
Status of Imperial tasks

Paul Dauncey

Imperial tasks

- Simulation updates and production - Paul
- Bad pixels, configuration and threshold – Paul
- Efficiency, 2D method – Paul

- **Simulation**
 - Nothing done since last meeting ☹
- **Bad pixels**
 - Have first order list of bad pixels for each run
 - Some simple software to handle the information
- **2D efficiency**
 - Efficiency vs impact position of track relative to pixel
 - Some basic results on this

Bad pixels

- Based on masking, bad configuration columns, bad pedestals
 - Does not include full memory flagging
- Complicated by sensor configuration having only **destructive readback**
 - Only know configuration is bad after run finishes
 - Need to find bad pixels before analysis job
 - If run crashes, no check at all
- **Selection** of bad pixels/columns/sensors
 - Pixel: masked, trim=0, or wrong on readback
 - Column: >100 pixels with trim=0, trim=31 or wrong on readback
 - Sensor: no runEnd readback
- Results stored in **files** in data/pxl/
 - One file per run and layer; single bit per pixel
 - E.g. Run447790Layer0.pxl

Using the bad/good pixel lists

- Do an rsync from the Imperial data area to get the data/pxl/ directory
- Define the objects to contain the lists

```
MpsGoodPixels mgp[6];
```
- At runStart, read in the list files

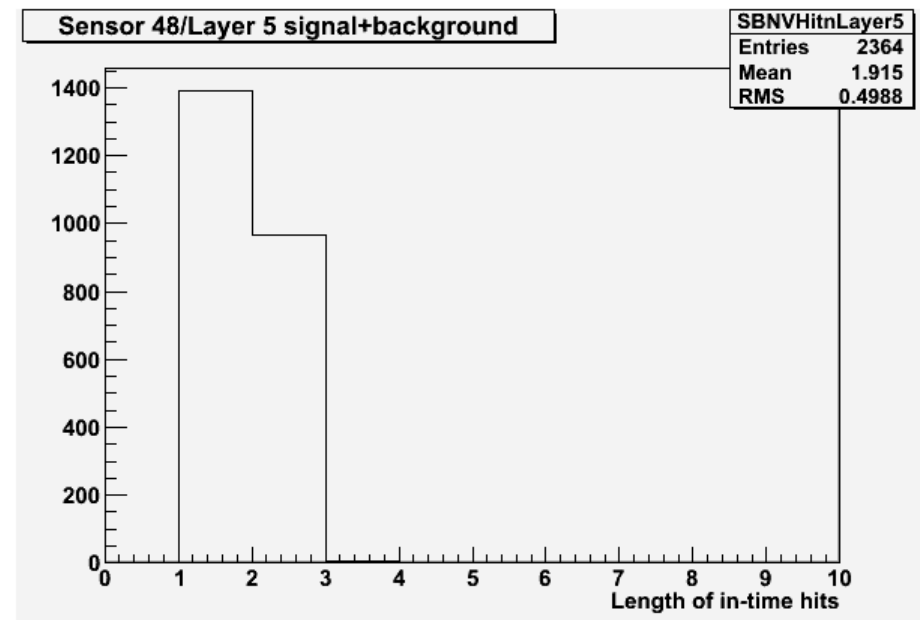
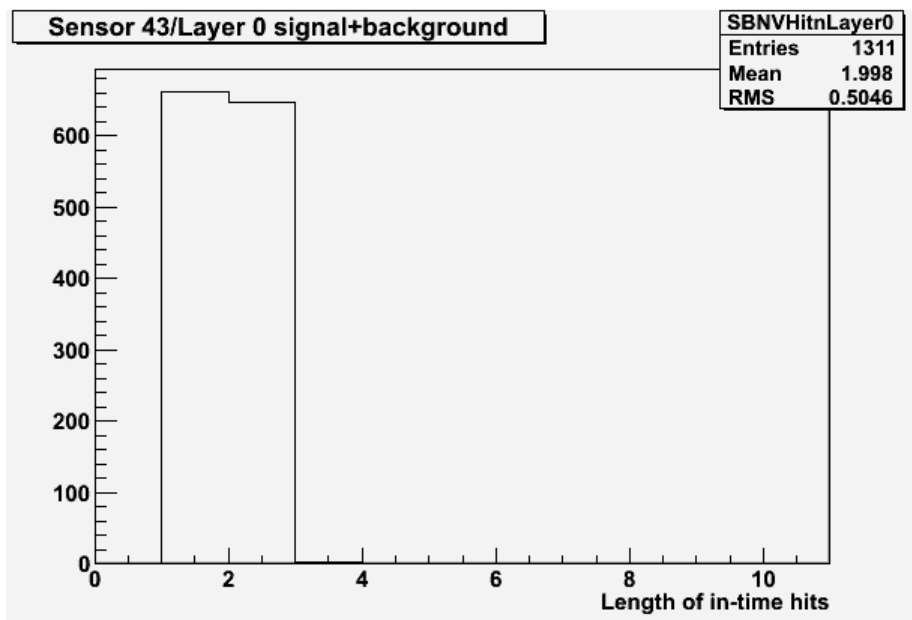
```
for(unsigned layer(0);layer<6;layer++) {  
    mgp[layer].readRunLayer(runNumber,layer);  
}
```
- Find number of good pixels in a layer

```
unsigned gn=mgp[layer].goodNumber();
```
- For any pixel $x < 168$ and $y < 168$

```
if(mgp[layer].good(x,y)) {  
    // Use for analysis
```
- Check `daquser/inc/mps/MpsGoodPixels.hh` for other useful methods

