Status Update On The New HMS Wire Chamber

Joint Hall A & C Summer Collaboration Meeting

June 22-23, 2017

Bishnu Pandey

Hampton University, VA, USA

Jefferson Lab

HAMPTON UNIVERSITY

THE STANDARD OF EXCELLENCE

Outline

- Introduction
- Basic Design of HMS Chamber
- Test of HMS Chamber
- Cosmic Rays Signal Test Set Up
- Plateau Curve
- Hardware Status at ESB
- Test Summary at ESB
- Summary and Future Plans
- Some Snapshots
- Acknowledgements

Introduction

The new HMS Chambers are being built to replace the old existing 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

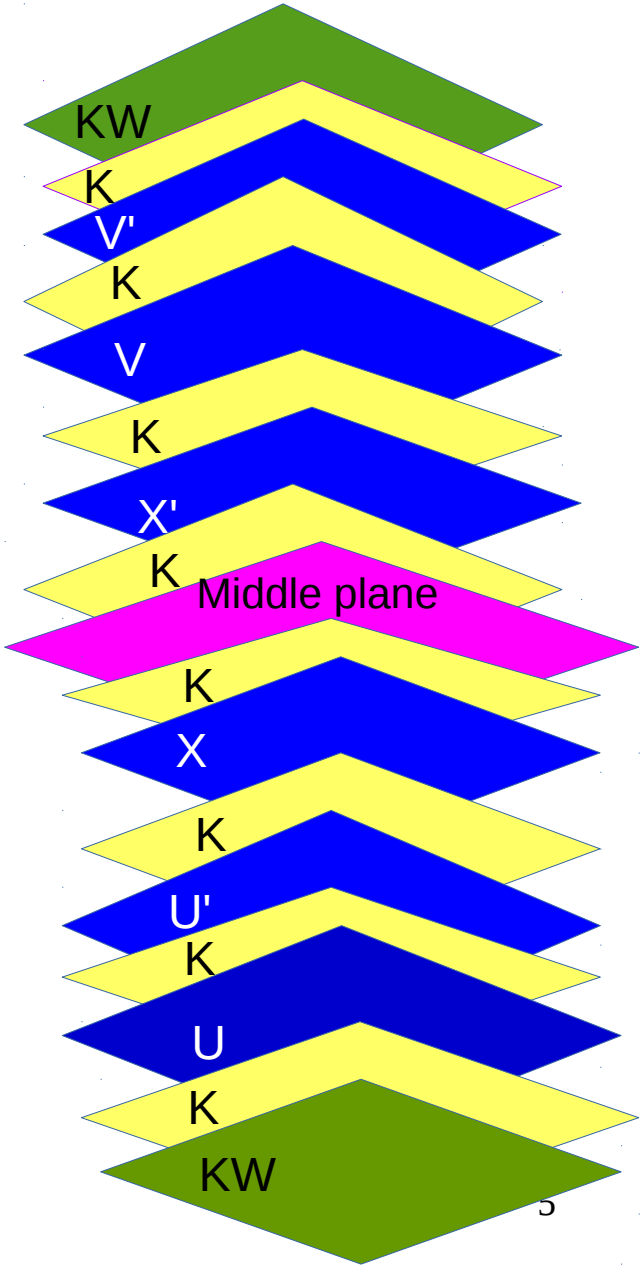
First Chamber
Started: May 10 2016
Completed: August 10 2016
Shipped to Jlab: 08/12/2016

Second Chamber
Started: August 12 2016
completed: November 06 2016
Shipped to Jlab: 11/11/2016

Basic Design

It consists of:

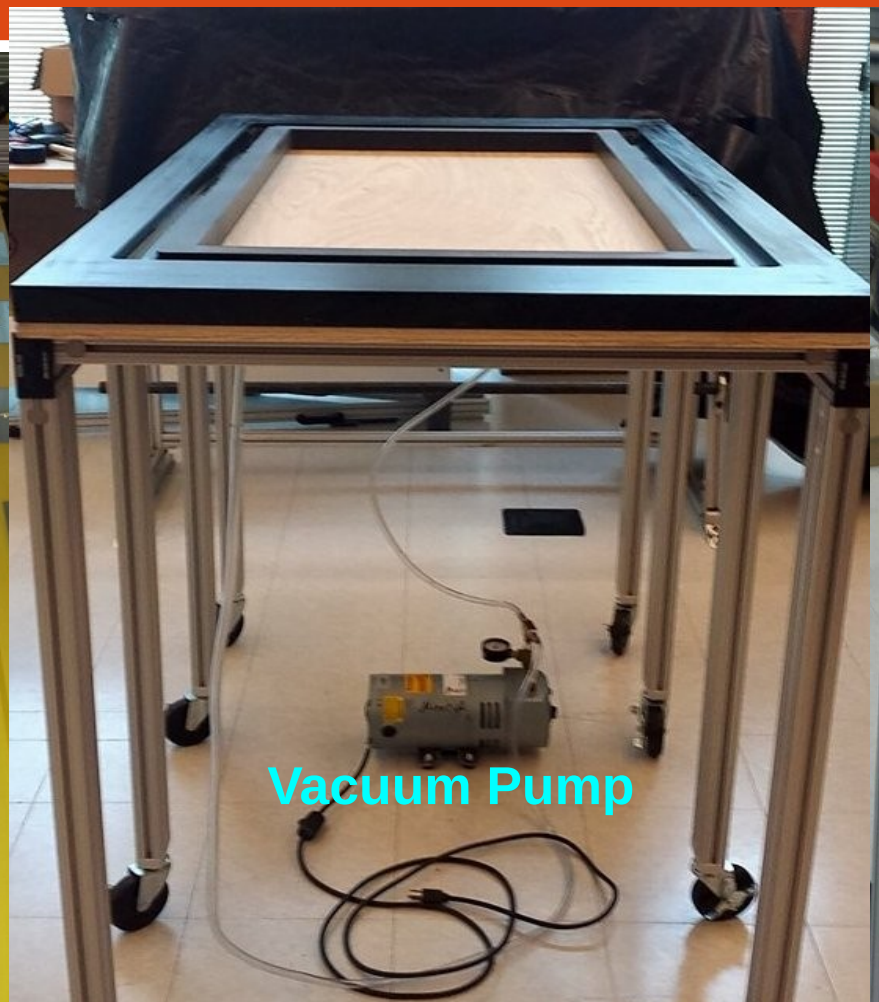
- 2 cathode windows (KW)
- 8 cathode planes (K)
- 6 wire planes (X,X',U,U',V,V')
- 1 middle plane with card carriers and readout electronics
- 2 Aluminum frames

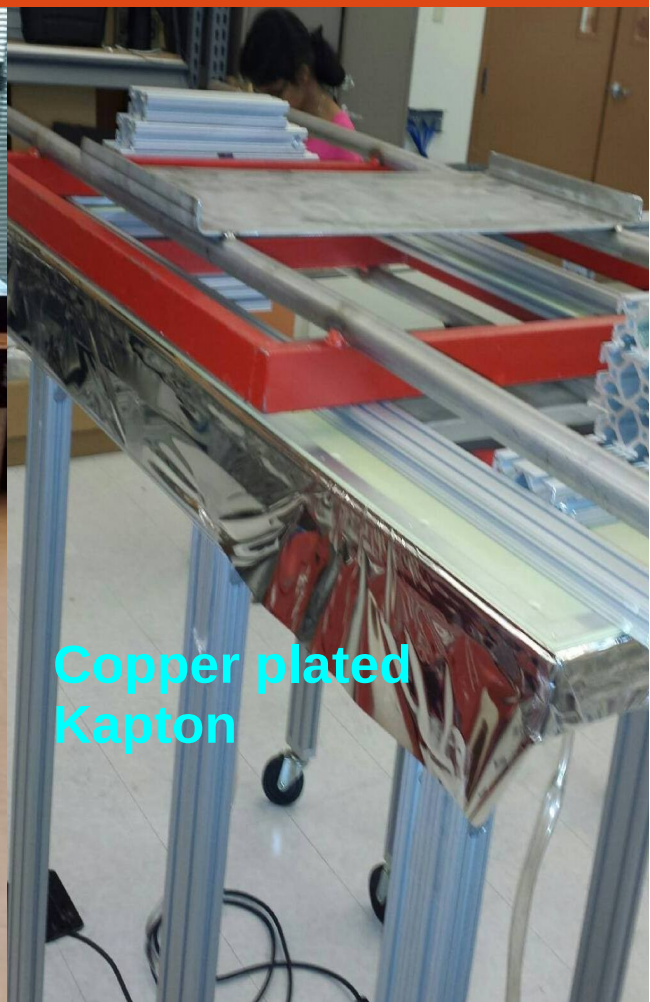


Construction of Planes

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.



