Commisioning of Multiwire Drift Chamber for SHMS in Hall C at

Deb

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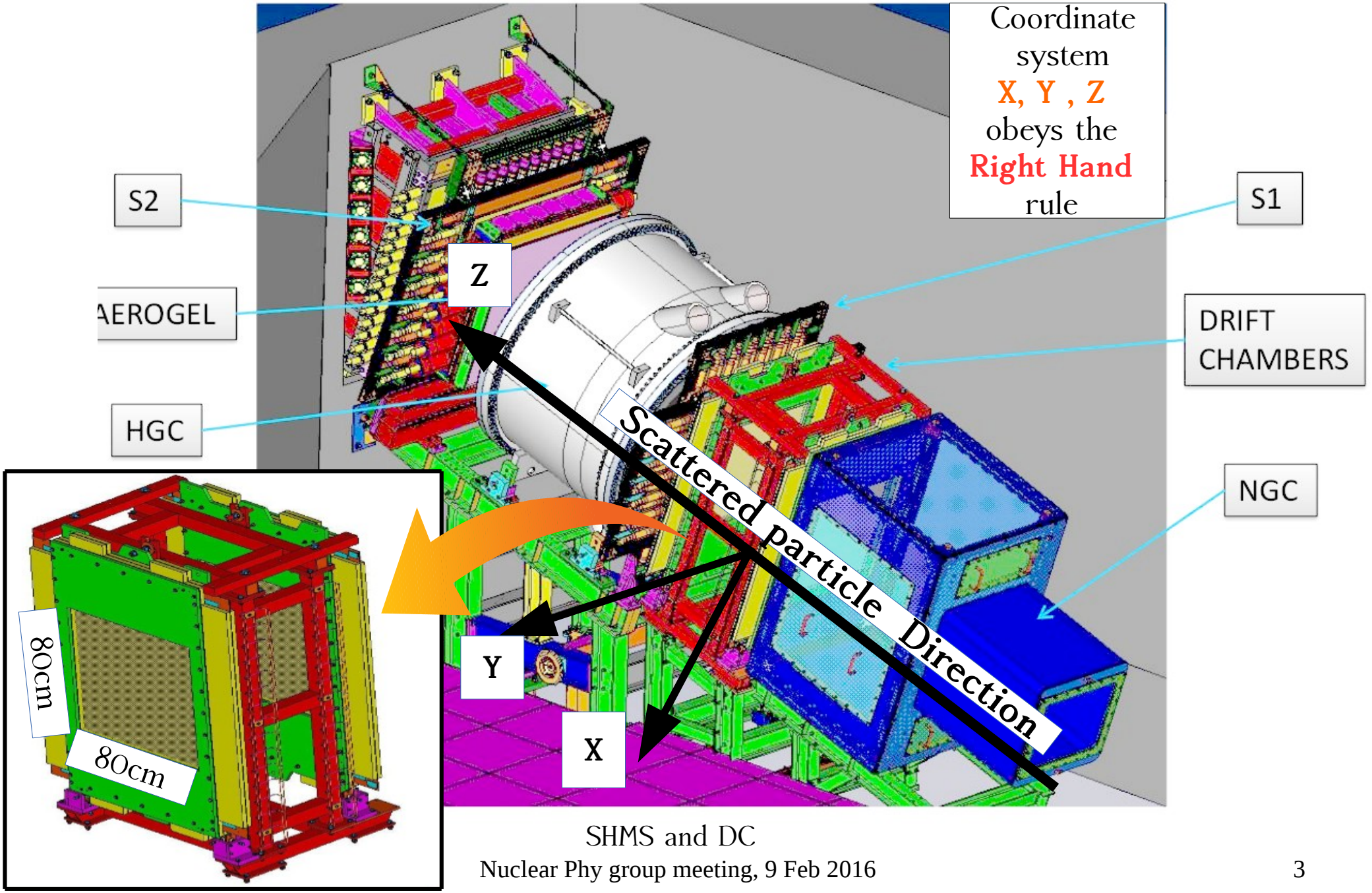
Nuclear Physics Group Meeting
Hampton University
Feb 9, 2016

Outline

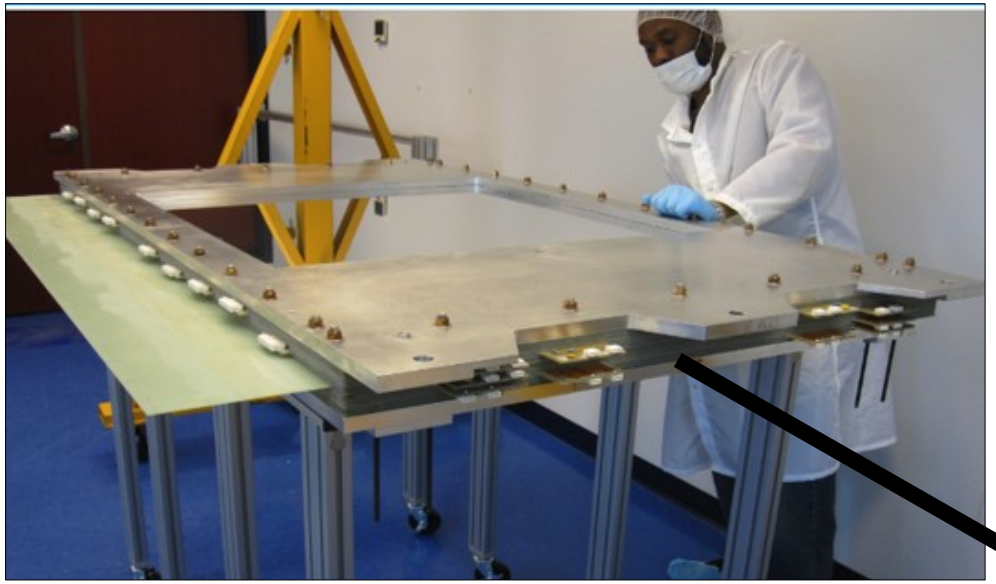
- Basic design of the detector package for Super High Momentum Spectrometer (SHMS) in Jefferson Lab Hall C
- Basic construction of main tracking detector (Multiwire Drift Chambers) in SHMS
- Basic working principle of Multiwire Drift Chambers
- Cosmic test setup
- First checks of operation
- Future Plans
- Acknowledgements

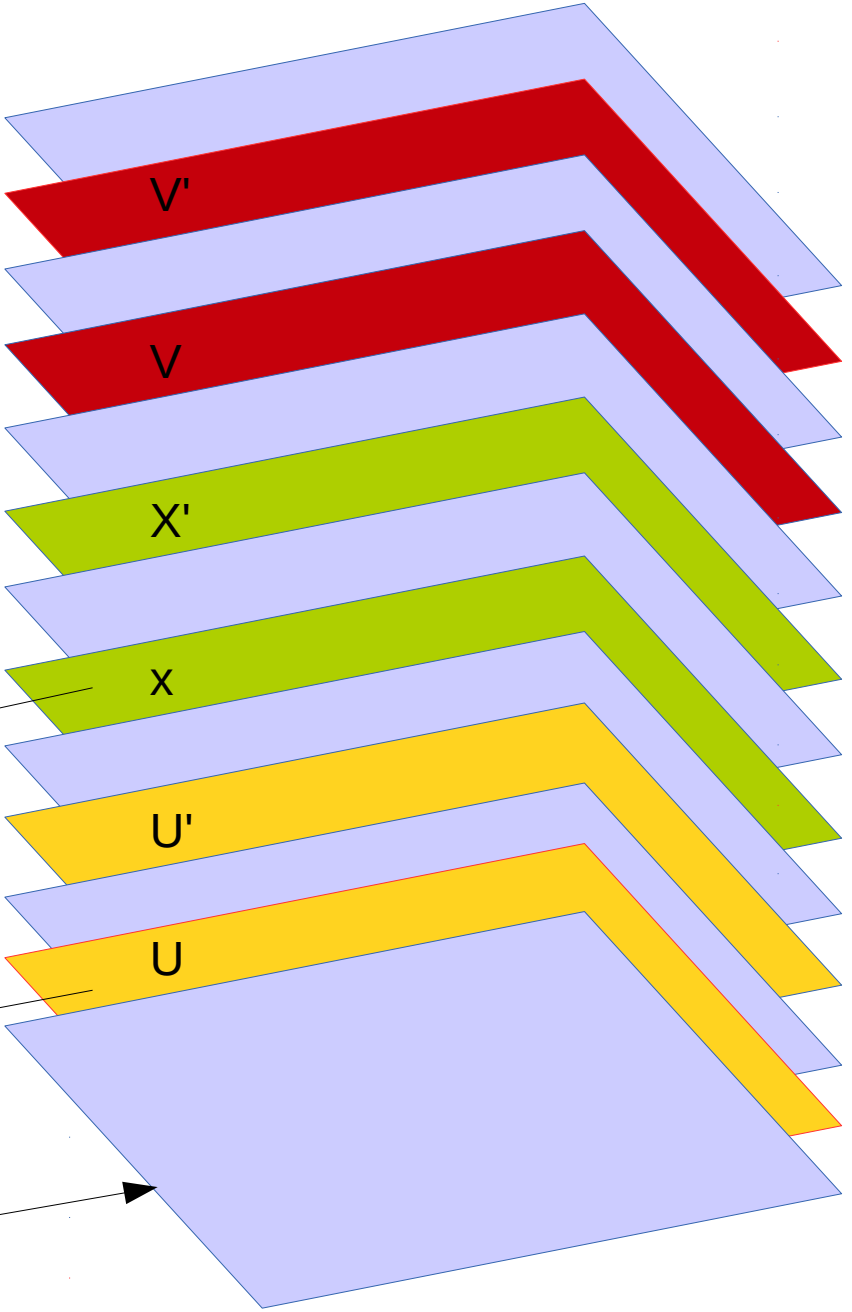
Diagram of Super High Momentum Spectrometer and Drift Chambers



