

Instrumentation School in Particle, Nuclear and Medical Physics

Student presentations

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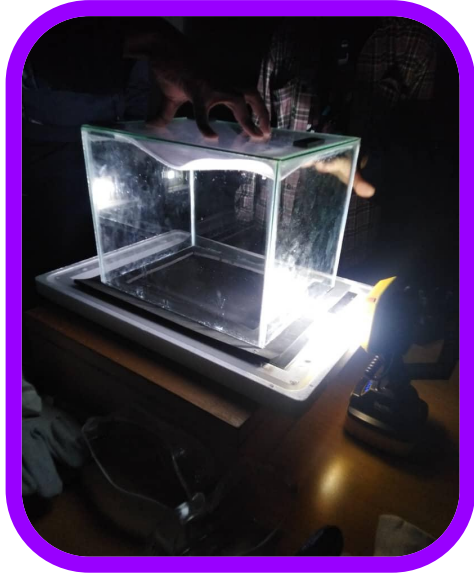
science
& technology

Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

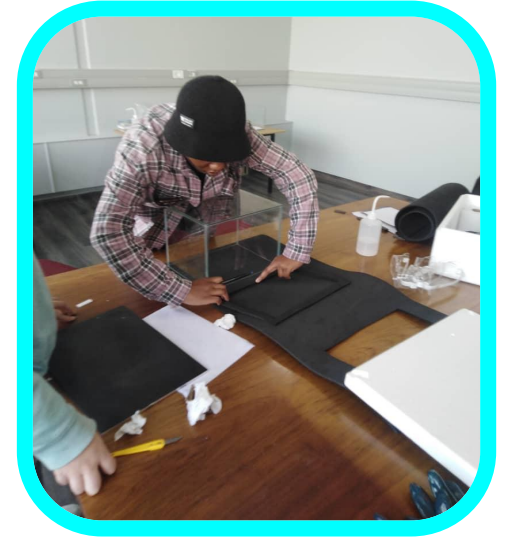


CLOUD CHAMBER

1. Building a cloud chamber

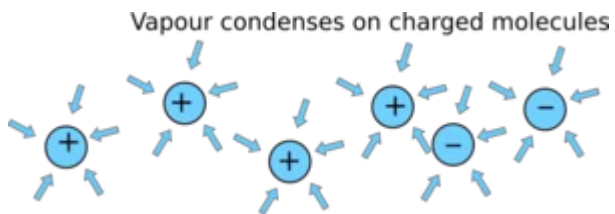
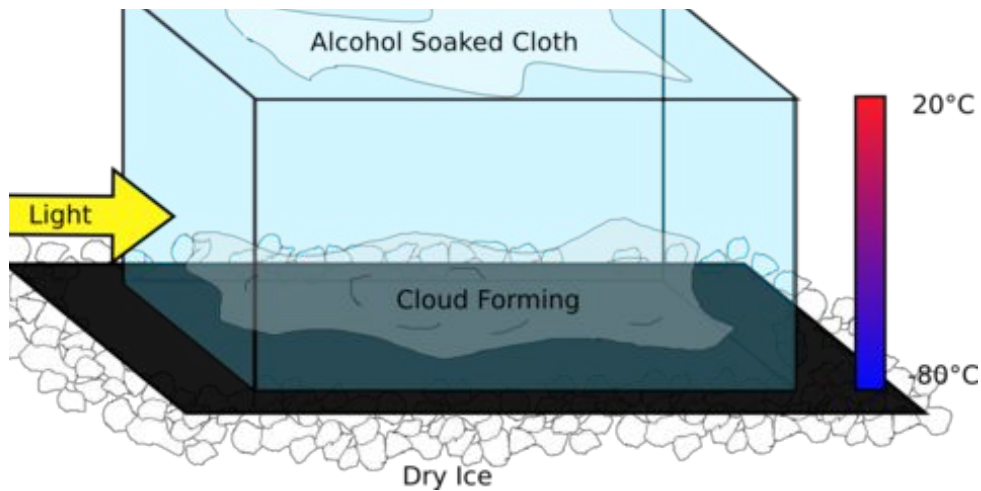


2. Observing tracks made by ionizing radiation



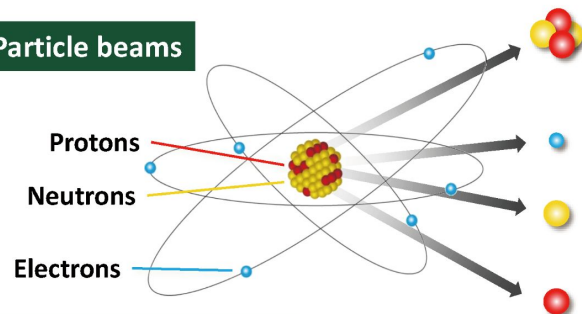
Using a radioactive source to observe tracks

