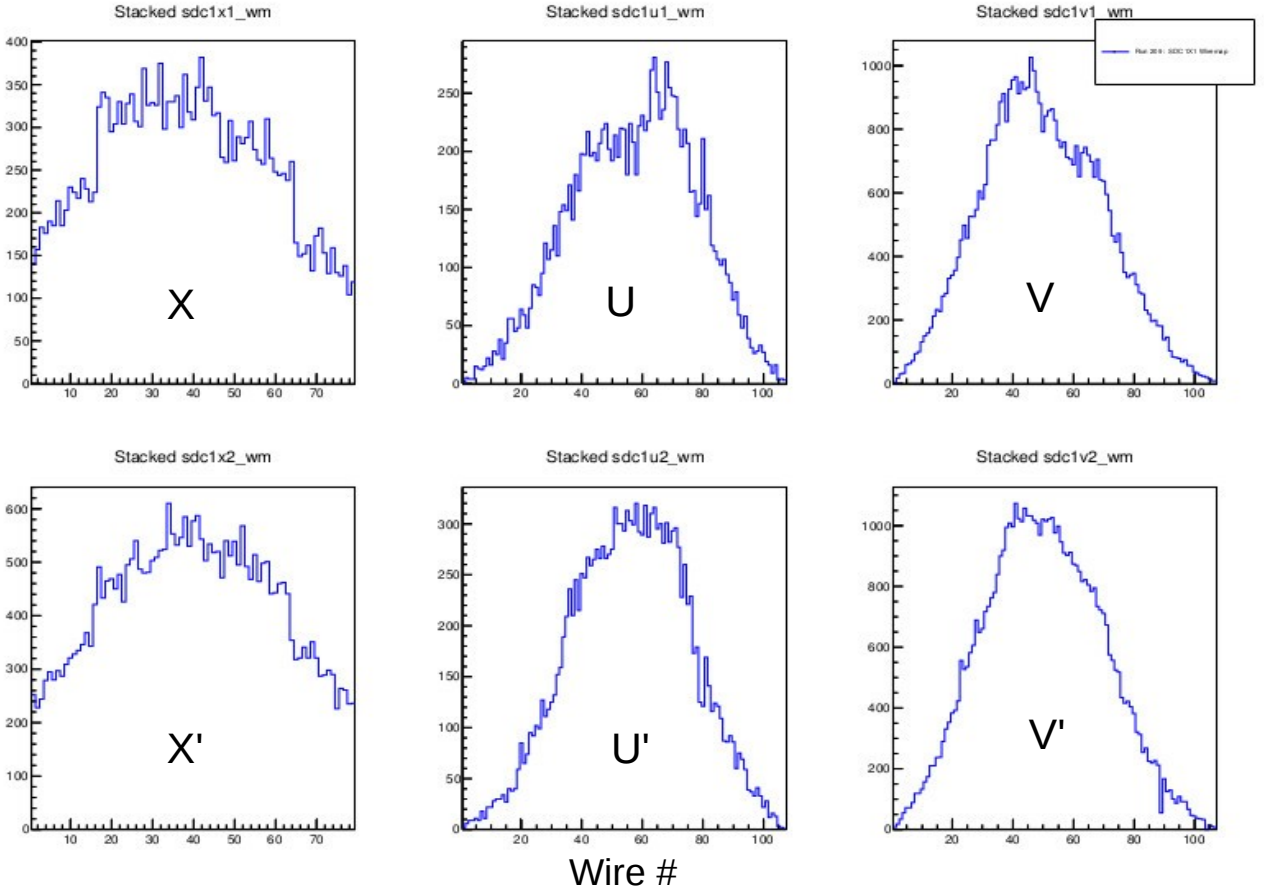
Fig : 9 : electronics arrangements for test

ESB test summary

Plateau (ArCO2 80/20)