Two Drift Chambers

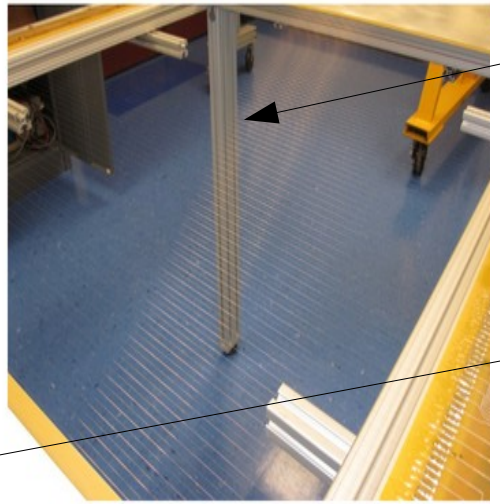
Drift Chamber and the wire planes





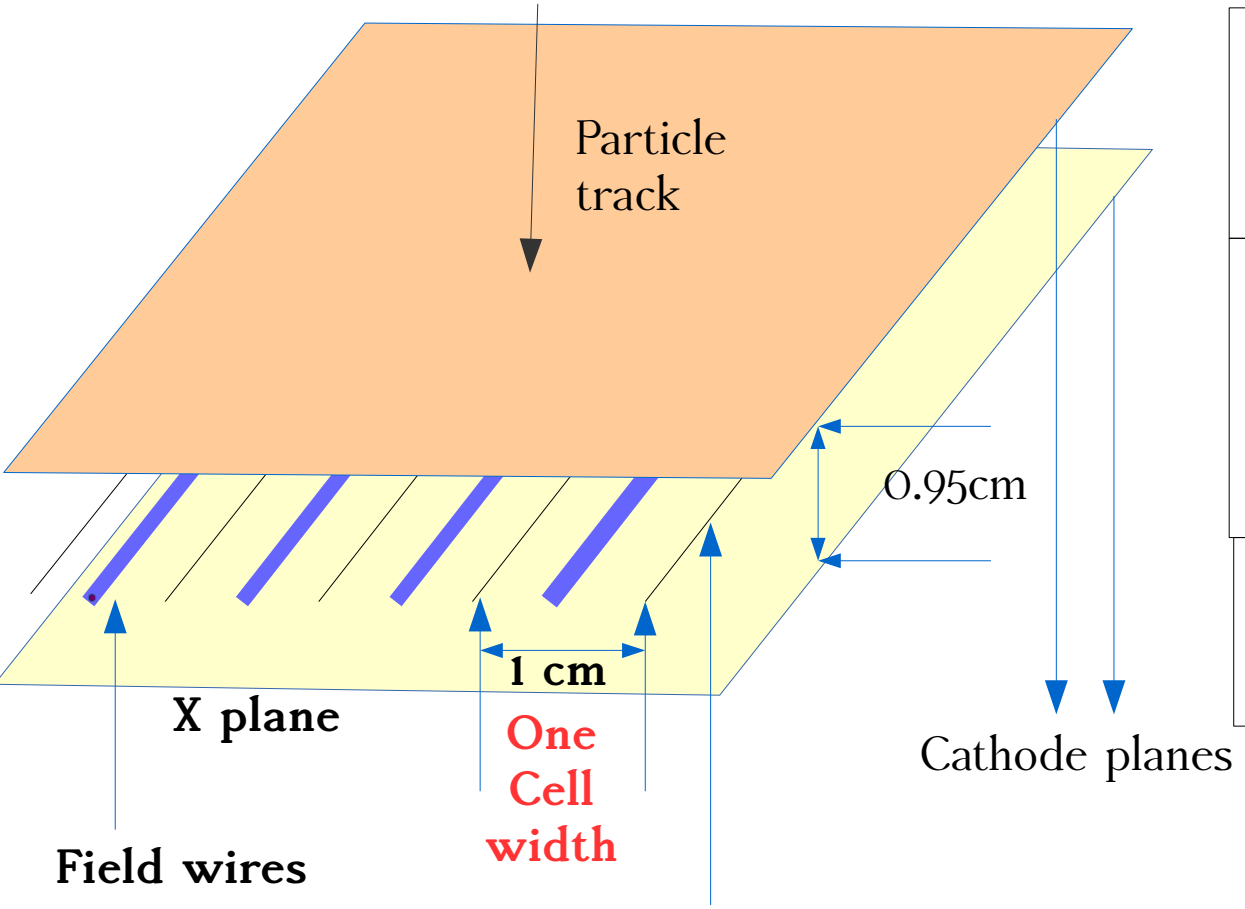
U-Plane:

X-Plane:



Cathode plane

Design Specifications and Basic working principle of Drift Chamber



Field wires

Copper plated berilium : 100 micro meter diameter

Signal wires

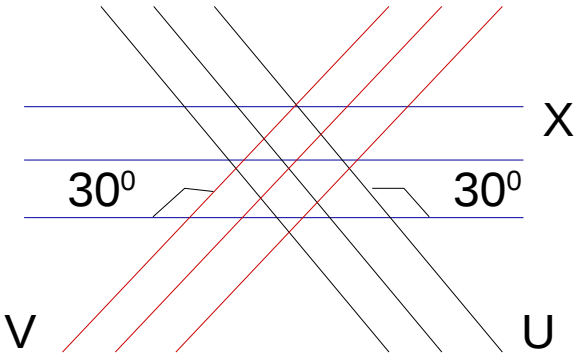
Gold plated tungsten : 20 micro meter diameter

one x plane and cathode planes

X & X' planes : 80 signal wires
And 81 field wires
U, U', V & V' : 107 signal wires
And 108 field wires

Per Drift Chamber we have 2 X (X & X'), 2 U (U &U') and 2 V (V & V') planes. Signal wires from X and X' planes are shifted 0.5 cm in the perpendicular direction of their length to resolve the left right ambiguity

Angle between X and U is 30^0 clockwise
Angle between X and V is 30^0 anticlockwise



Gas mixture used in Drift Chamber

Jefferson Lab Hall C experiment

Ethane : Argon :: 50 : 50 (by volume)

Better performances at high rates

Harder for a spark to occur at chamber breakdown, even if discharge happen it should quench faster

For testing and calibrating the drift chambers

Ar : CO_2 :: 75 : 25 (by Volume)

Ar : ionizing gas ; CO_2 : quenching gas

Used because this mixture is non flamable and can be used for testing without very high precautions