Aside on monostable lengths

- Checked number of **contiguous hits** in time for each pixel
 - See high rate of pixels with more than one hit
 - Disagrees with Benedict's study; needs to be cross-checked

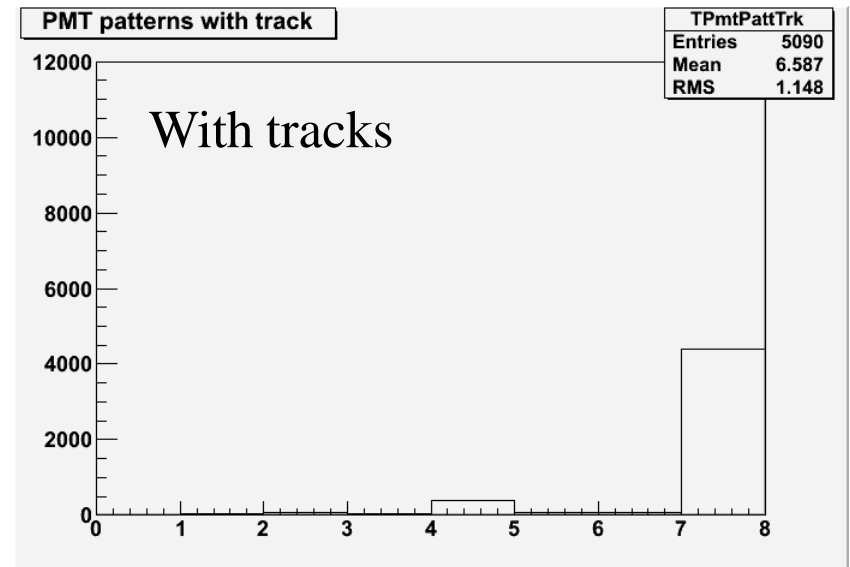
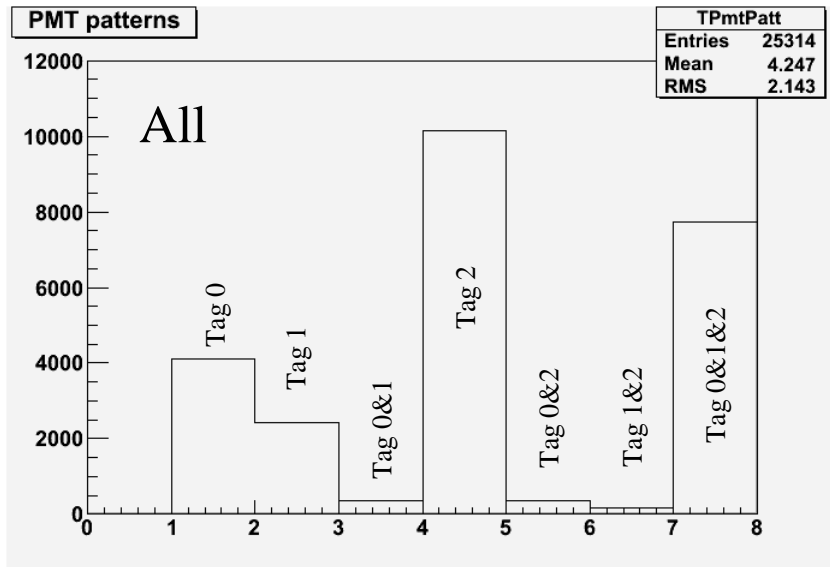


- N.B. Quick check so not systematic
 - Only checked for hits within ± 1 of PMT time
 - Contiguous hits could be longer