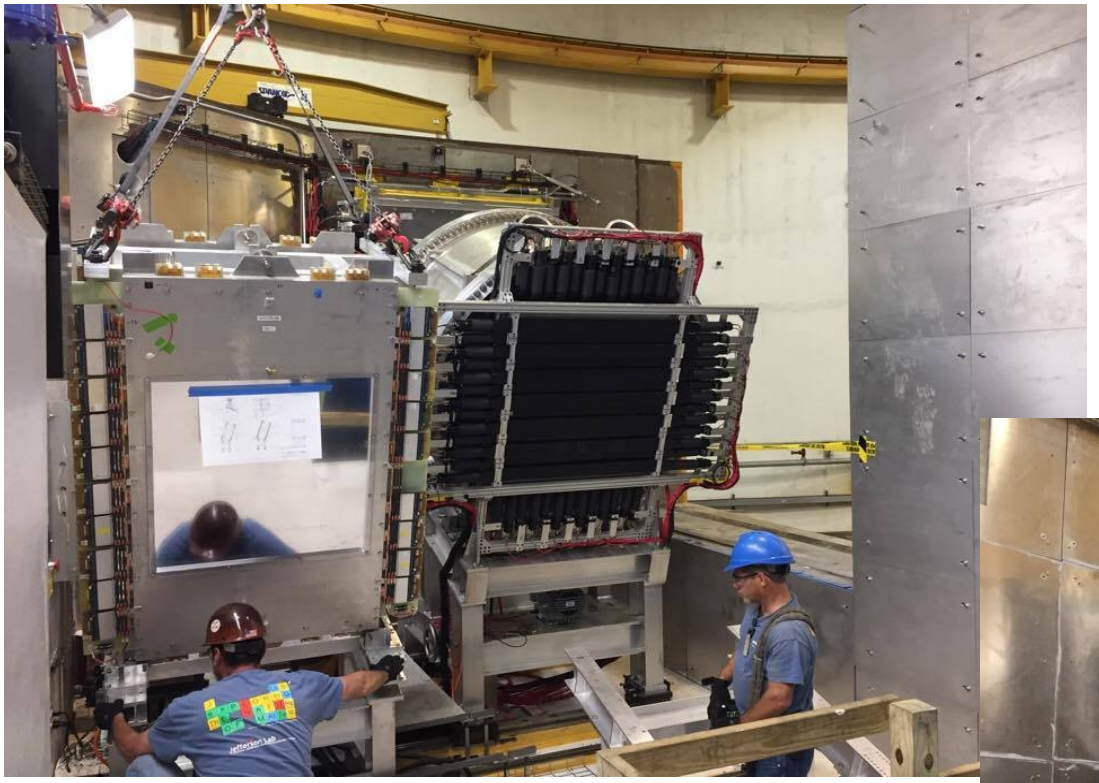
Per plane hit distributions (no timing cuts)



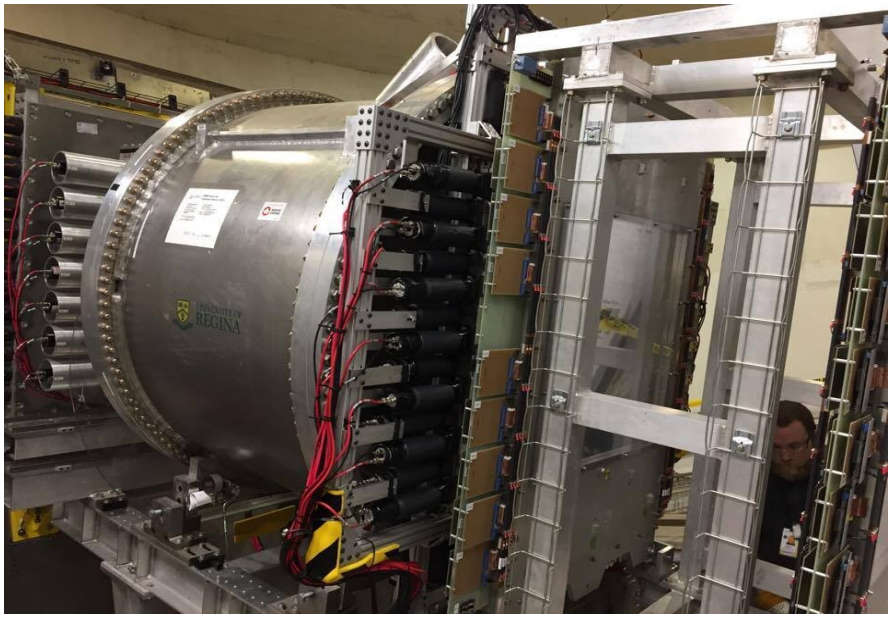
→ All channels firing

→ Shape as expected (acceptance ⊗ wirelength) with little noise variation between cards