Cloud Chamber



Ionizing radiation

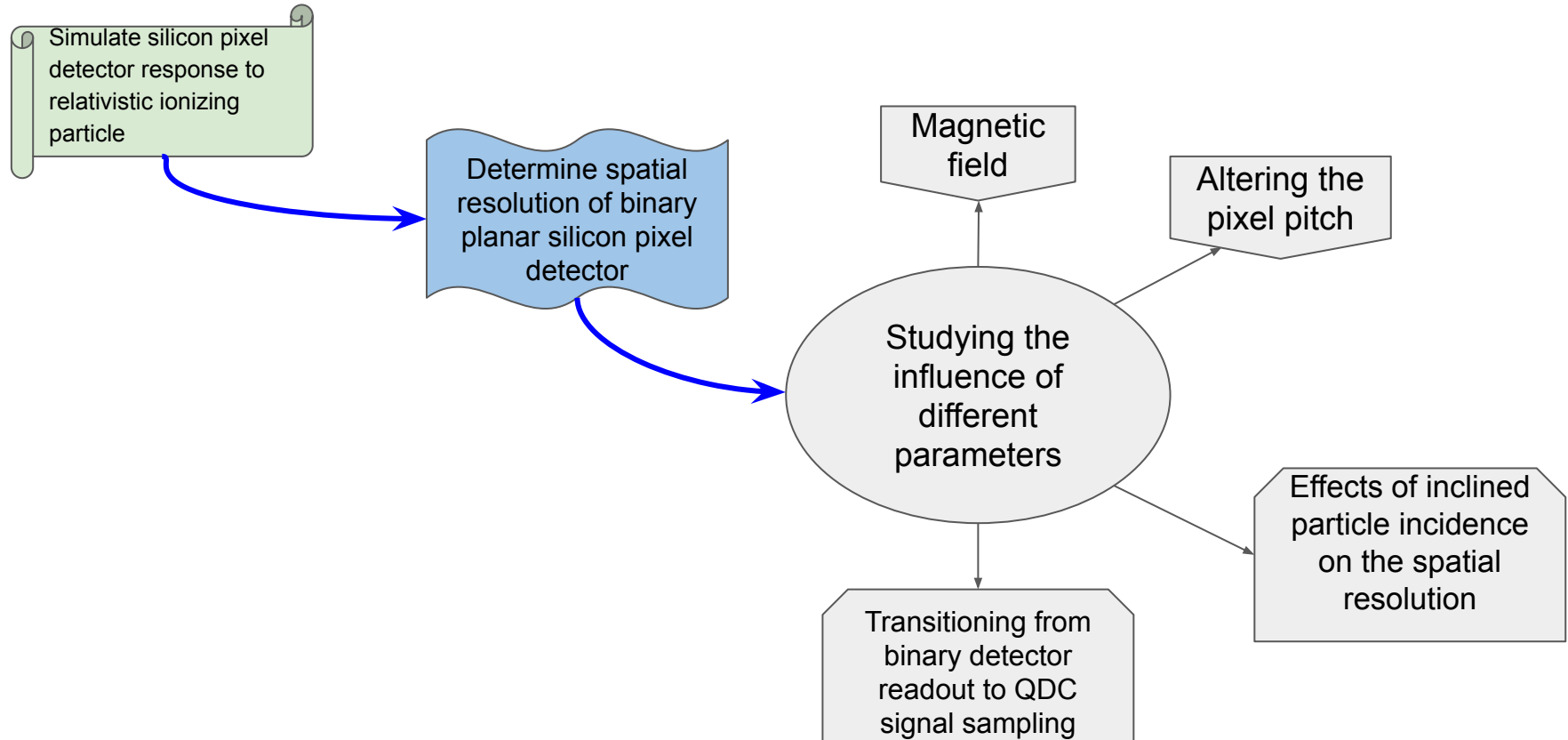
Particle beams



Muons
 γ -rays
X-rays
 α -particles



Resolution of a silicon pixel detector-Objectives

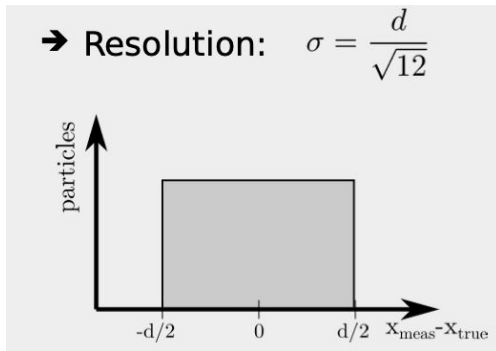


Resolution of a Silicon Pixel Detector - **Allpix Squared**

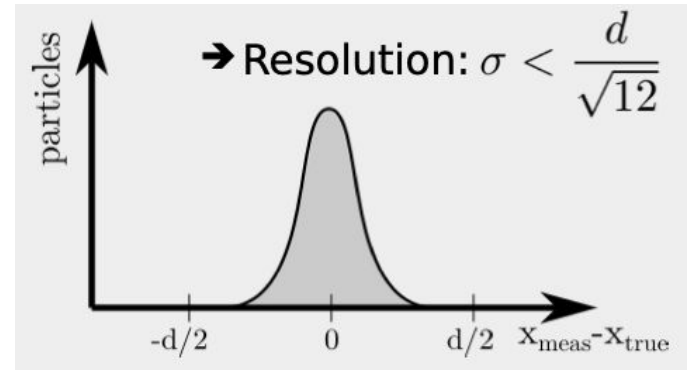
- Signal generation:
 - **Energy Deposit:** An incident particle deposits energy in the sensitive volume, creating electron-hole pairs.
 - **Propagation:** Created electron-hole pairs propagate through the sensor, by diffusion and drift.