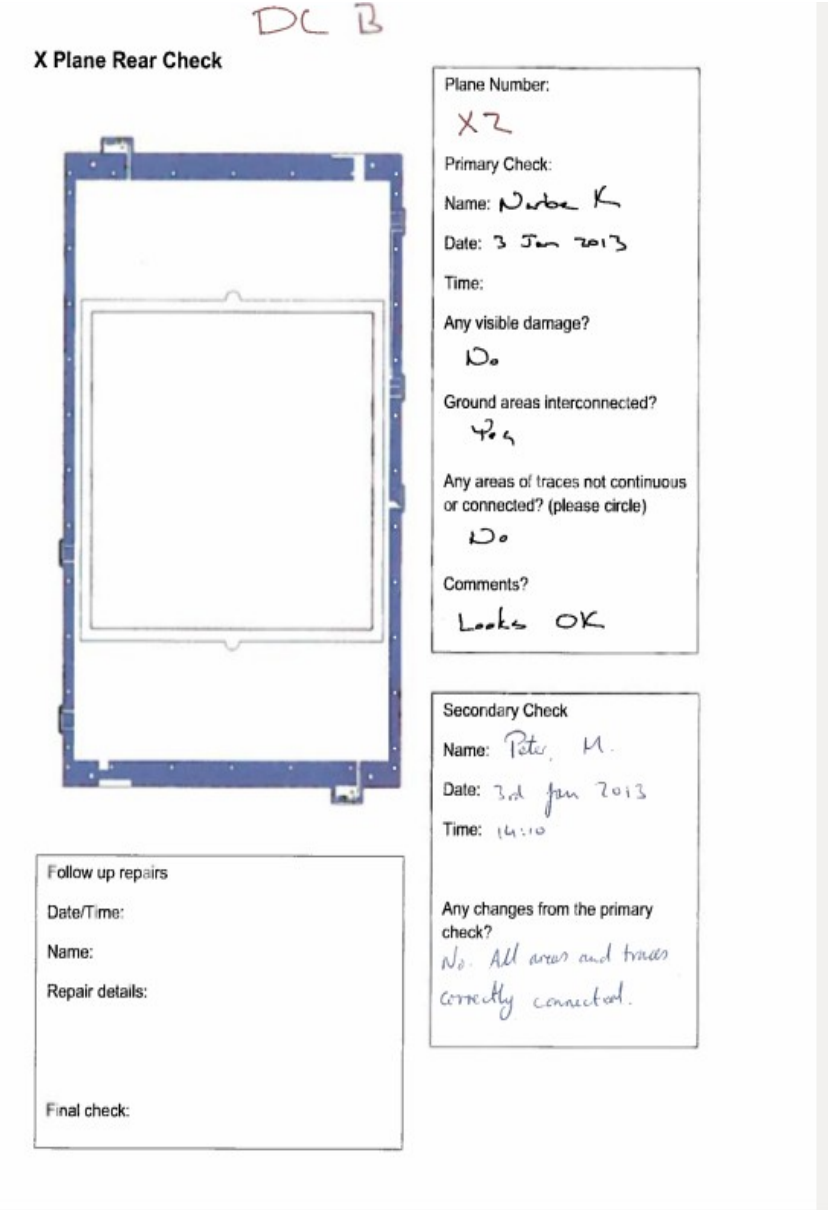
Checks at Hampton University Lab

1. We checked all electrical connections and in general boards' conditions and made Q&A sheets

2. Checked the resistances of all wires of all planes

3. Conditioned the chambers with High Voltage which helped to burn out any dust particle inside and made the chamber more stable

4. Checked signals from all wires in cosmic rays using a 2 MegOhm resistance accorss the wires


DC B

X Plane Rear Check

Plane Number: X2

Primary Check:

Name: Nurbek K

Date: 3 Jan 2013

Time:

Any visible damage? No

Ground areas interconnected? Yes

Any areas of traces not continuous or connected? (please circle) No

Comments? Looks OK

Secondary Check

Name: Peter M.

Date: 3rd Jan 2013

Time: 14:10

Any changes from the primary check? No. All areas and traces correctly connected.

Follow up repairs

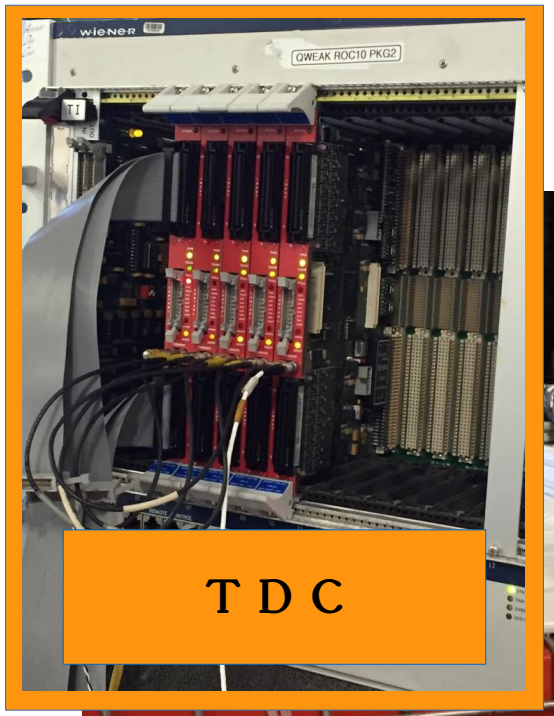
Date/Time:

Name:

Repair details:

Final check:

Cosmic ray test setup



Hodoscope /scintillator 1

Hodoscope / scintillator 2

60% of the total illuminated area is covered by the 32 wires

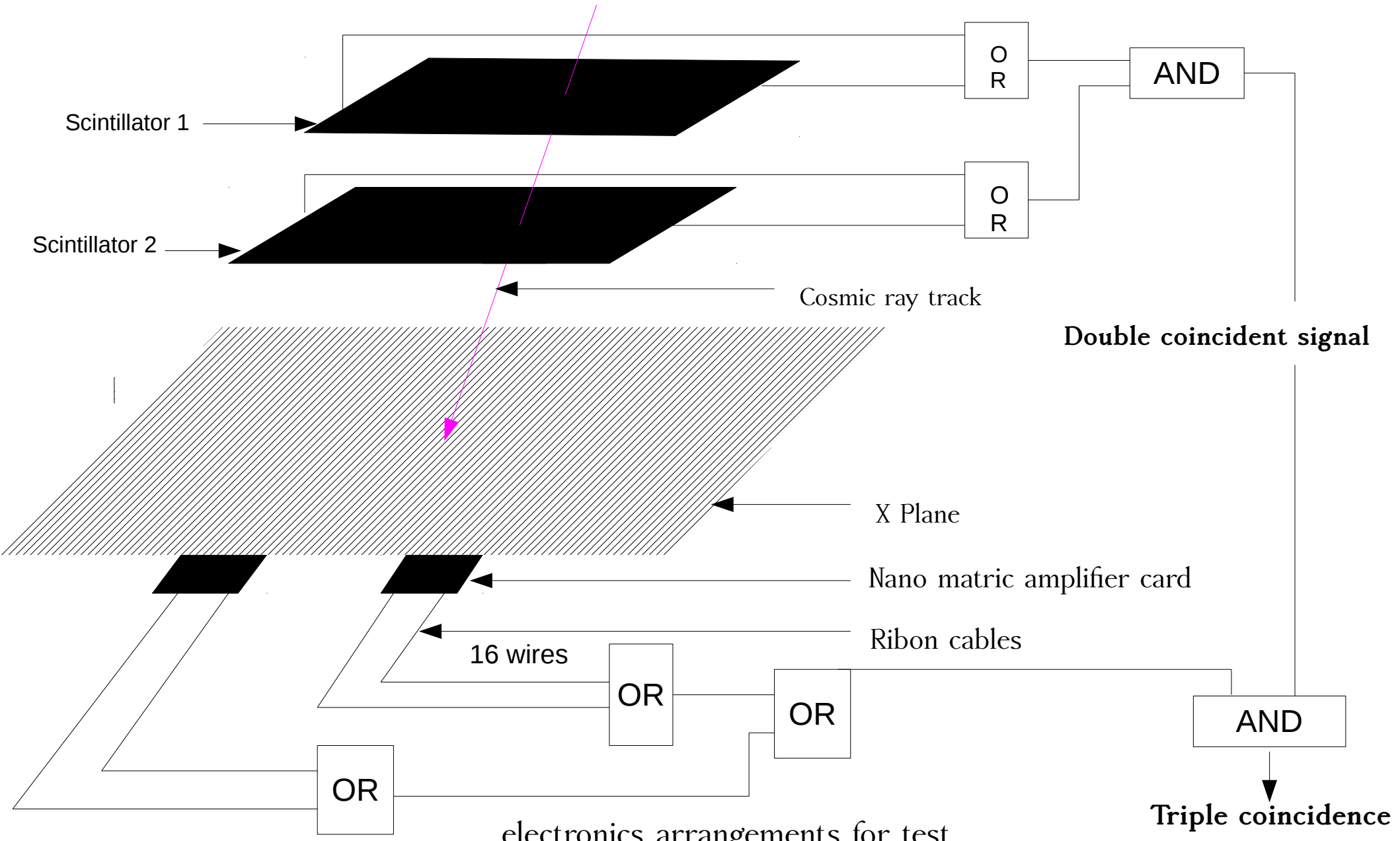
Drift Chamber

Nano metric Amplifier cards

Ribon Cables

Cosmic test set up for DC's

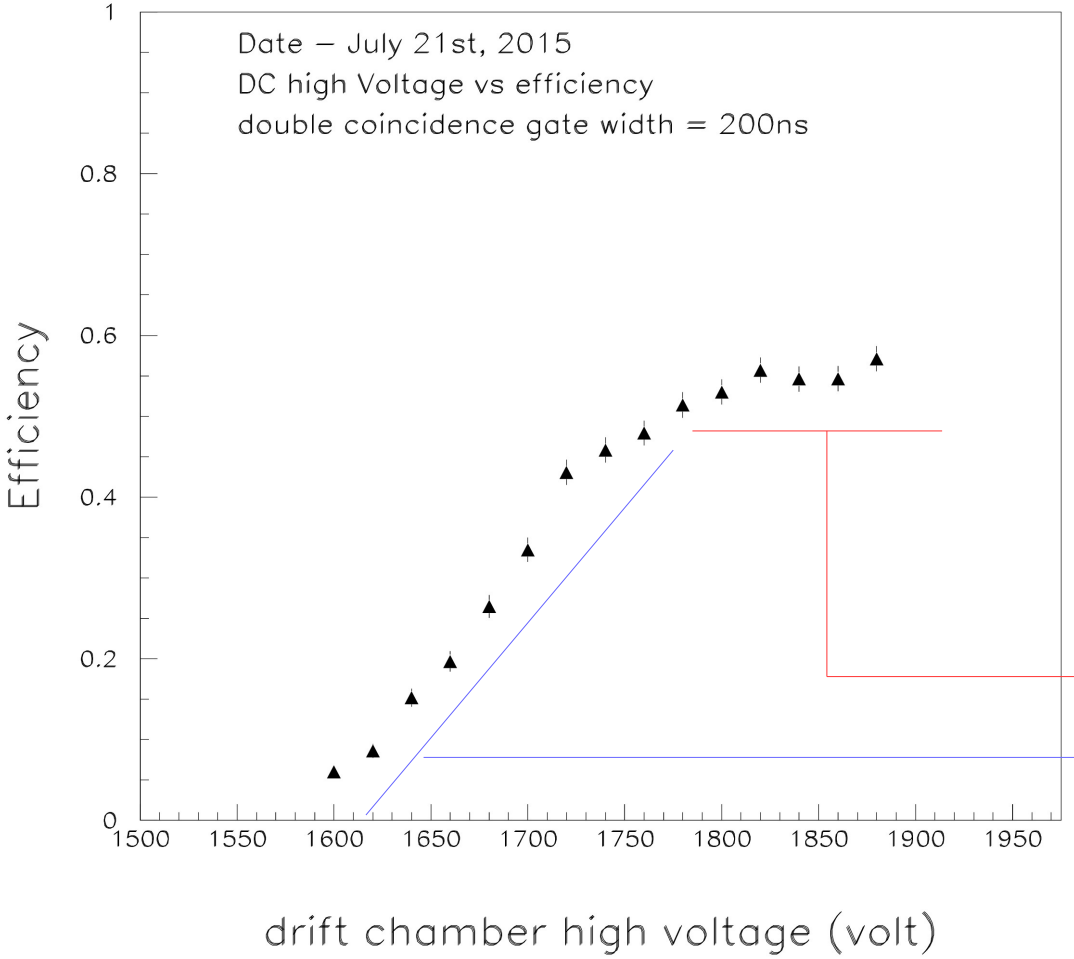
Circuit arrangements for the determination of operating voltage



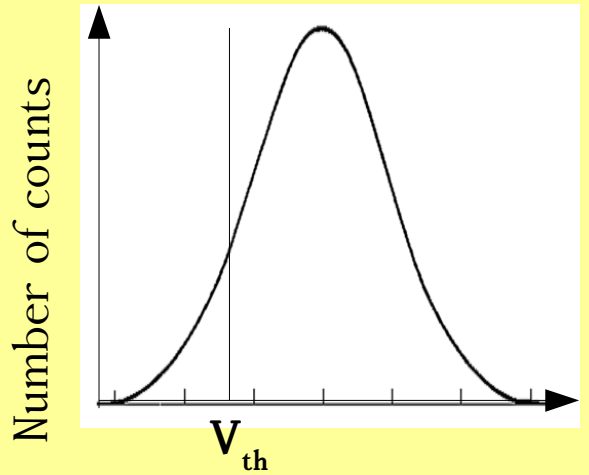
electronics arrangements for test

Efficiency vs operating voltage of the drift chamber

Efficiency = number of triple coincidence / number of double coincidence



Scintillators cover 60% of the active area of X plane : hence the highest efficiency is 60 % for the 32 wires for the Drift Chamber



Peak of the gaussian curve moves towards right with increasing operating voltage

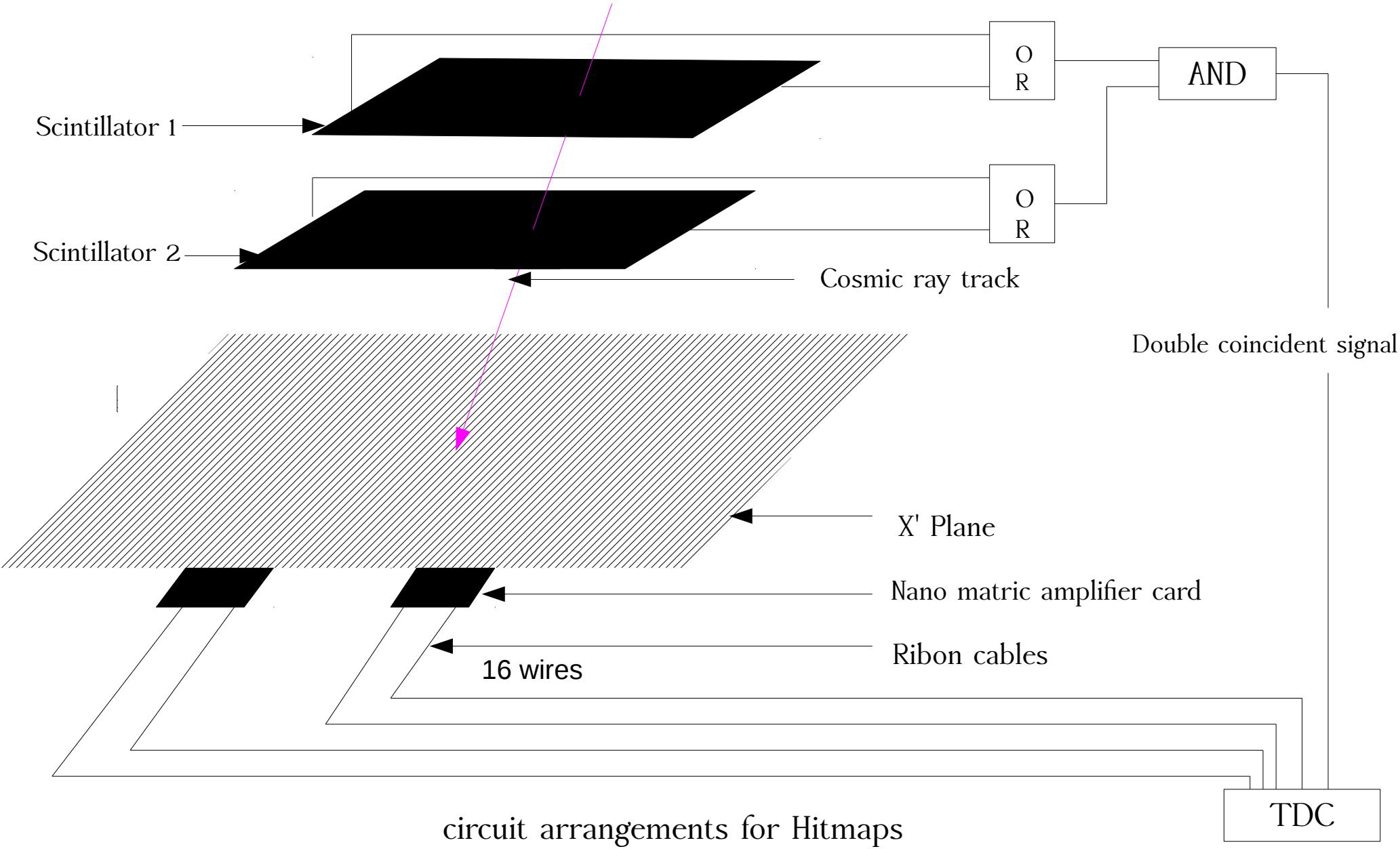
efficiency is almost indepent of the operating high voltage

efficiency is proportional to the operating voltage of the chamber

Operating voltage should be well inside the plateau region so that the chamber works with highest efficiency