Fiducialised and moved to hall c hut

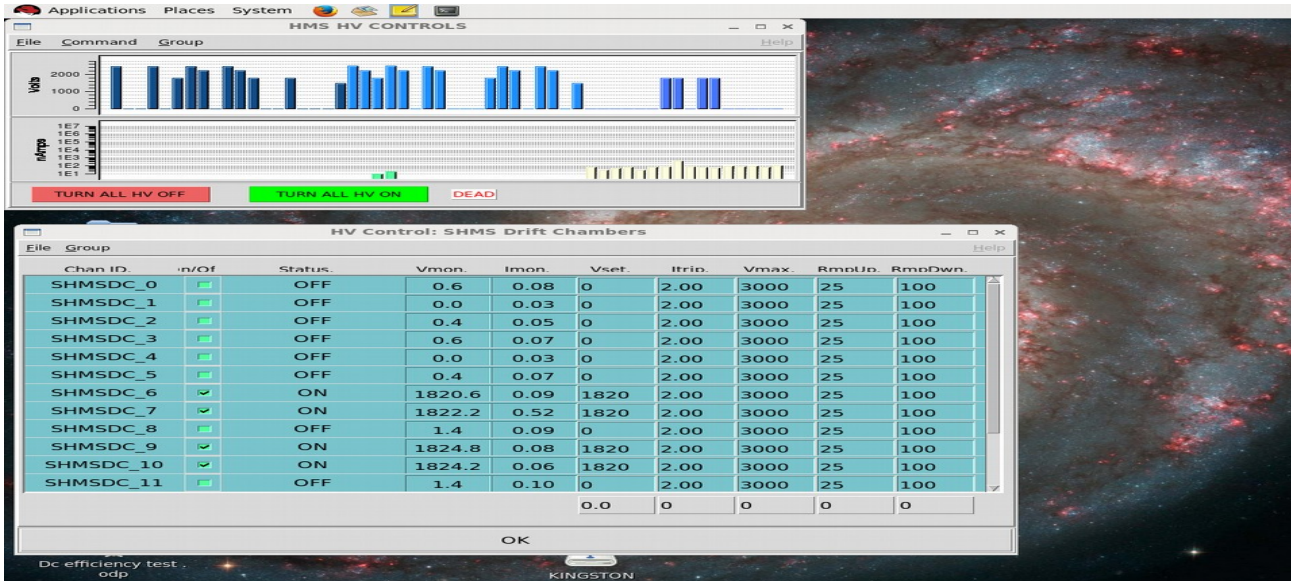


Hardware Status



- Drift Chambers were installed in SHMS stack at Hall C on late October 2016
- The High Voltage connections from Hall C counting house to the DC were installed
- The cathode planes and the wire planes were powered up separately for each chamber so that we can control wire planes and the cathode planes separately for fine tuning
- The Chambers are very well conditions and drawing very low amount of current (~10 nA) in 1800-1820 volts

- HV GUI was set and HV can be controlled remotely
- LV rails, card carriers, nano-metric cards, LV jumpers cables, signal cables installed



Hardware Status: Low voltage and Threshold

Amp / Disc threshold power supply
(future plan is to remotely control the threshold)

- Total 4 LV power supplies (Accopian) are used to supply the total power needed for all Amp / Disc (Nanometric) cards
- Each DC uses one +5V and one -5V power supply

LV Distribution box

- Original plan was to connect all the nano metric cards with LV supply in series
- Voltage was dropping much below the required 5 Volts
- LV rails were installed in the chamber and jumper cables were used power the pre amp cards
- To minimize the voltage drop from LV power supply to the rails LV distribution box was installed (Thanks to Chuck)
- Very Low guage wires were used to mimimize the Voltage drop and connected to rails through the fuses