 - **Readout Channel:** The signal formed by movement of charge carriers is assigned to a readout channel.
 - **Front-end Electronics Response:** The front-end electronics response (amplification, digitisation, etc..) finalises the signal for output.

Resolution of a Silicon Pixel Detector - **Allpix Squared**

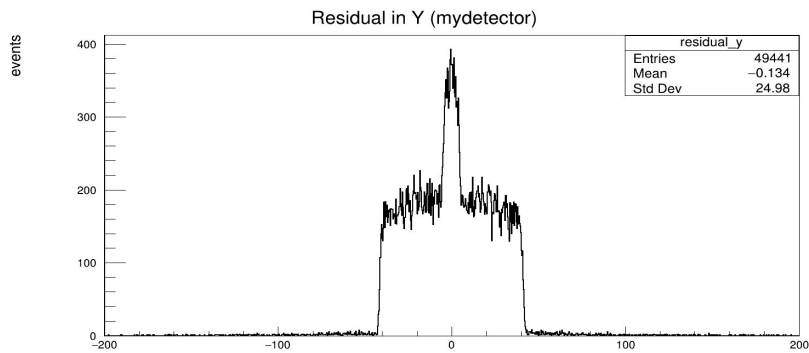
- The Resolution depends on the following:
 - **Residuals, Spatial Resolution:** Difference between true position and reconstructed position -> Width of residuals



Single responding pixel

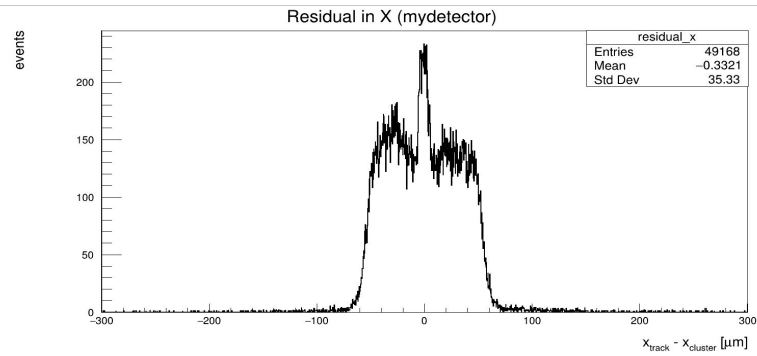
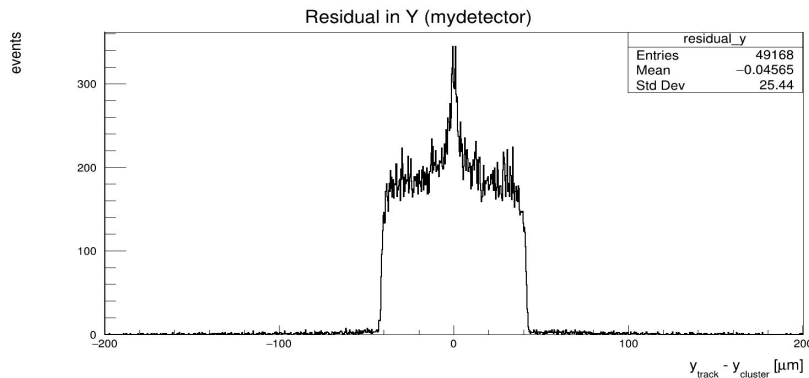
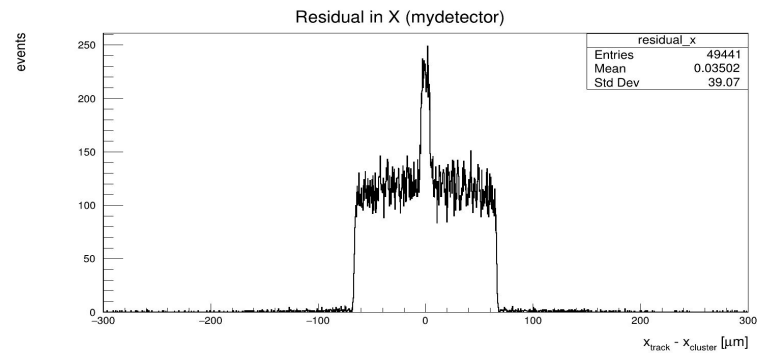