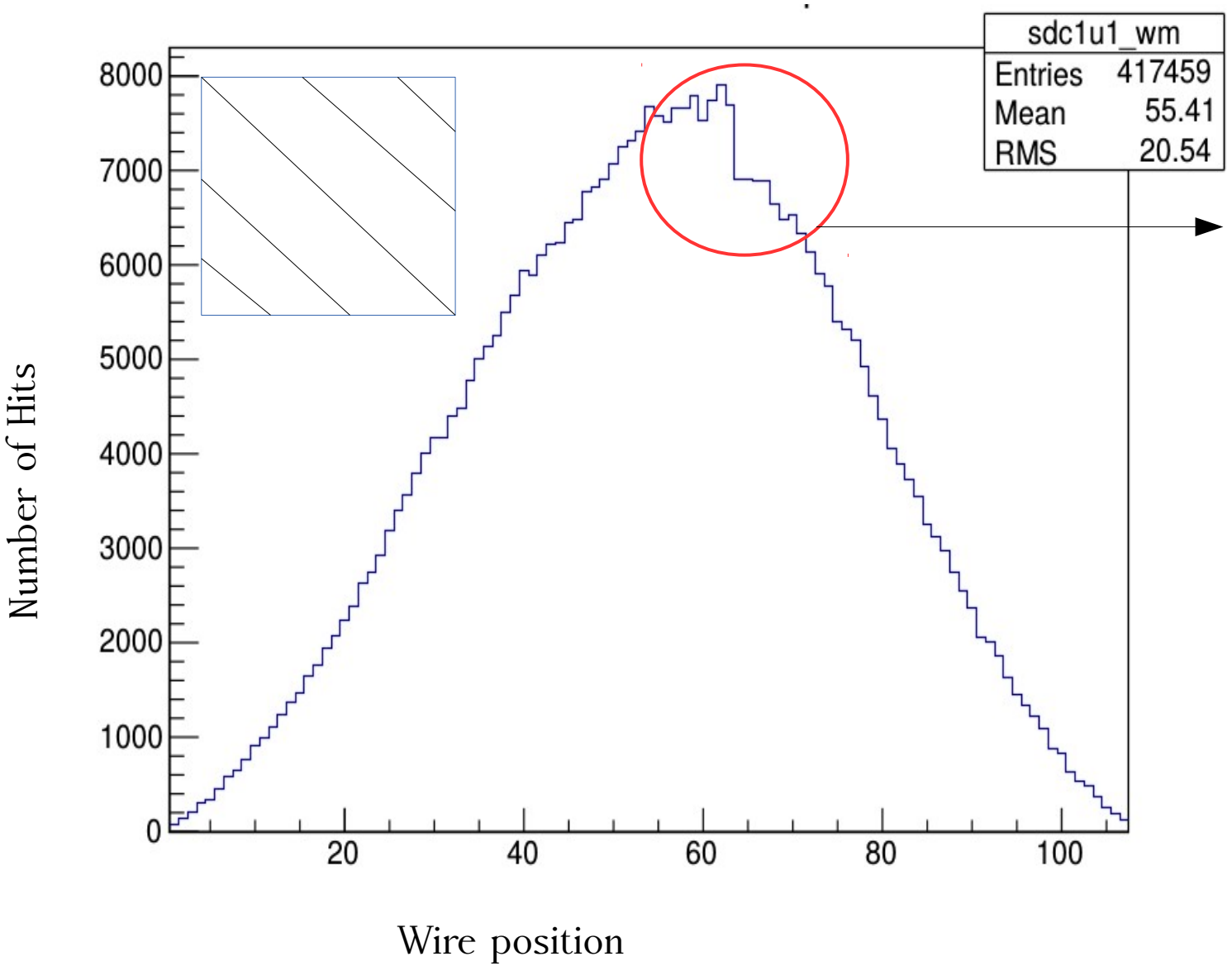
Operating voltage : 1800 volt

Circuit arrangements including data acquisition system



circuit arrangements for Hitmaps

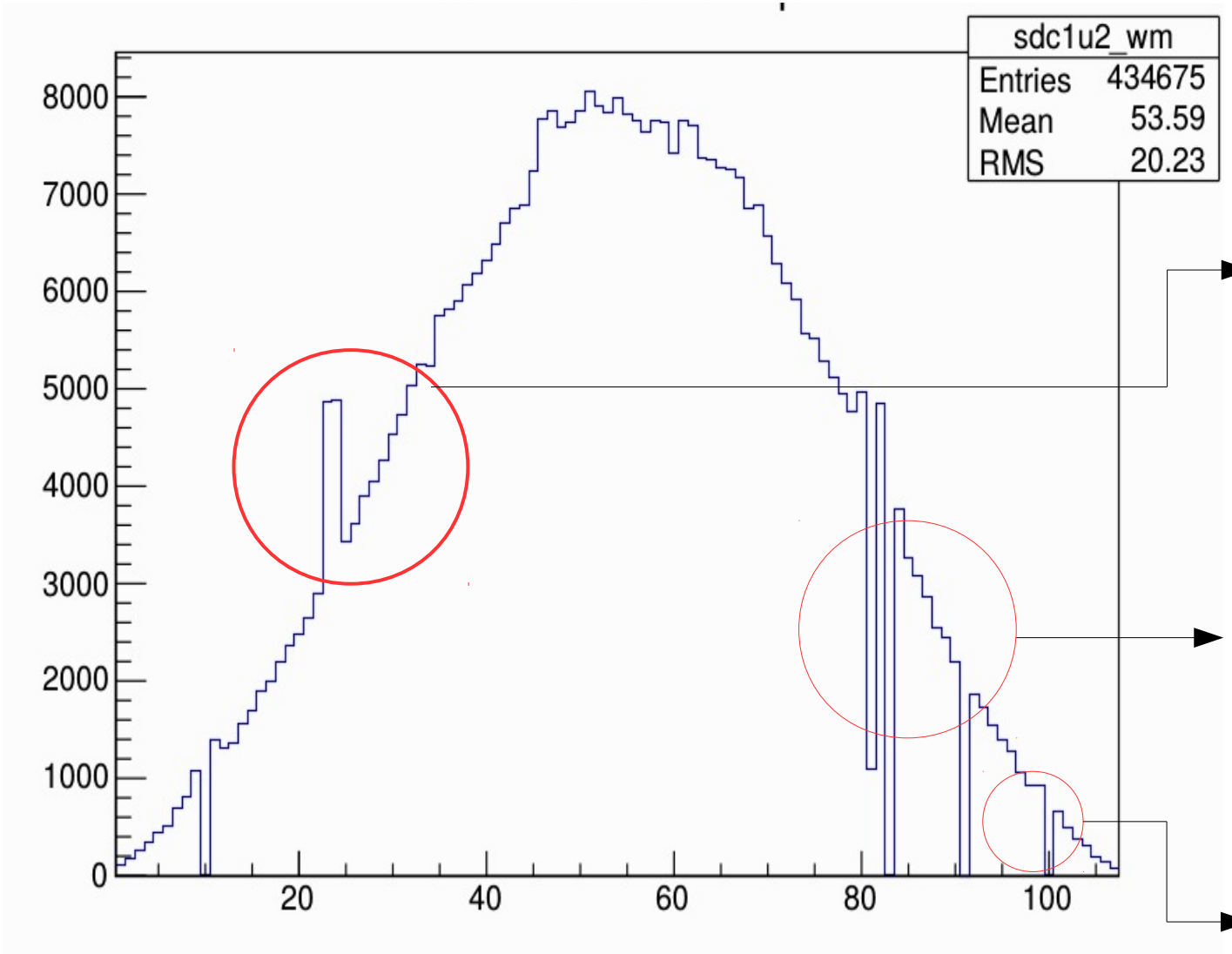
Wire Maps (U Plane)



Bump causes from the different noise levels in different amplifier cards

shape would be a perfect triangle if we consider the geometry of the wires only. But due to statistical fluctuation and angular dependence of the cosmic rays we got this shape.

Wire maps (U' plane)

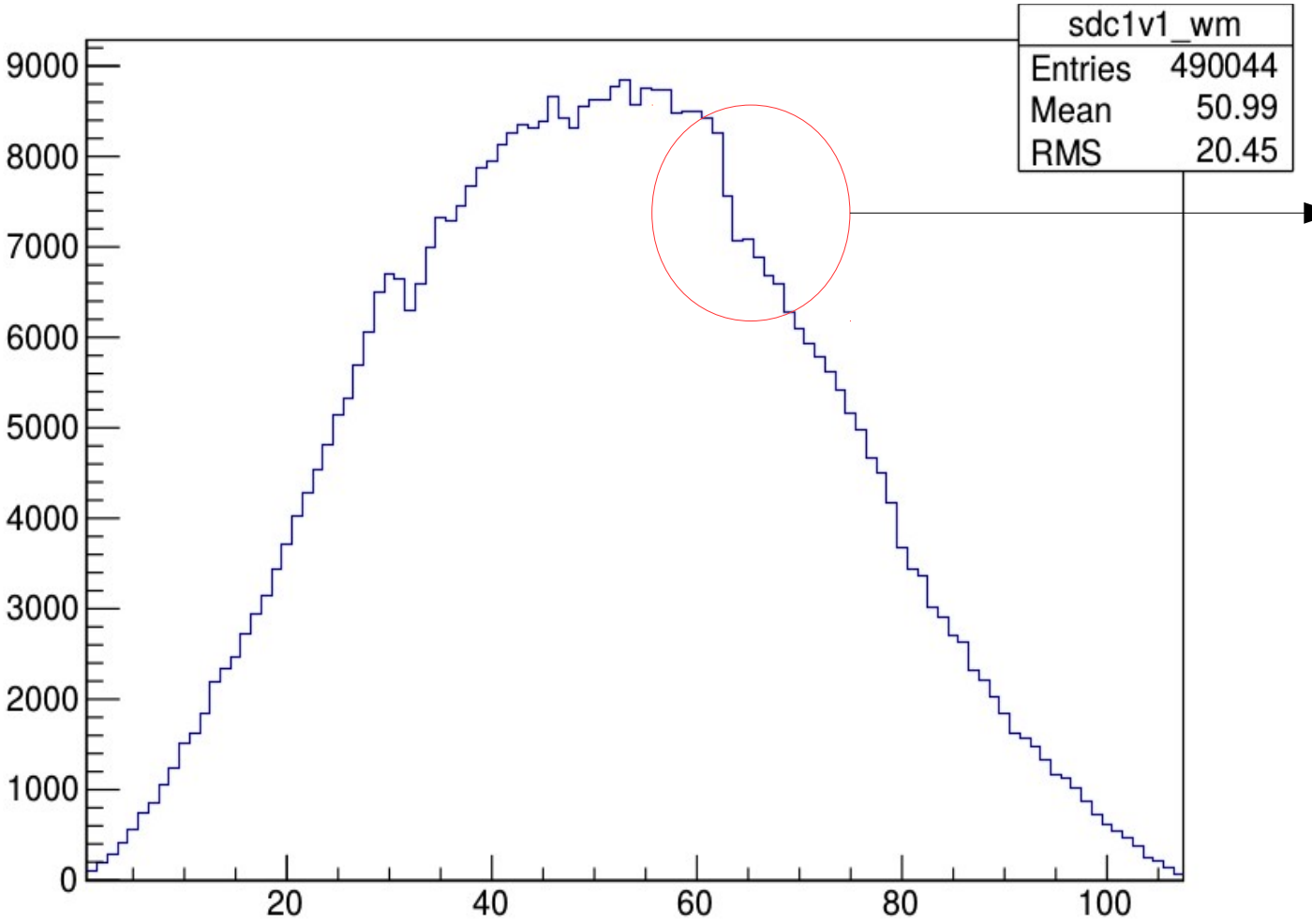


This noise is important for the cosmic test only. For the real experiment this much of noise will be insignificant w.r.t. the much higher signal.