Hardware Status: Complete

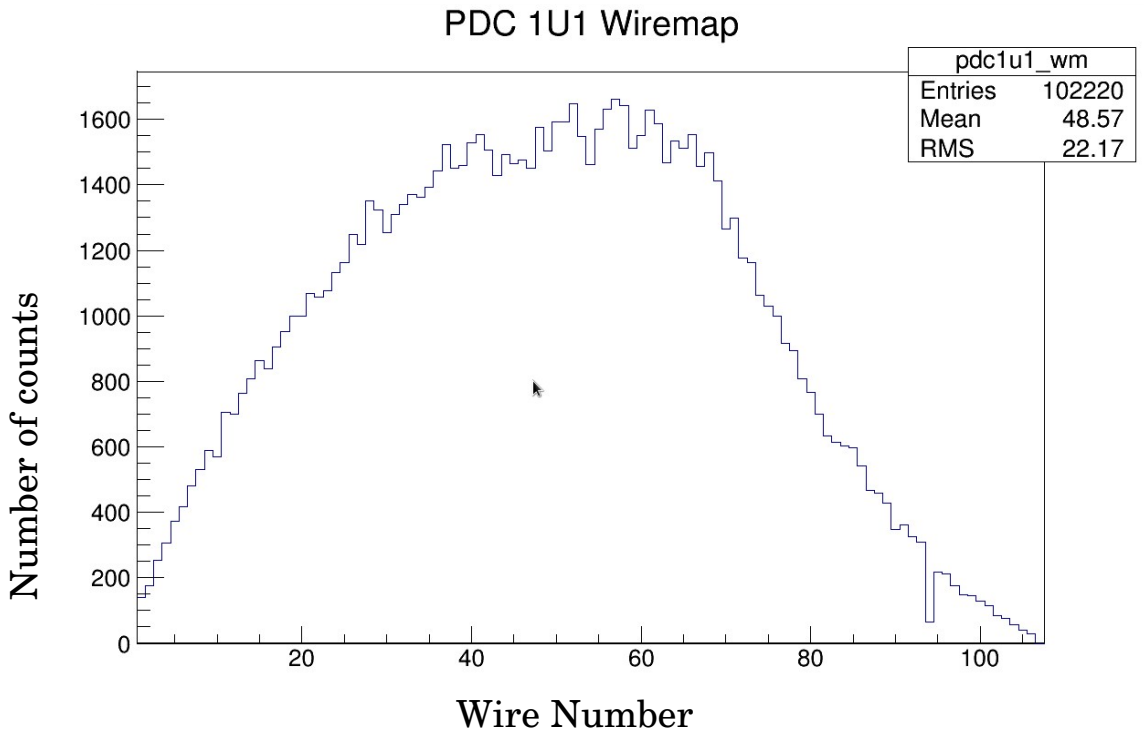
- Signal cables connected to Nanometric cards on chamber side
- Cables are propely dressed into the cable trays attached to the frame
- Ribbon cables run under the flooor and come to the next room and are connected to the TDCs
- Chambers and front end electronics are properly grounded

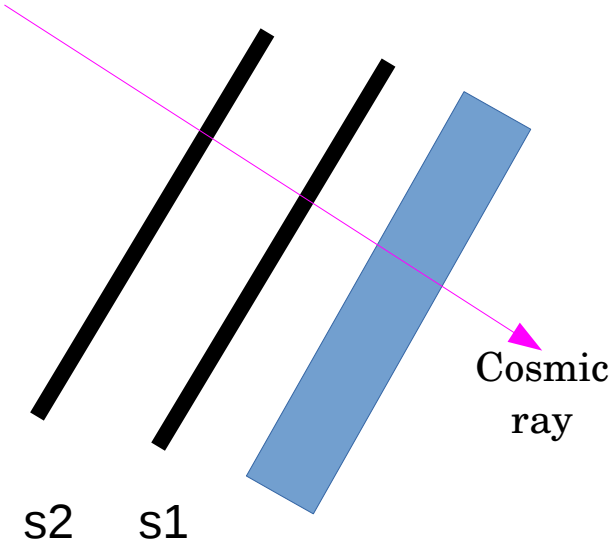
Safety Measures

- All the voltage connections are labeled
- The back of the low voltage power supply were covered
- High Voltage jumper cable connections were covered by plastic boxes
- LV rails are covered by plastic cases
- Everything is well labeled so that even someone not familiar with the hardware can easily understand
- Caution signs were used for the all high voltage connections