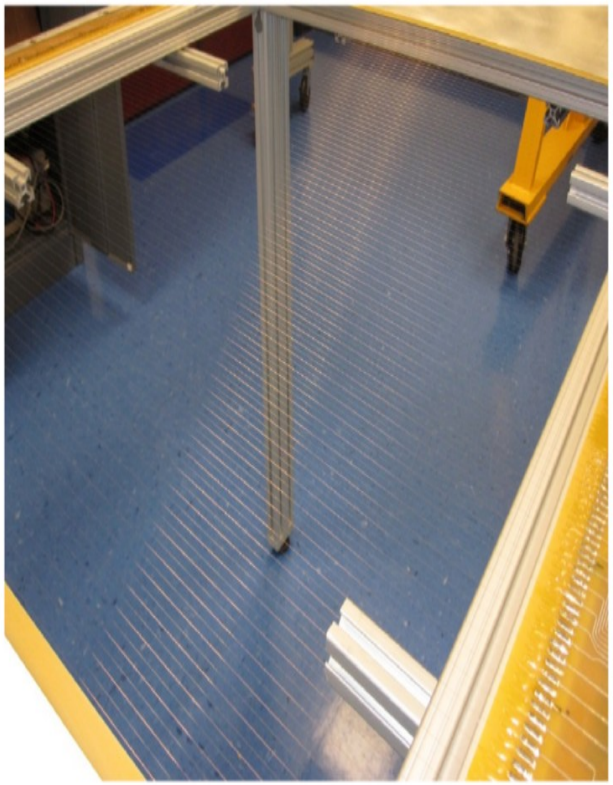


Wire plane

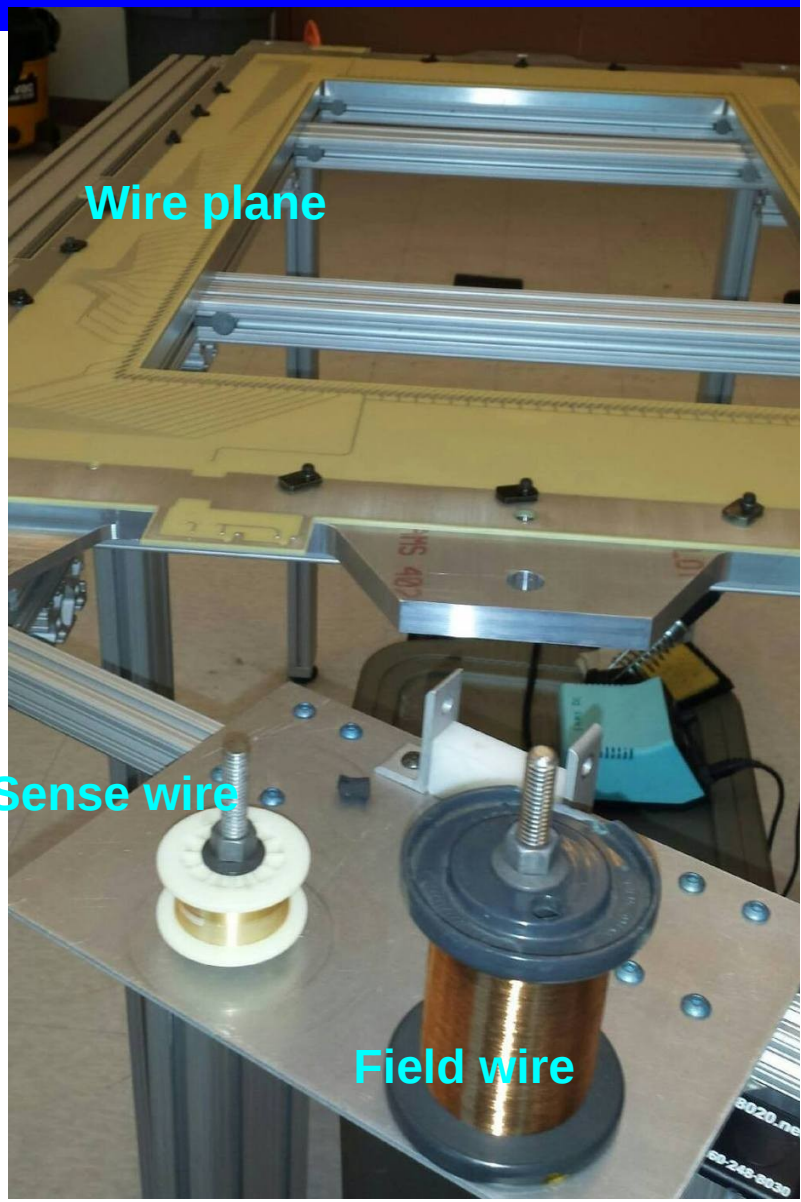
Wires are strung along the wire plane over the printed circuit board. Tension is fixed by hanging an iron bar on the wire. The position of the wire is fixed by solder and epoxy.

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

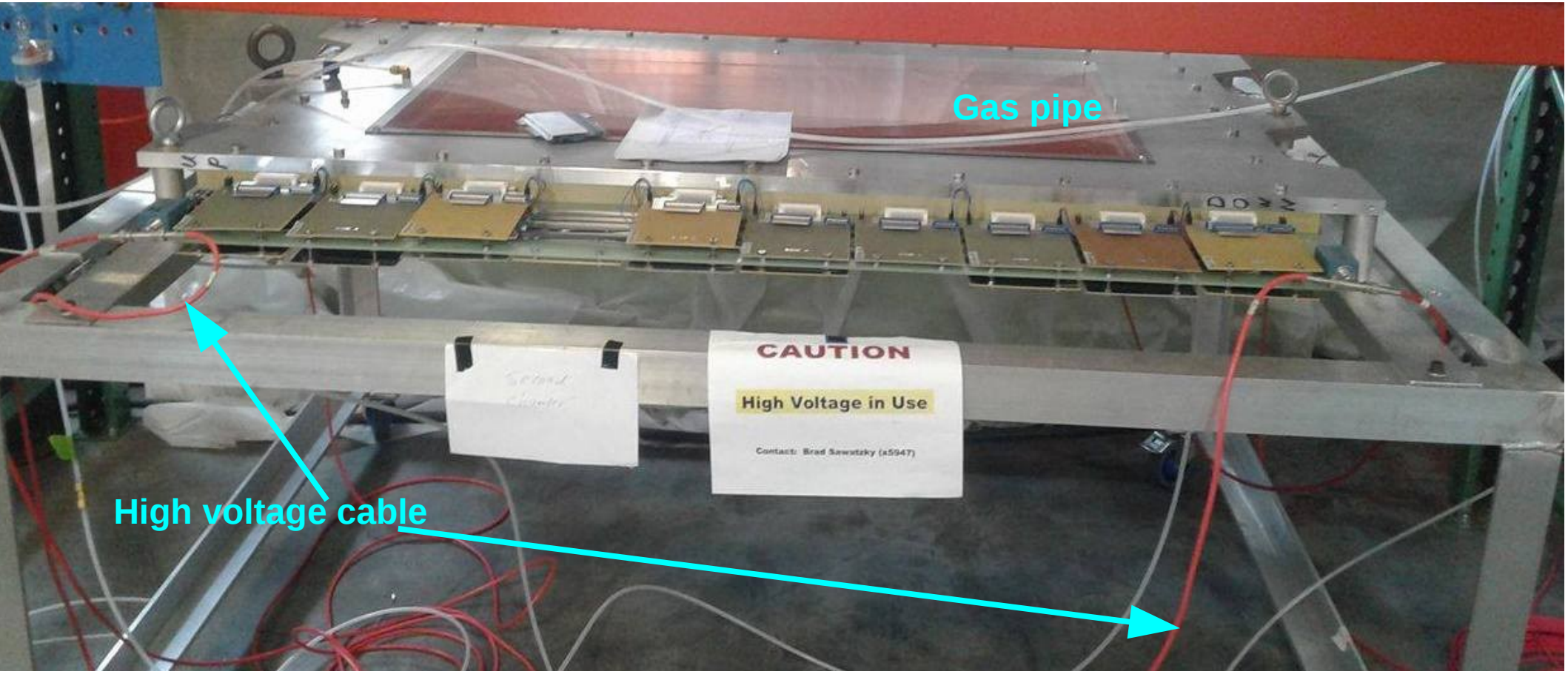
CO_2 quenching gas

The mixture is non flammable

Conditioning

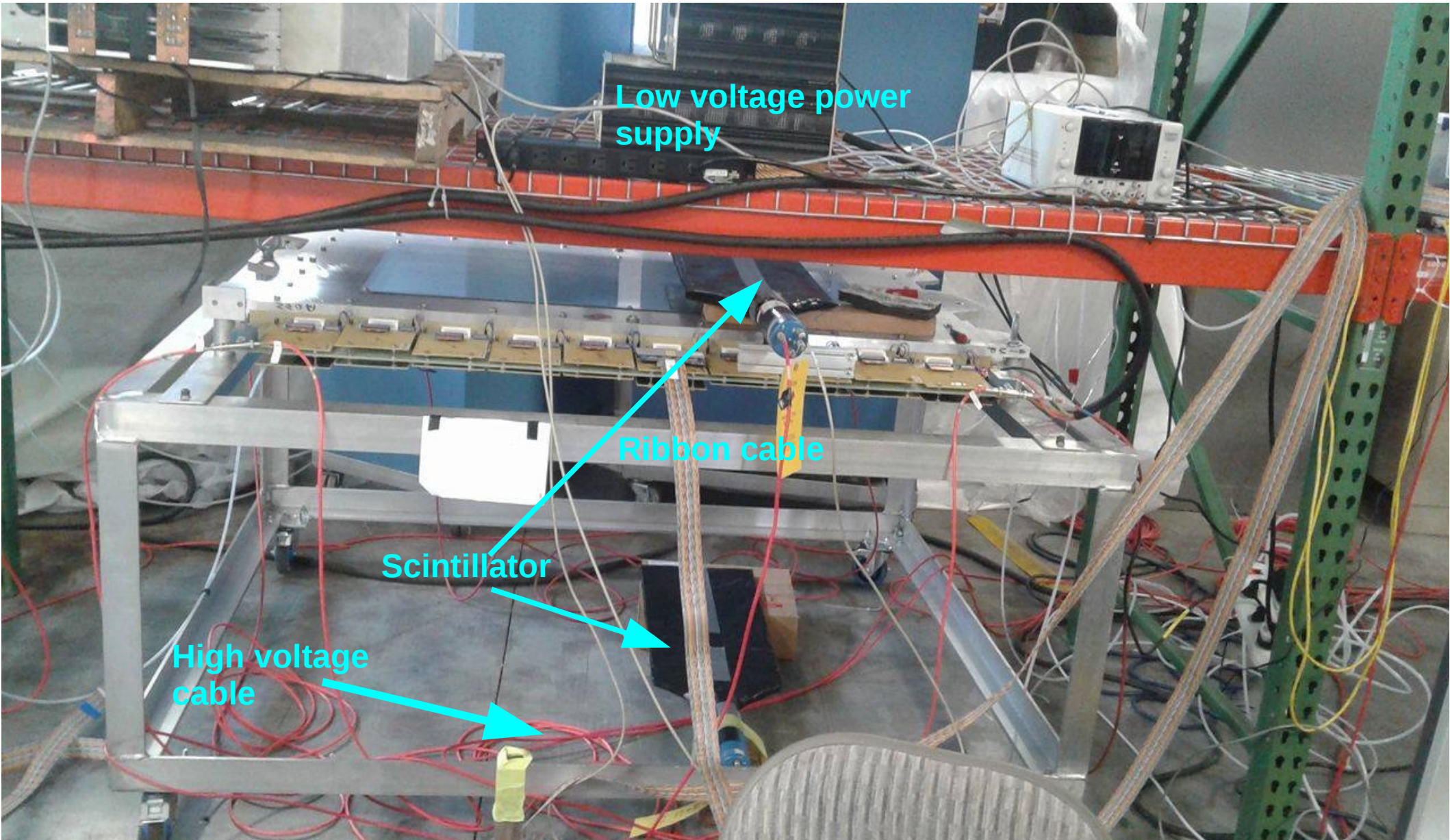
High voltage conditioning started before mid November and completed around first week of January 2017.

