

**Status Update On The New HMS Wire Chamber
Hampton University Group Meeting
12/05/2017**

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Outline

- Introduction
- Basic Design of HMS Chamber
- Test of HMS Chamber
- Plateau Curve
- Test Summary at ESB
- Summary
- Some Snapshots

Introduction

The new HMS Chambers are being built to replace the old existed chambers using the same design of the SHMS chambers. The chambers will be used to track the scattered particles after beam collides with a fixed target to determine the momentum and scattering angle.

Chamber Construction at Hampton University

First Chamber

Started: May 10 2016

Completed: August 10 2016

Shipped to Jlab: 08/12/2016

Second Chamber

Started: August 12 2016

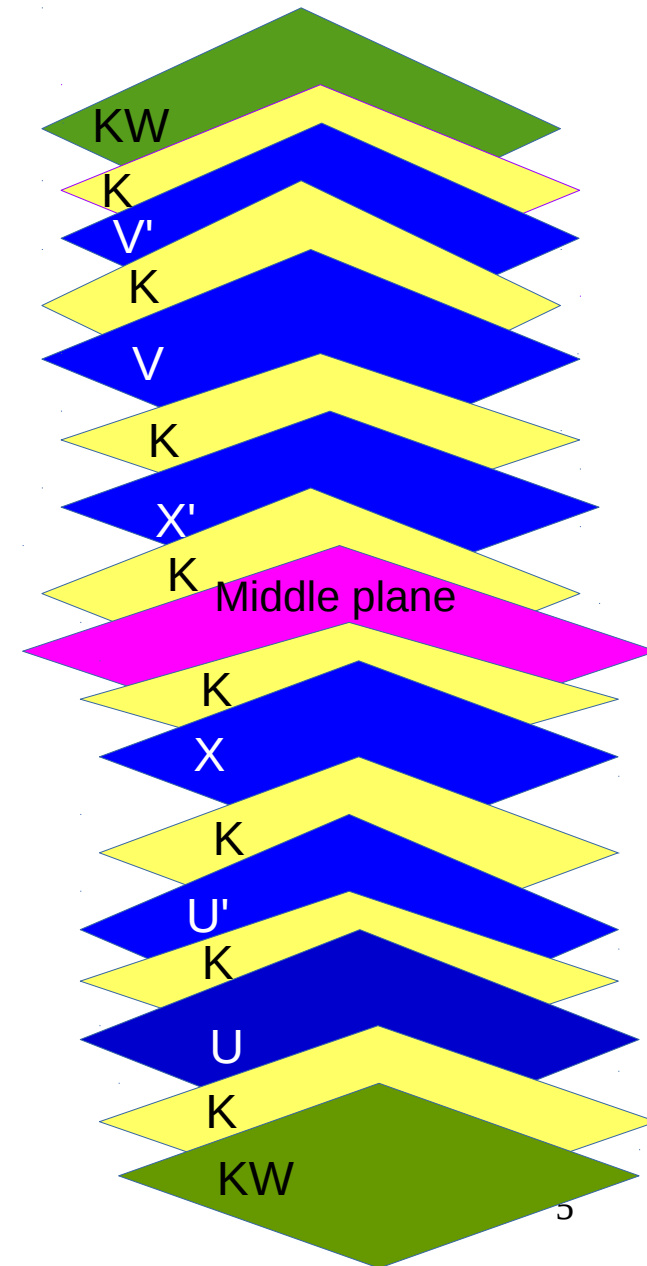
completed: November 06 2016

Shipped to Jlab: 11/11/2016

Basic Design

It consists of:

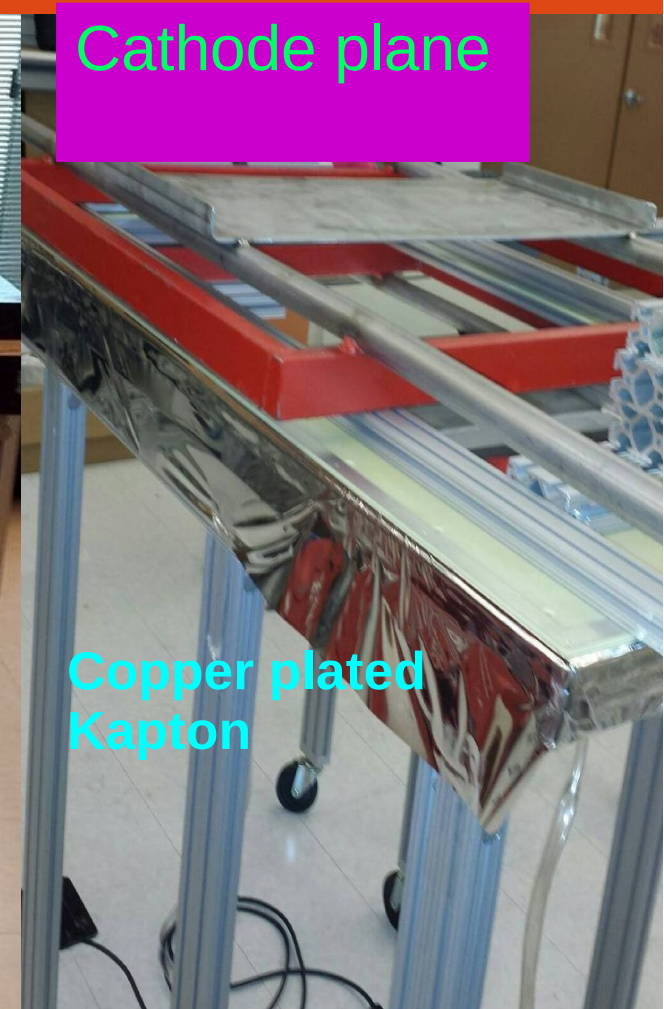
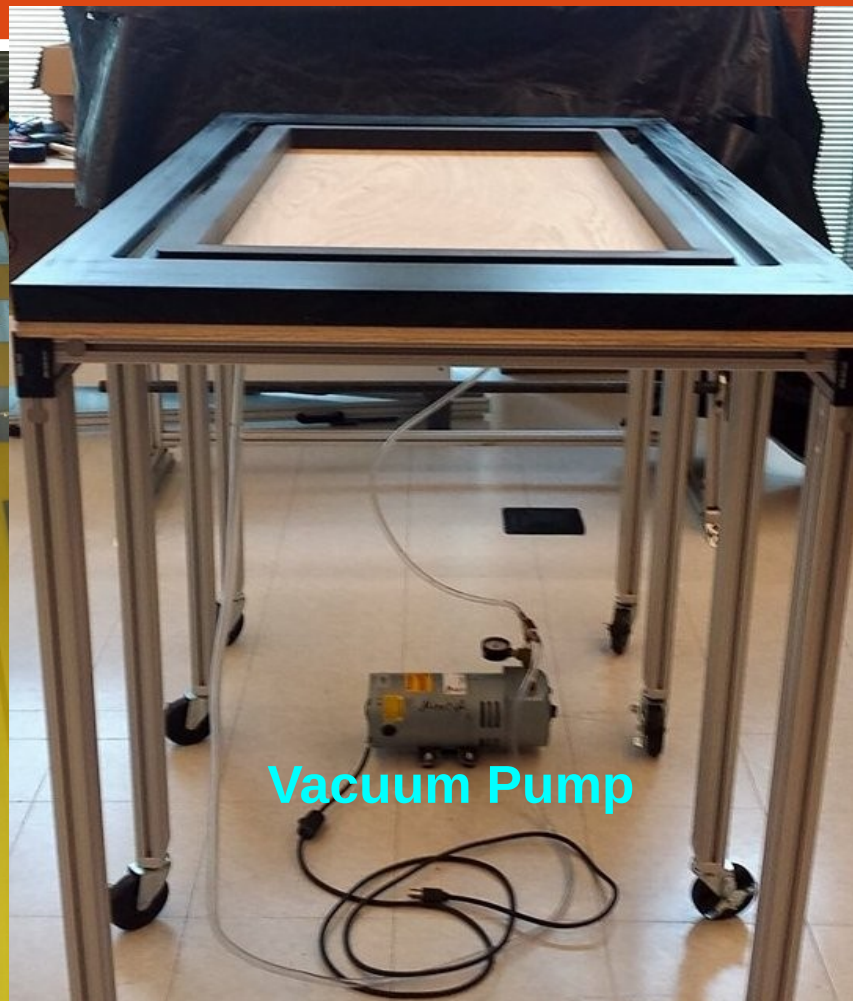
- 2 cathode windows (KW)
- 8 cathode planes (K)
- 6 wire planes (X,X',U,U',V,V')
- 1 middle plane with card carriers and readout electronics
- 2 Aluminum frames



Construction of Planes

Cathode plane

foil is stretched along a table connected with a vacuum pump and a k plane after applying mechanical epoxy is placed over the foil for 24 hours.



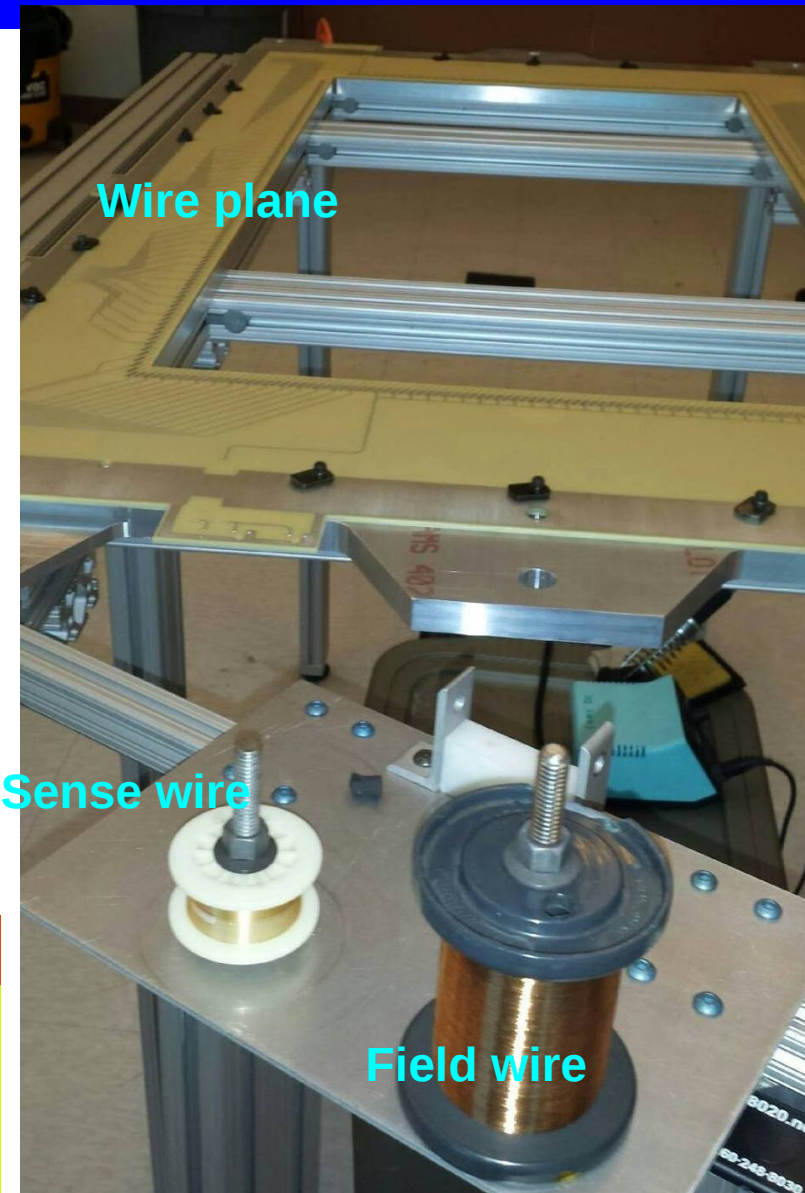
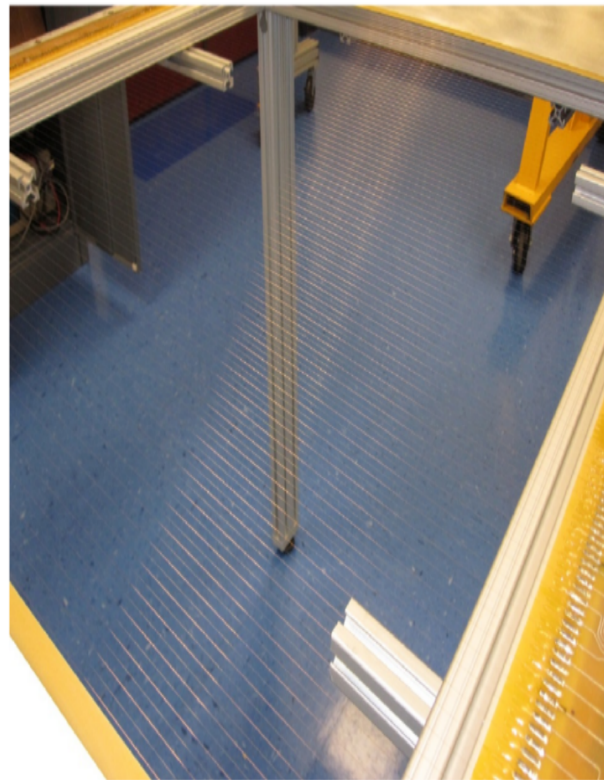
Wire plane

Wires are strung along the wire plane over the printed circuit board. Tension is fixed by hanging an iron bar on the wire. The position of the wire is fixed by solder and epoxy.

U-Plane:



X-Plane:

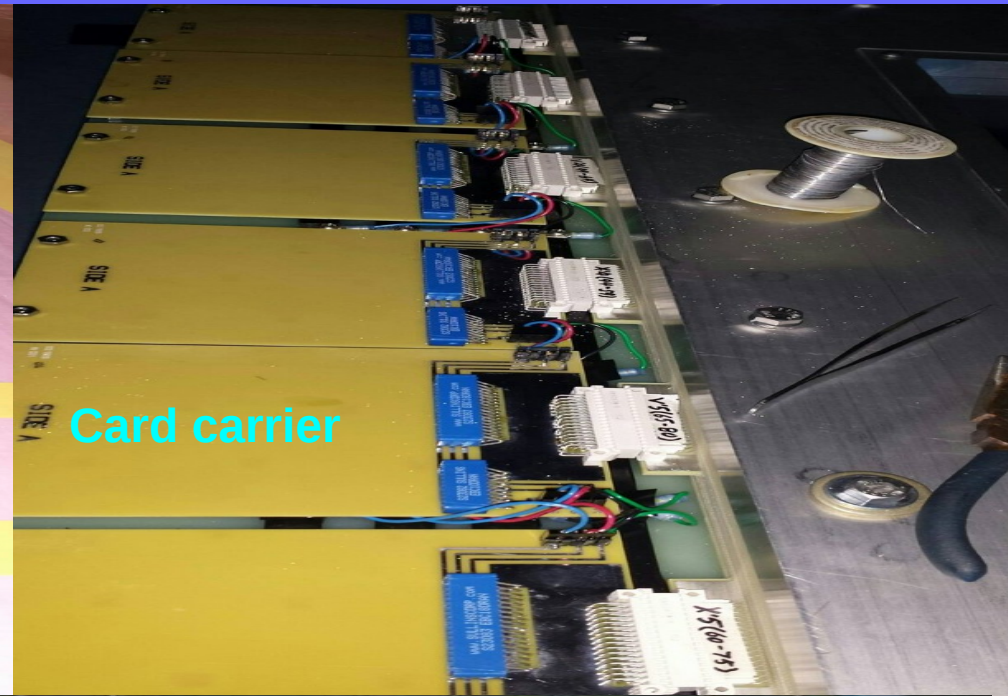


Picture shows SHMS wire plane

Types of wire used

- 20 μm Gold plated Tungsten sense wire
- 100 μm Copper-Beryllium field wire

Some Other Elements of Chamber



Operational Testing at ESB

Gas mixture used

Ar : *CO*₂ 75:25 by volume

Ar Ionizing gas

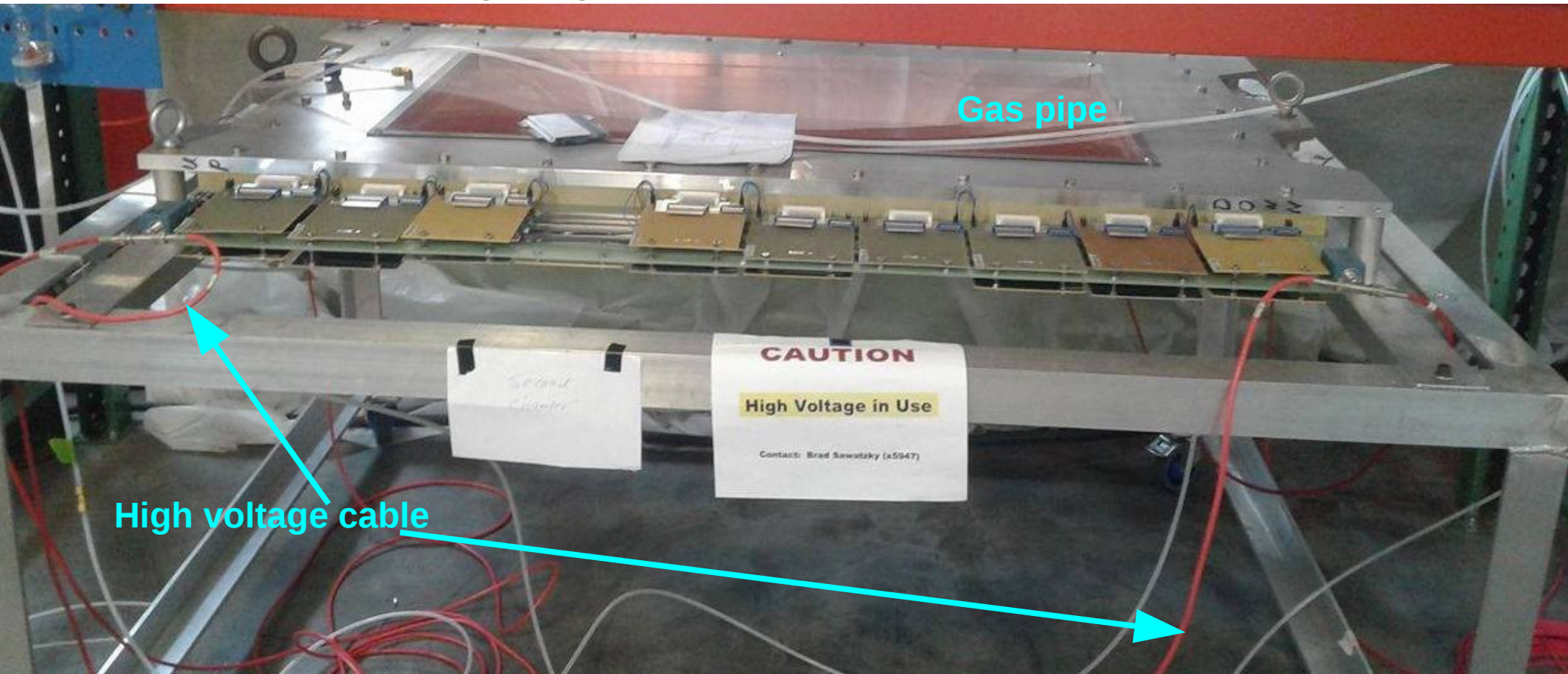
*CO*₂ quenching gas

The mixture is non flammable

Conditioning

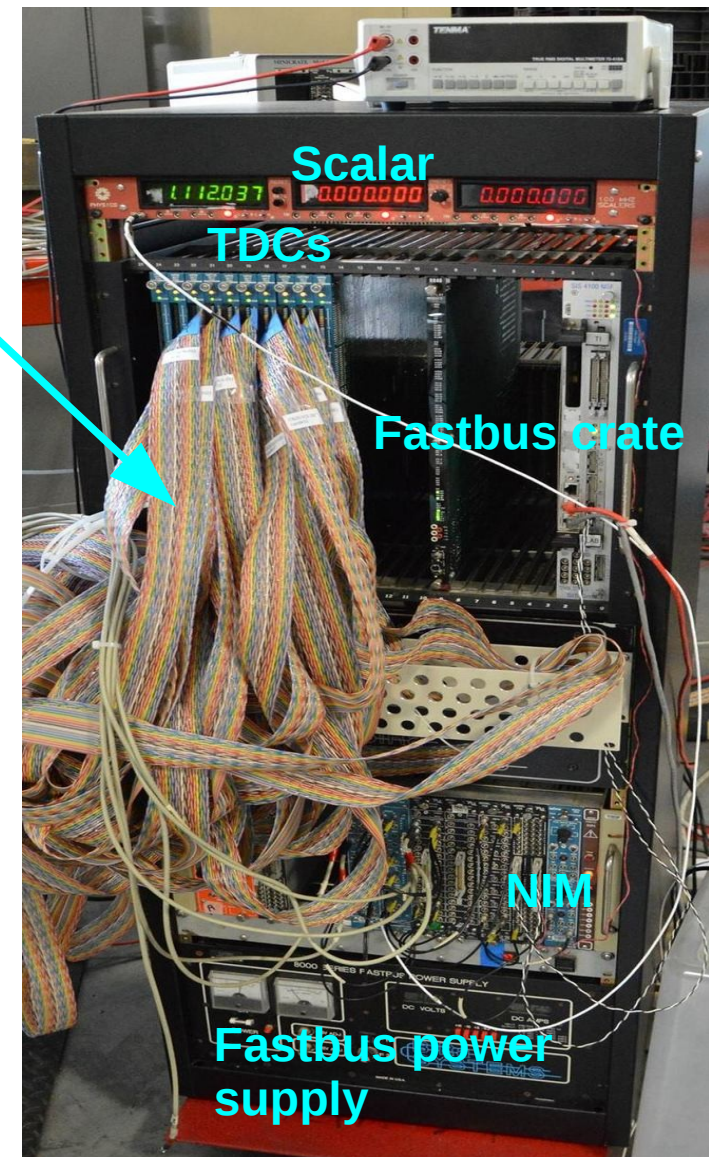
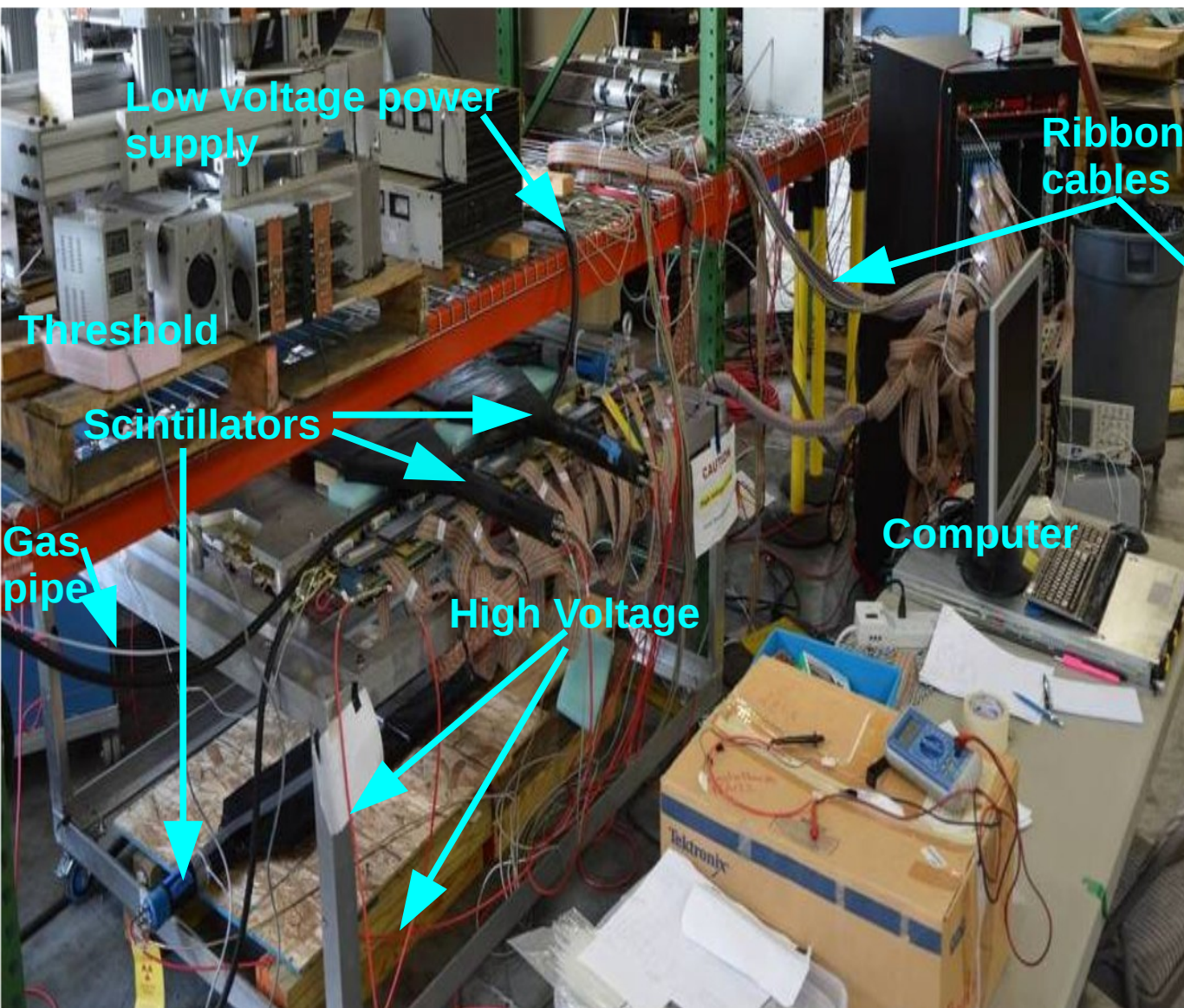
High voltage conditioning started before mid November and completed around first week of January 2017.

- chamber is connected to gas
- raised voltage up to 1860V
- At 1800V current per plane is less than 100nA



Hardware Setup at ESB

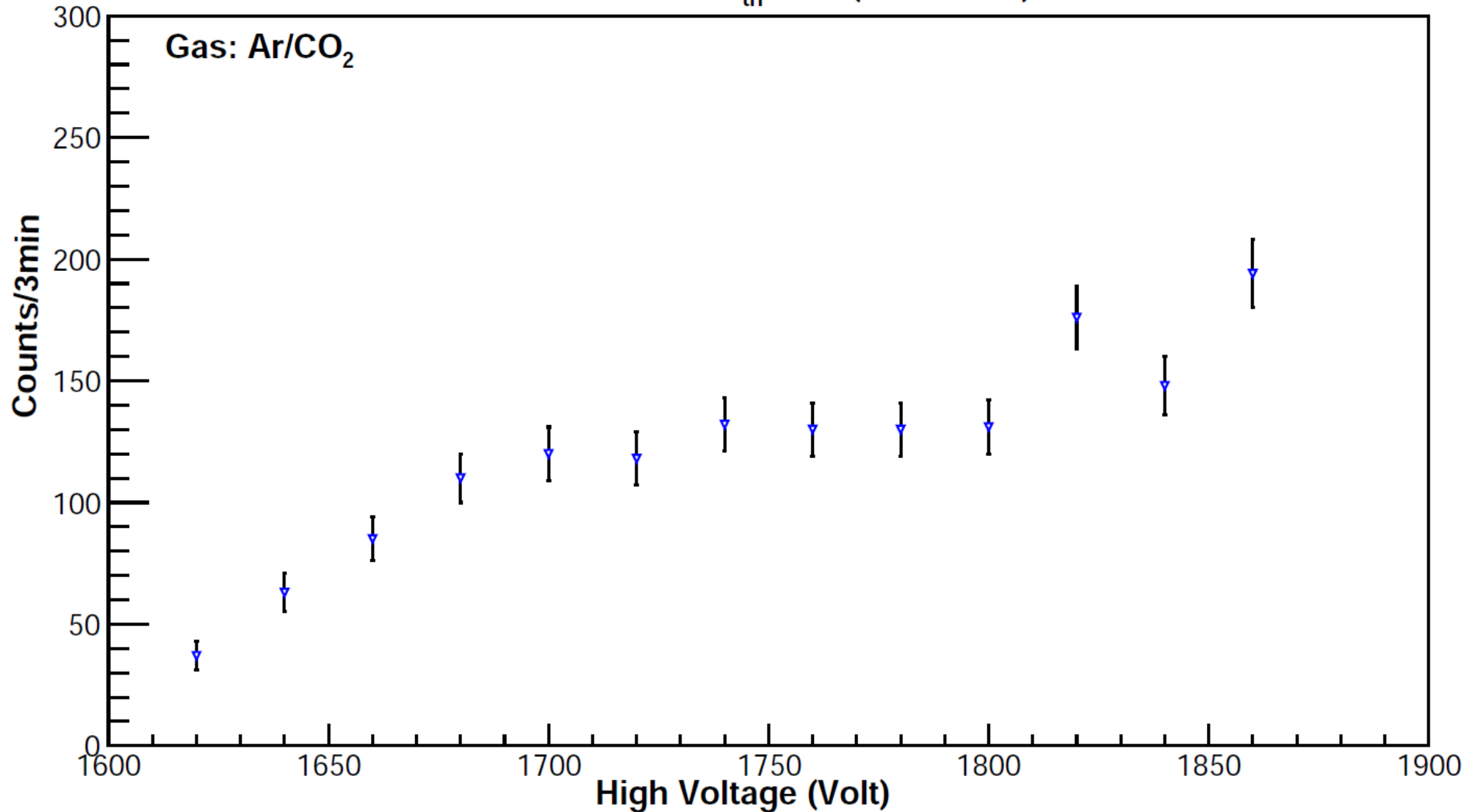
- All the ribbon cables connected from chamber (Nanometric cards) to the TDCs.
- Low voltage, threshold voltage and the high voltage are connected.
- Gas mixture, $ArCO_2$ is connected to the chamber.



Plateau Curve

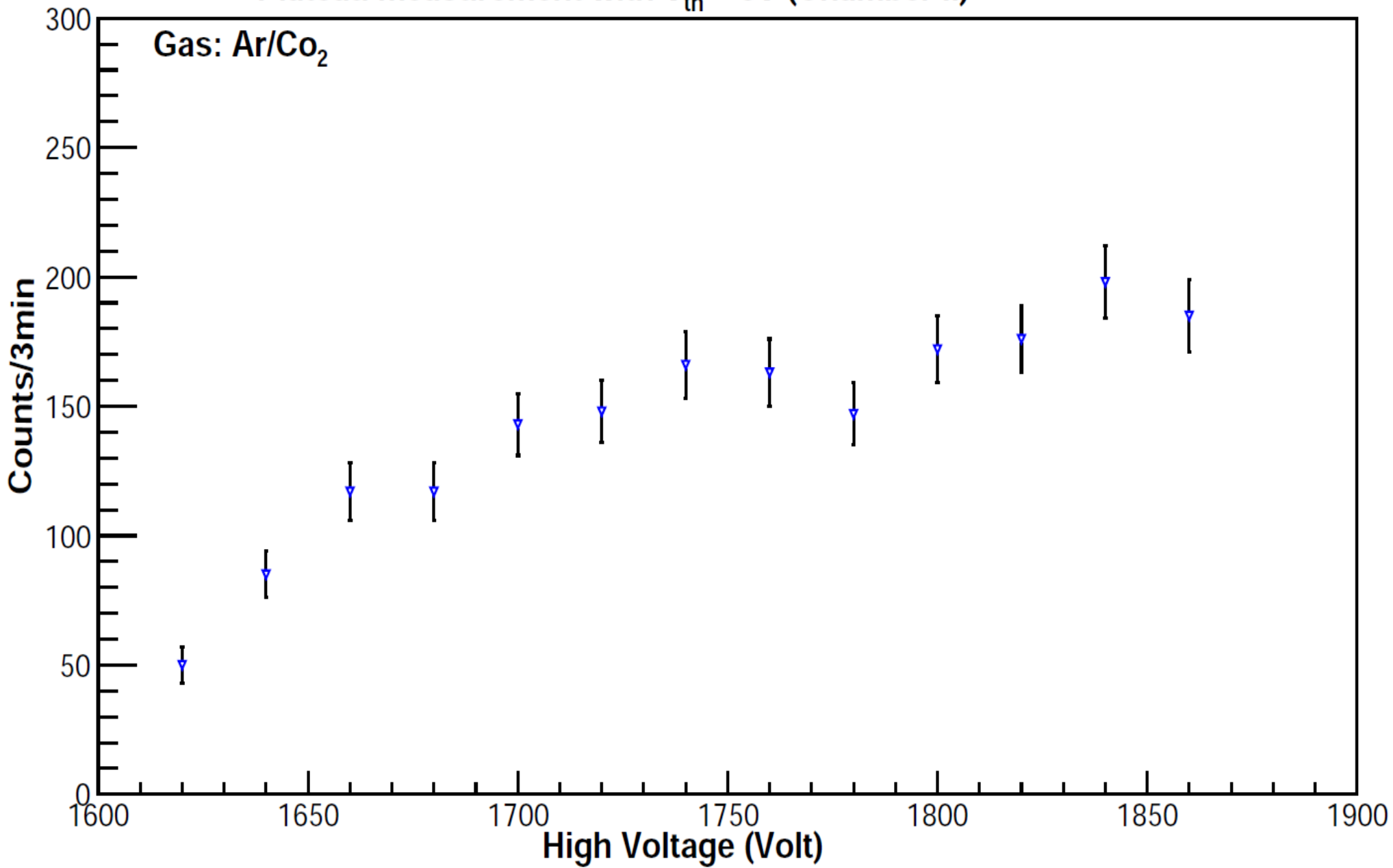
Plateau measurement started mid January 2017.

Plateau measurement with $V_{th} = 3V$ (Chamber I)



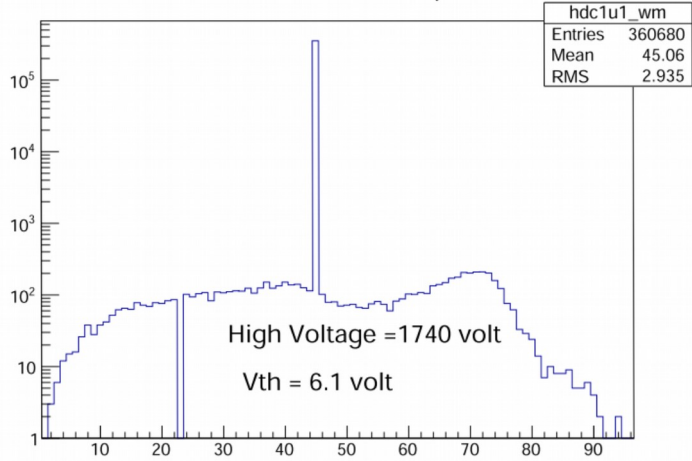
Plateau measurement with $V_{th} = 3V$ (Chamber II)