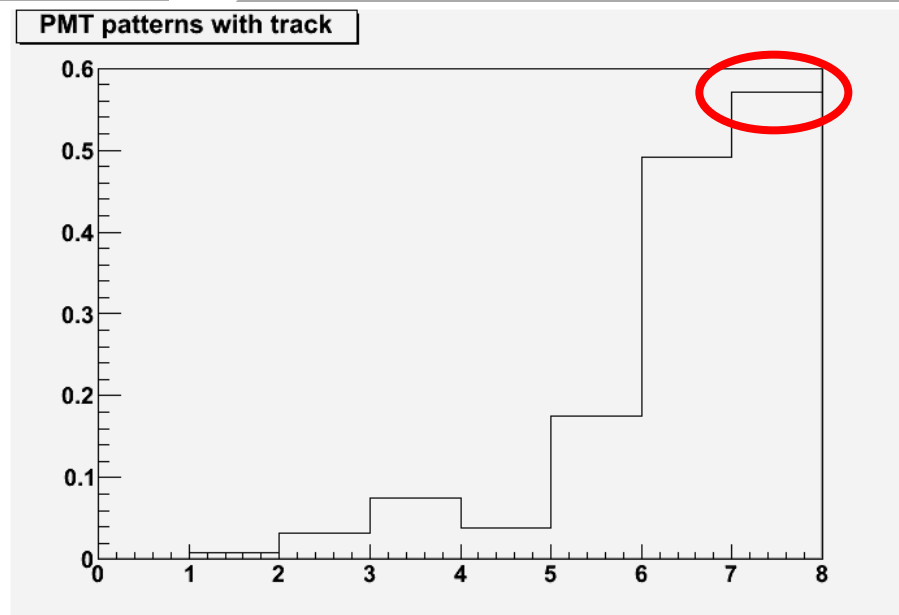
2D efficiency

- **Basic concept**
 - Form a track from all layers except the one under study
 - Project track onto layer under study
 - Find position of track projection relative to each good pixel (within 7×7)
 - Plot number of hits in good pixel as a function of position
 - Divide by track position plot to get efficiency as a function of position
- Need to check **track quality**
 - Badly reconstructed track will not project to right position on sensor
 - Gives artificial inefficiency; not yet tackled this
- Construct **“best” track** from all combinations of all hit in all layers
 - All tracks required to have at least 3 layers and fit χ^2 probability > 0.1
 - Always pick track with highest number of layers
 - Pick highest probability if multiple tracks with highest number of layers
- Repeat selection for all tracks with **each layer excluded** in turn
 - Used for efficiency estimate