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



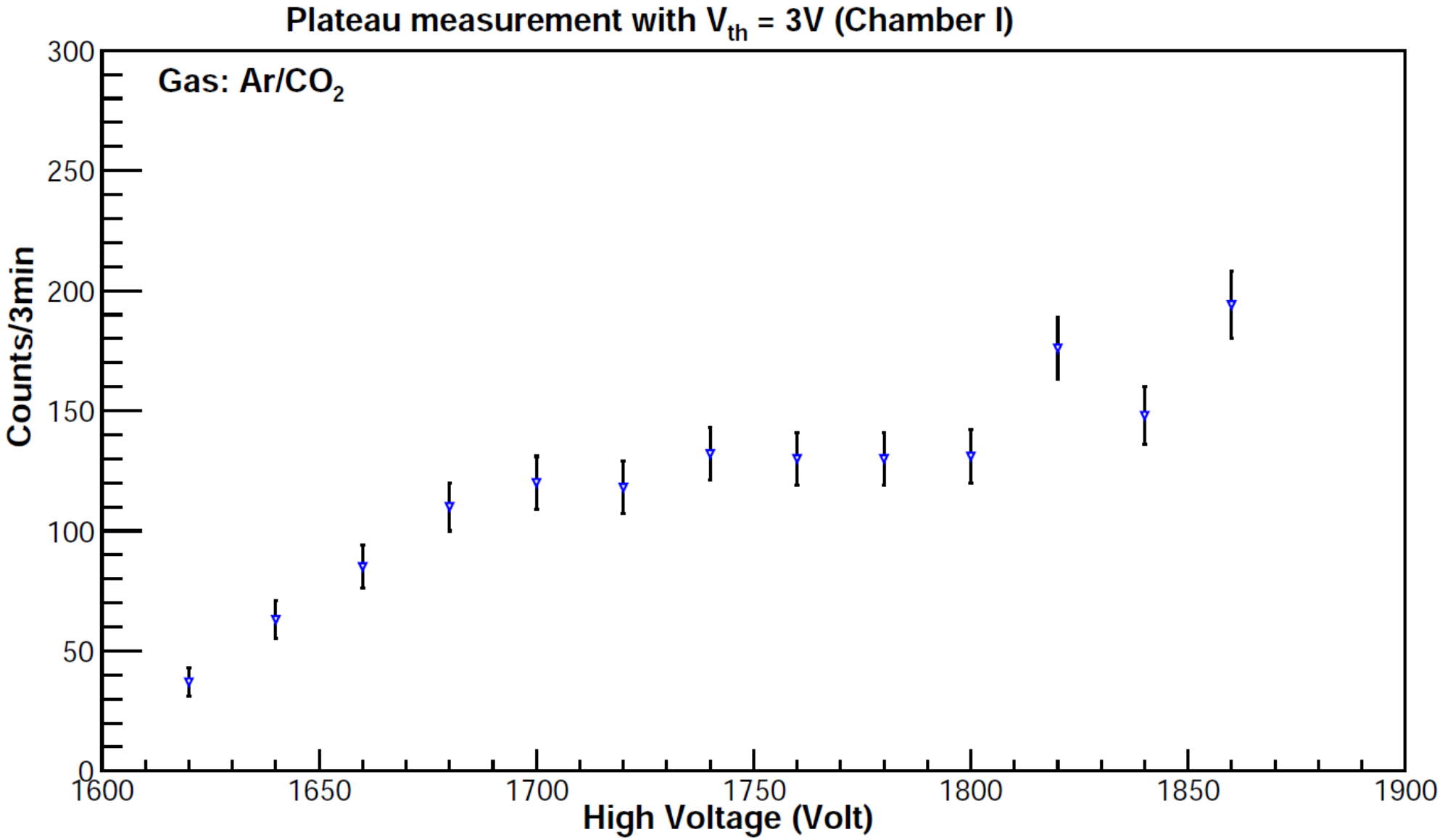
Cosmic Ray Signal Test Set up

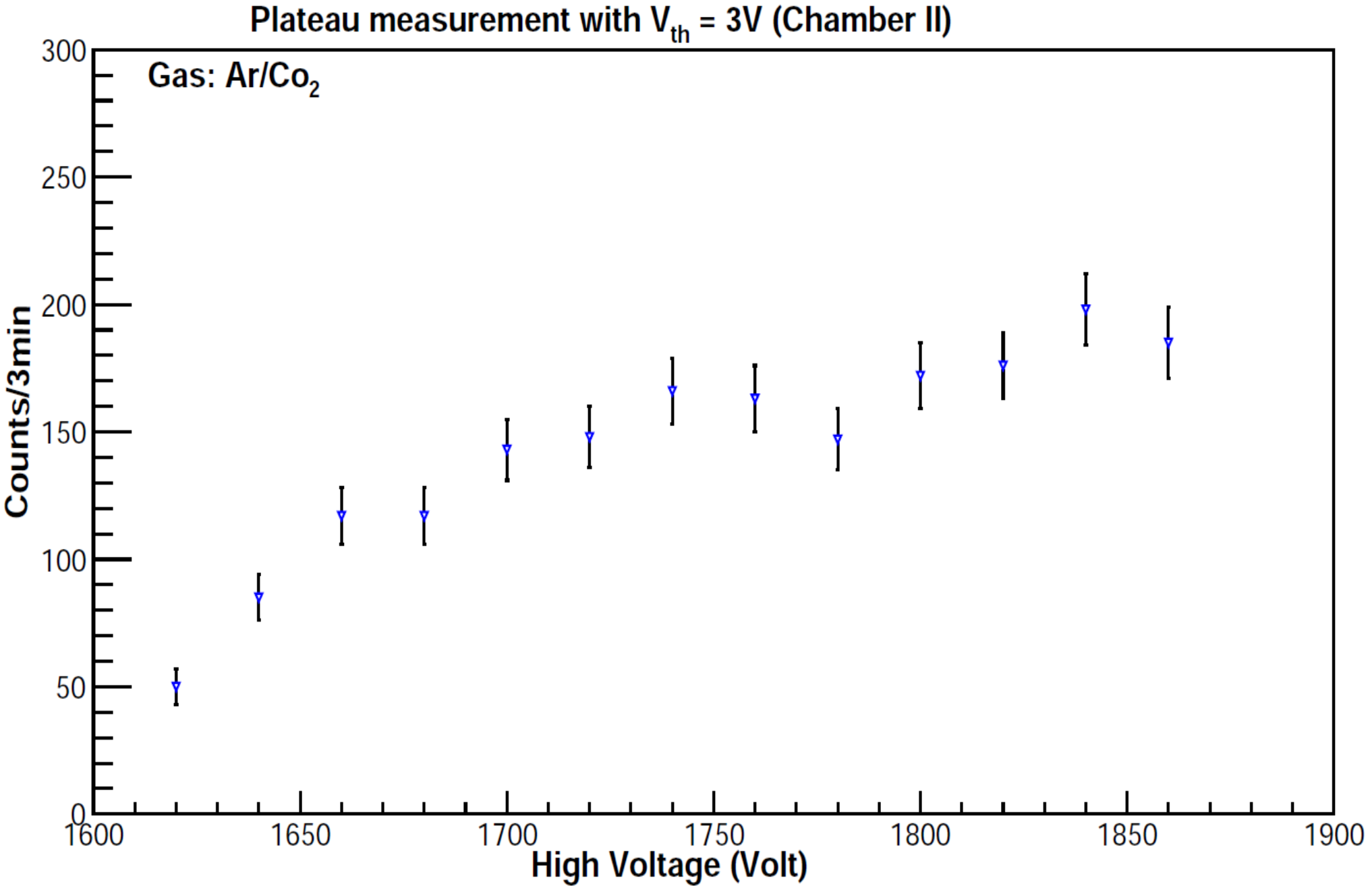
Started signal test beginning in January 2017.



Plateau Curve

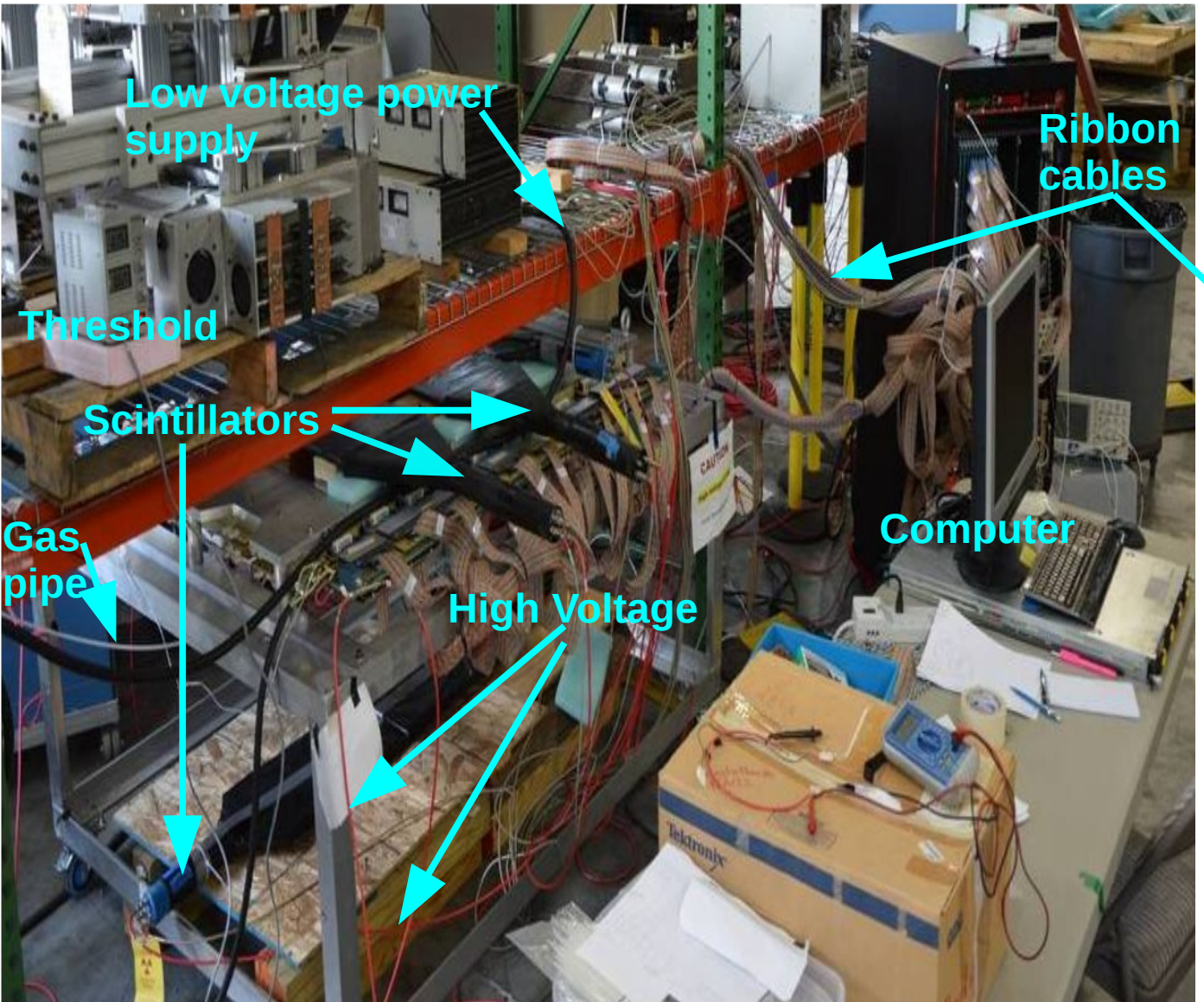
Plateau measurement started mid January 2017.