Could be a amp. Card issue . Working on it.

Well out of the region of interest for the scattered beam

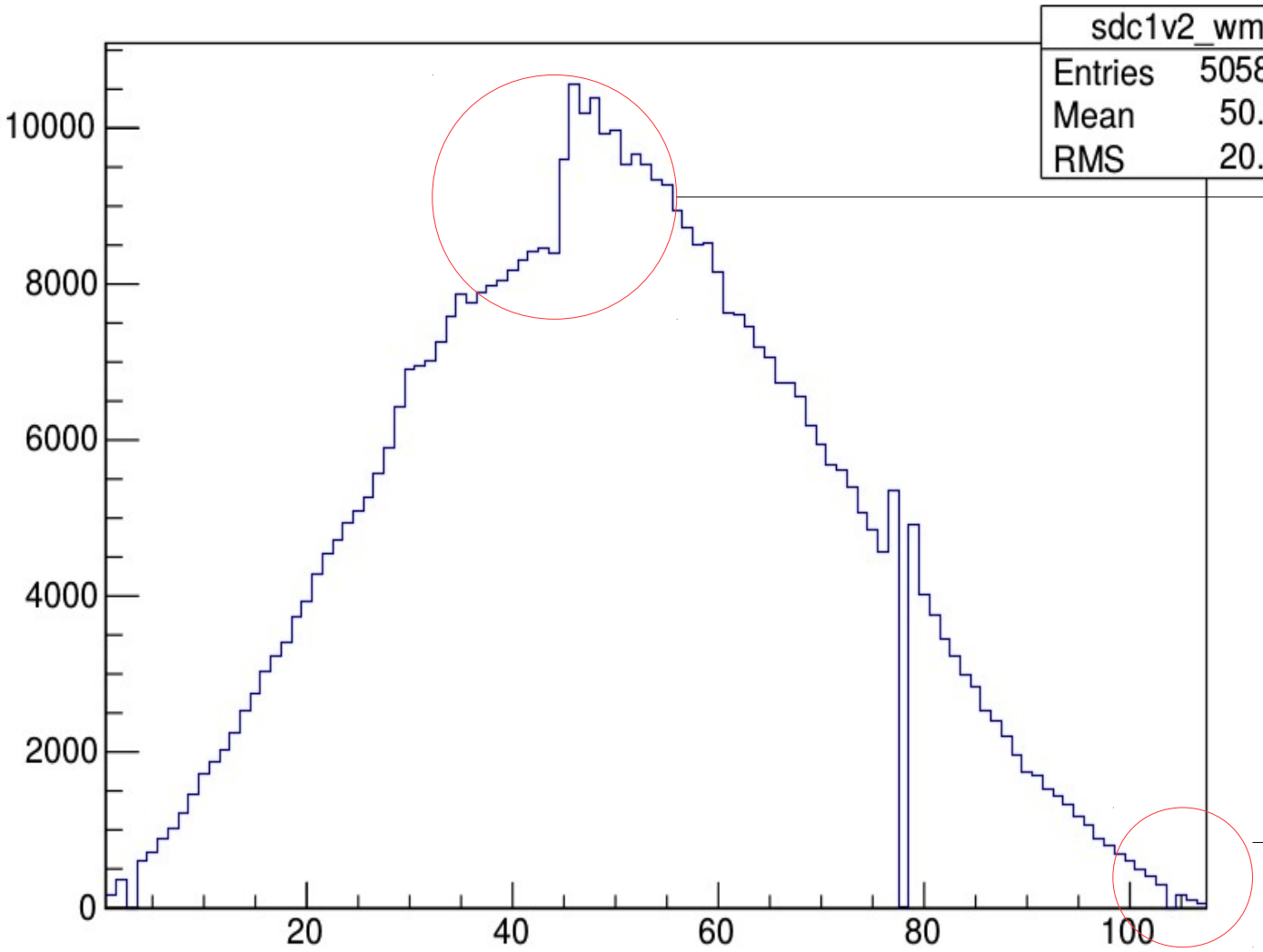
Wire maps (V plane)



Bump due to the difference in the noise level in two consecutive amplifier cards

Number of hits

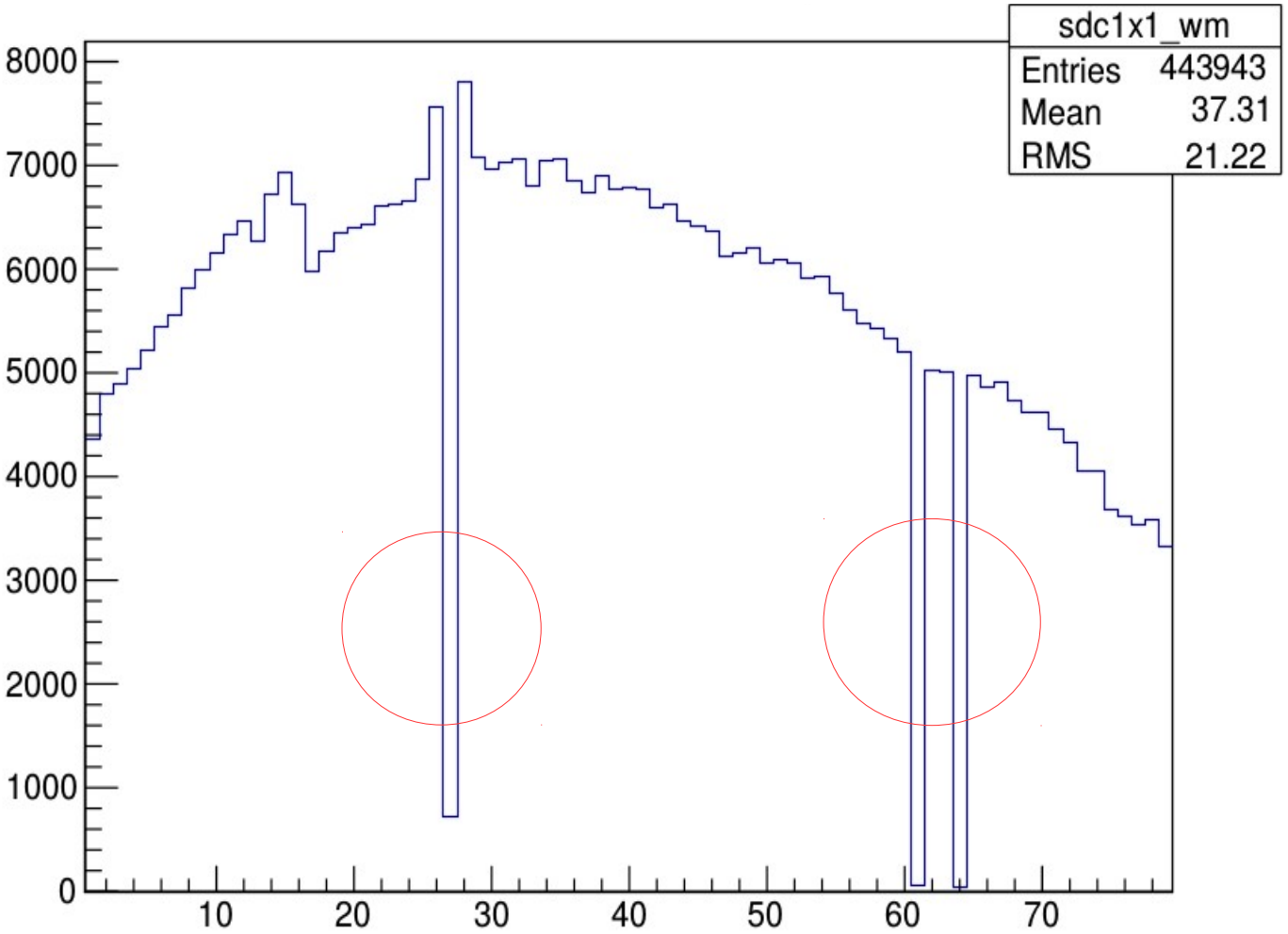
Wire maps (V' plane)