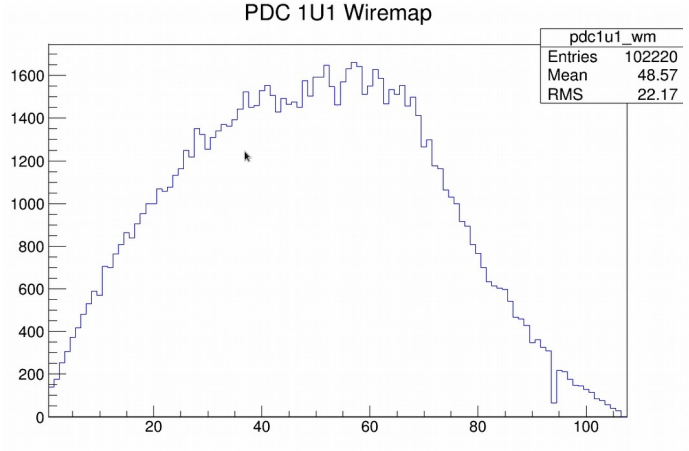
Software / Analysis Status

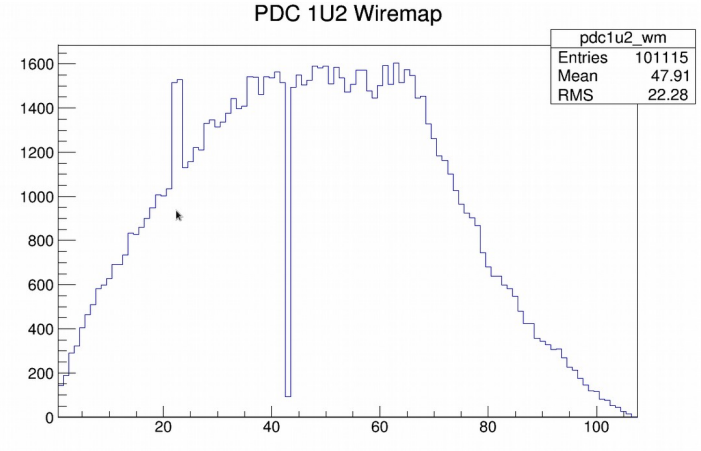
- Chamber has been read out by HallC DAQ
- HV GUI is set up
- HV GUI and DAQ can be controlled remotely through a VNC session
- Hall C analyzer is used to produce ROOT files and histograms of hitmaps time distribution can be drawn