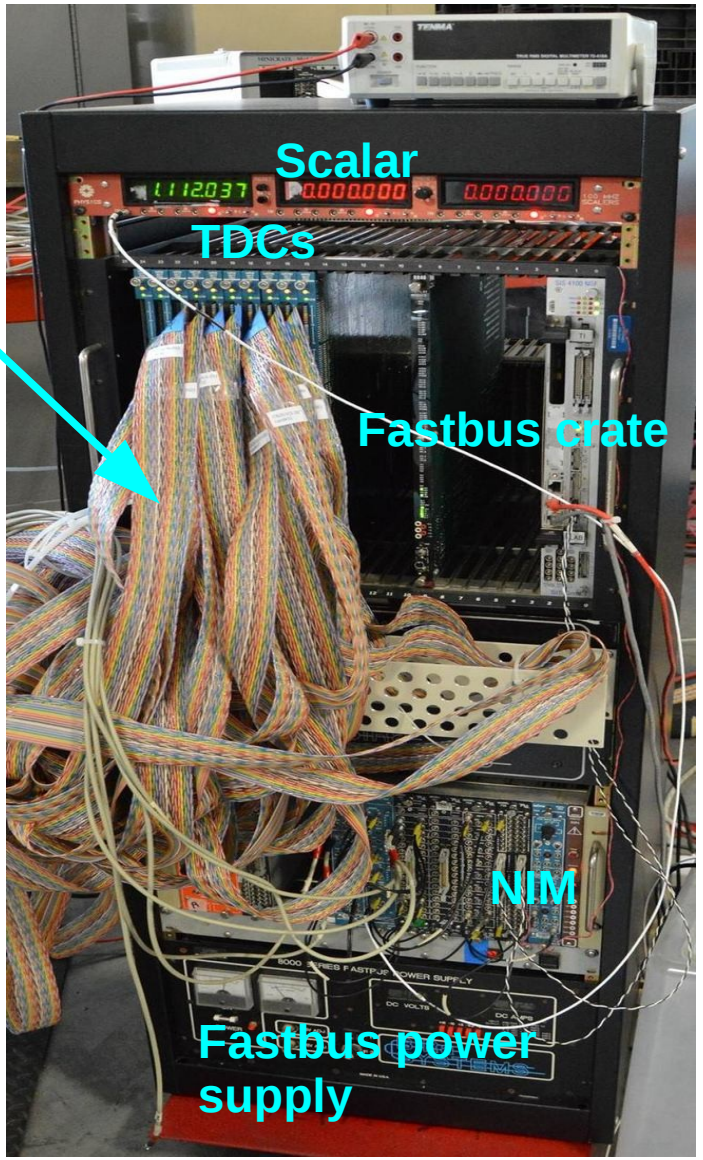



Plateau measurement with V_{th} = 3V (Chamber II)
Gas: Ar/Co_2
Counts/3min
High Voltage (Volt)
0
50
100
150
200
250
300
1600
1650
1700
1750
1800
1850
1900

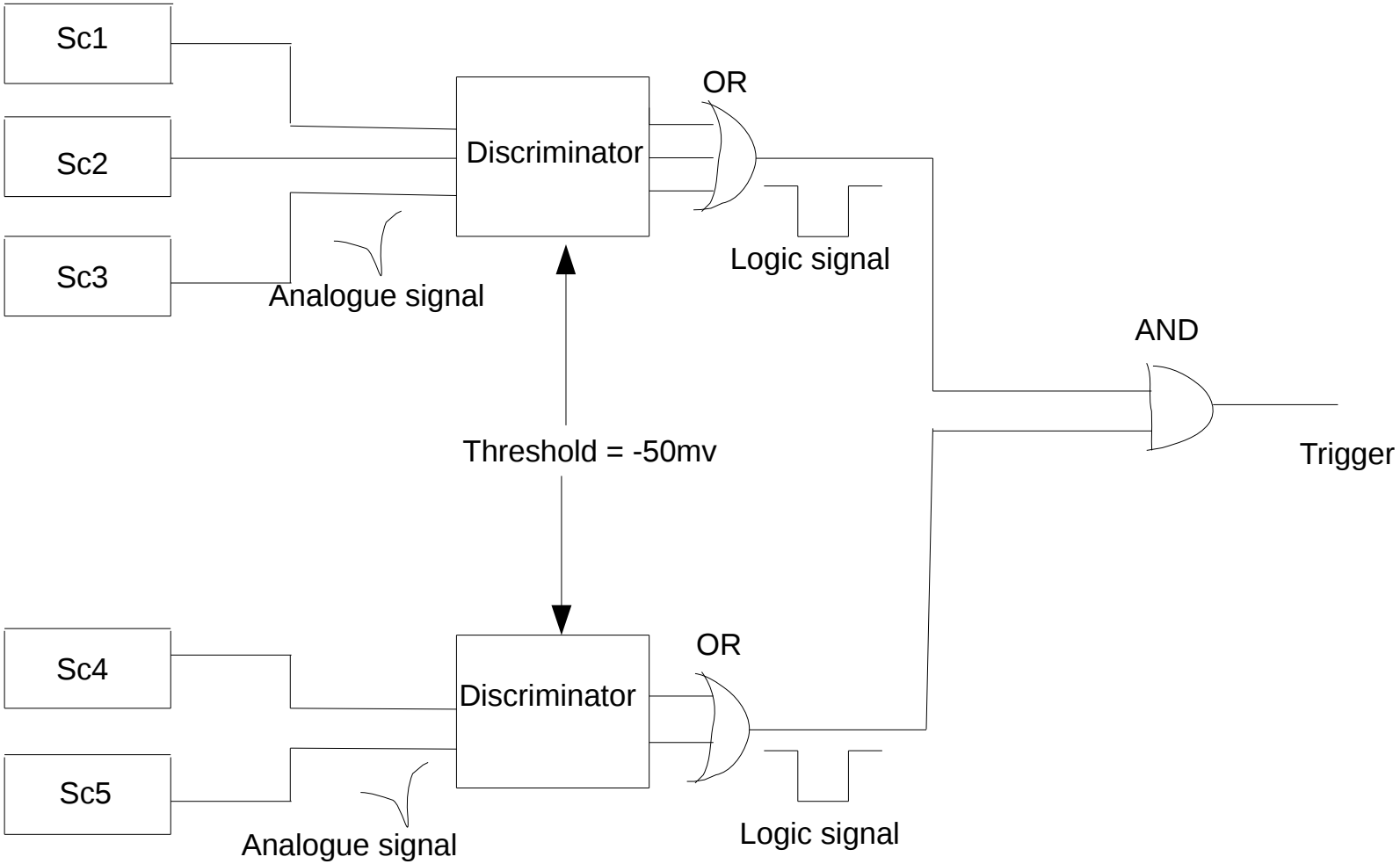
Hardware Status at ESB

- 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.