Tracks dependence on PMT hits

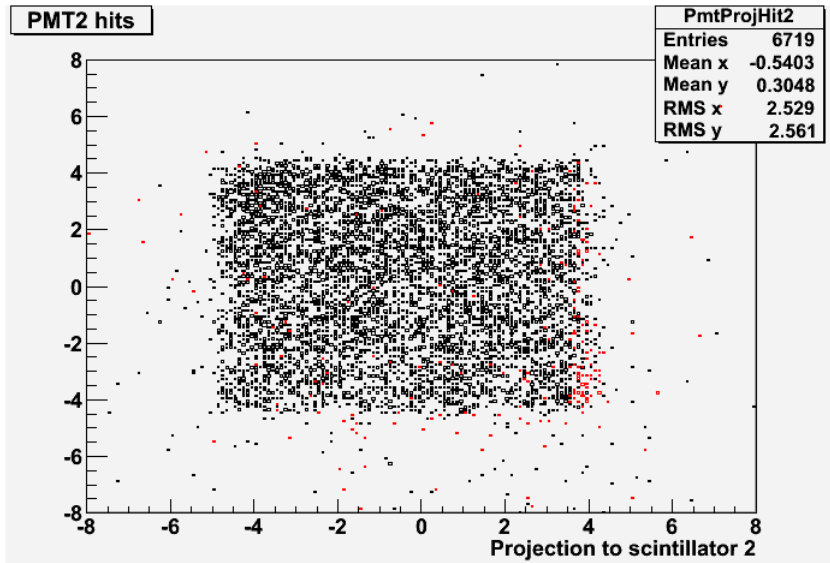
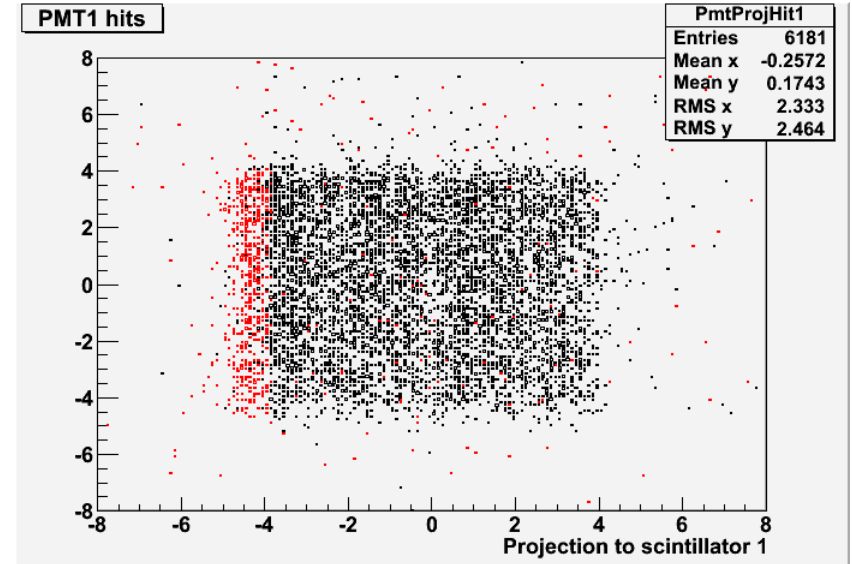
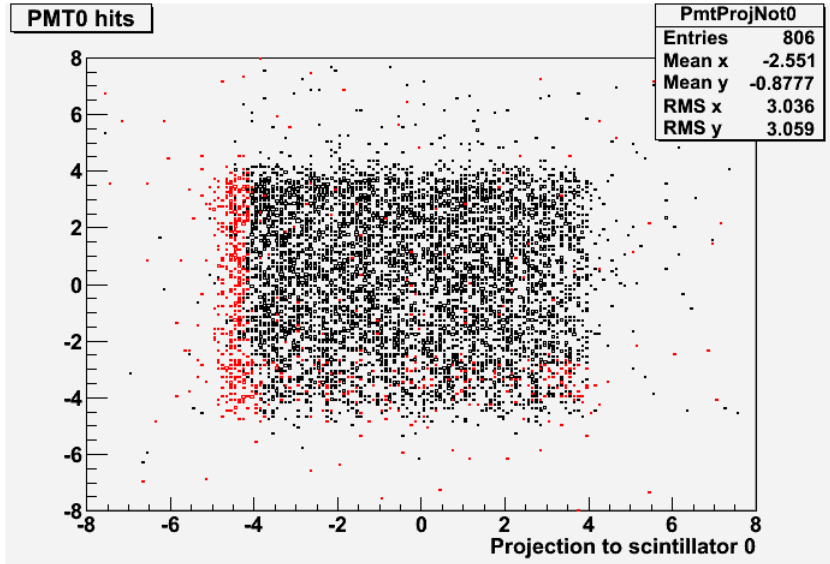


- PMT output clean; use **all** singles and coincidences to try to find tracks
- **Probability** of finding a track given a particular pattern of scintillator hits