Gas: Ar/CO₂

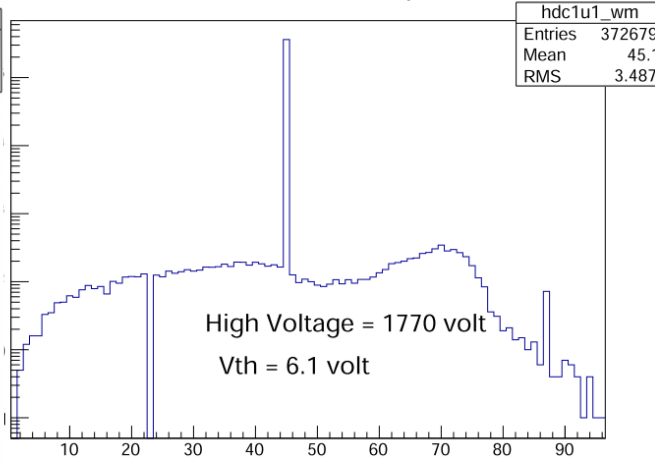


U Planes at Different Voltages

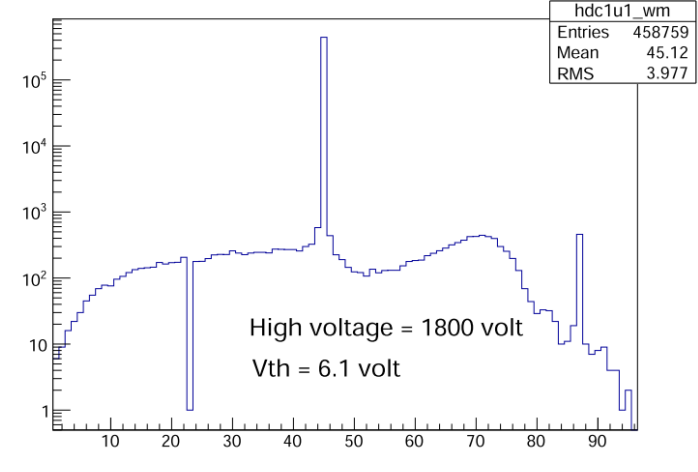
HDC 1U1 Wiremap



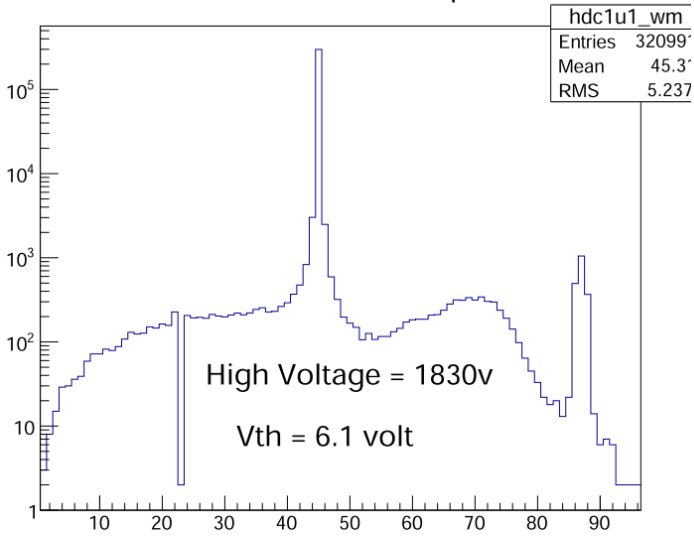
HDC 1U1 Wiremap



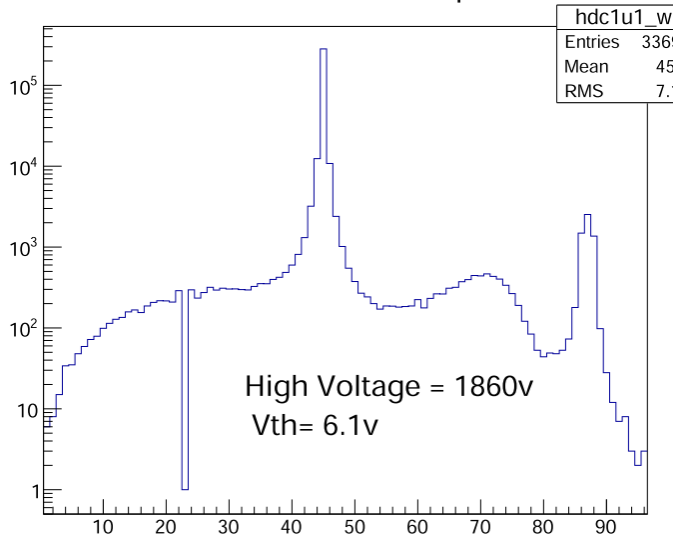
HDC 1U1 Wiremap



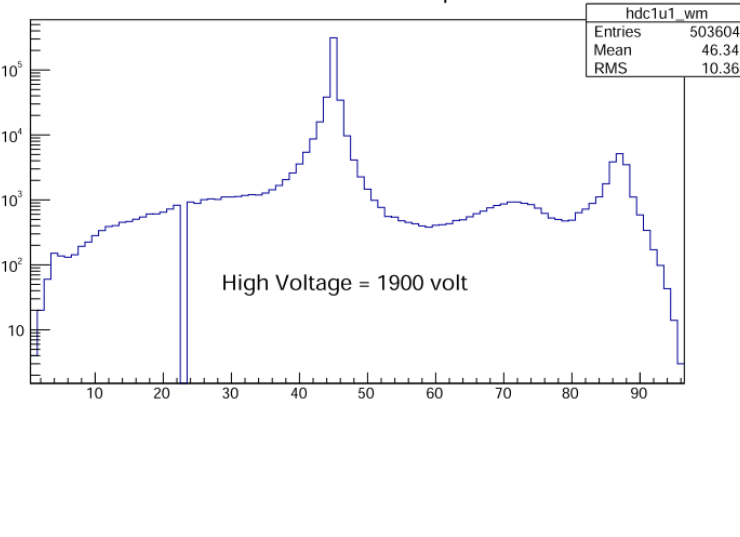
HDC 1U1 Wiremap



HDC 1U1 Wiremap

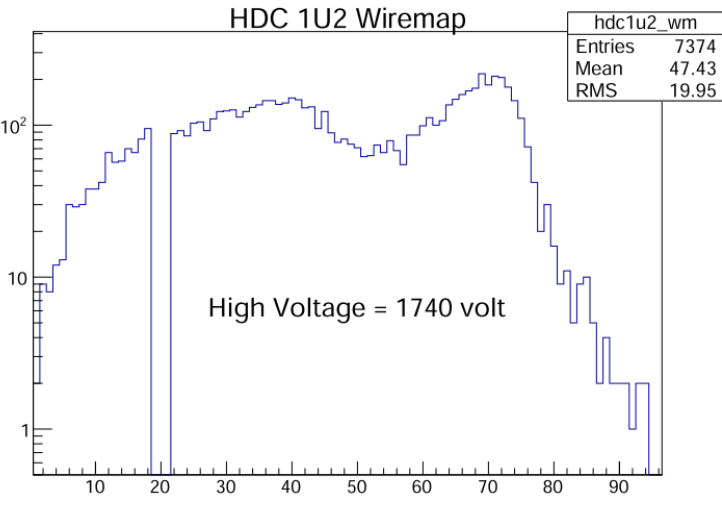


HDC 1U1 Wiremap

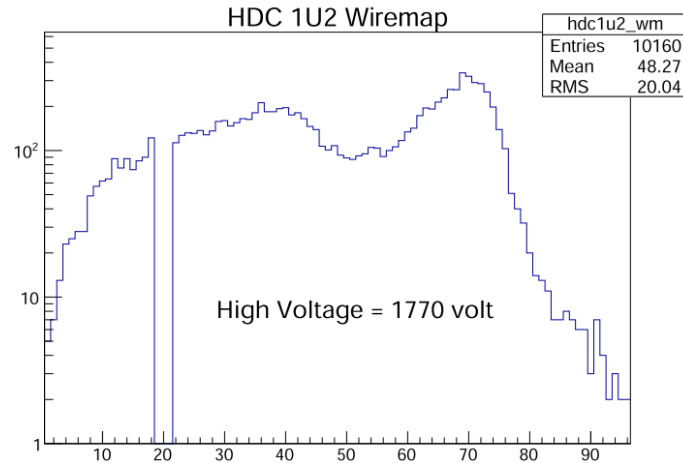


U' Planes at Different Voltages

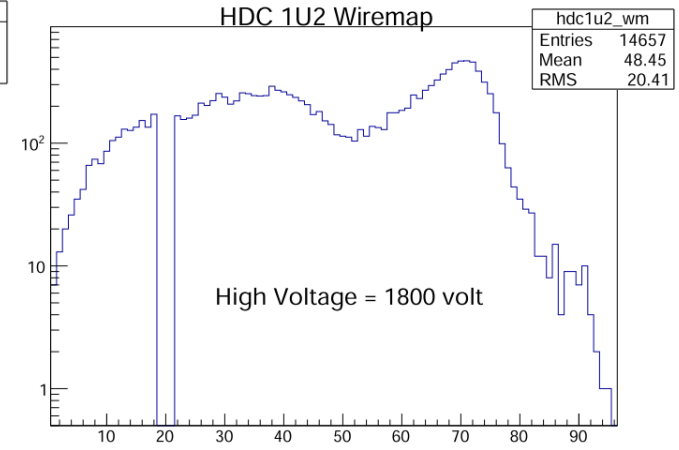
HDC 1U2 Wiremap



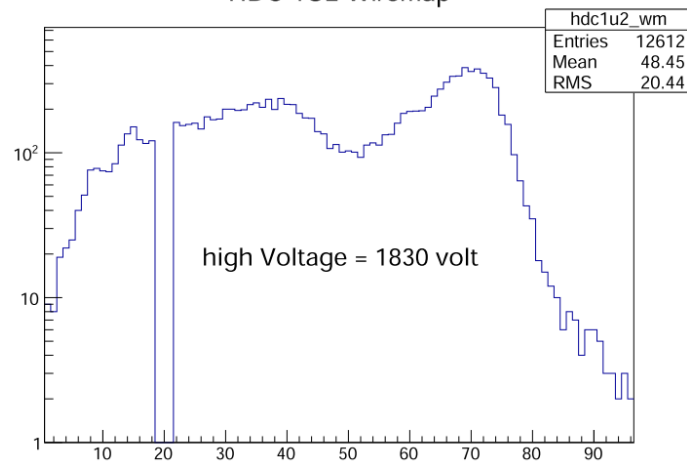
HDC 1U2 Wiremap



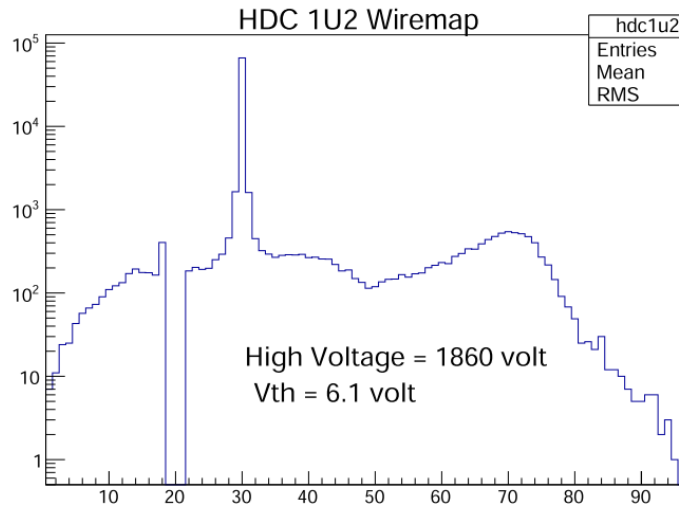
HDC 1U2 Wiremap



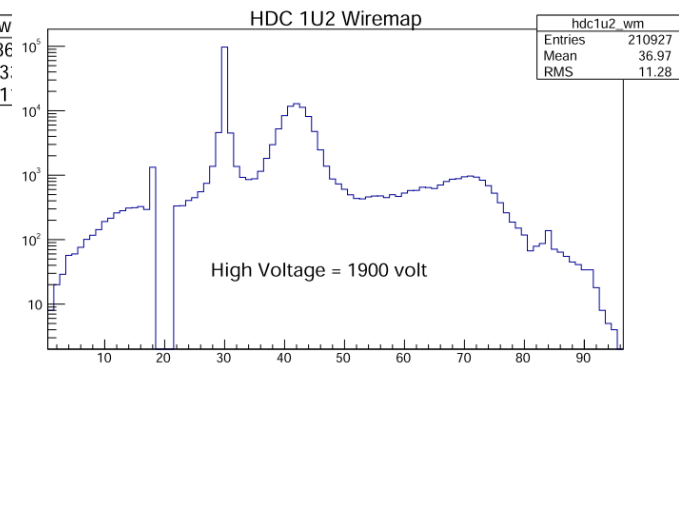
HDC 1U2 Wiremap



HDC 1U2 Wiremap

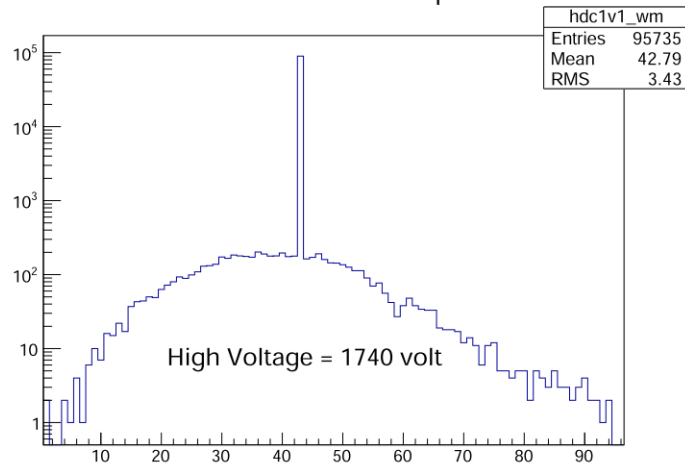


HDC 1U2 Wiremap

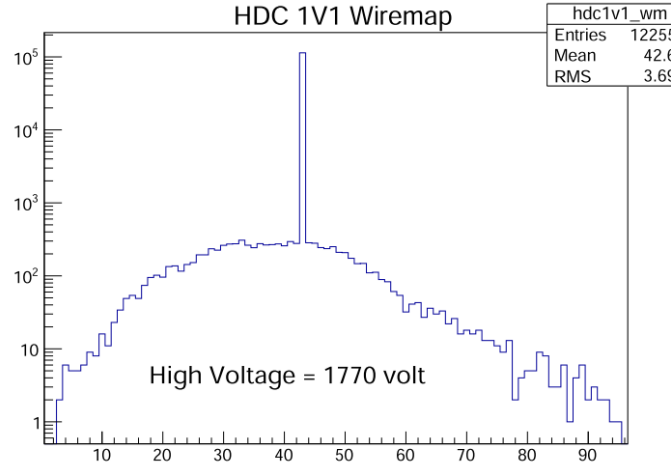


V Planes at Different Voltages

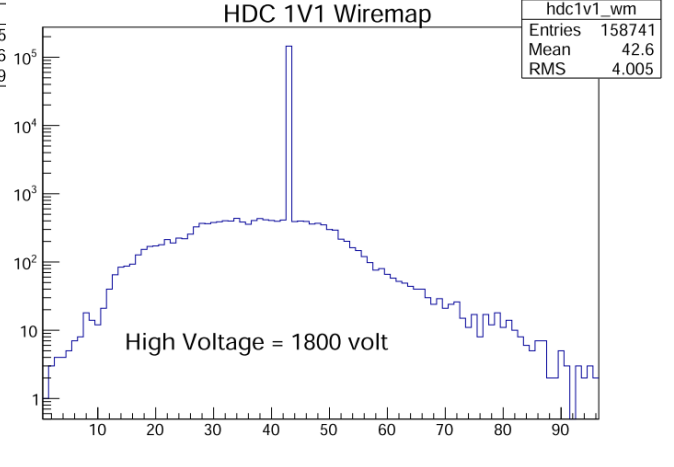
HDC 1V1 Wiremap



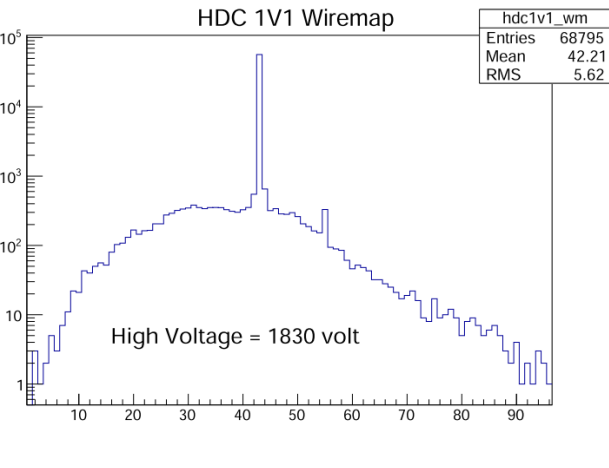
HDC 1V1 Wiremap



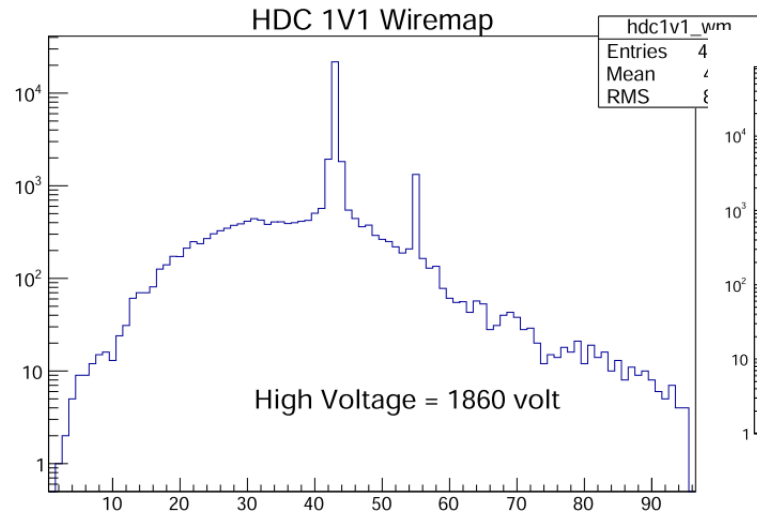
HDC 1V1 Wiremap



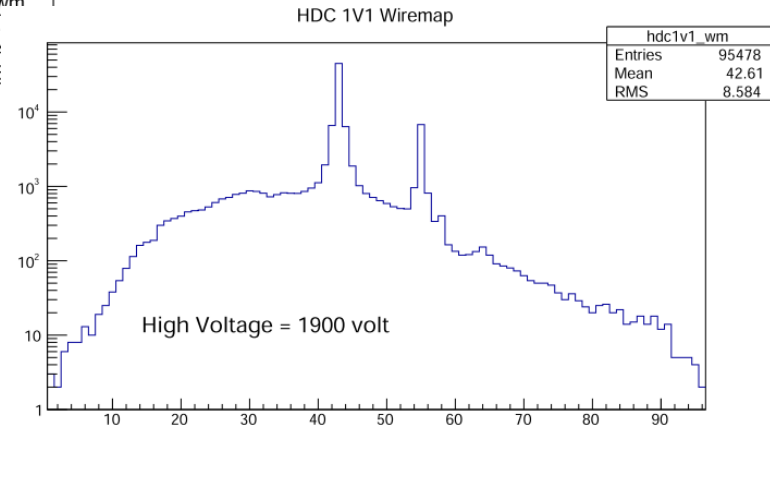
HDC 1V1 Wiremap



HDC 1V1 Wiremap

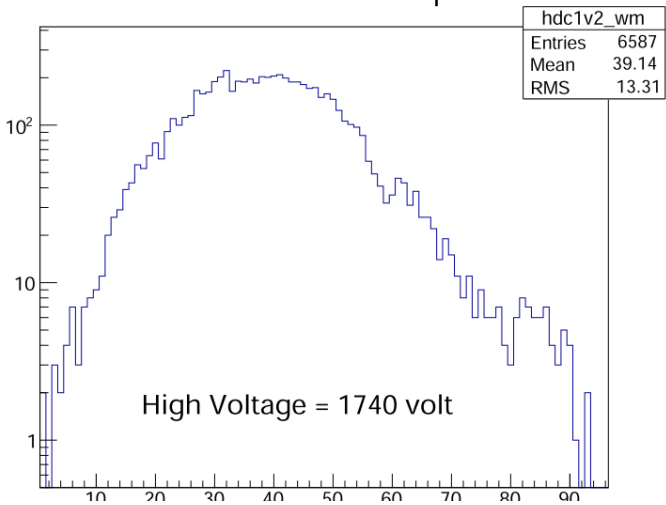


HDC 1V1 Wiremap

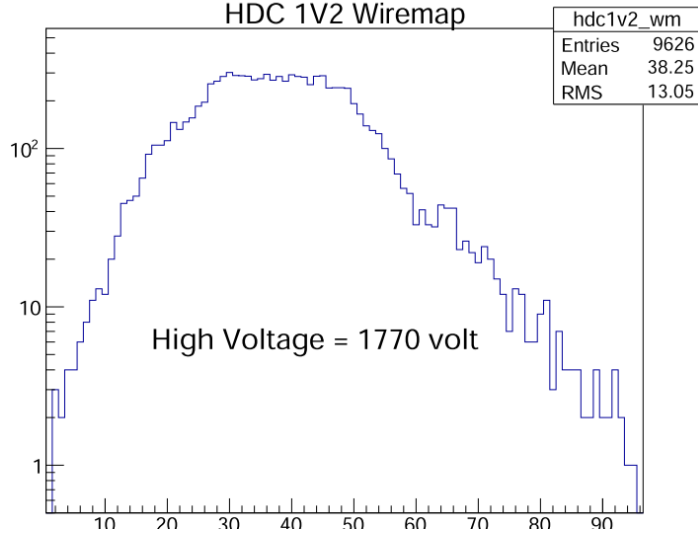