Diffent noise level in two consecutive amplifier cards

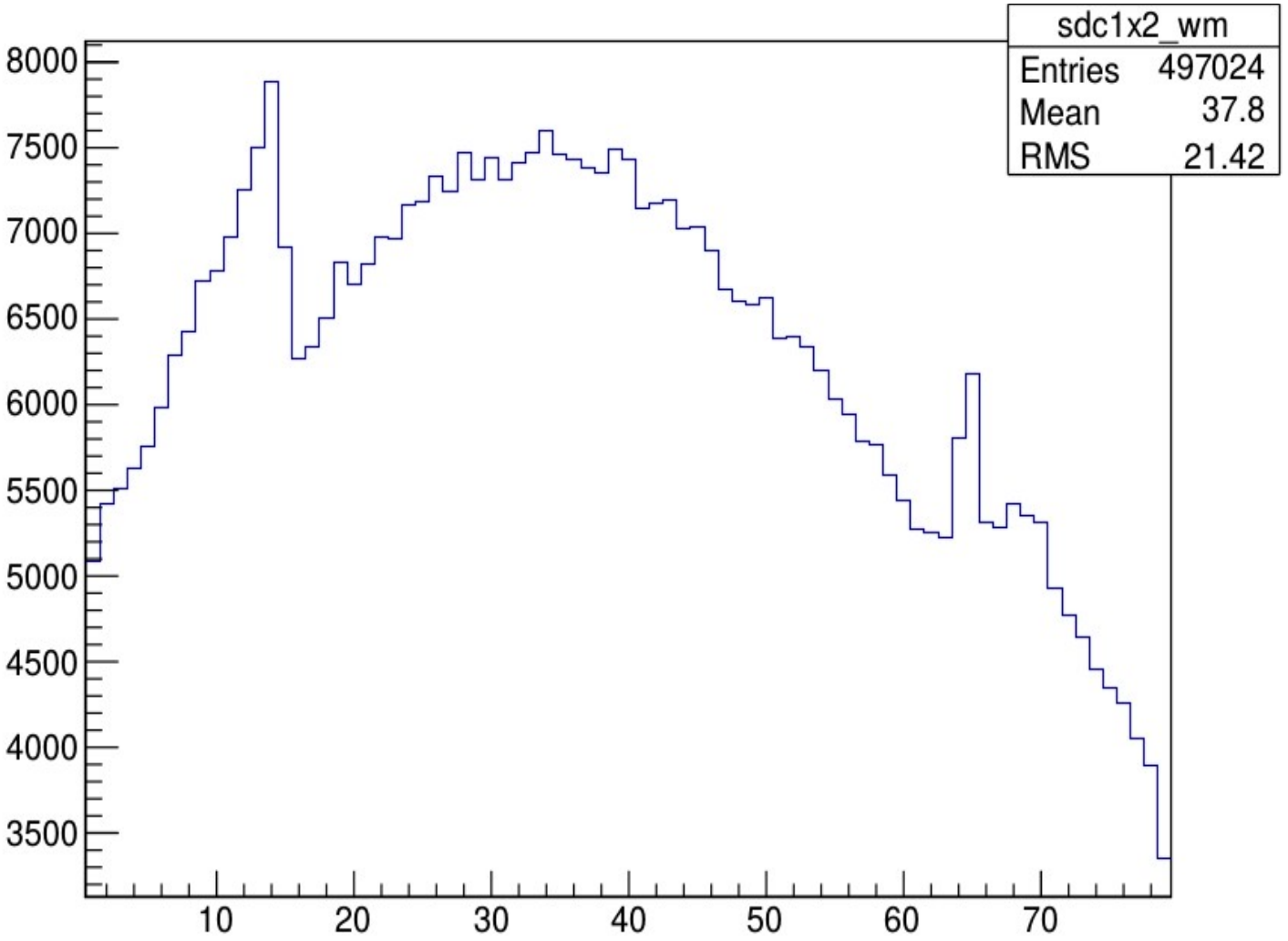
Even if its a low efficiency or dead wire its way out of the region of interest

Wire maps (X plane)



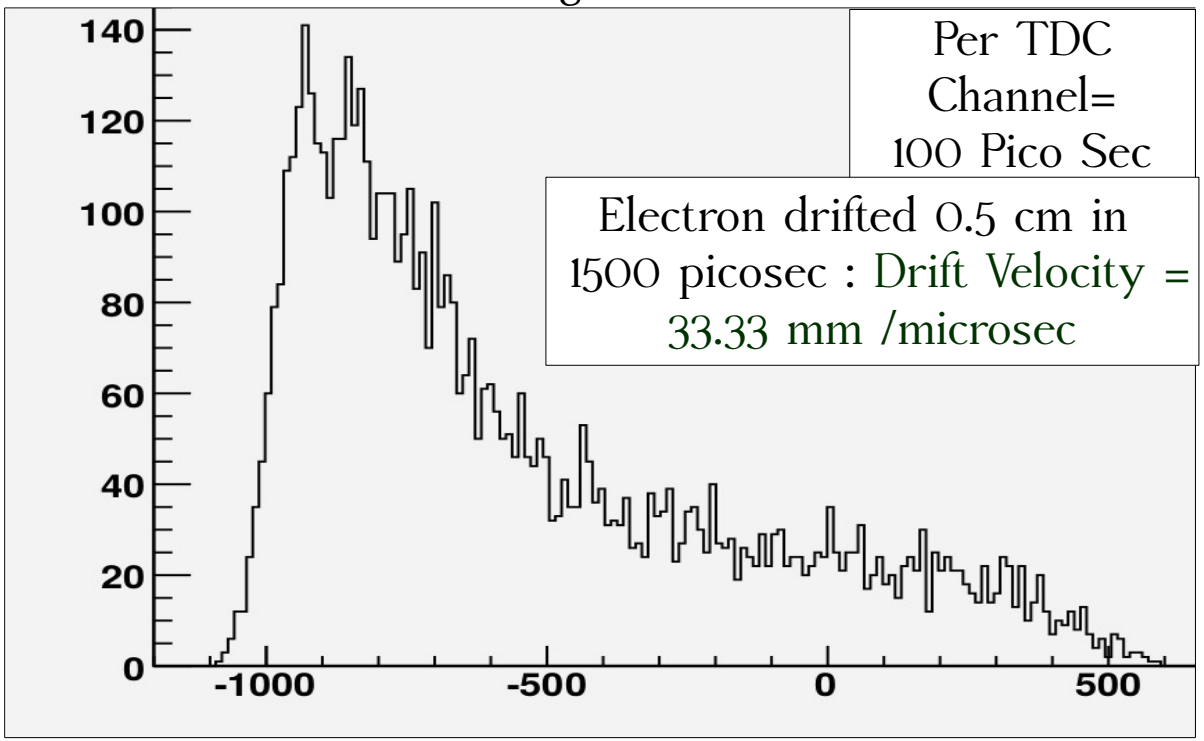
Three low efficiency wires

Wire maps (X' plane)