Several responding pixels

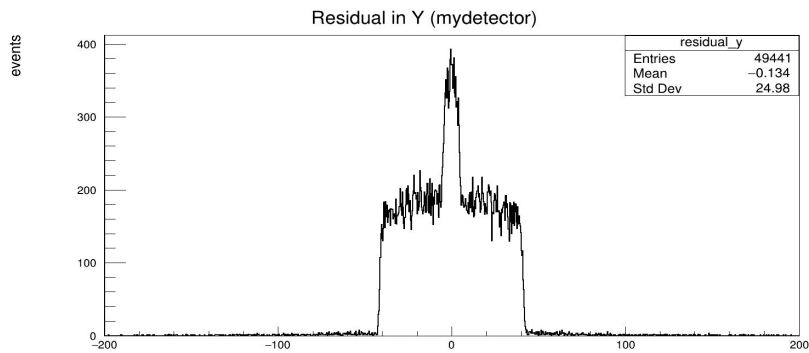


At QCD_resolution = 4, 0deg0T

At QCD_resolution = 4, 27deg0T

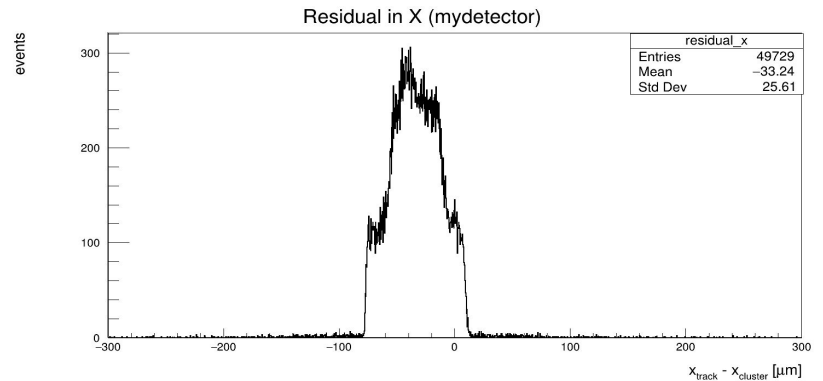
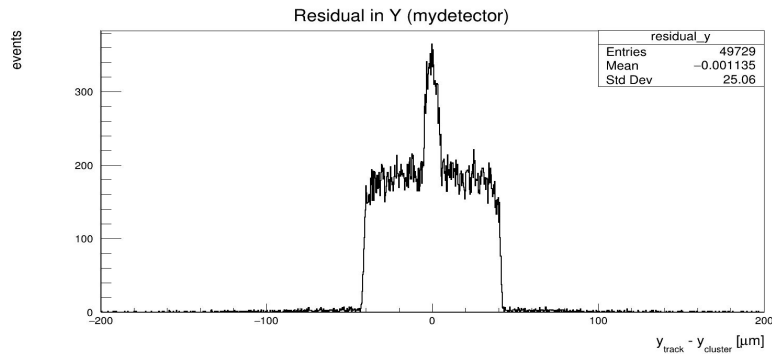
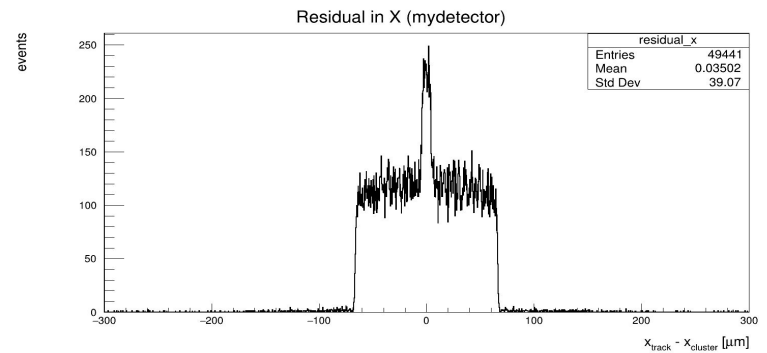


We observe slight increase in resolution in the Y as we increase rotation when rotation is changed!