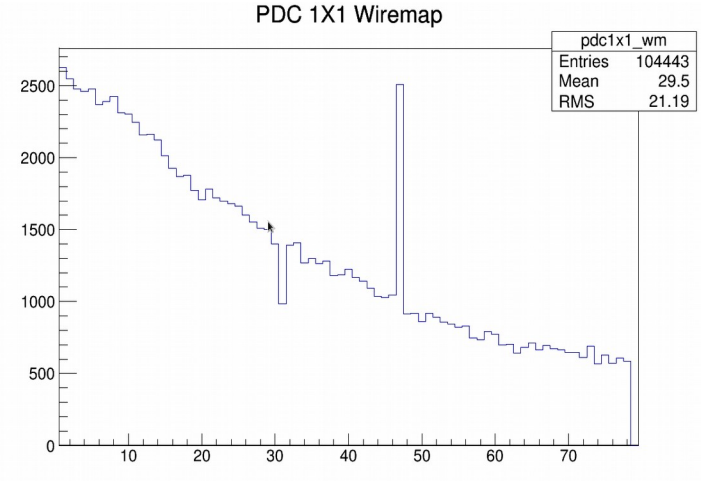


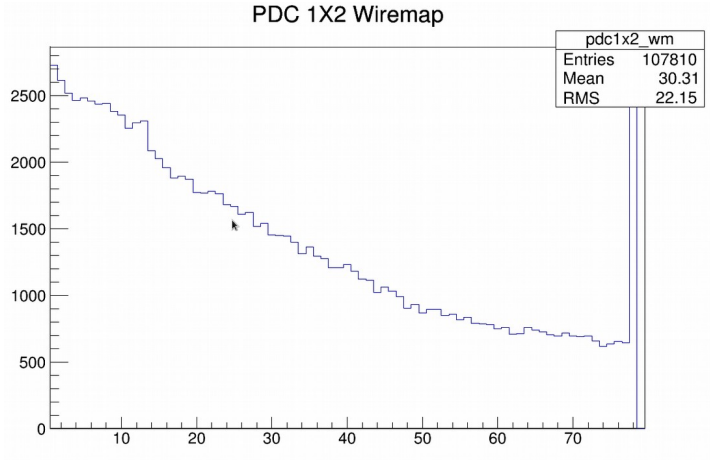


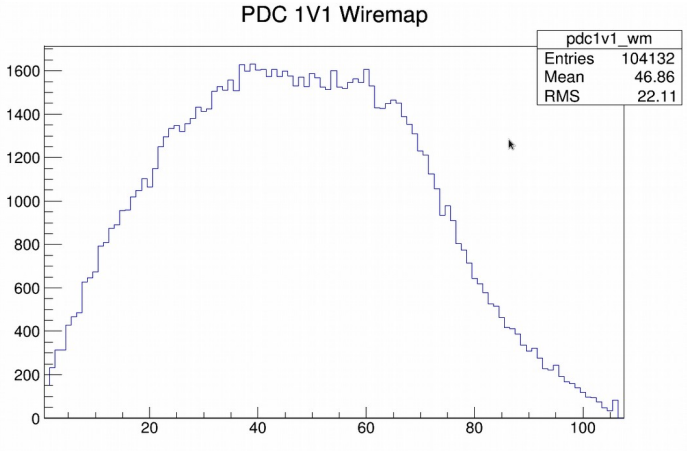
Software / Ananalysis Status
Hit Maps for chamber1