V' Planes at Different Voltages

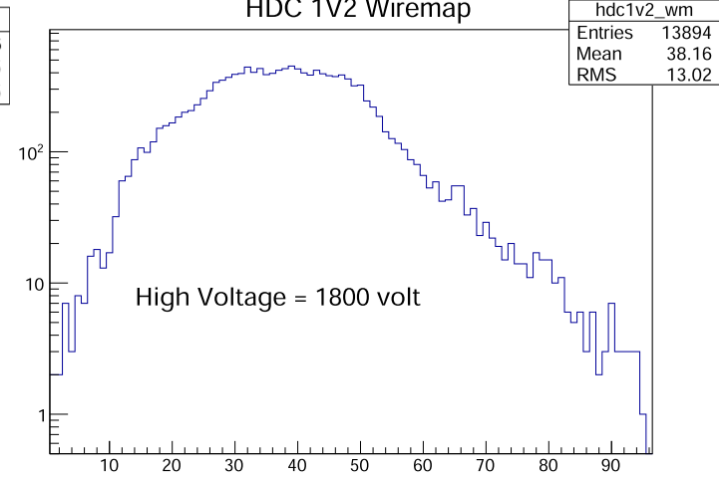
HDC 1V2 Wiremap



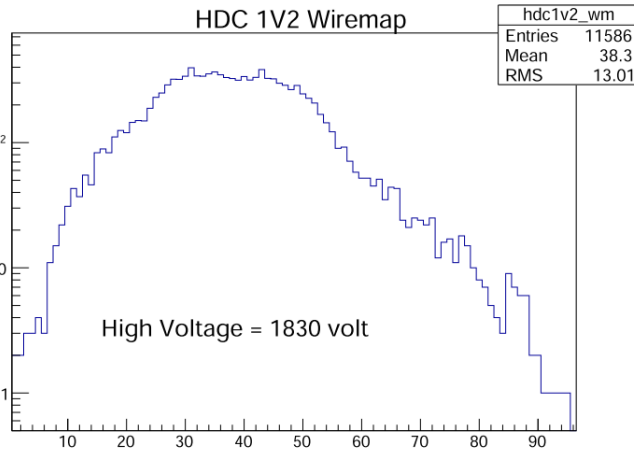
HDC 1V2 Wiremap



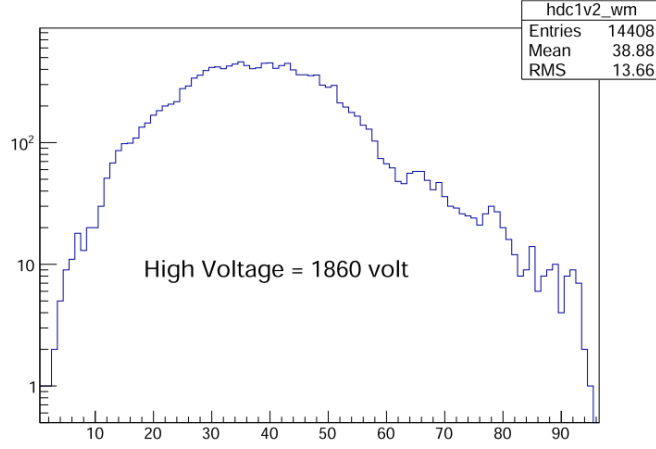
HDC 1V2 Wiremap



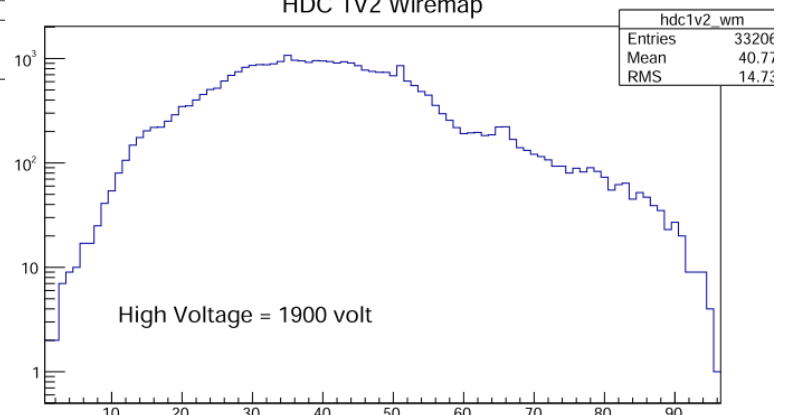
HDC 1V2 Wiremap



HDC 1V2 Wiremap

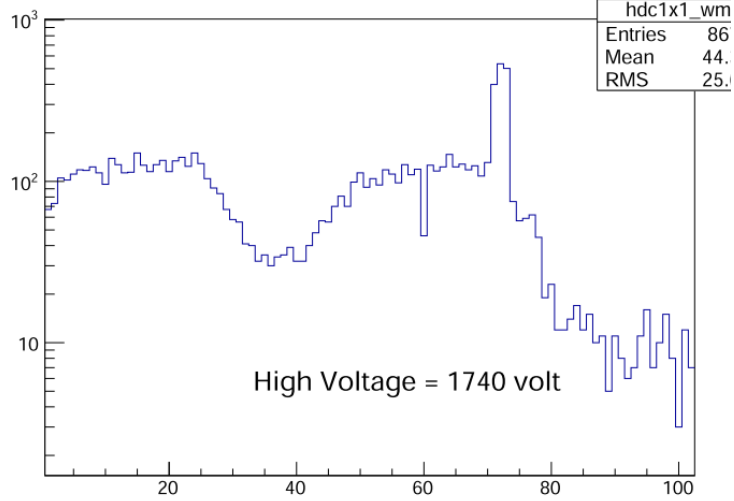


HDC 1V2 Wiremap

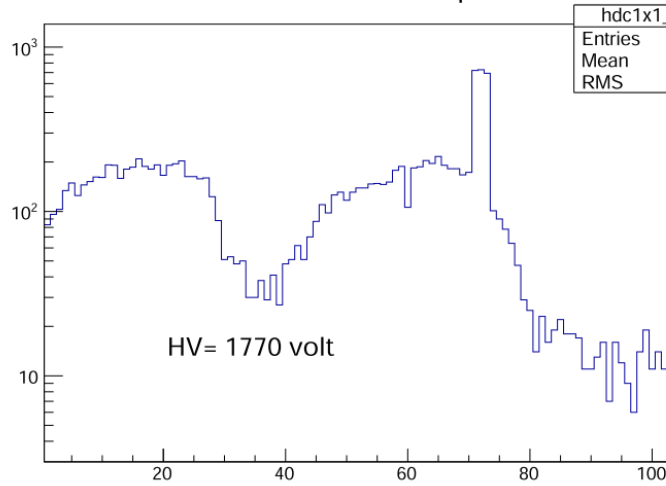


X Planes at Different Voltages

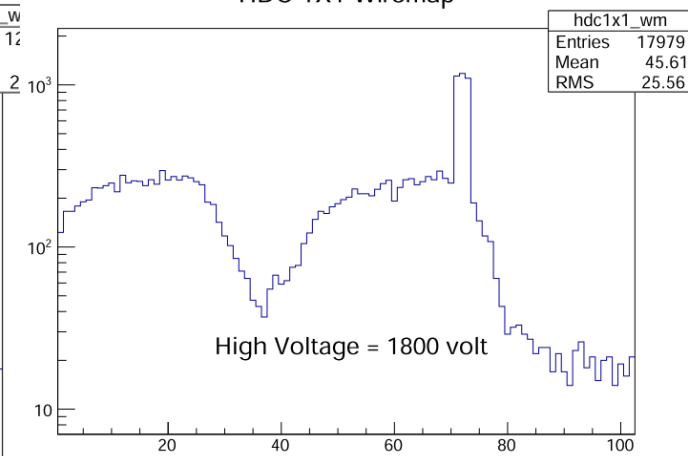
HDC 1X1 Wiremap



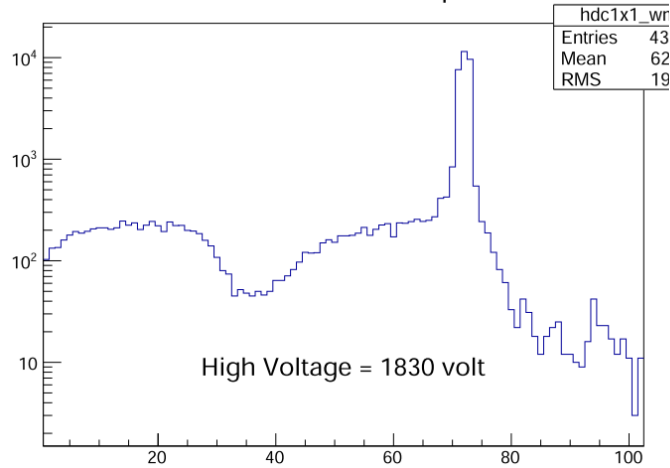
HDC 1X1 Wiremap



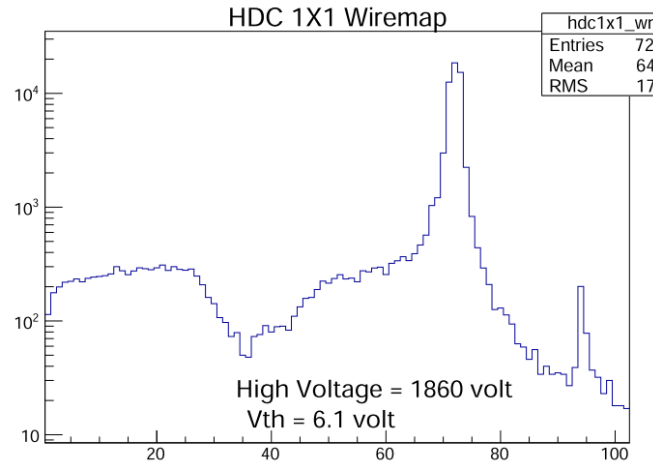
HDC 1X1 Wiremap



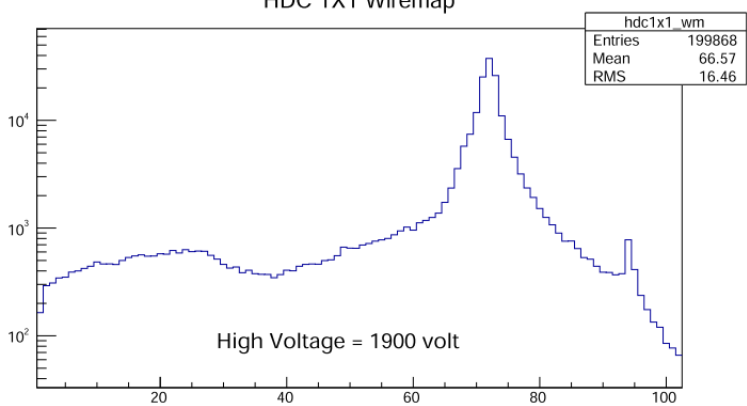
HDC 1X1 Wiremap



HDC 1X1 Wiremap

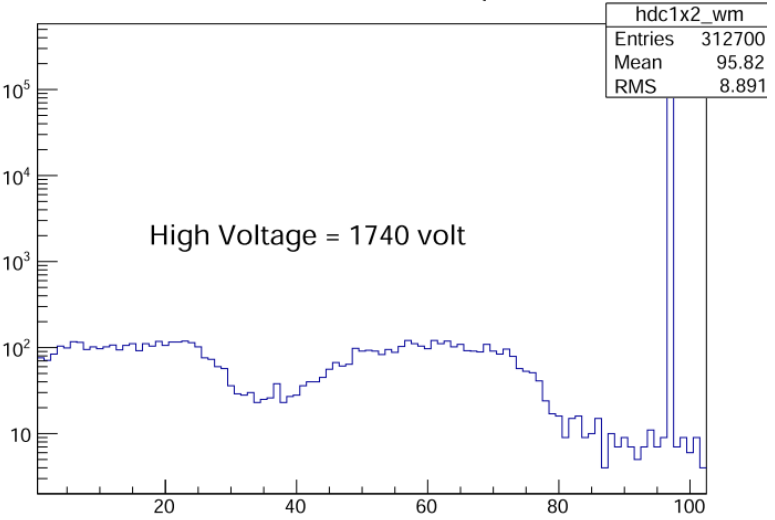


HDC 1X1 Wiremap

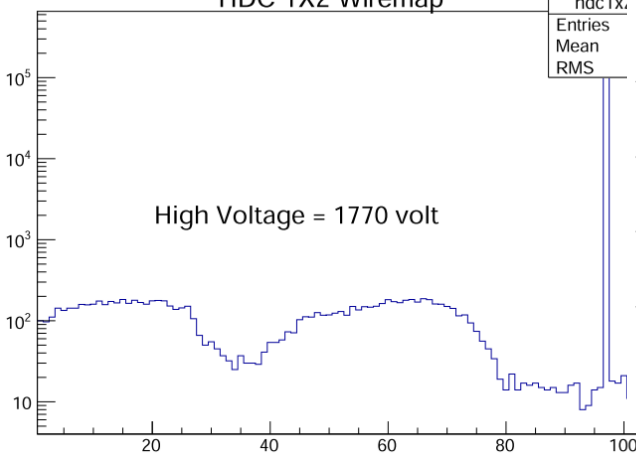


X' Planes at Different Voltages

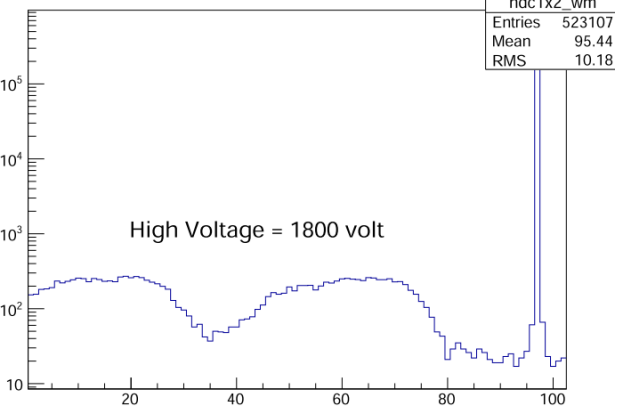
HDC 1X2 Wiremap



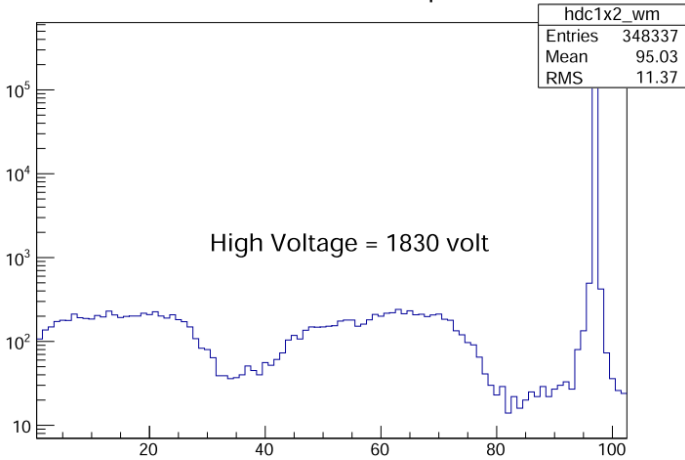
HDC 1X2 Wiremap



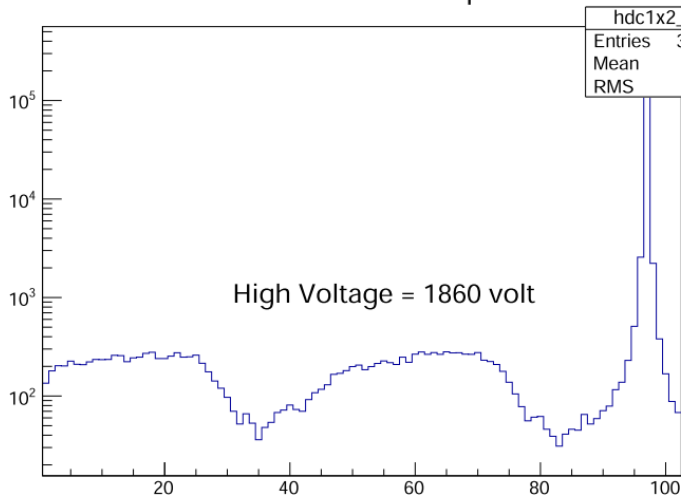
HDC 1X2 Wiremap



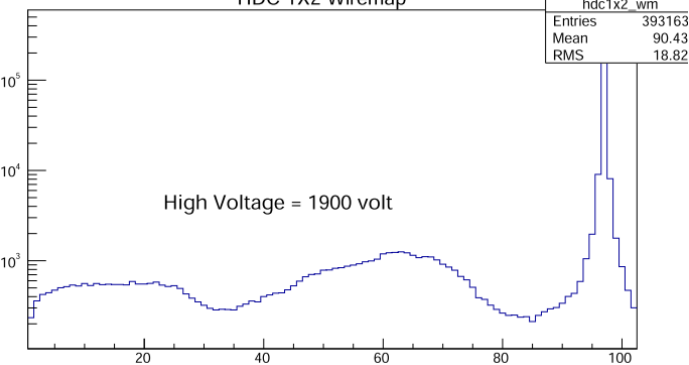
HDC 1X2 Wiremap



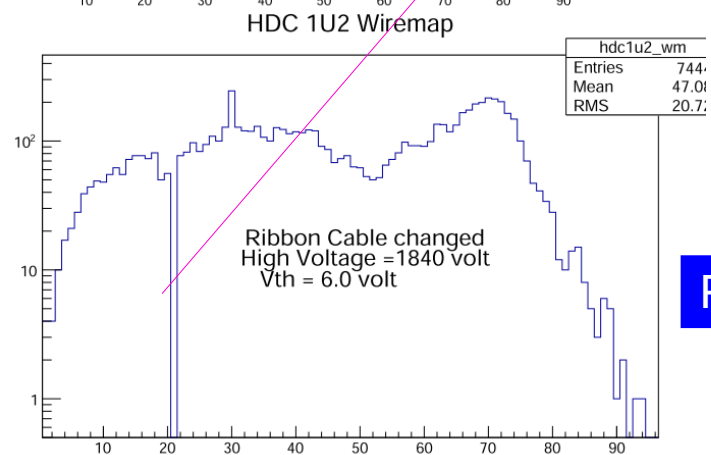
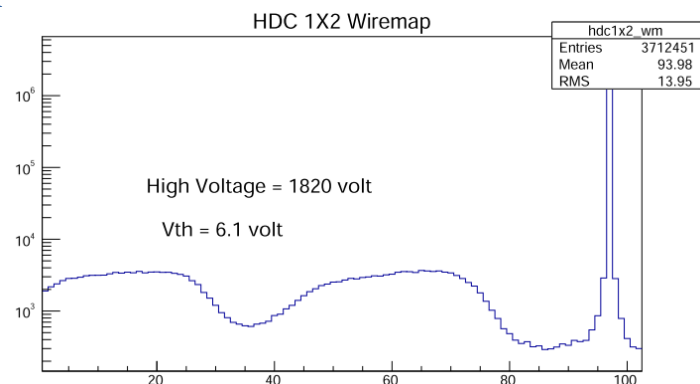
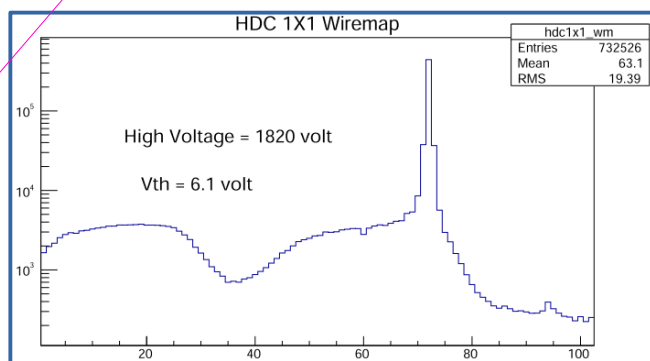
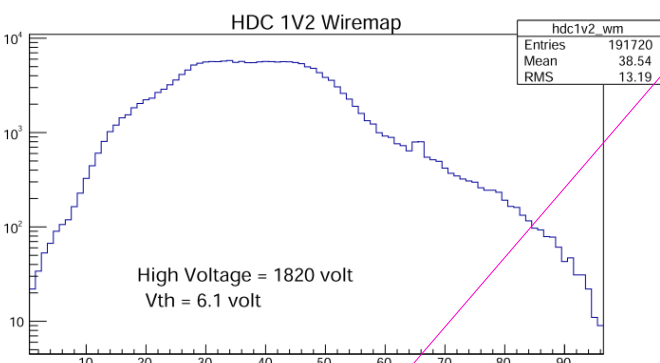