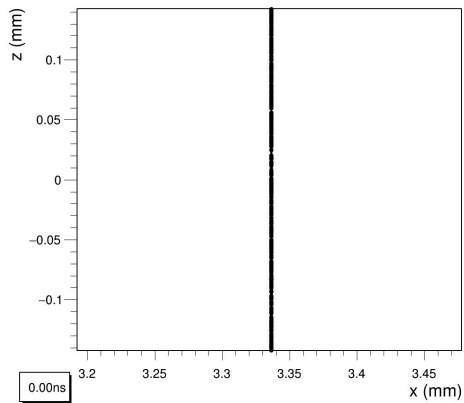


At QCD_resolution = 4, 0deg0T

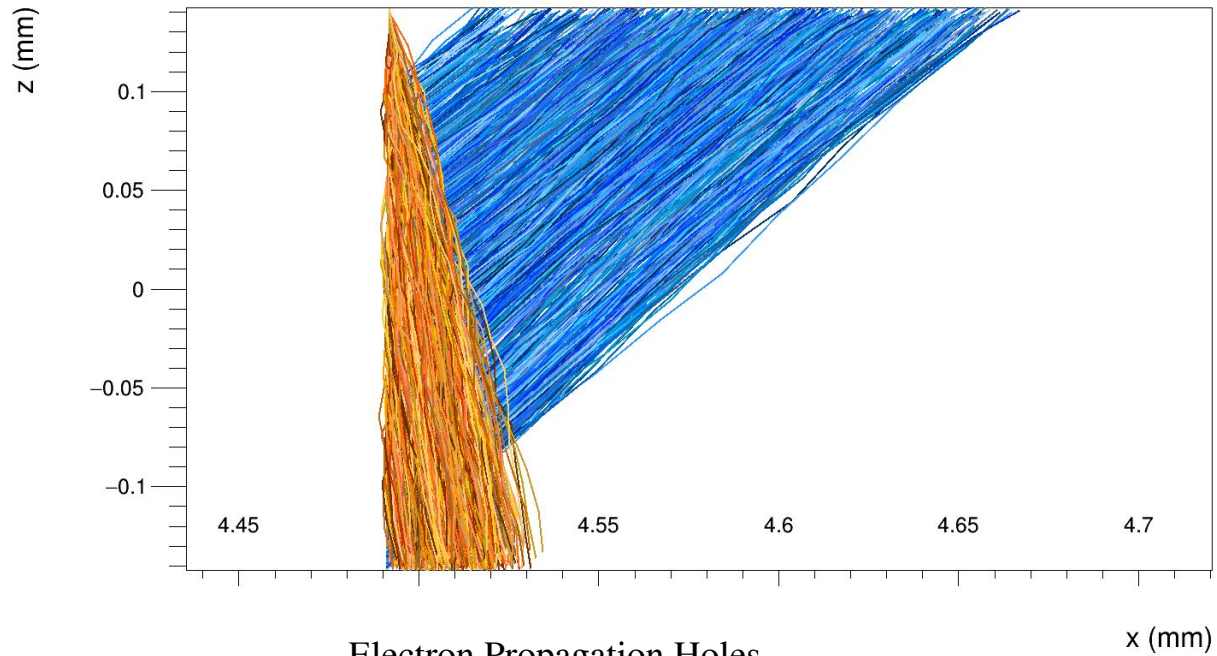
At QCD_resolution = 4, 0deg2T



We observe slight increase in resolution in the Y as we increase rotation when the magnetic field is changed!



Electron movement

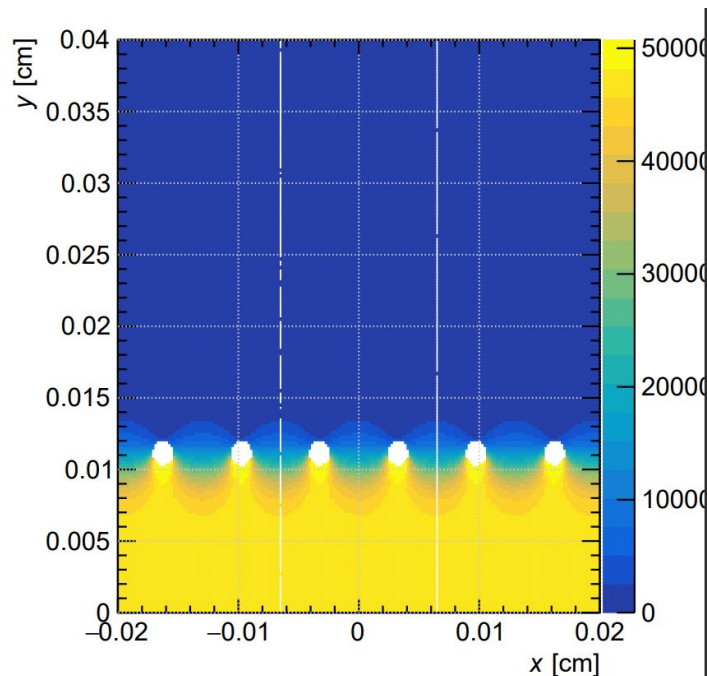
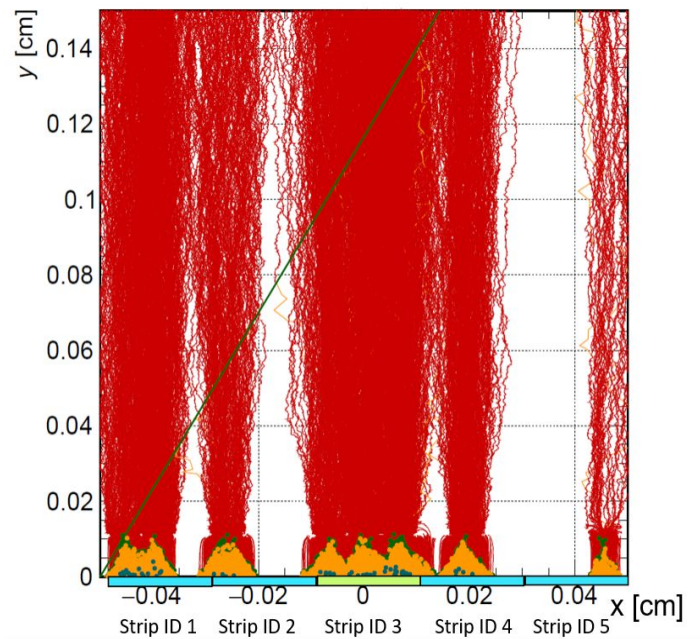