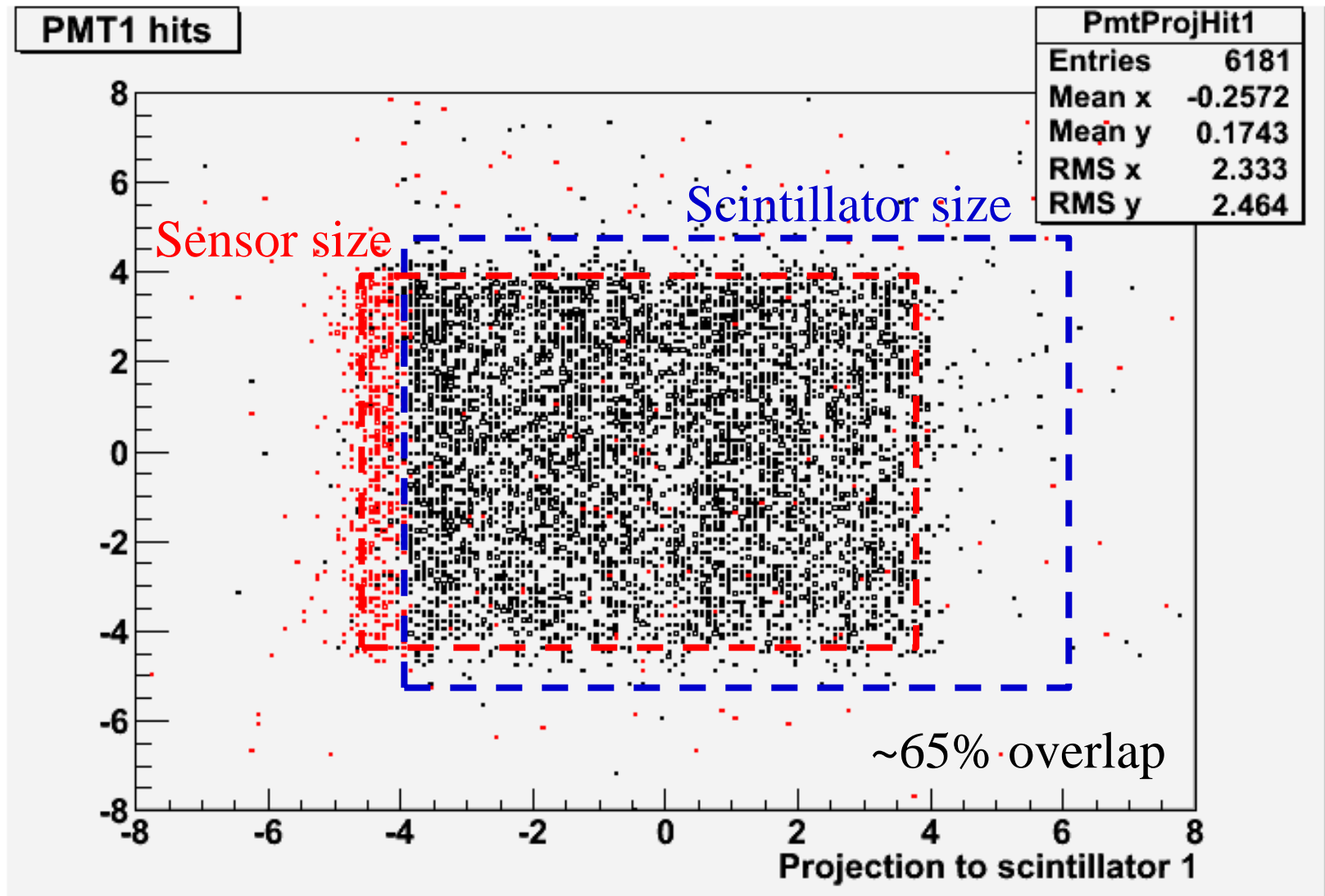
~58%

Scintillator positions

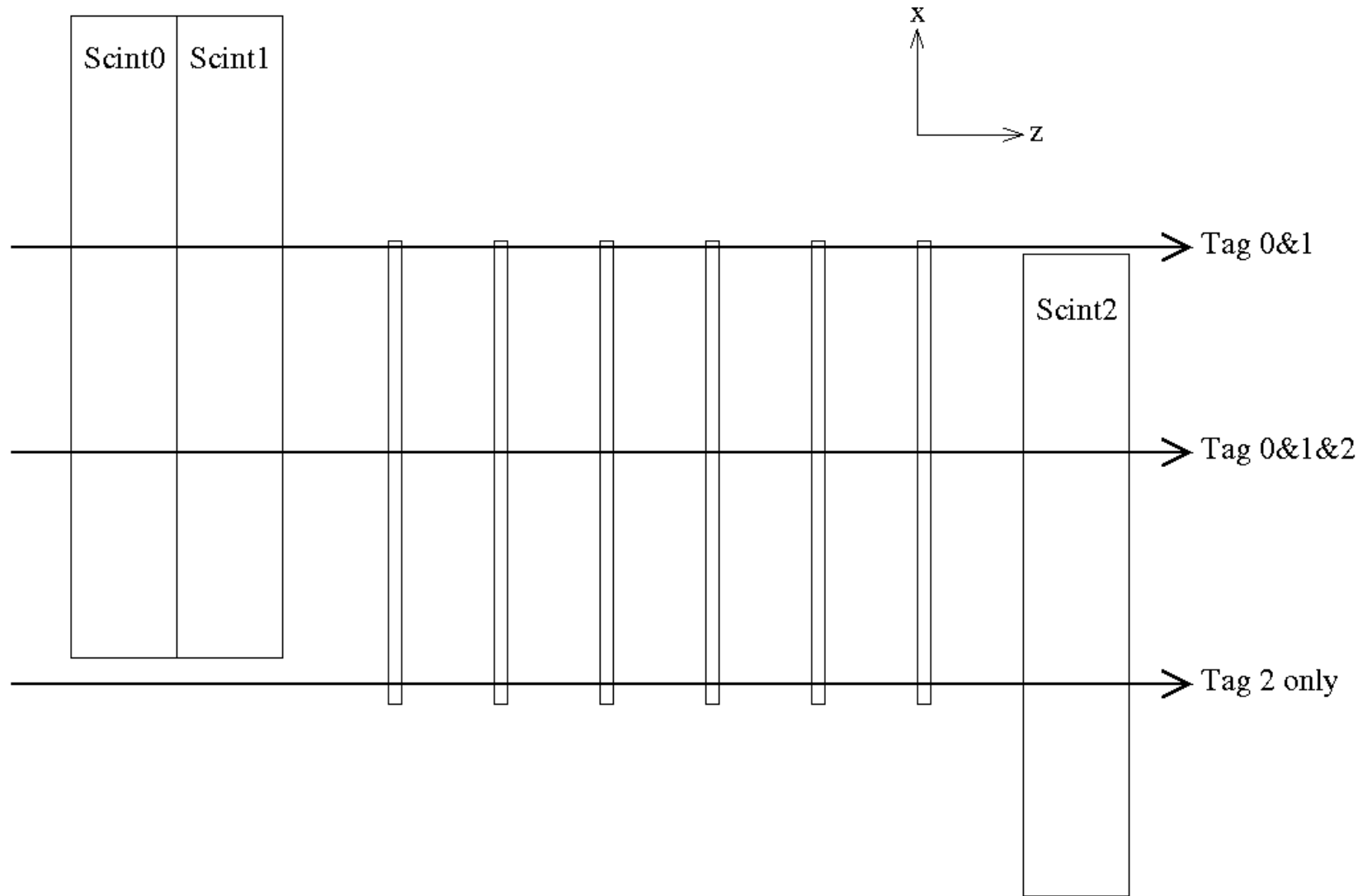


- Project tracks into plane of scintillators
- Black points are if scintillator gives tagging hit, **red if no tagging hit**
- Clear edge of scintillators 0 and 1
- Possible edge of scintillator 2