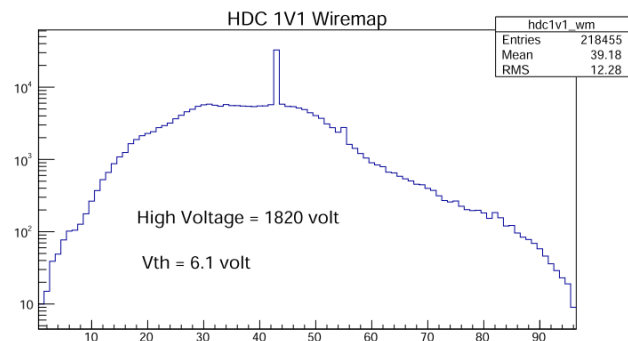
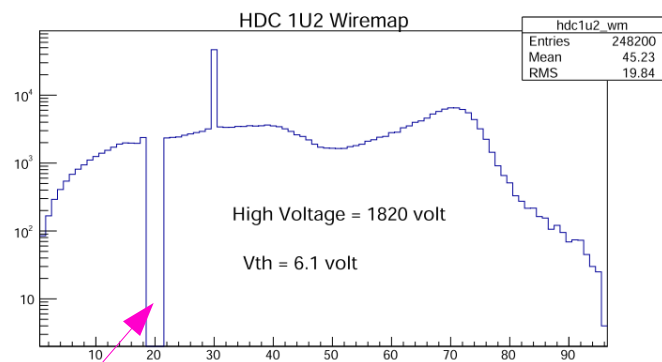
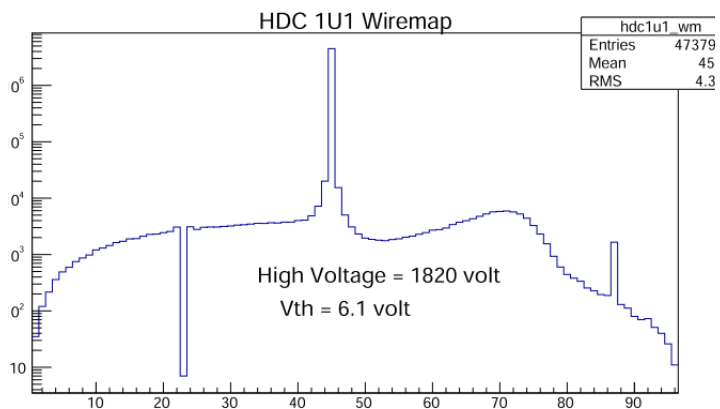
HDC 1X2 Wiremap



HDC 1X2 Wiremap



Overnight Run



Ribbon cable changed.

Summary

Chamber I

Missing Channel

1. U1 plane wire # 23
2. U2 plane wire # 21

Hot Channel

1. U1 plane wire # 45 and 87
2. U2 plane wire # 30
3. V1 plane wire # 43
4. X1 plane wire # 72
5. X2 plane wire # 97

At 1905 volt it draws ~45 uA current.

Chamber II

Hot Channels

1. V2 plane wire # 23
2. X1 plane wire # 71
3. X2 plane wire # 34

At 1905 volt it draws ~37 uA current.

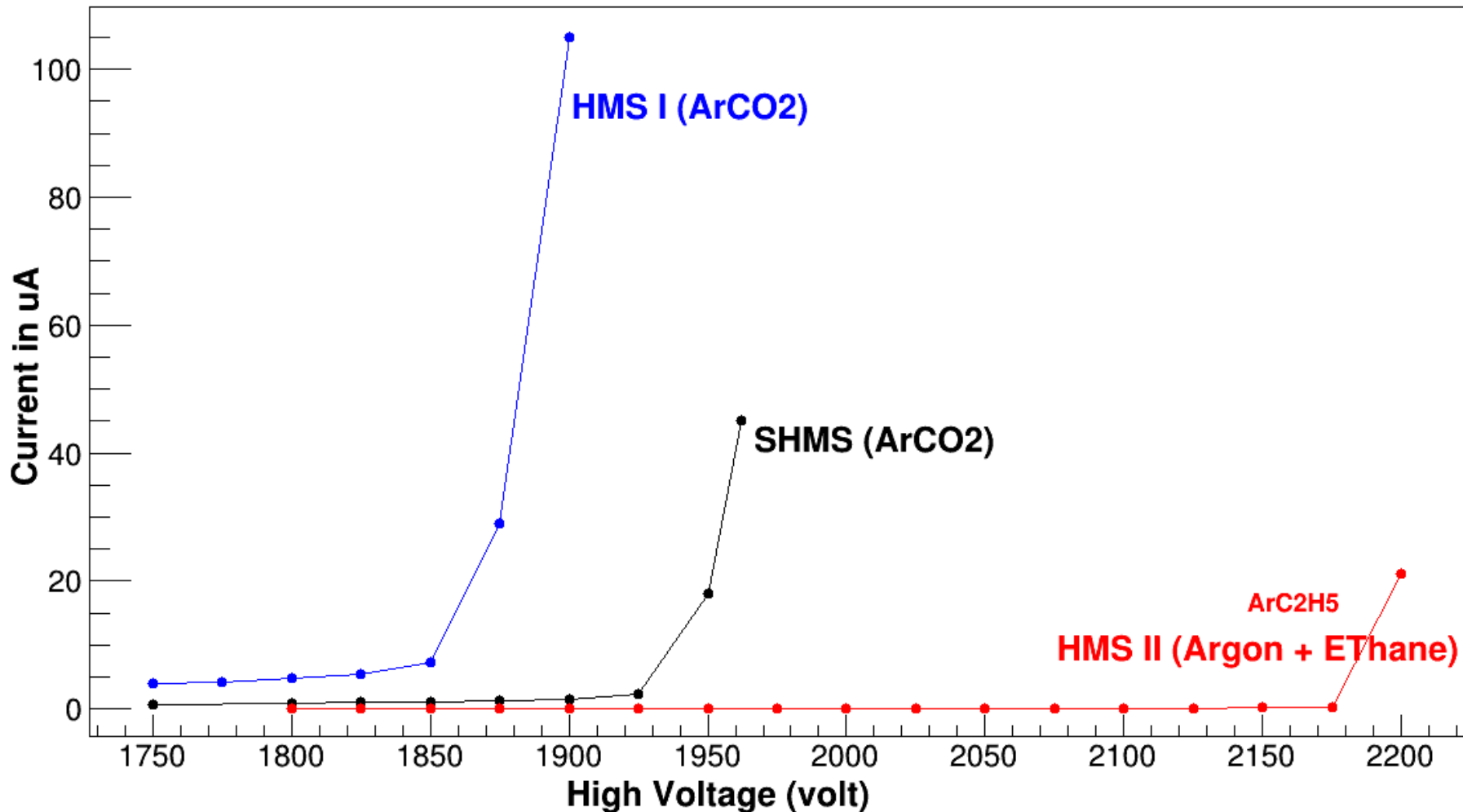


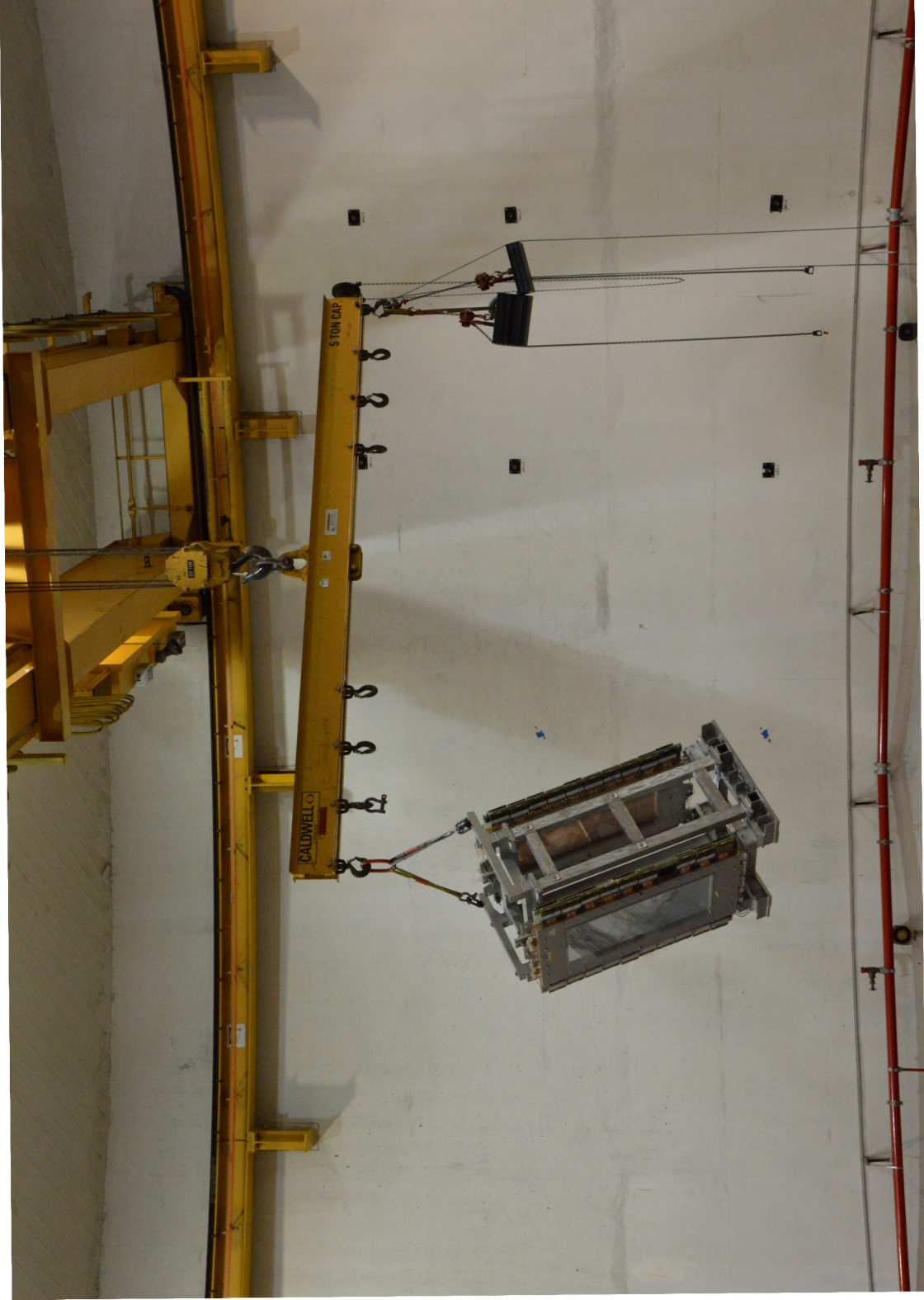
Burnt spot

Chamber II is moved to Hall C

1. A mixture of Ar-Ethane is connected to the chamber.
2. Did the same test here in order to check the dark current.
3. Chamber is drawing ~110 nA current at 2100 volt.

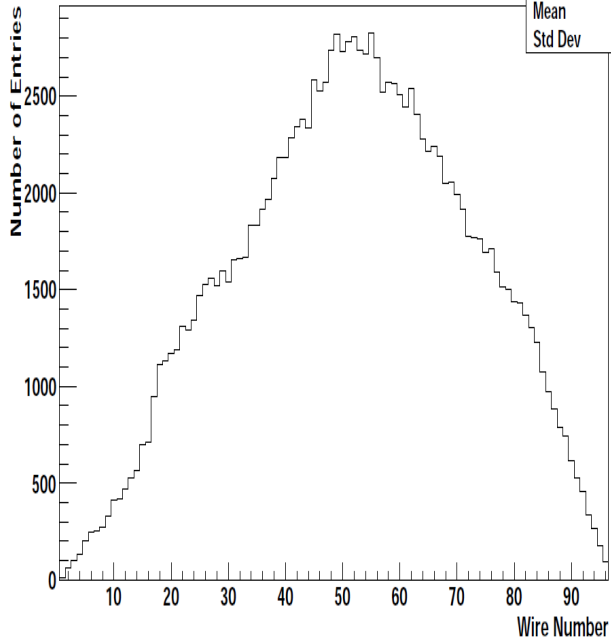
comparision between HMS and SHMS:





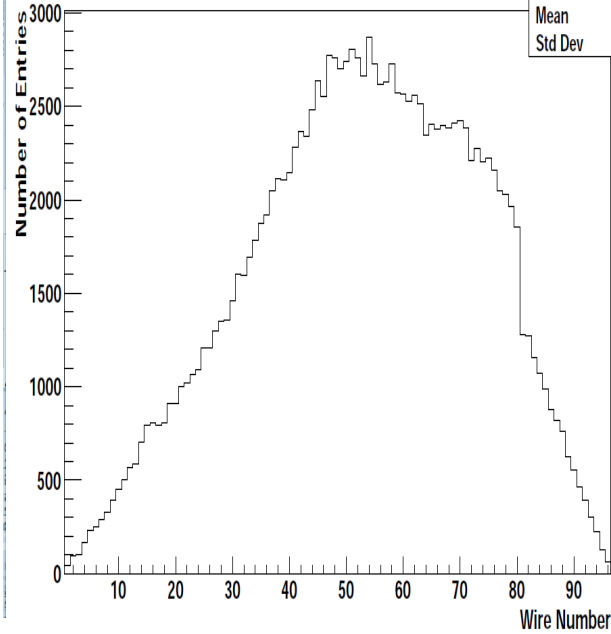
At HMS Stack

HMS DC 1U1 Wiremap



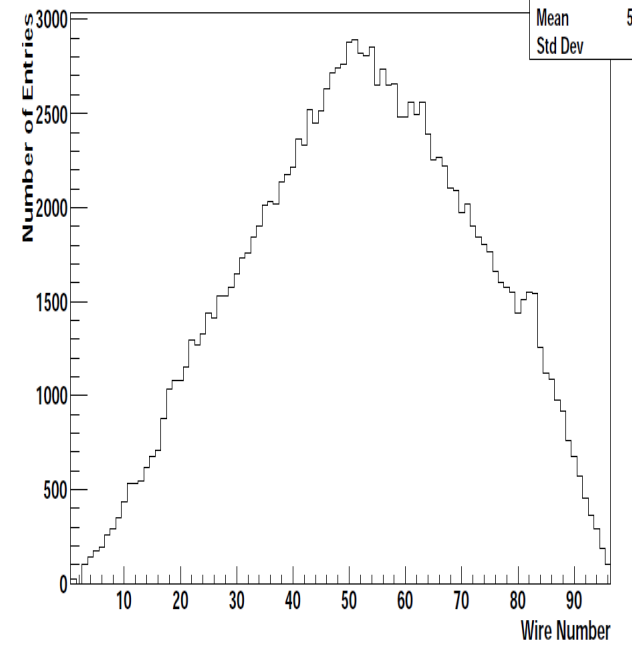
hdc1u1_wirenum	
Entries	146475
Mean	51.88
Std Dev	19.97

HMS DC 1U2 Wiremap



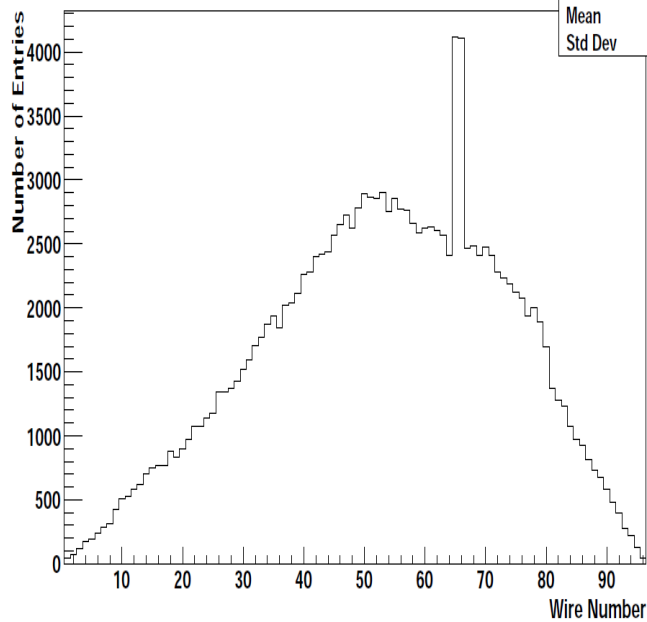
hdc1u2_wirenum	
Entries	149952
Mean	52.9
Std Dev	19.78