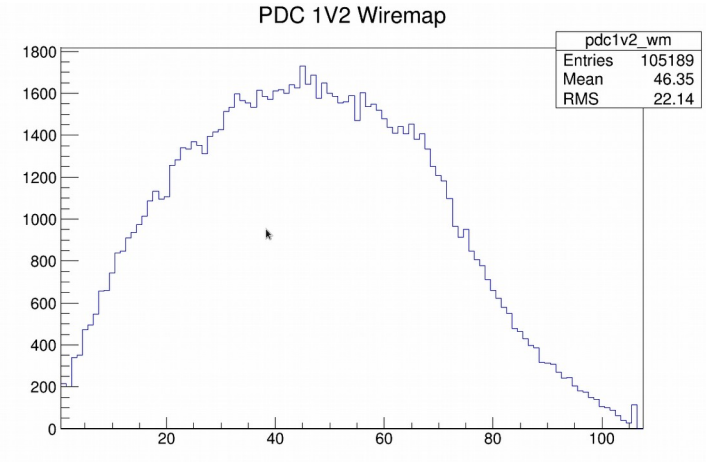




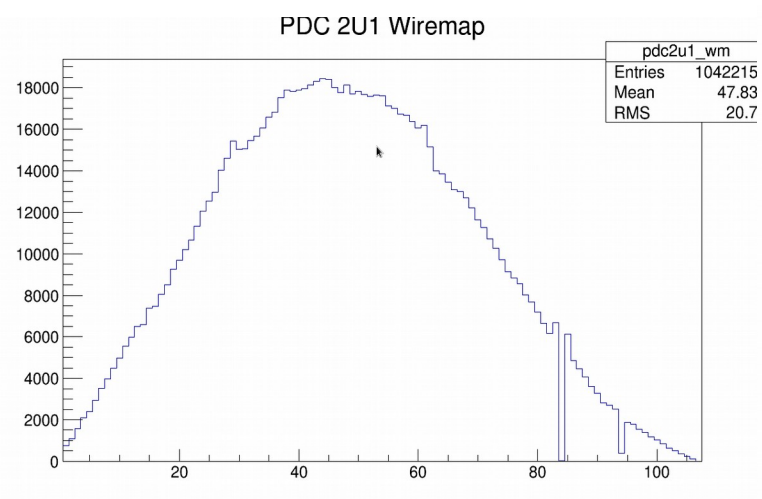


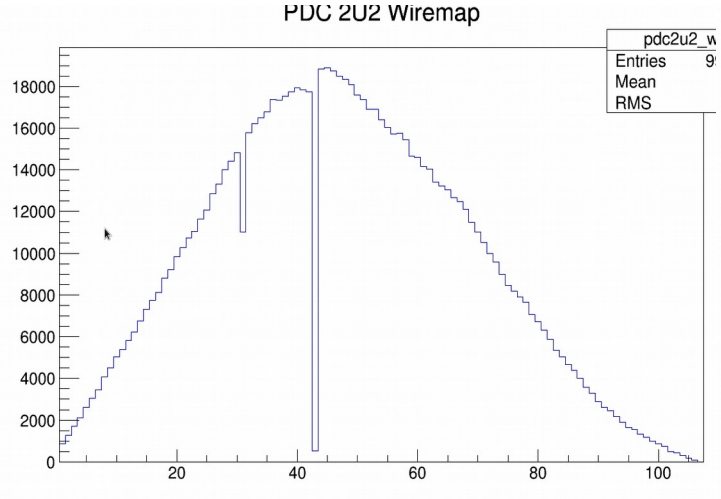


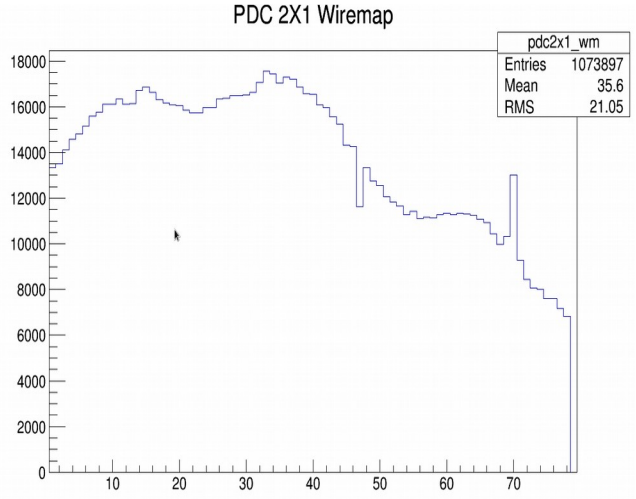


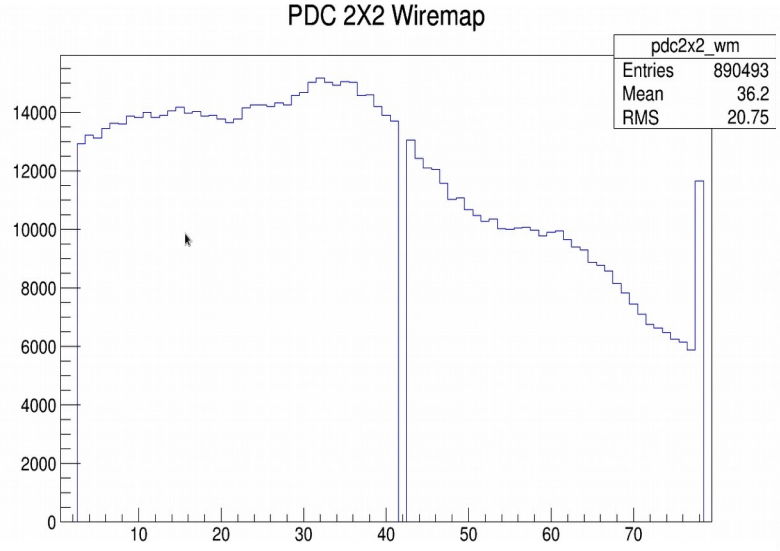


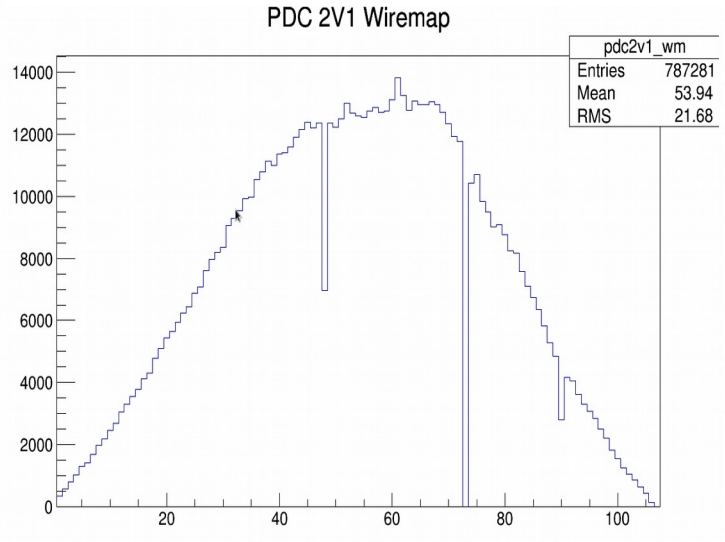
Hitmaps for chamber2

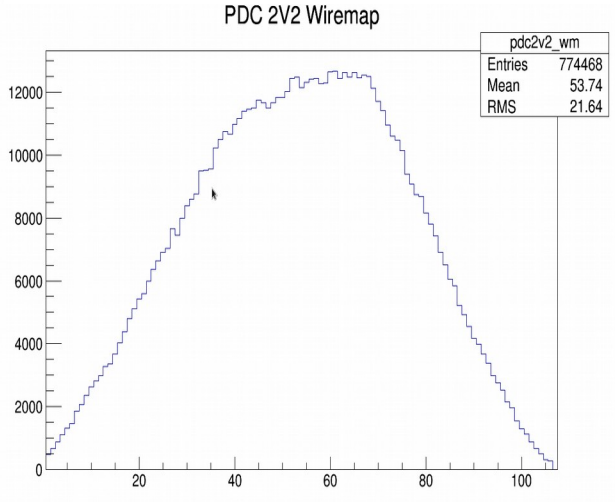












Per plane efficiency and noise ratio (NR)

- Right now we are not using the scintillators to define per plane efficiency
- If there are hits in all other 5 planes, that event corresponds to a real track (should)
- Then we should expect a hit in our plane of interesrt
- When all other 5 plane fires, we should look if there is any hit for our plane of interest (did)
- Efficiency is defined as the ratio of (Number of did) to (number of should)
- Noise ratio (NR) is defined as the ratio of (Number single or multiple hits) to (Numbers of single hits)
- By threshold scan and the HV scan we have to find out operating HV and threshold for which NR will be minimized and Efficiency will be maximized

Per plane efficiency and NR

Plane	Efficiency	Noise Ratio
1U1	0.961392	1.2802
1U2	0.955339	1.287
1X1	0.964503	1.29334
1X2	0.977949	1.3028
1V1	0.964931	1.24446
1V2	0.956163	1.24567