Scintillator-sensor overlap



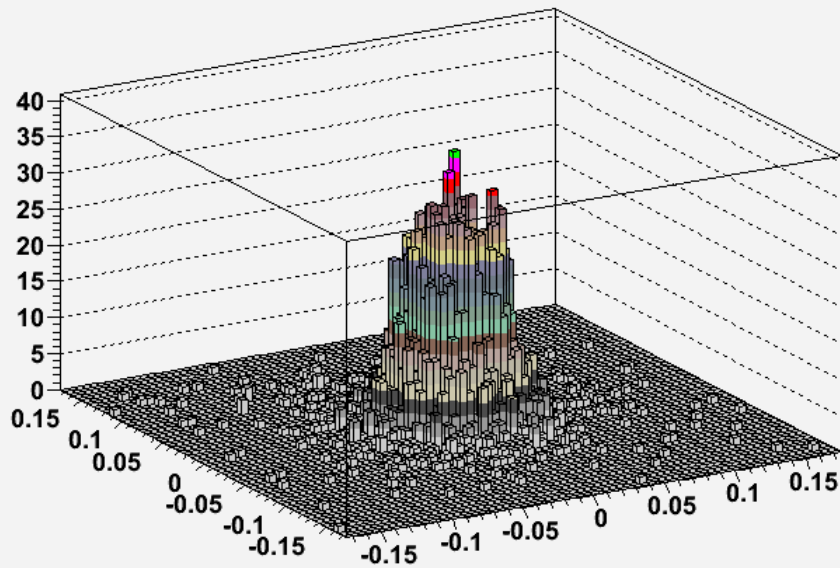
Cartoon of scintillator geometry



Hits in and out of time

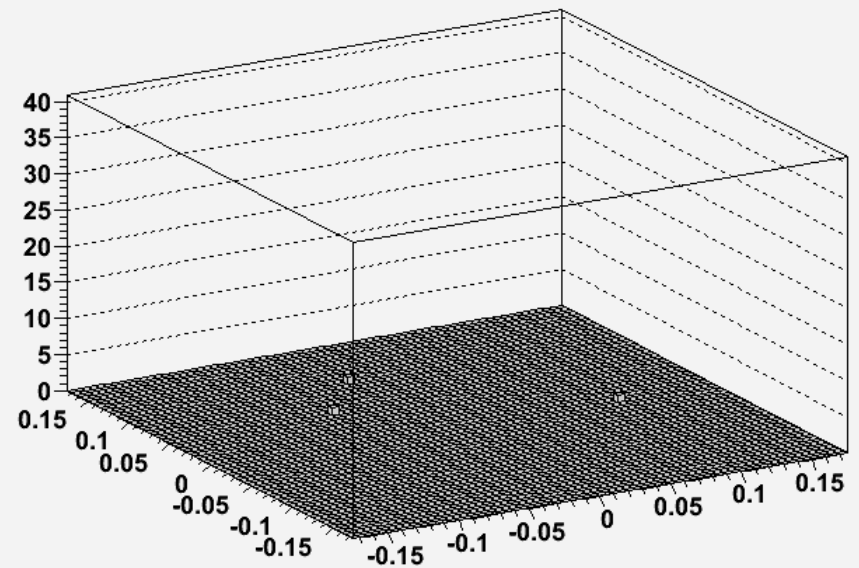
- Typical run 447794, threshold 170
 - Number of sensor hits as a function of track position w.r.t. pixel centre
 - Plot is for 7×7 pixel array = $\pm 175 \mu\text{m}$