HMS DC 1V1 Wiremap



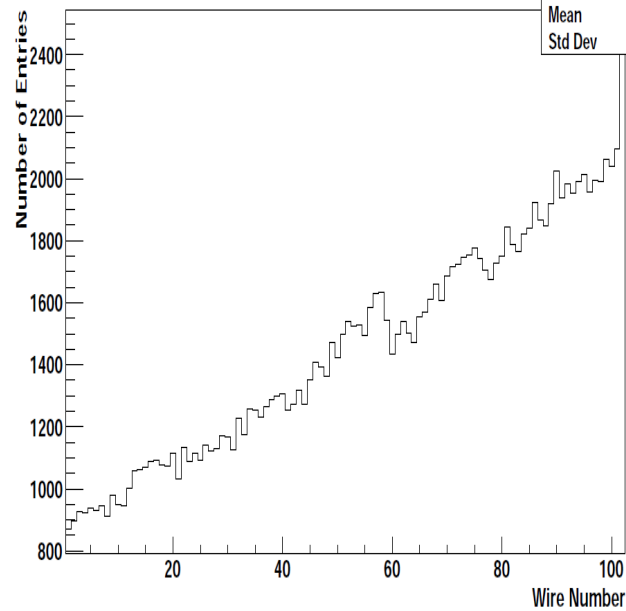
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Entries	150033
Mean	52.18
Std Dev	20

HMS DC 1V2 Wiremap



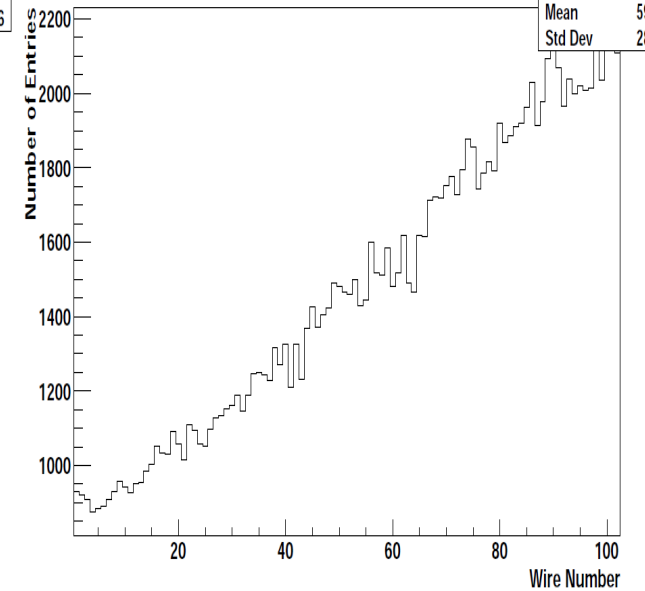
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Std Dev	19.59

HMS DC 1X1 Wiremap



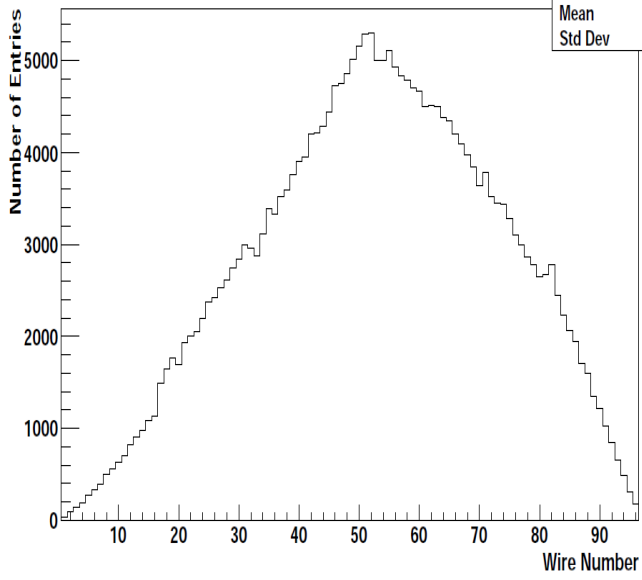
hdc1x1_wirenum	
Entries	148572
Mean	58.68
Std Dev	28.76

HMS DC 1X2 Wiremap



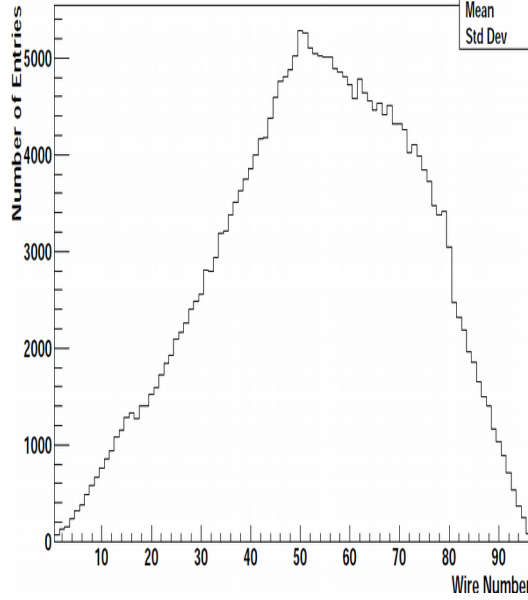
hdc1x2_wirenum	
Entries	150042
Mean	59.26
Std Dev	28.58

HMS DC 2U1 Wiremap



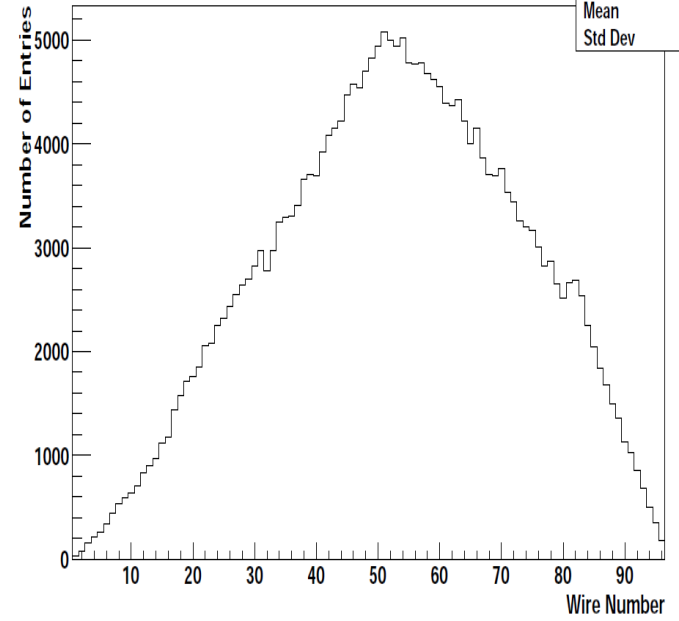
hdc2u1_wirenum	
Entries	265147
Mean	52.9
Std Dev	19.7

HMS DC 2U2 Wiremap



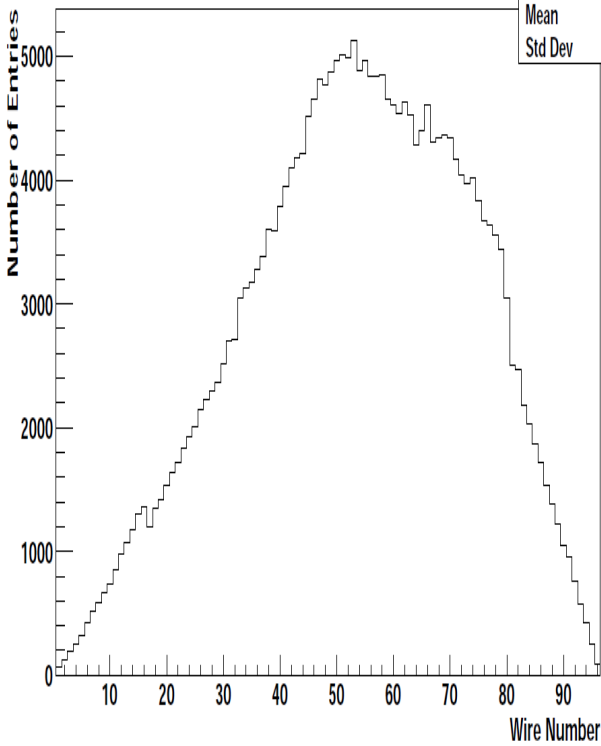
hdc2u2_wirenum	
Entries	268707
Mean	53.3
Std Dev	19.5

HMS DC 2V1 Wiremap



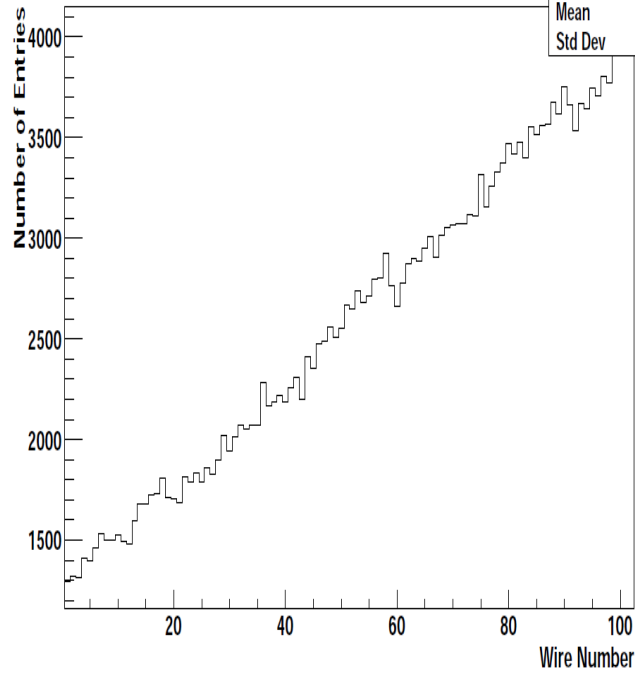
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Mean	52.71
Std Dev	19.83

HMS DC 2V2 Wiremap



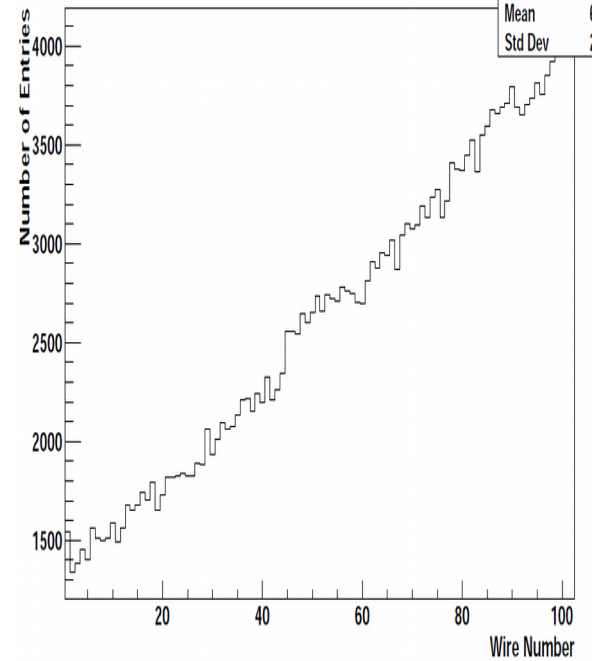
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Std Dev	19.67

HMS DC 2X1 Wiremap



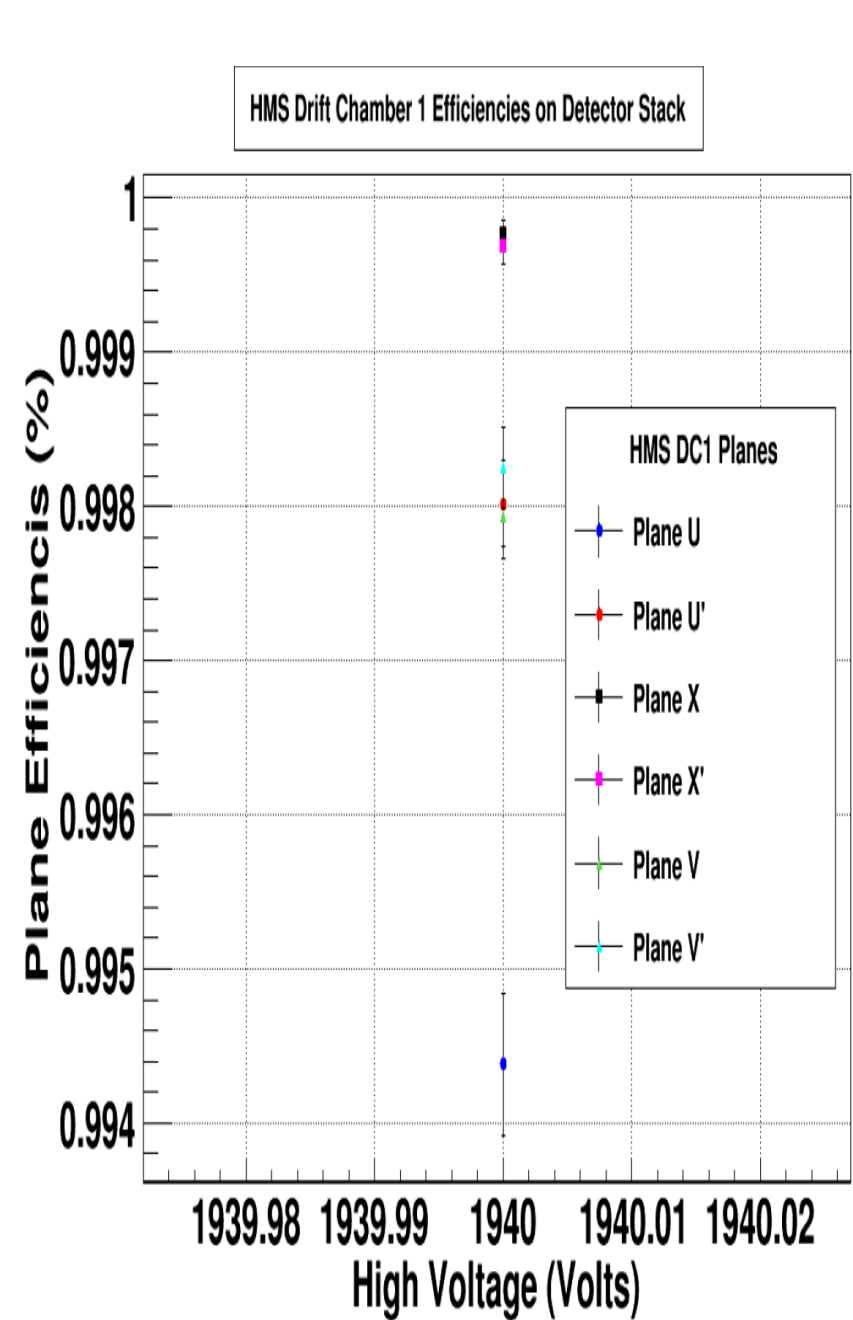
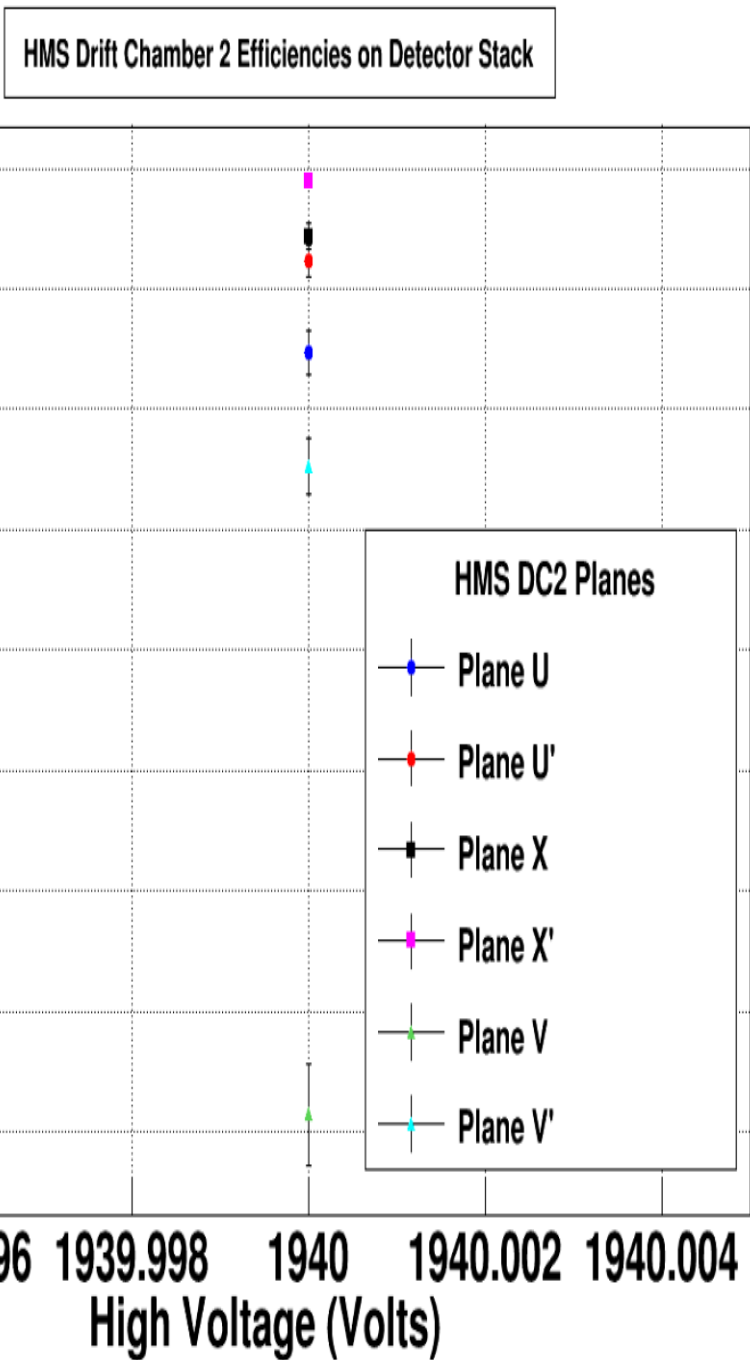
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Mean	60.38
Std Dev	28.16