2U1	0.983878	1.48223
2U2	0.973586	1.45393
2X1	0.978698	1.67411
2X2	0.932943	1.45565
2V1	0.910134	1.29506
2V2	0.900648	1.28468

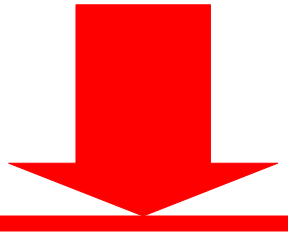
High Voltage : 1800 Volts

Threshold : 4.5 Volts

- For this particular combination of HV and Th, Efficiency per plane looks satisfactory
- For plane 2V1 , 2V2 efficiency is little bit low
- Probably for some missing wires in 2V1, 2V2 effciency become little bit low

Future Plan before getting beam in Hall C

- Recover all the dead channels which were working perfectly at ESB
- Complete our Threshold and HV scan with Ar + CO_2 (75:25) mixture
- Generate time to distance map (by next week)
- Completion of tracking and position residuals (by end of January)
- Optimizing threshold and HV for Ar + Ethane (50:50) mixture



Ready for KPP run !

Documentation

Documentation about Drift Chambers can be found in Hall C howtos

Link : https://hallcweb.jlab.org/document/howtos/shms_drift_chambers.pdf

(This Page will be updated soon with recent experiment results)

Link for standard equipment manual :

https://hallcweb.jlab.org/safety-docs/current/Standard-Equipment-Manual.pdf

Acknowledgements

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Thanks You !