Sensor 39/Layer 2 Hit position - track projection



In-time

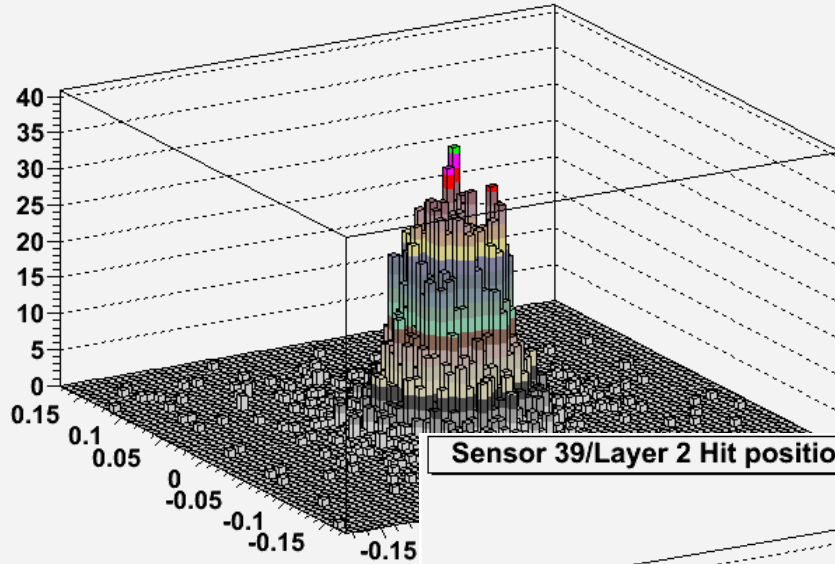
Sensor 39/Layer 2 Hit position - track projection