HMS DC 2X2 Wiremap



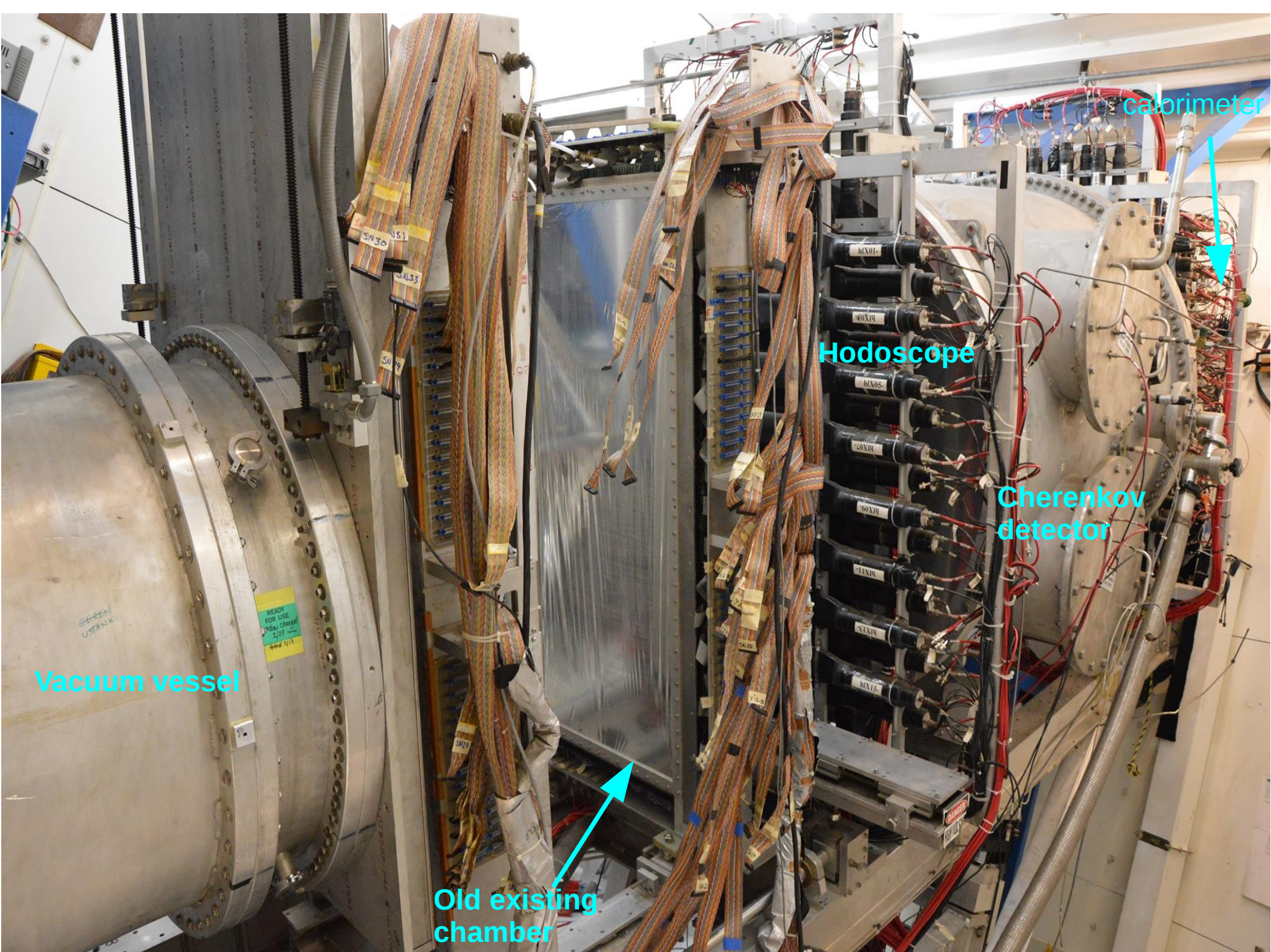
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Entries	267823
Mean	60.34
Std Dev	28.26

Efficiency of Chamber



Summary

- Two HMS wire chambers were built at Hampton University from May to November 2016.
- After the primary test at Hampton, the chambers were shipped to Jlab (ESB building) for testing.
- High voltage conditioning completed mid-January 2017.
- Plateau curve test is done and plateau voltage found 1940.
- Chambers were installed in the HMS stack by mid October 2017.
- Both of the chambers having efficiency between 99 to 100%.



Vacuum vessel

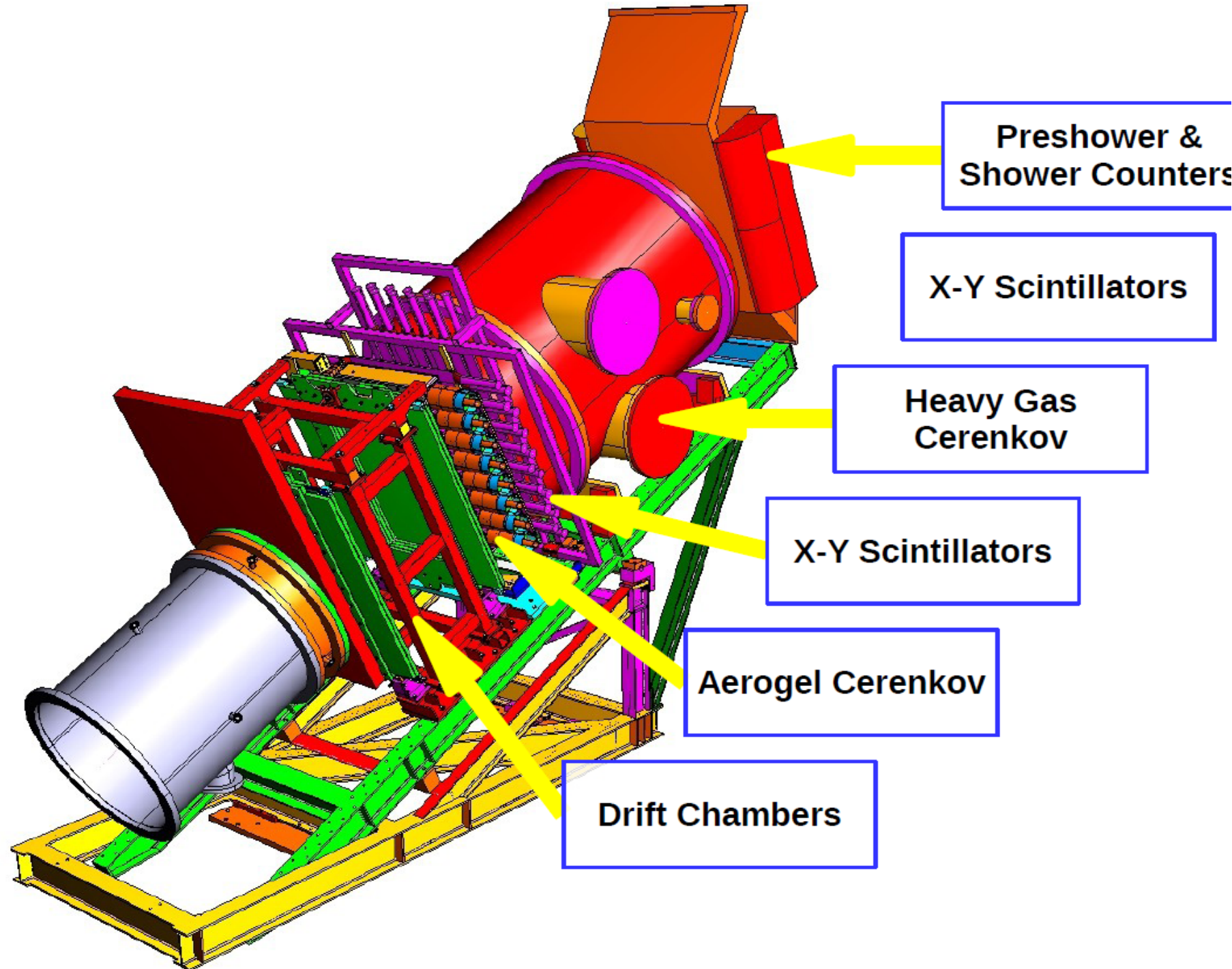
Old existing chamber

Hodoscope

Cherenkov detector

calorimeter

Particle Detectors inside the HMS



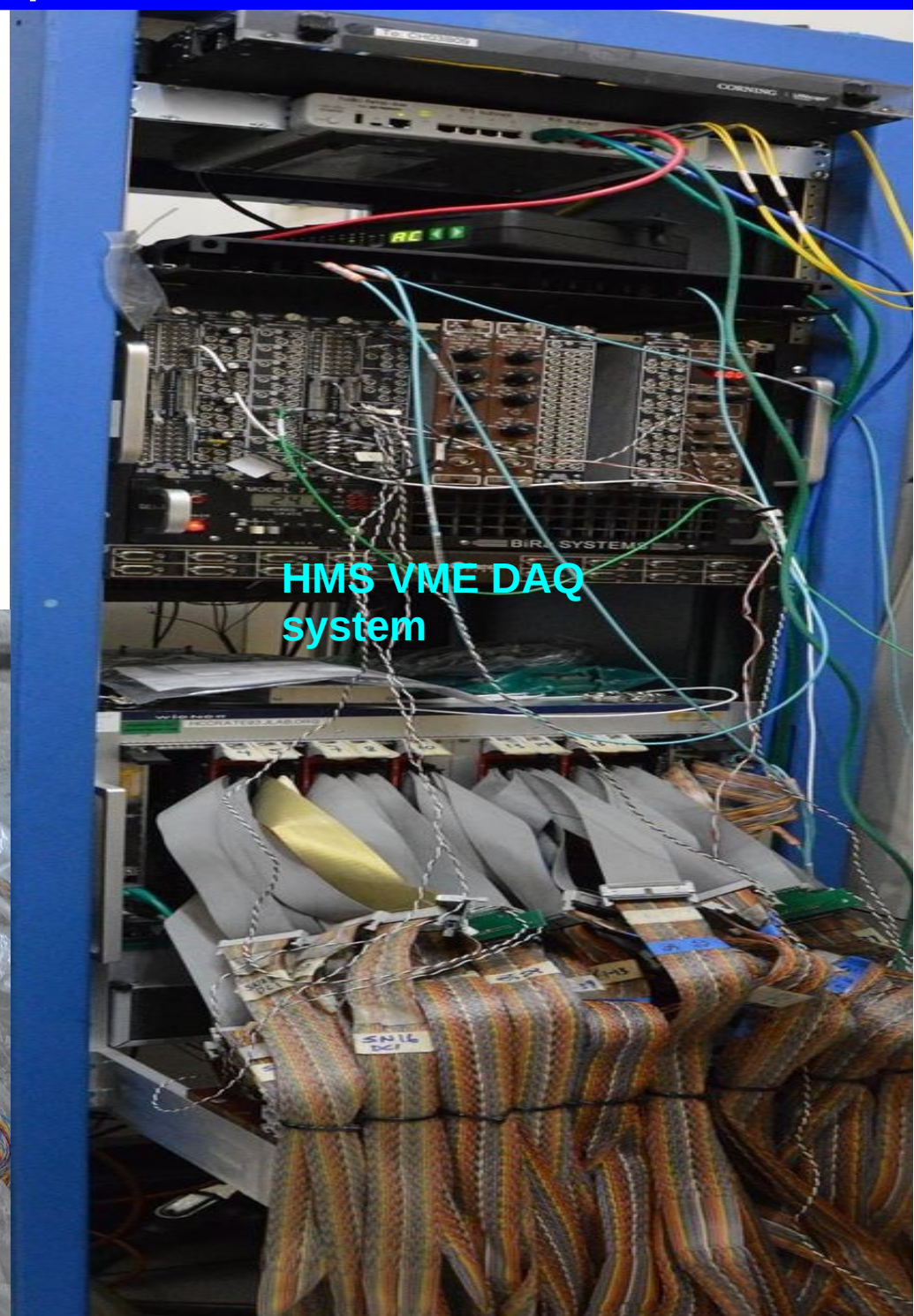
Some Snap shots



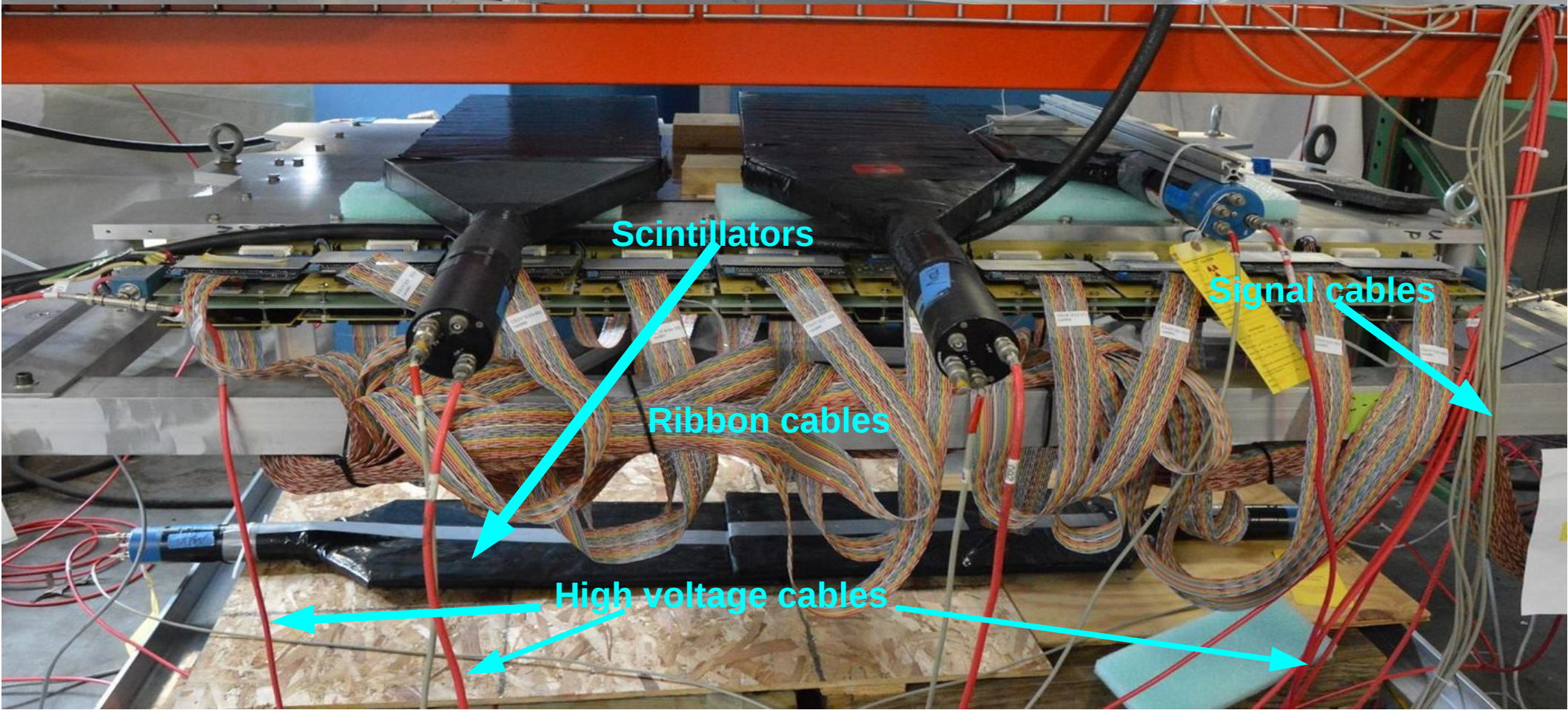
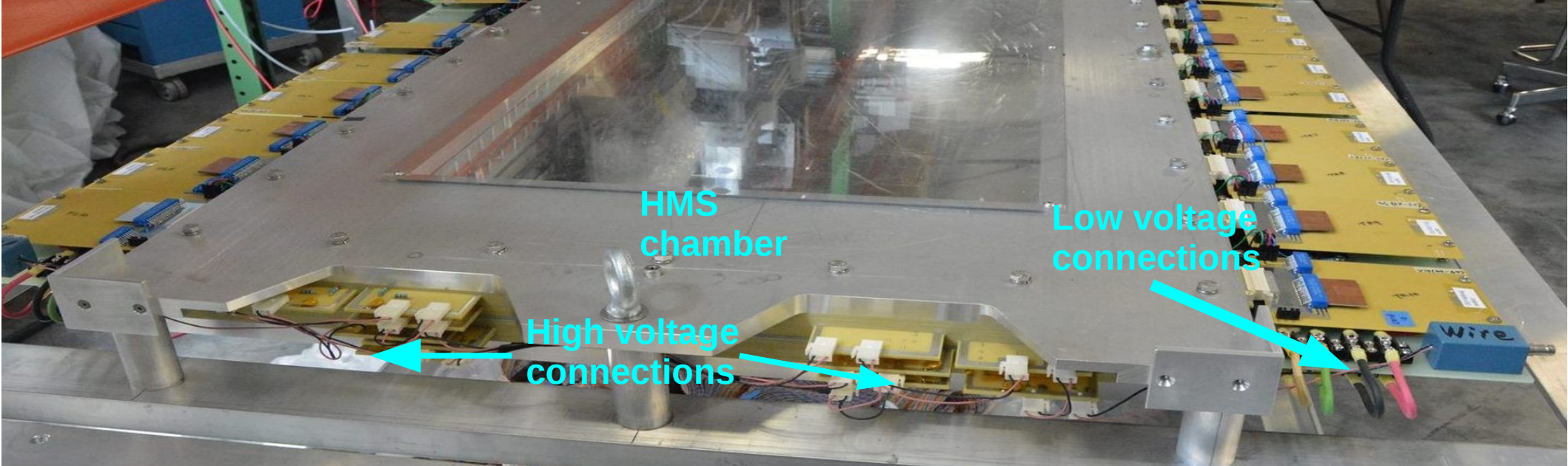
Hampton
University