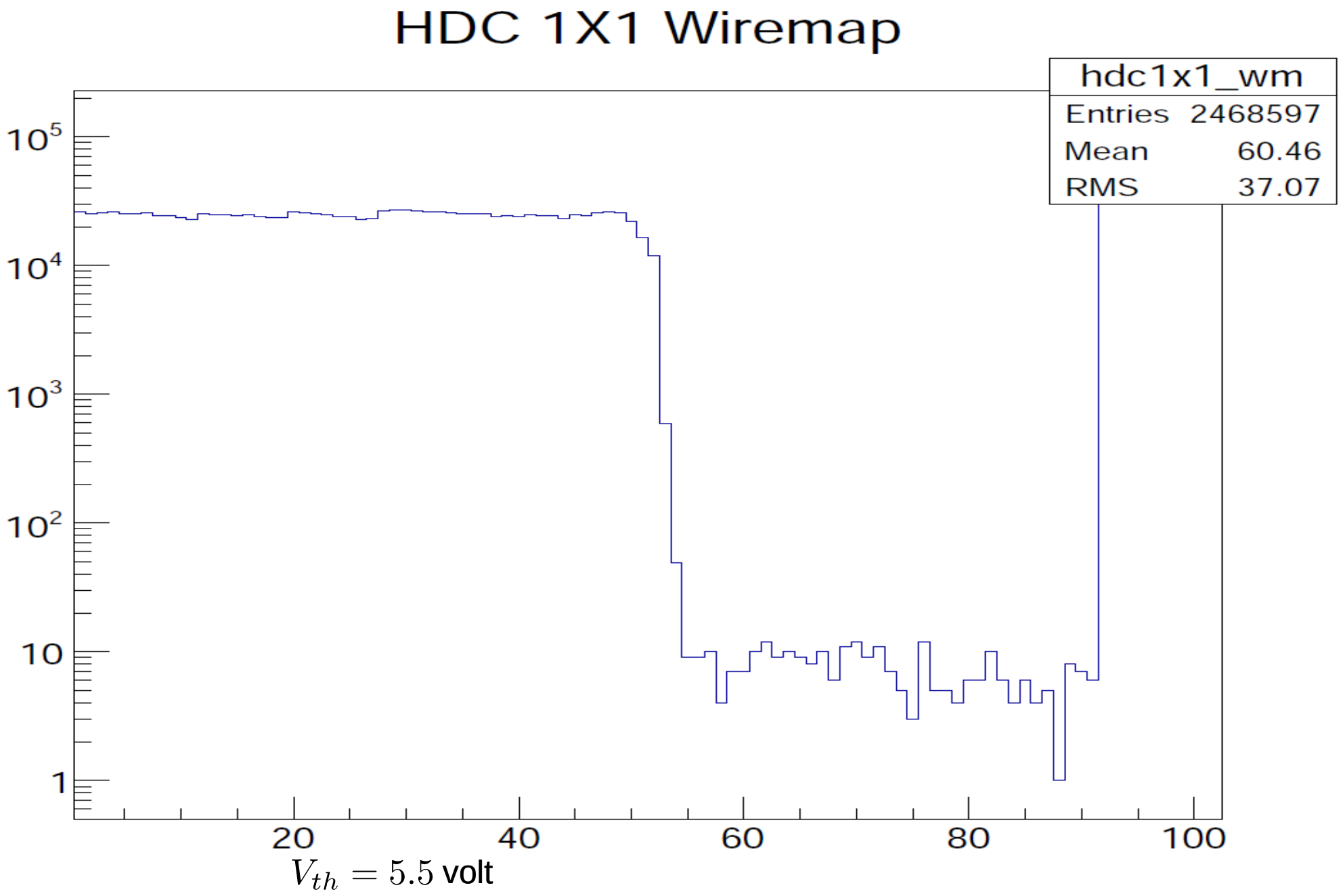


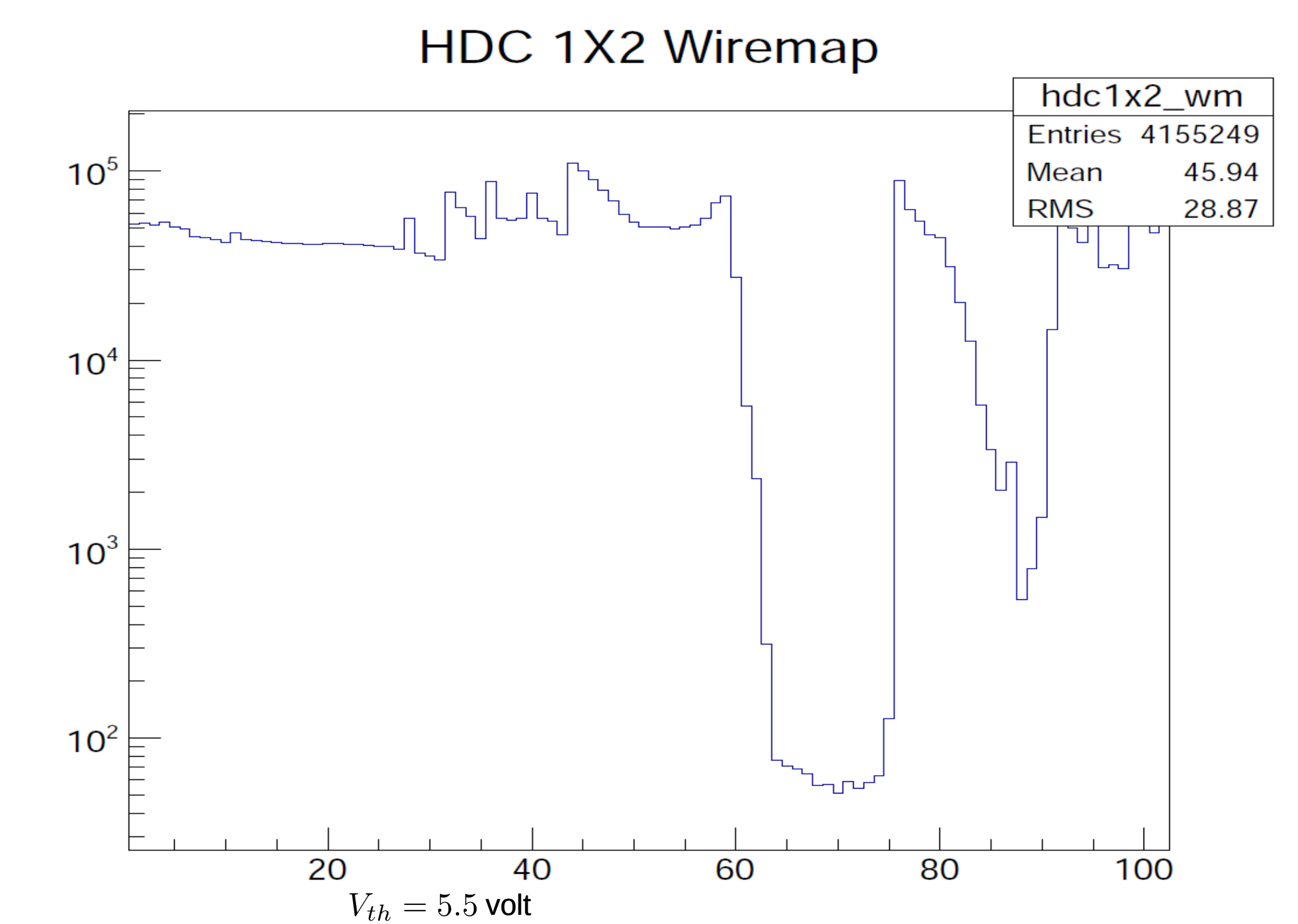
Test of Chamber

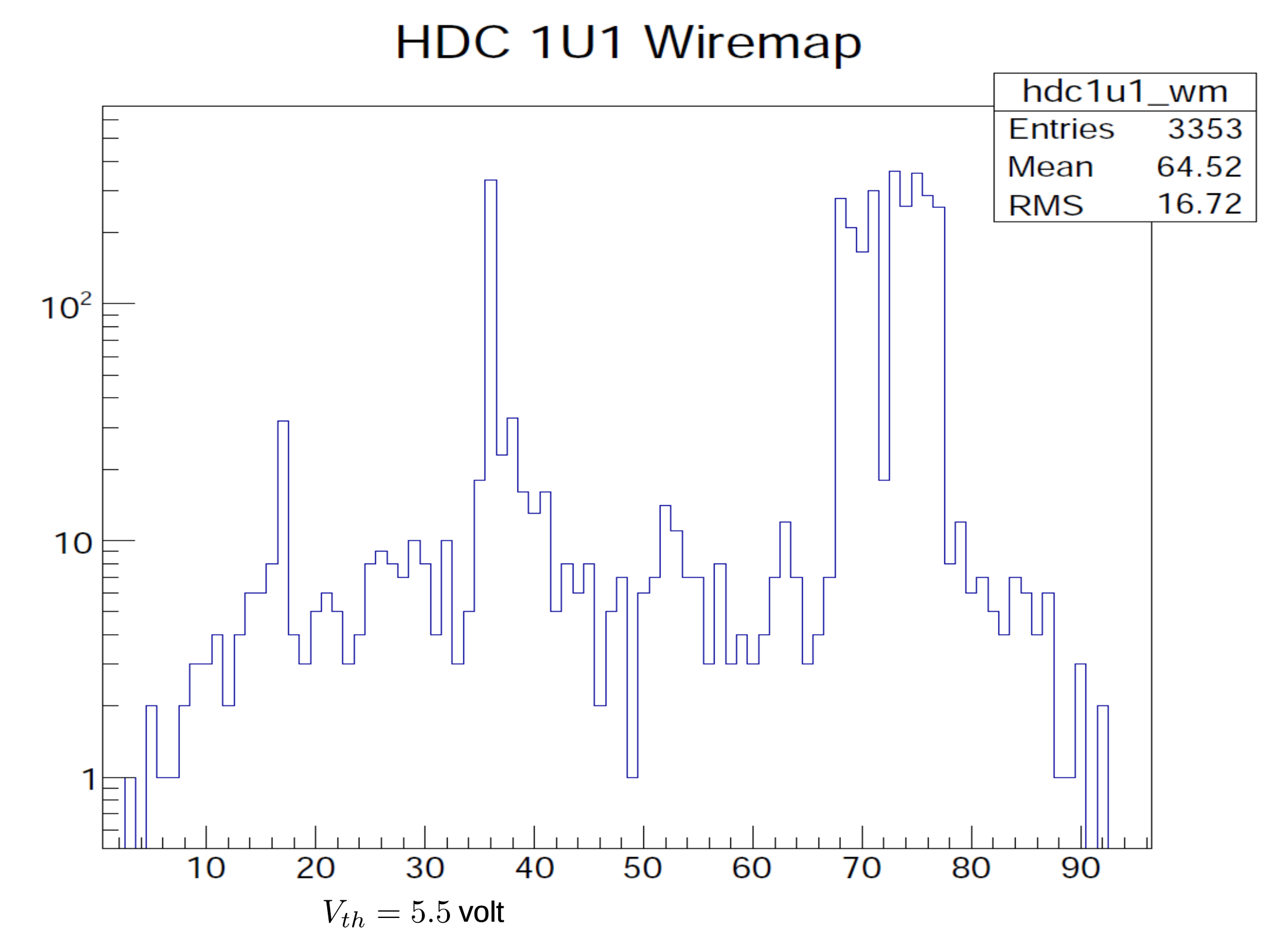


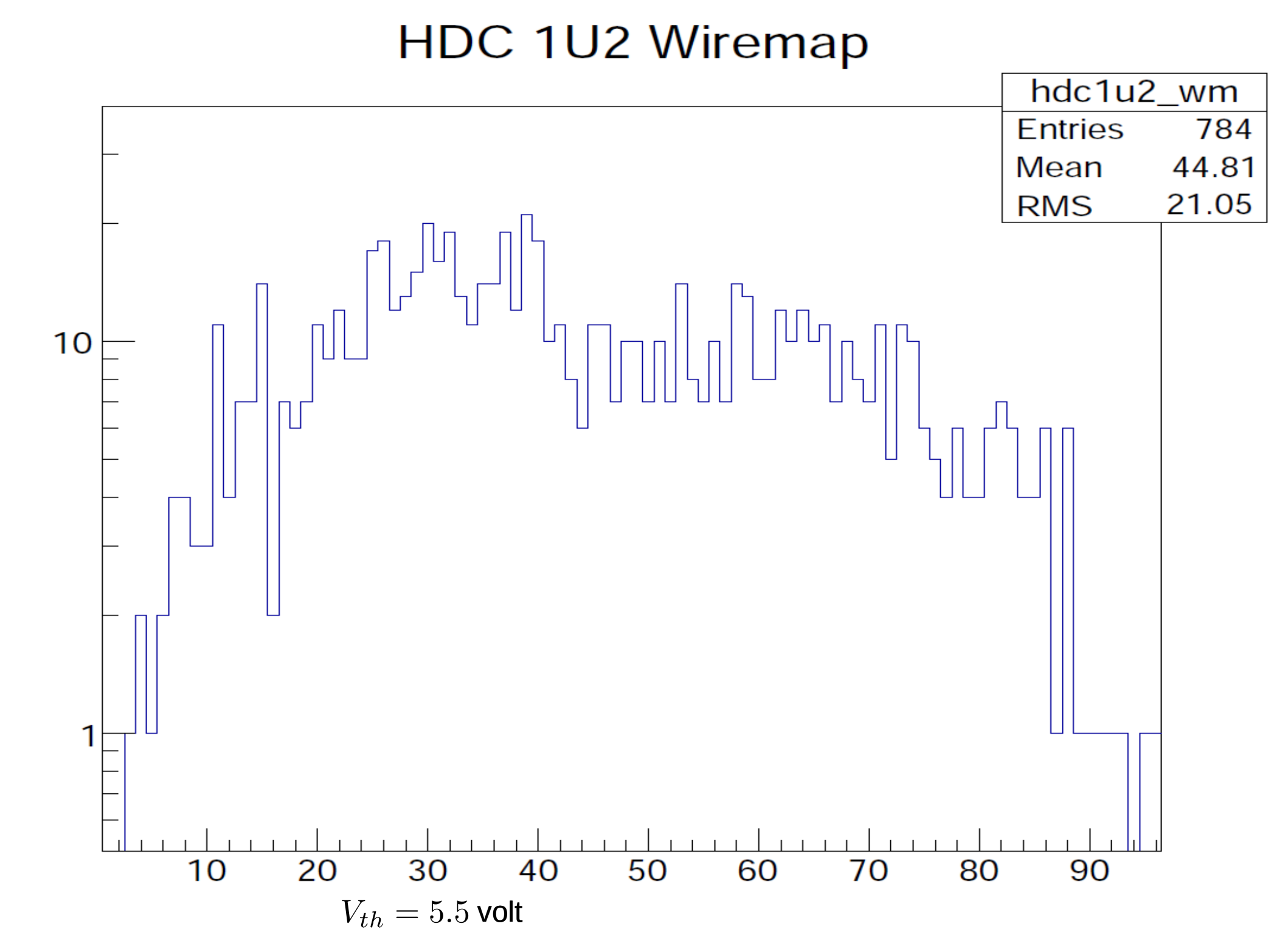
Test Summary at ESB

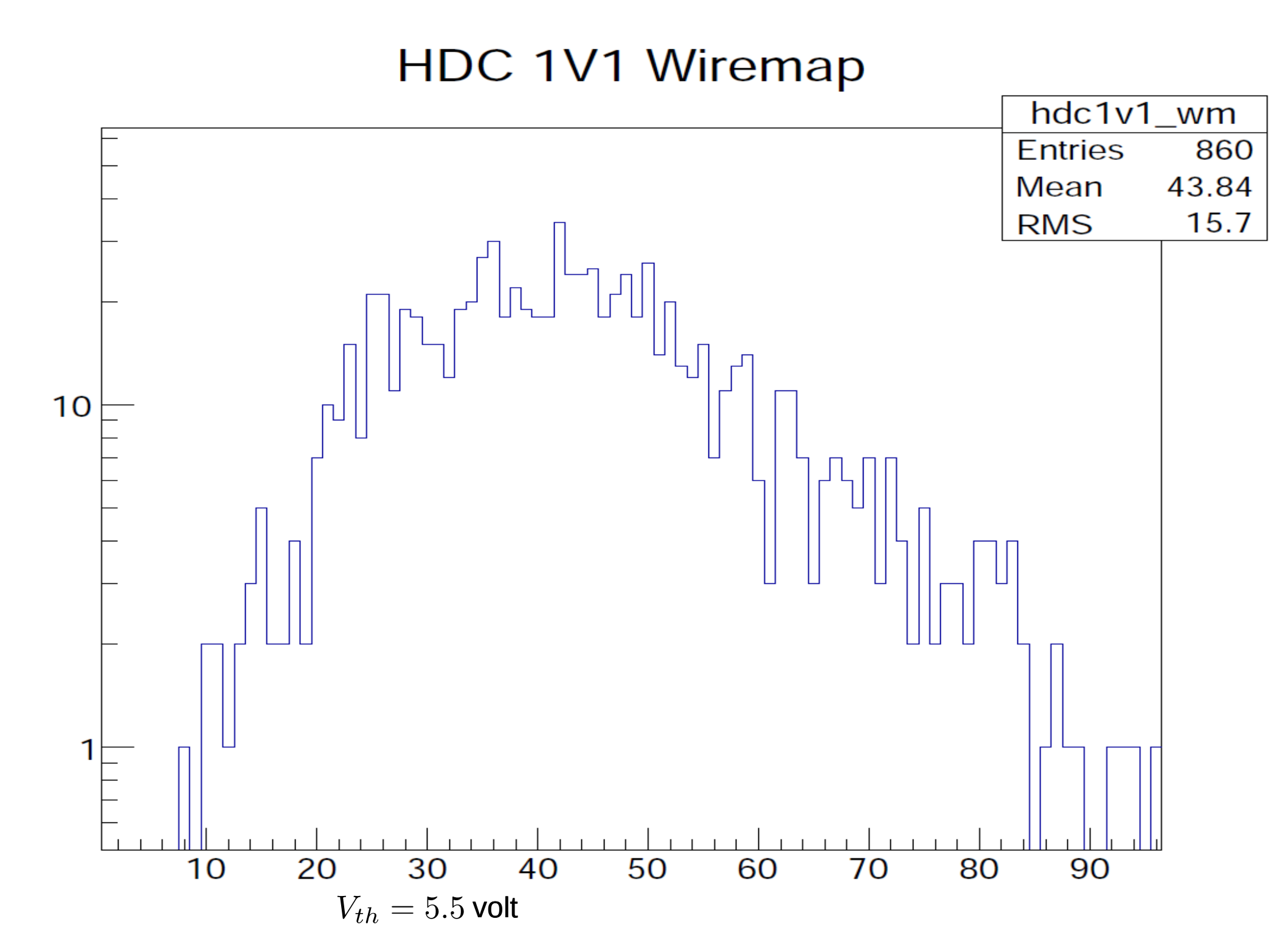
For threshold voltage 5.5 volt