Total Hits Vs Time Histogram for particular wire

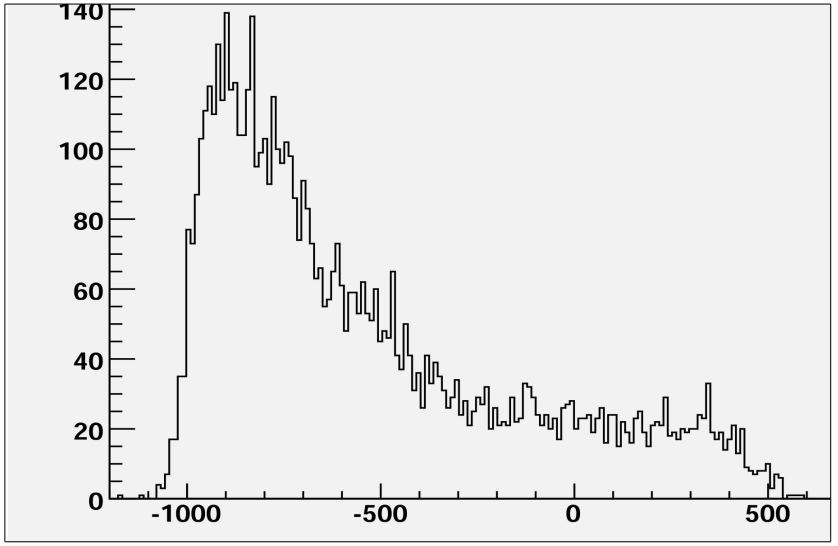
Fig : 13

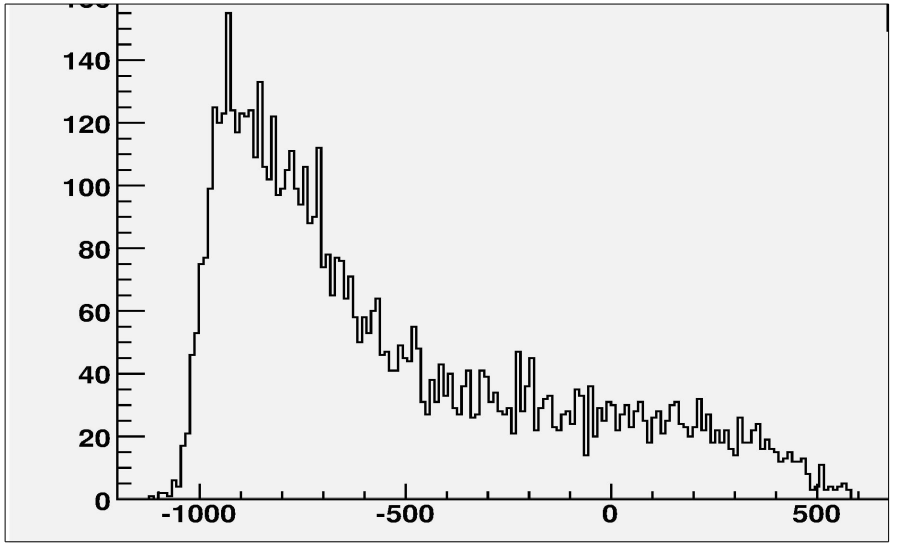


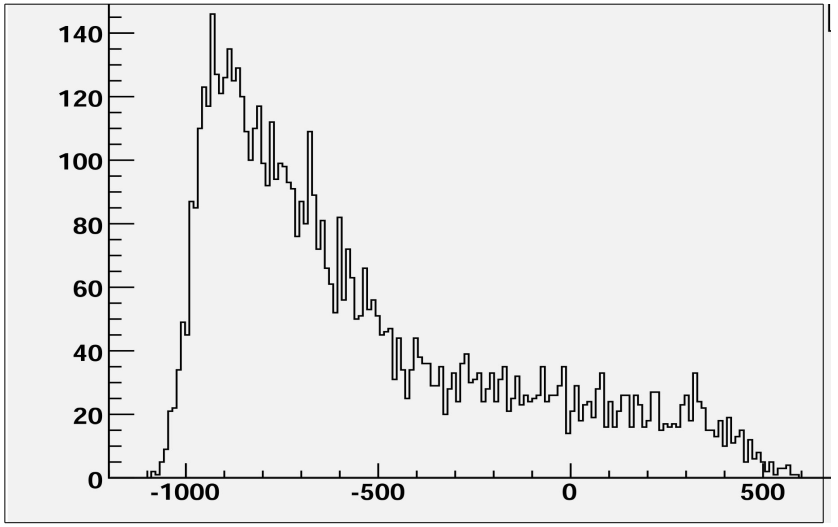
This time is corresponds to half a cell width , i.e. **0.5 cm** which corresponds to one signal to next field wire

electric field gradient is high near the signal wires. Which produces large number of secondary electrons and electrons are accelerated more due to high field gradient. Which induces larger amounts of signals at signal wires. Hench there is a peak near the signal wire. For rest of the half cell the elctric field is pretty uniform and hence the curve is almost flat elsewhere.

Total hits vs time histograms for different wires







Three other hitmaps are shown for three wires from X plane . The general structure is remained the same for all. We got the hit maps of same shapes for all 32 wires.

!!!! Noise !!!!

Problem

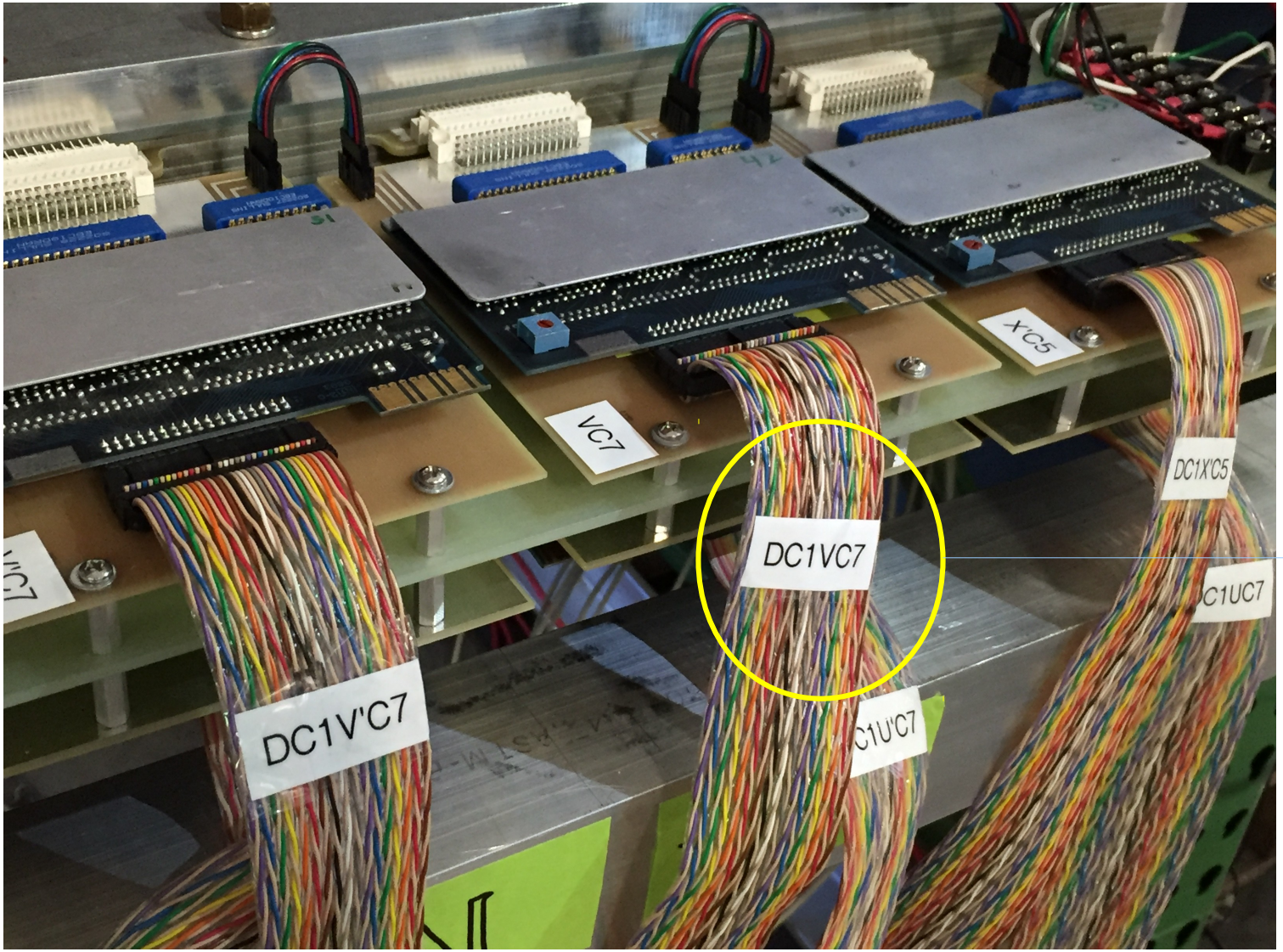
In some of the runs we saw a lot of noises in the data

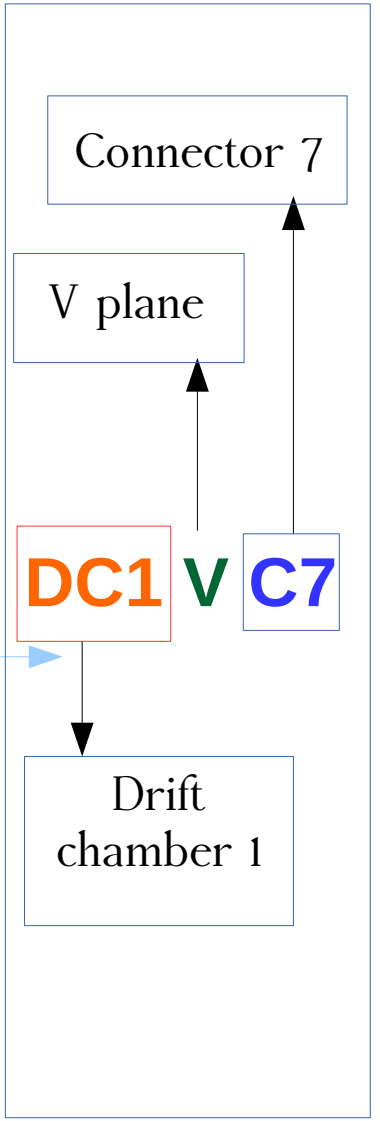
Basically all the amplifier cards started ringing under certain threshold value

Solution

Got rid of the problem by connecting the ground connections from the amplifier card carriers, Power supply crate and metal plates of chambers all together with the main ground connection of the ESB building

Labelling of ribbon cables





Future Plans

Jan	Week : 4 : Check grounding issues of DC 1 . Get rid of the noise for DC 1.
Feb	Week : 1 Find out the source of the problem for the wires with very low or no signal for DC 1 --- Week : 2 Swipe DC 1 with DC 2 for cosmic ray test. --- Week : 3 & Week 4 : Mount DC 1 and DC 2 in the frame and make them horizontal for cosmic ray test.
March	Week : 1 & 2 : Cosmic Ray test for DC 3 --- Week : 3 & 4 : Mounting of DC 1 & DC 2 in frame at Hall C

Summary

- Three drift (one is spare) chambers were built at Hampton University
- Several primary checks at Hampton University are done
- Two of them are being conditioned with HV
- Efficiency test is done for one of the DCs which gives the expected result and we set the operating voltage at 1800 volt
- We got expected wire maps for every plane of DC 1 (with some missing wires)
- Expected Hit maps for several wires

Acknowledgements

Eric Christy, Hampton University

Narbe Kalantarians, Hampton University

Brad Sawatzky, Jlab

Steve Woods, Jlab

Jlab Technical staffs

Funding Acknowlwdgements

National Science Foundation's grant numbers

PHY-1307415, PHY-0723062

Jefferson Science Associates

Thanks!