Electron Propagation Holes

x (mm)

Micro Pattern Gas Detector

- Reconstruct a track of a particle (muon) in a micromegas detector using Garfield++



VME bus Data Acquisition (DAQ) System

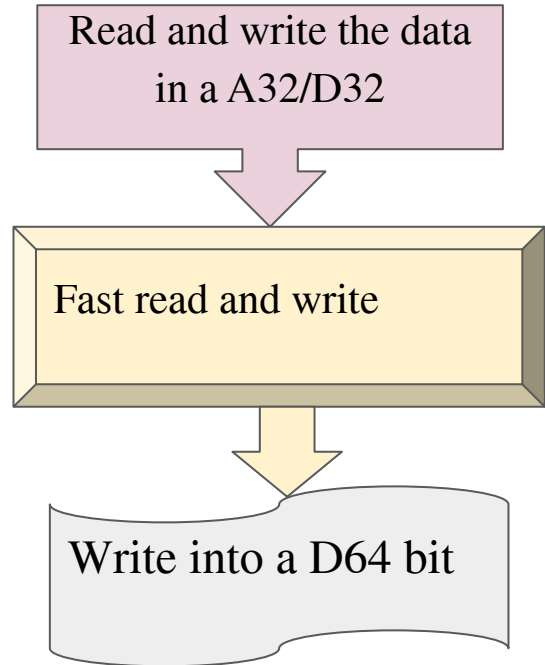
Basic Modules:

- Master -> Initiates Data Transfers
- Analyzer -> Information from master & slave
- Slave -> Responds to Master



VME bus Data Acquisition (DAQ) System- Objectives

Basic Objectives of the exercise were to;