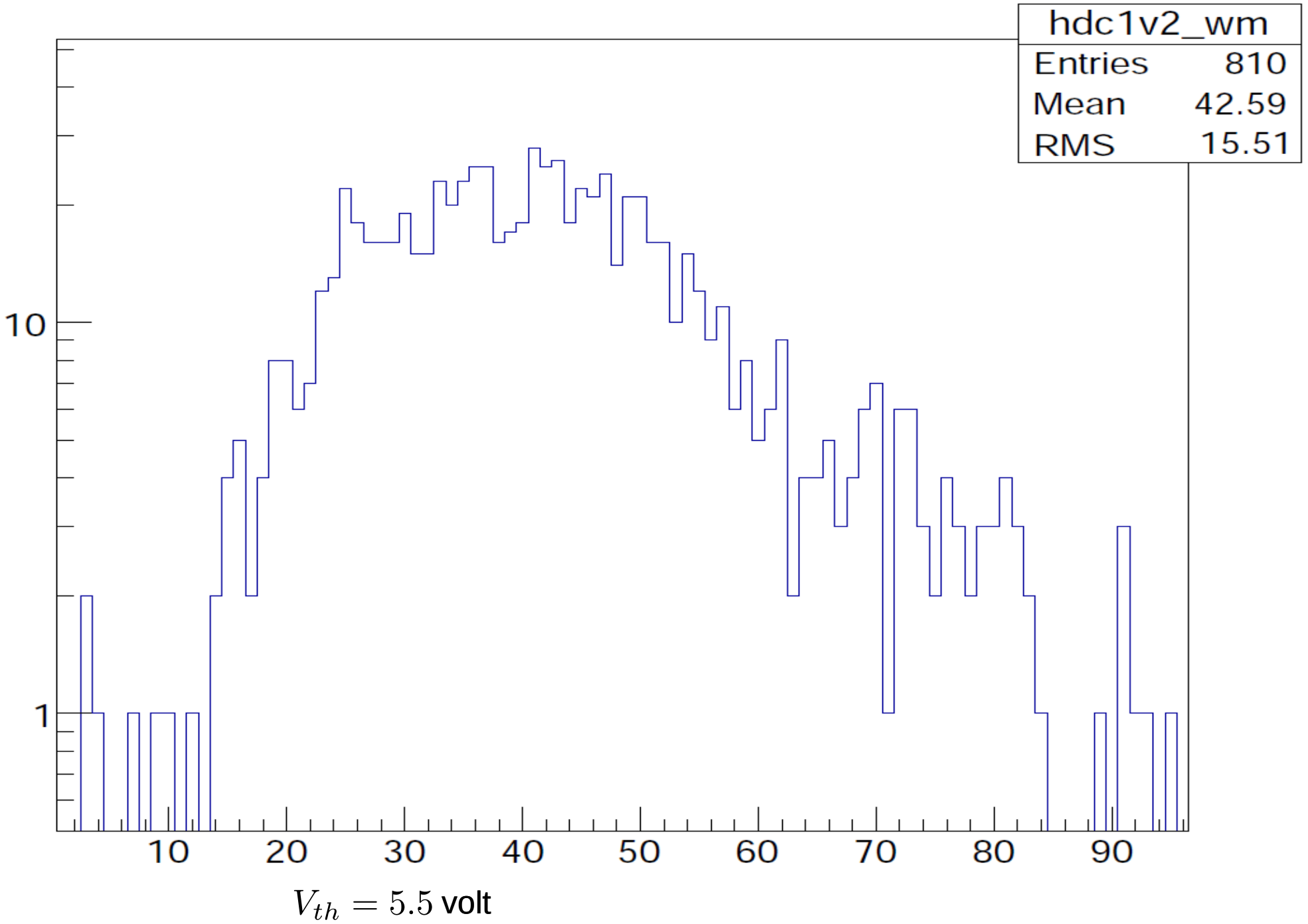

HDC 1X2 Wiremap
hdc1x2_wm
Entries 4155249
Mean 45.94
RMS 28.87
10^5
10^4
10^3
10^2
20
40
60
80
100
$V_{th} = 5.5$ volt


HDC 1U1 Wiremap
hdc1u1_wm
Entries 3353
Mean 64.52
RMS 16.72
10^2
10
1
10
20
30
40
50
60
70
80
90
$V_{th} = 5.5$ volt