New ribbon
cable bundles



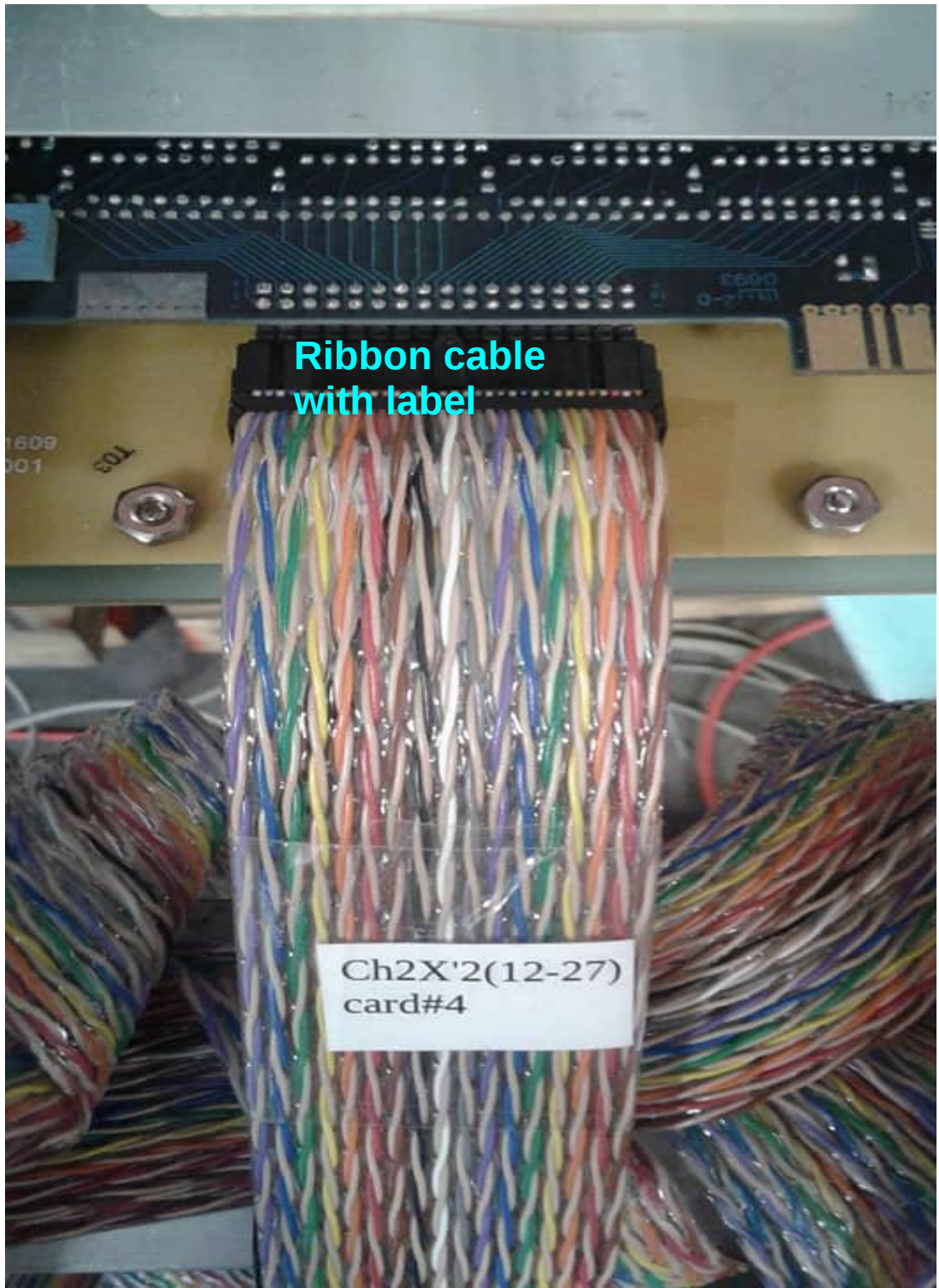
HMS VME DAQ
system



Detector
frame

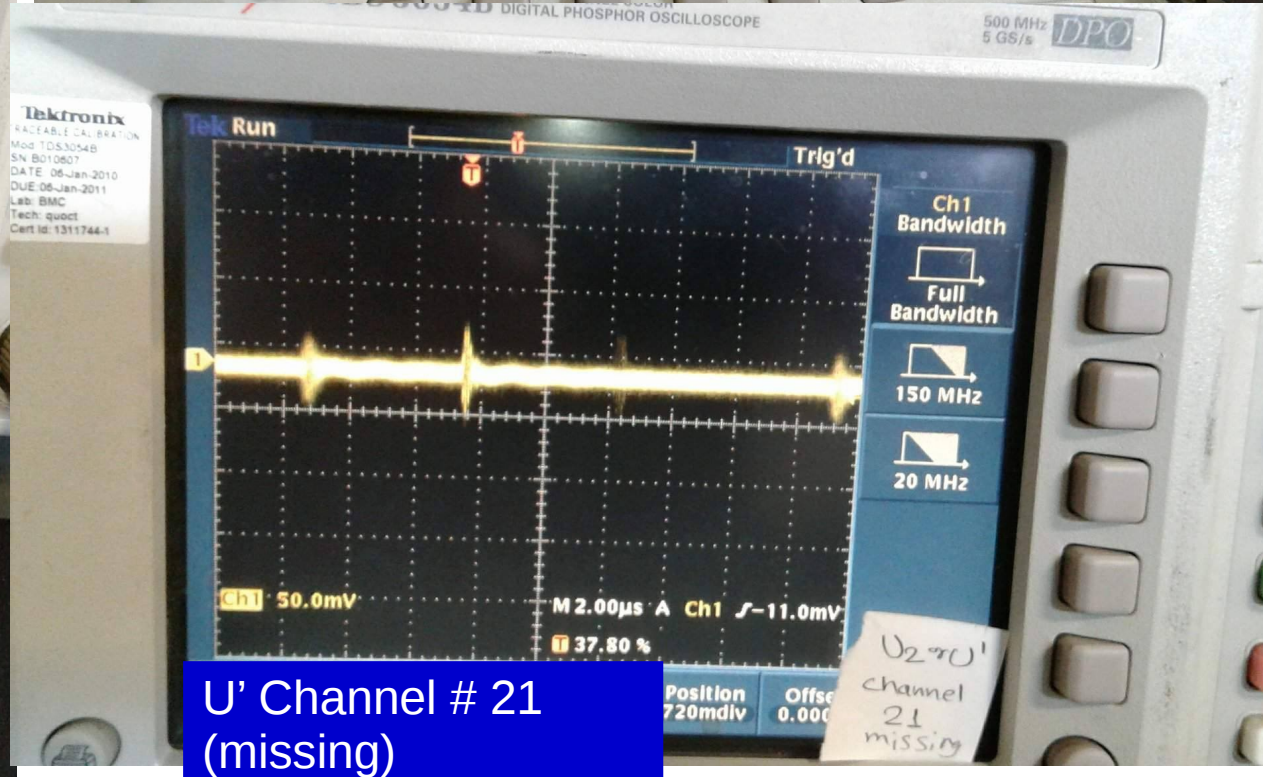
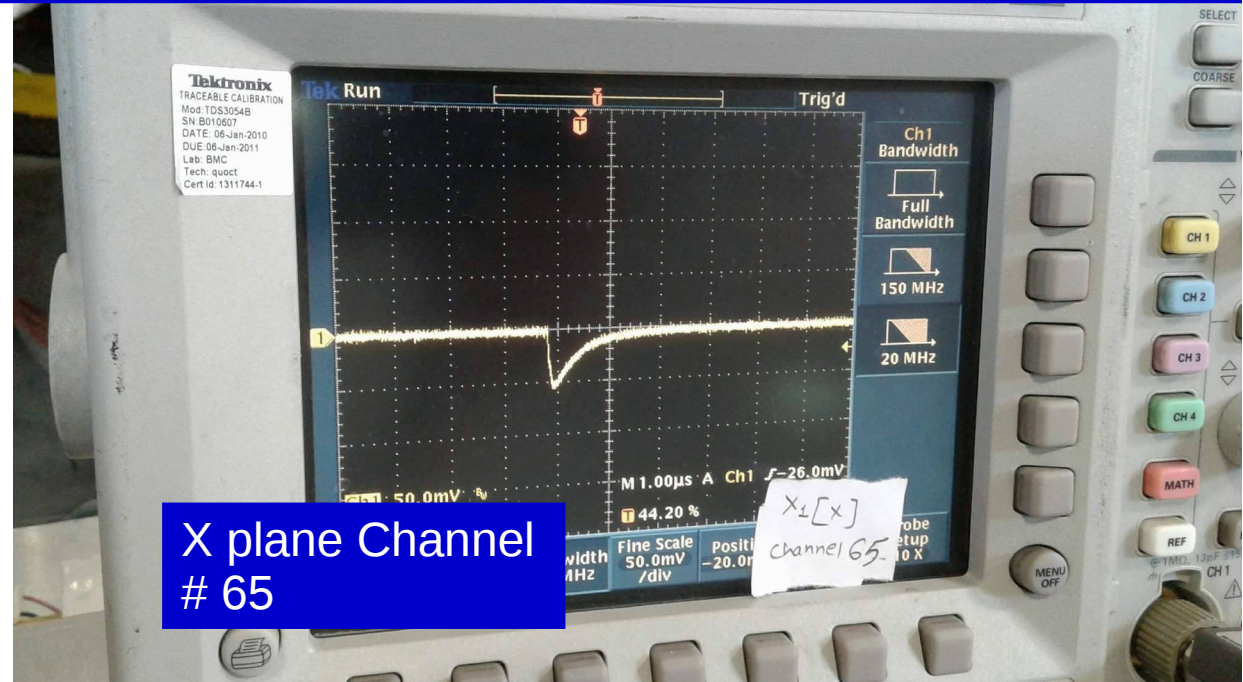
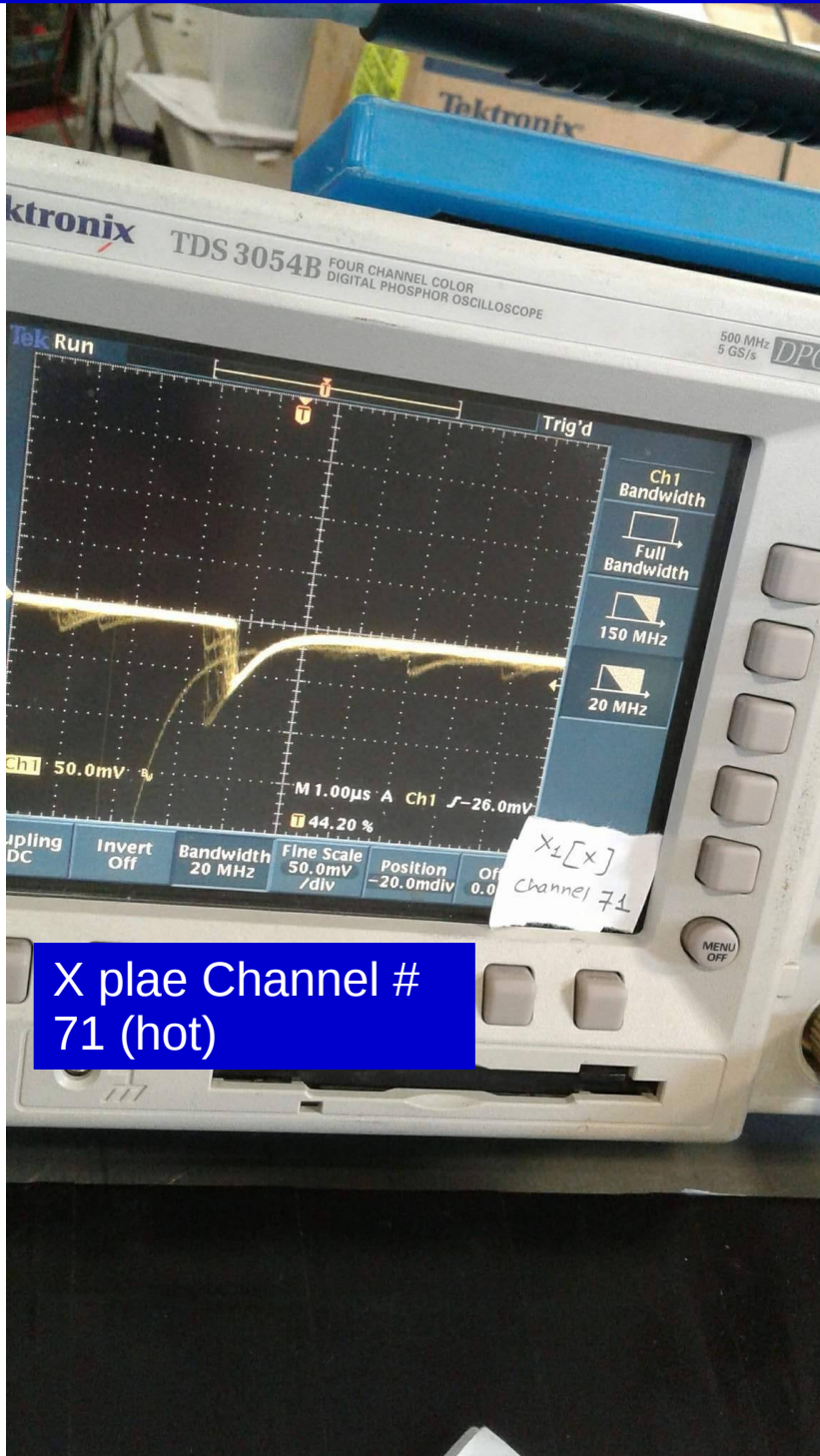


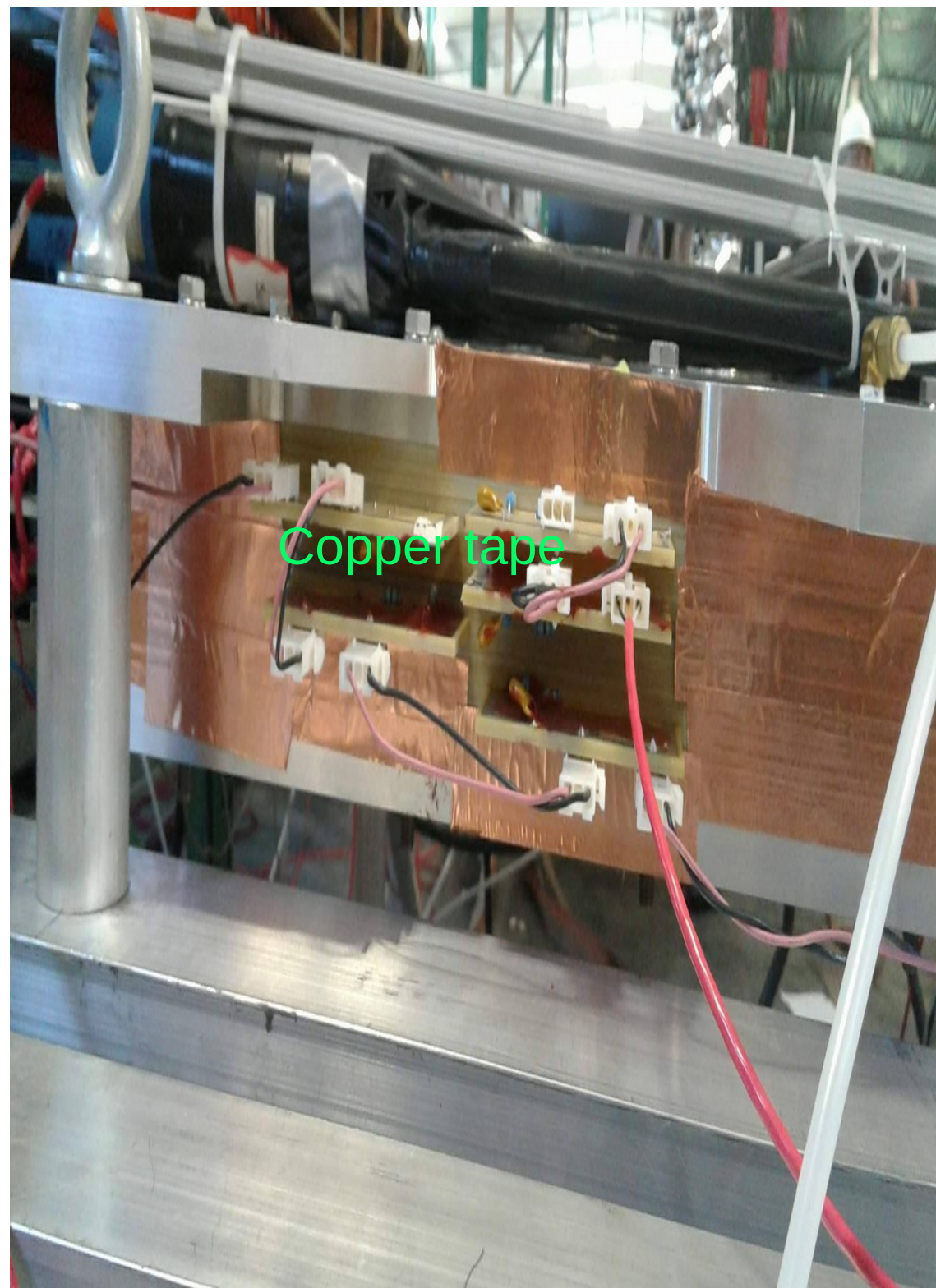
Ribbon cable
with label

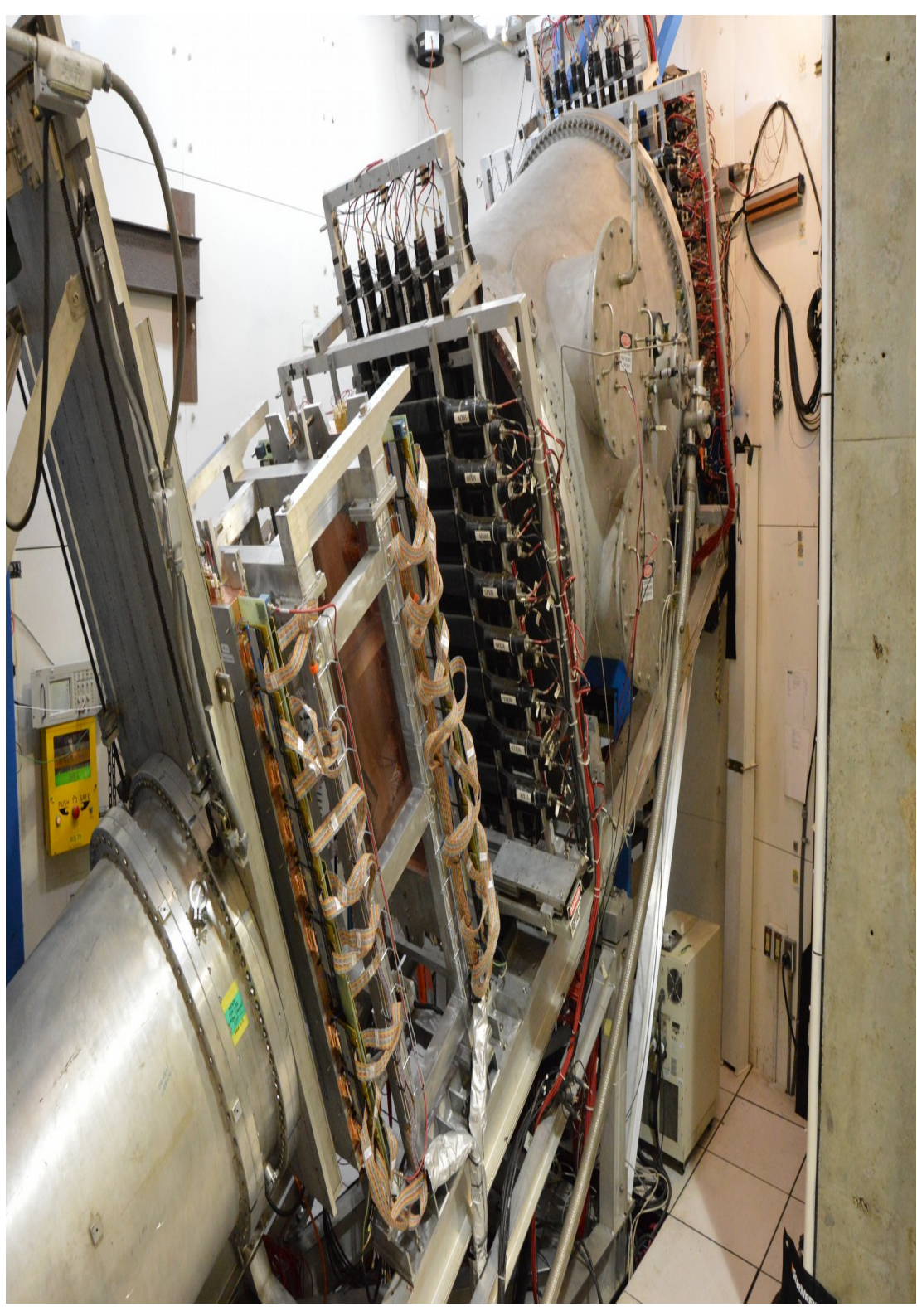


Ch2X'2(12-27)
card#4

Test with Oscilloscope









Thank You