VME bus DAQ - Results

```
isotdaq@sbc-isotdaq-1:~/exercise1/group5
File Edit View Search Terminal Help
//Compare written and read data
if (ldata != 0x12345678)
    printf("Safe single cycle error: data does not match. Read: 0x%09x\n", ldata);

unsigned long value;
//Get a virtual address for the mapped range
//.....

if (error_code = VME_MasterMapVirtualAddress(handle, &value)){
    VME_ErrorPrint(error_code);
    return(error_code);
}

printf("Press return to execute a A32/D32 fast write\n");
scanf("%c", &dummy);

unsigned int *vme_ptr;
ts_clock(&ts1);

//Task 3: Fast A32/D32 write cycle
//.....

ts_clock(&ts2);
delta = ts_duration(ts1, ts2);
printf("Delay of fast write = %f usecs\n", delta * 1000000.0);

vme_ptr = (unsigned int *)value; //Make the pointer point to VMEbus address offset 0x0

printf("Press return to execute a A32/D32 fast read\n");
scanf("%c", &dummy);

ts_clock(&ts1);

//Task 4: Fast A32/D32 read cycle
//.....
201,0-1 71%
```

```
File Edit View Search Terminal Help
[isotdaq@sbc-isotdaq-1 group5]$ ./solution
Press return to execute a A32/D32 safe write

Delay of VME_WriteSafeUInt = 168.845261 usecs
Press return to execute a A32/D32 safe read

Delay of VME_ReadSafeUInt = 189.369908 usecs
Press return to execute a A32/D32 fast write

Delay of fast write = 4.463887 usecs
Press return to execute a A32/D32 fast read

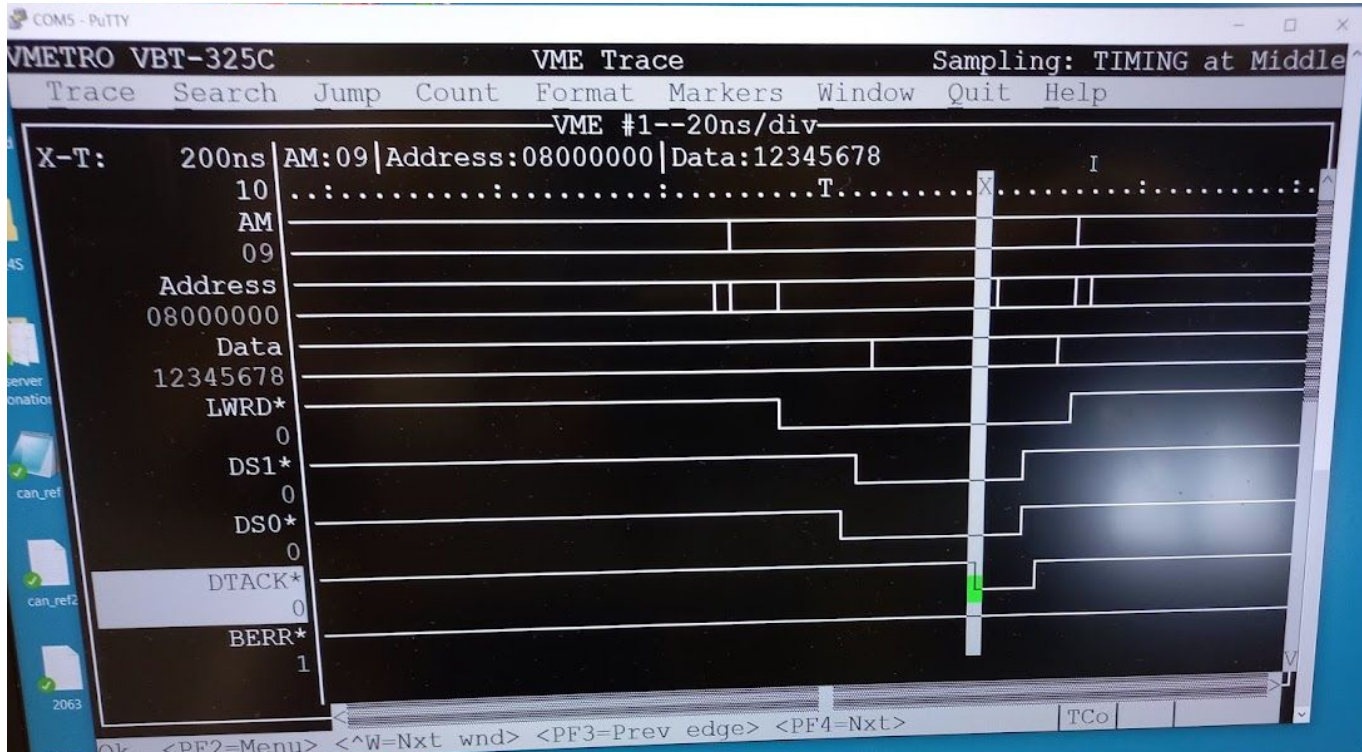
Delay of fast read = 11.182718 usecs
Press return to execute a A32/D32 block write transfer

Delay of D32 BLT write = 1202.303334 usecs
Press return to execute a A32/D64 block read transfer

Delay of D64 MBLT read = 490.060775 usecs
[isotdaq@sbc-isotdaq-1 group5]$
```

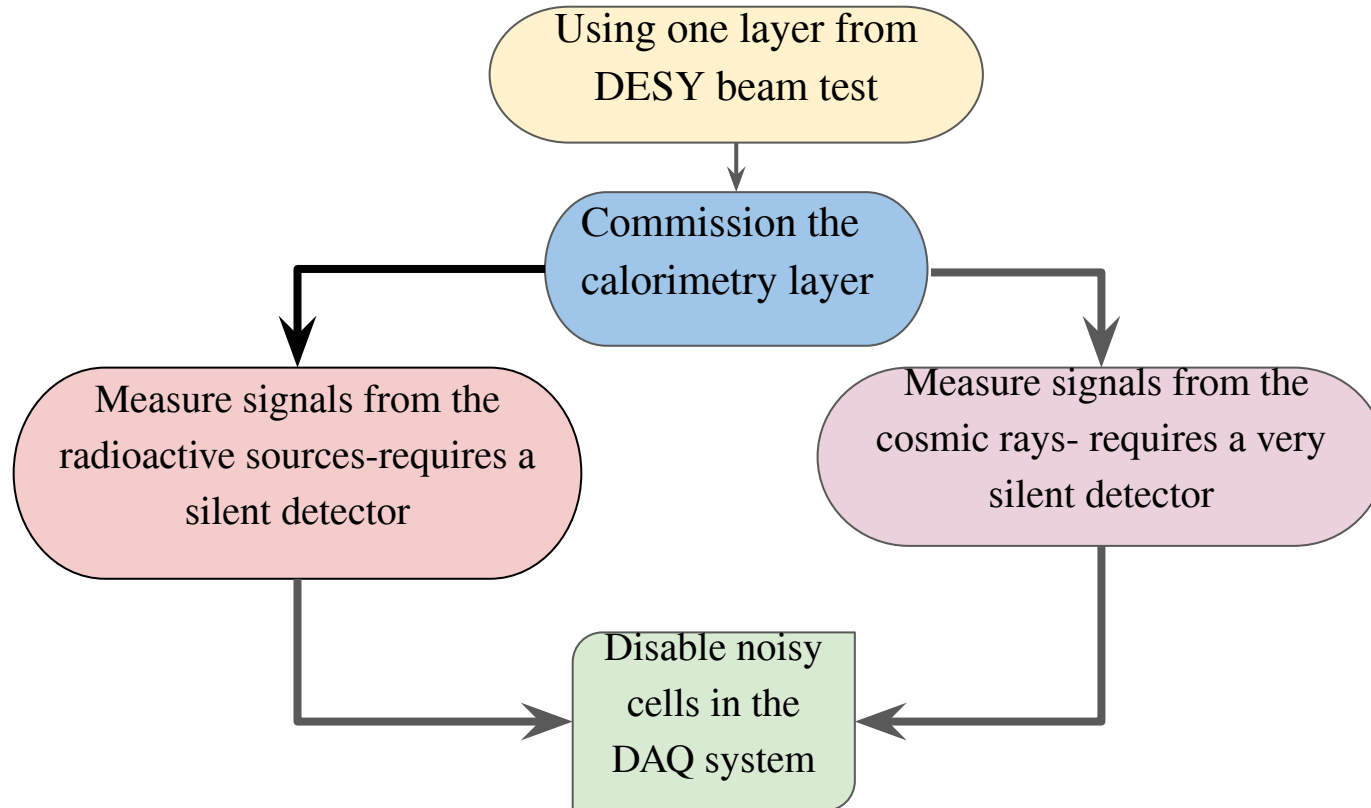
TRIG	Time	BgL	AM	Address	Data	Size	Cycle	Stat
1	221.50ms	----	09	08000000	12345678	LONG	WRI	OK
2	222.81ms	----	09	08000000	12345678	LONG	RD	OK
3	28.63s	----	09	08000004	87654321	LONG	WRI	OK
				08000000	12345678	LONG	RD	OK