HDC 1U2 Wiremap
hdc1u2_wm
Entries 784
Mean 44.81
RMS 21.05
10
1
10
20
30
40
50
60
70
80
90
$V_{th} = 5.5$ volt


HDC 1V1 Wiremap
hdc1v1_wm
Entries 860
Mean 43.84
RMS 15.7
10
1
10 20 30 40 50 60 70 80 90
$V_{th} = 5.5$ volt

HDC 1V2 Wiremap



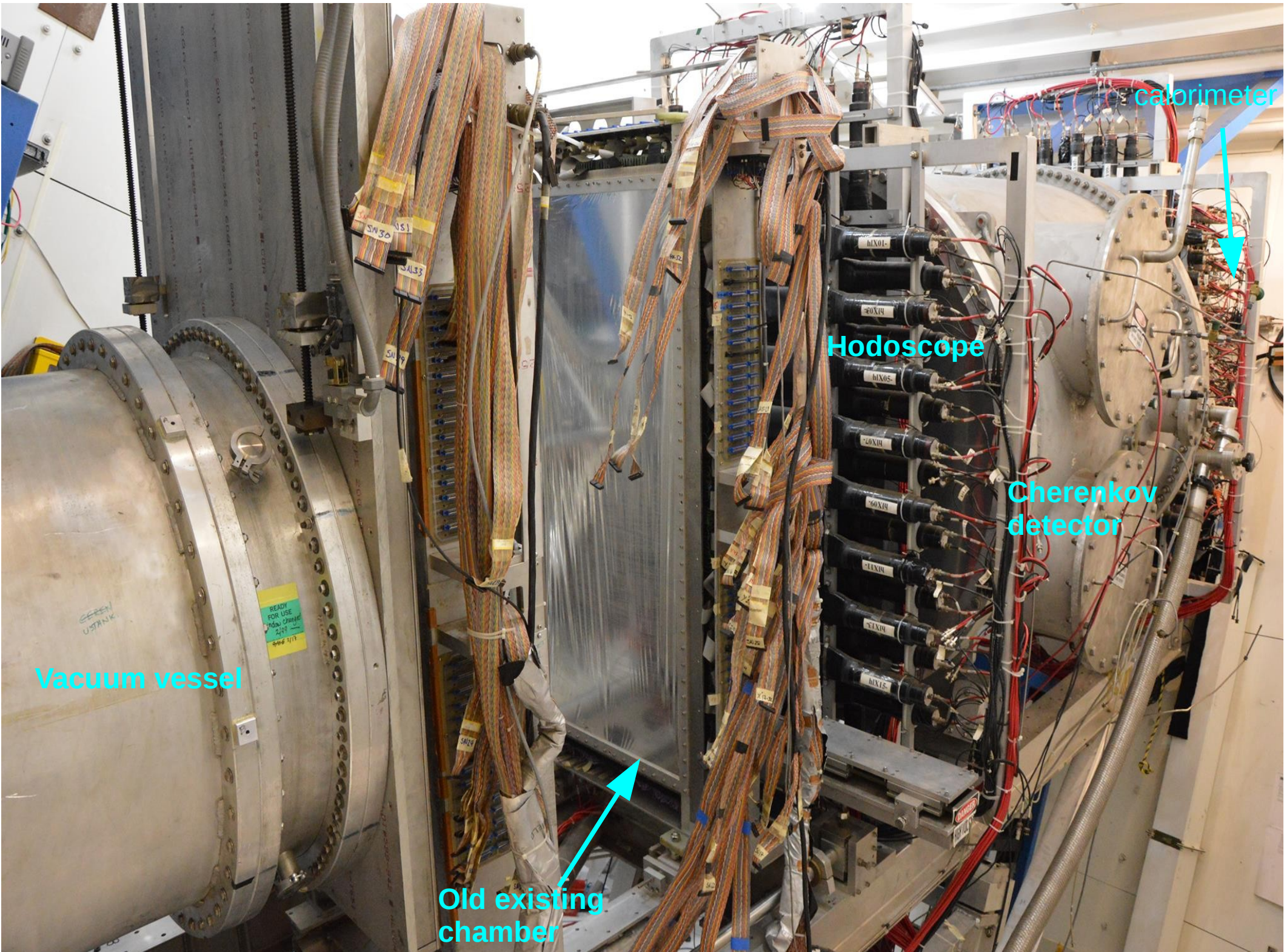
$V_{th} = 5.5$ volt

Summary

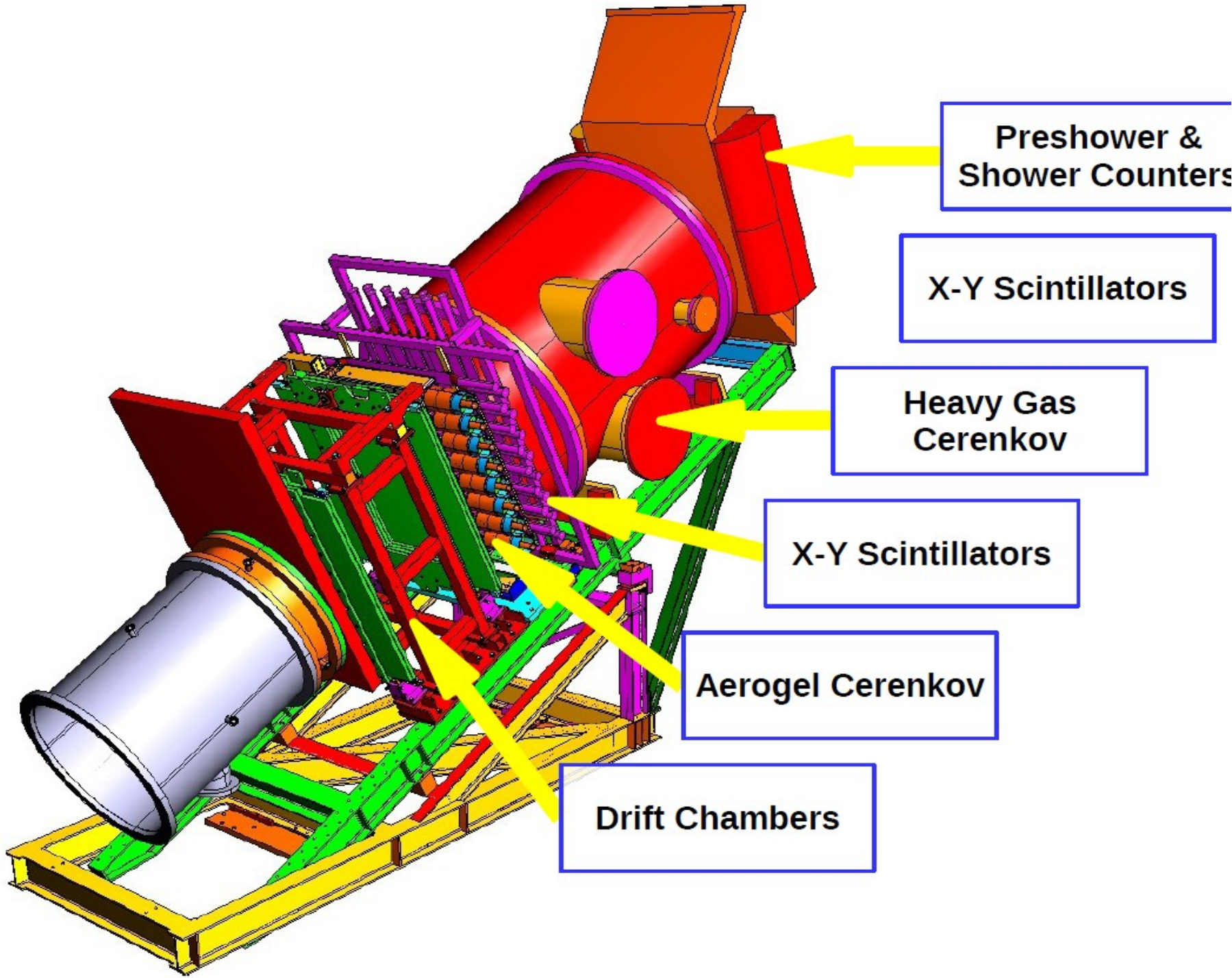
- Two HMS wire chambers were built at Hampton University from May to November 2016.
- After the primary test at Hampton, the chambers were shipped to Jlab (ESB building) for testing.
- High voltage conditioning completed mid-January 2017.
- Plateau curve test is done and plateau voltage found around 1750 volt.
- Started taking data from third week of June 2017.