VME bus DAQ - Results



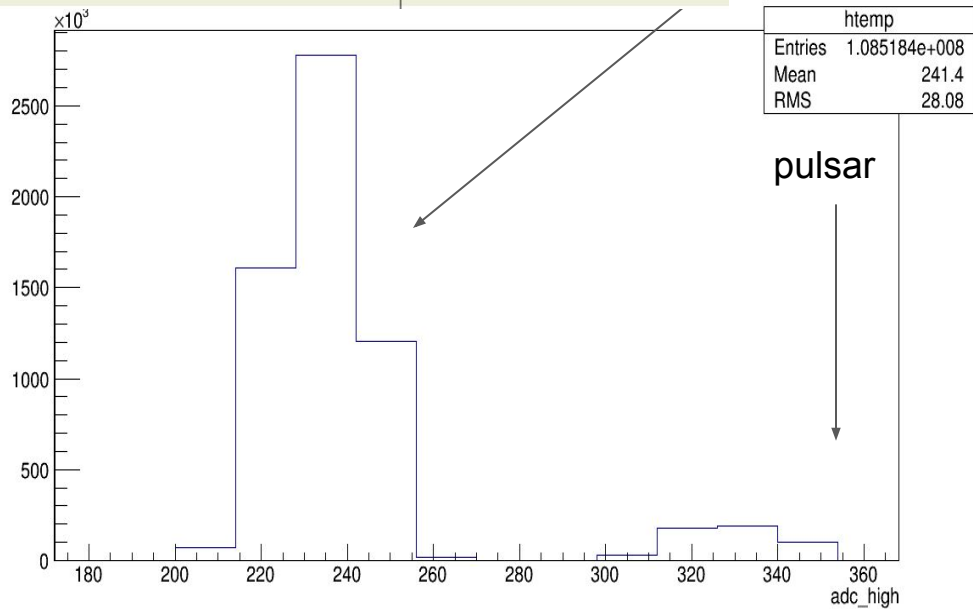
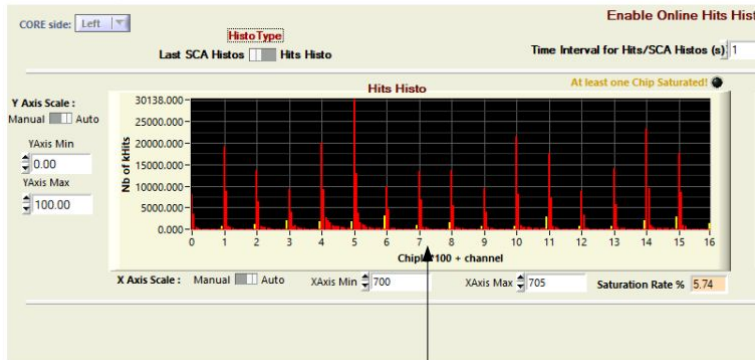
- **The transfer (Writing) of data from the Master to the slave.**
- **The transfer (Reading) of data from the Master to the slave**

Calorimetry Silicon Tungsten-objectives



Calorimetry Silicon Tungsten

Online Hits Histograms for Slabs 0 to 4





Thank You!