Future Plans

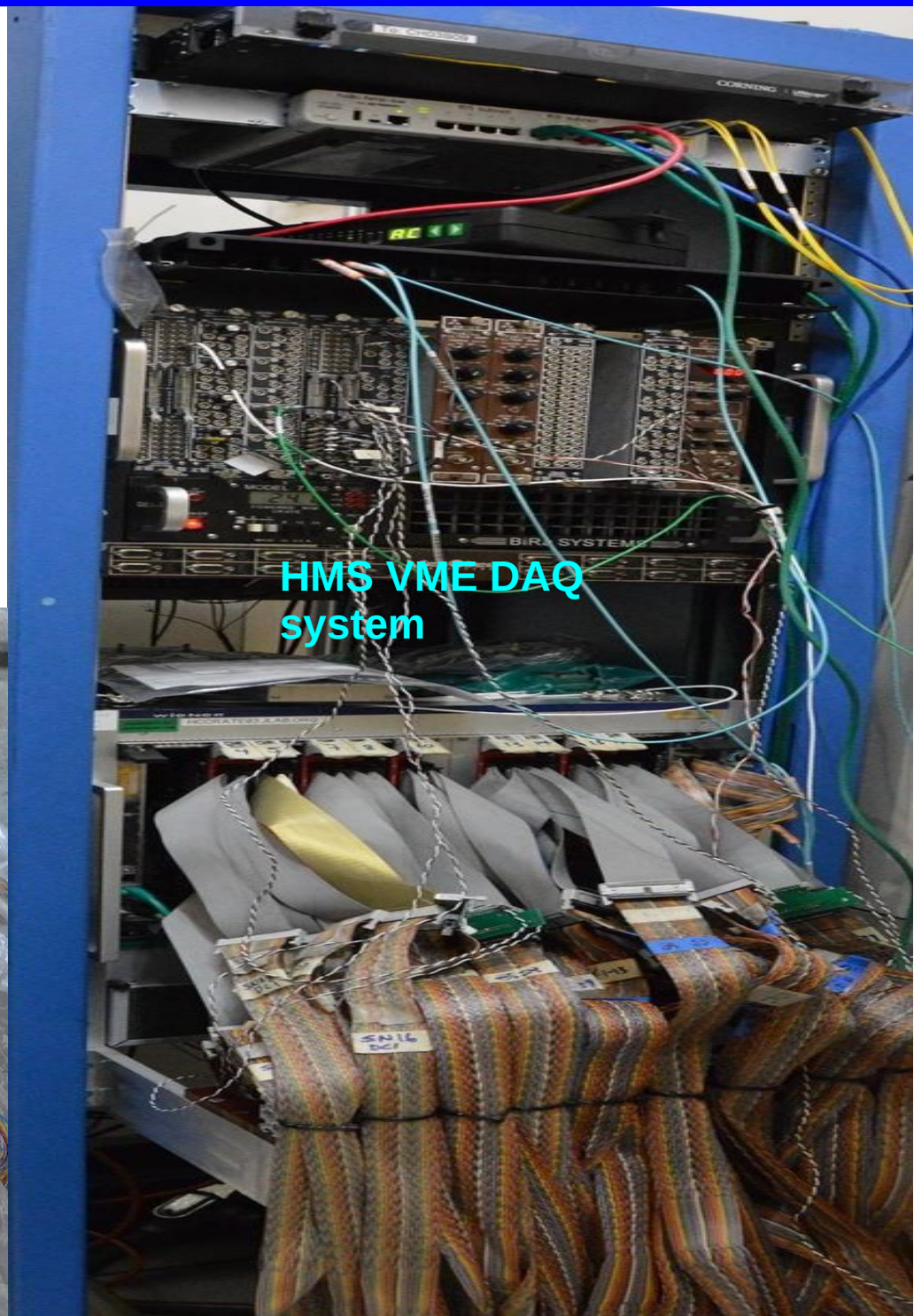
- The signal from each wire and the efficiency of each chamber will be tested.
- Chambers to be mounted on the frame in ESB and fiducialized.
- Old Drift chambers will be removed from HMS detector stack late July 2017.
- New Chambers will be installed in Hall C around mid August 2017.
- Cosmic testing in Hall C using $ArCO_2$

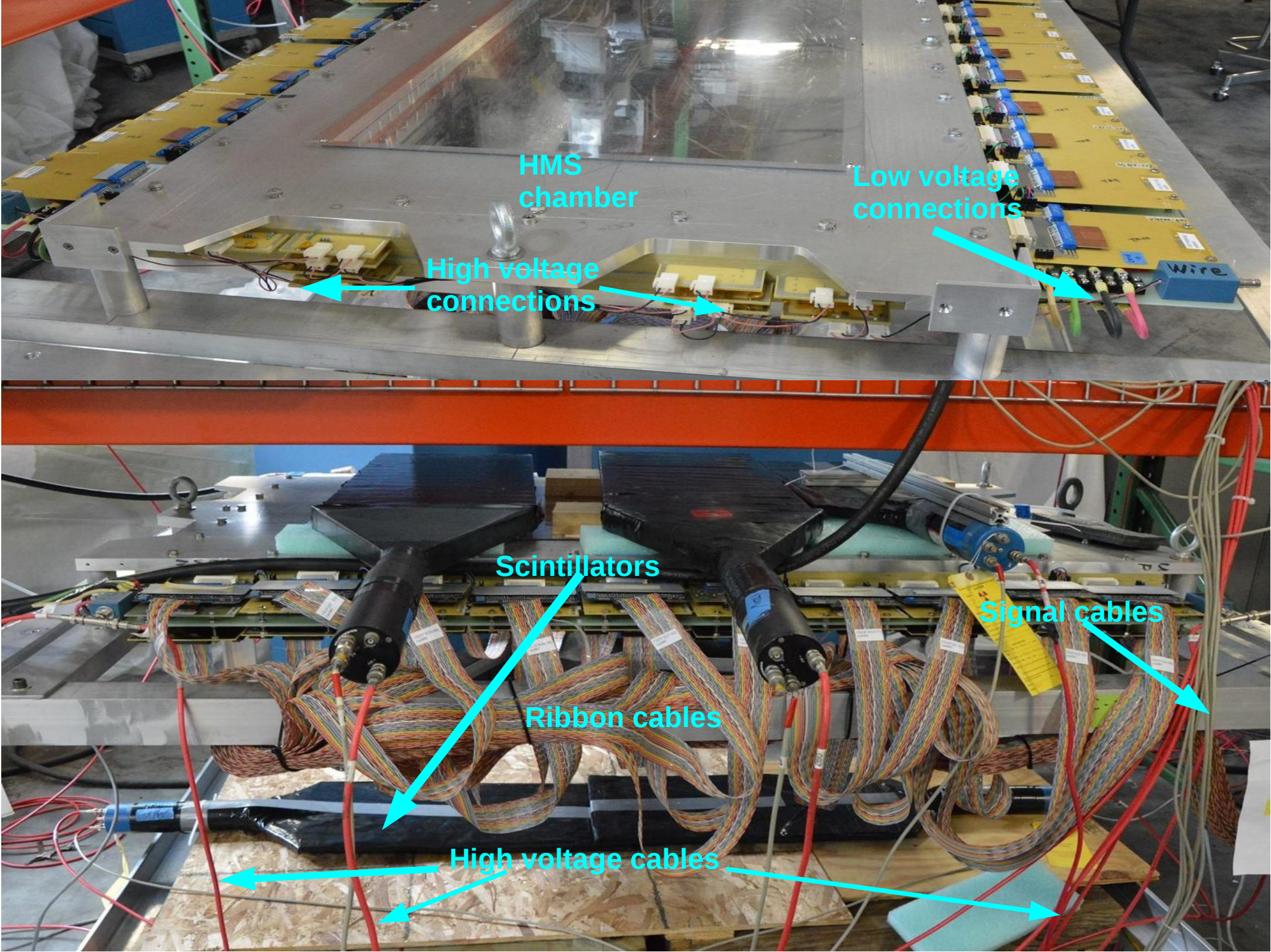

calorimeter
Hodoscope
Cherenkov detector
Vacuum vessel
Old existing chamber

Particle Detectors inside the HMS

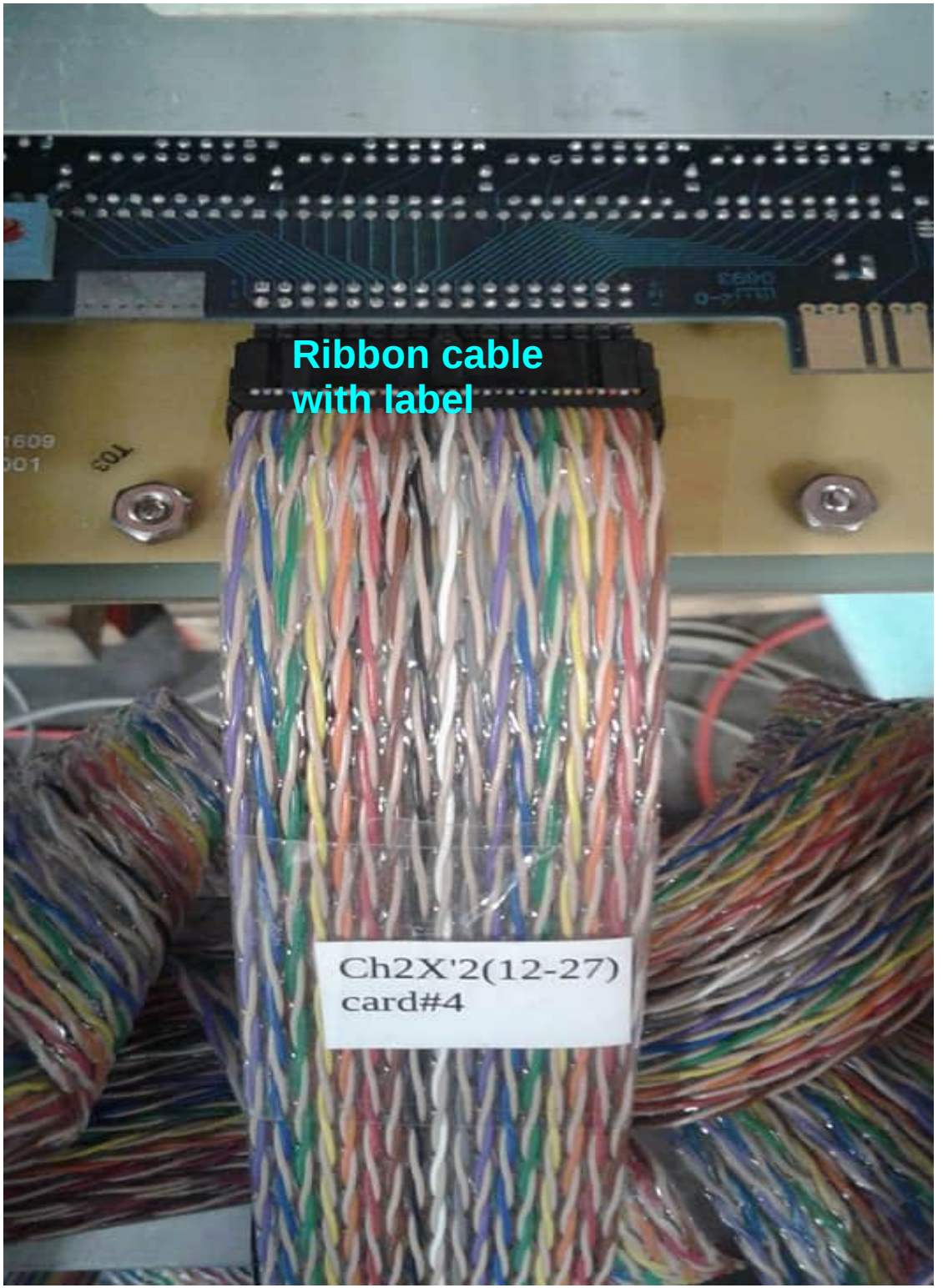


Some Snap shots




HMS
chamber
Low voltage
connections
High voltage
connections
Scintillators
Signal cables
Ribbon cables
High voltage cables


Detector
frame


Ribbon cable
with label
Ch2X'2(12-27)
card#4

Acknowledgements

Dr. Liguang Tang
Dr. Brad Sawatzky
Dr. Steve Wood
Mahlon Long (Chuck)

Thank You