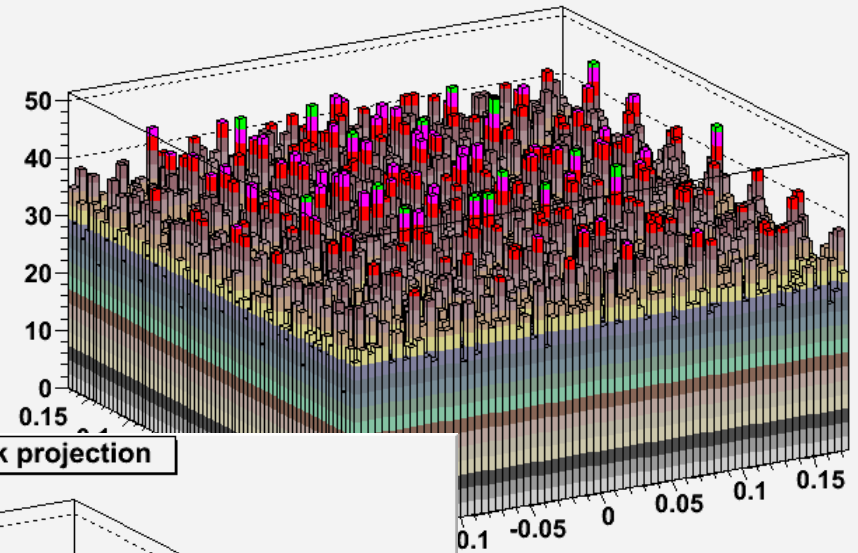
Out-of-time

Track distribution

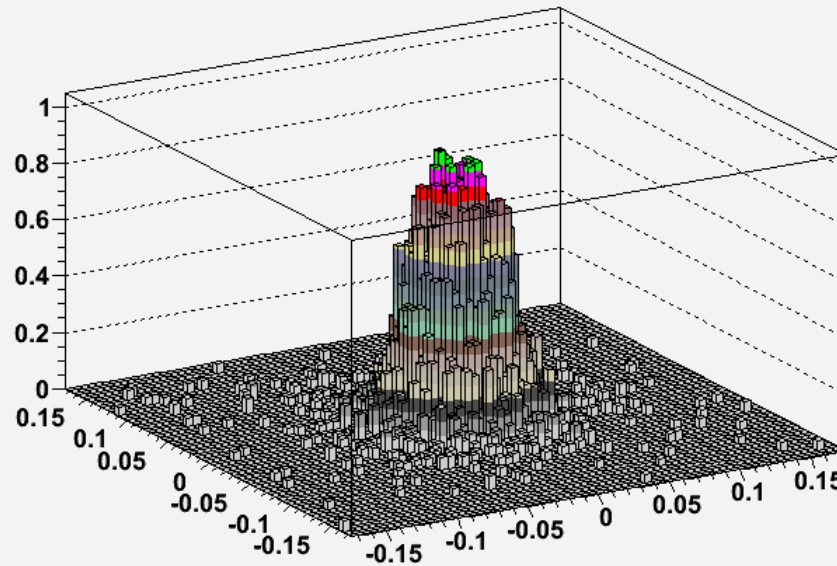
Sensor 39/Layer 2 Hit position - track projection



Sensor 39/Layer 2 Pixel position - track projection

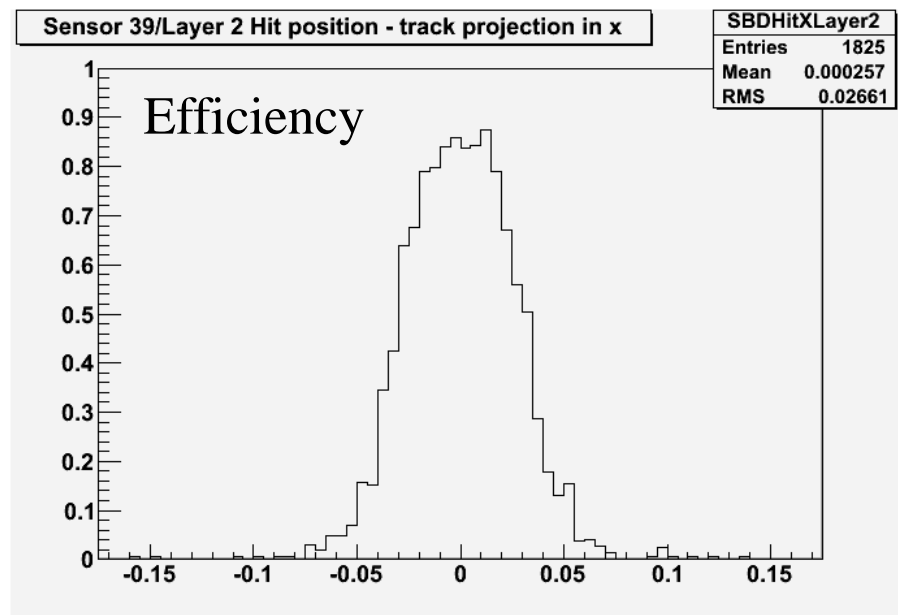
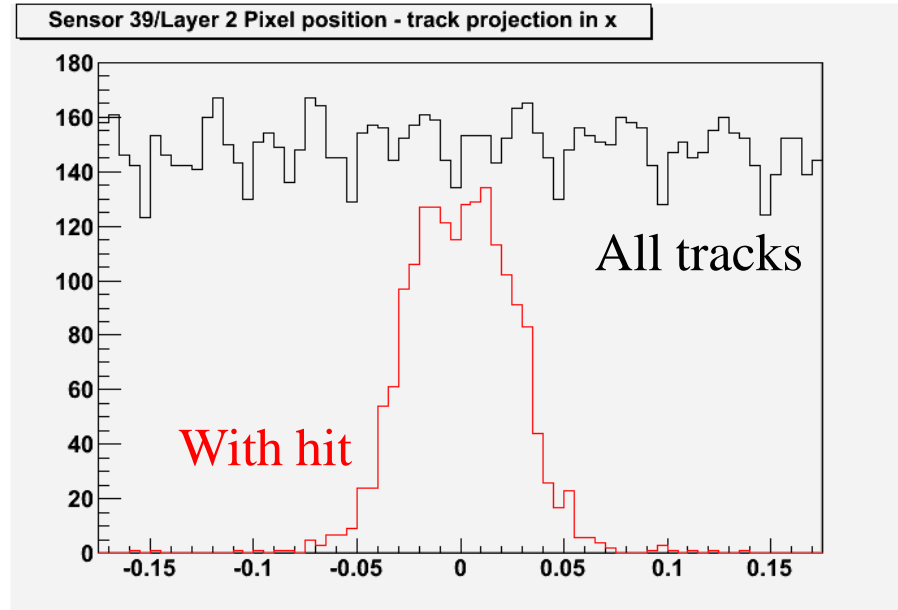
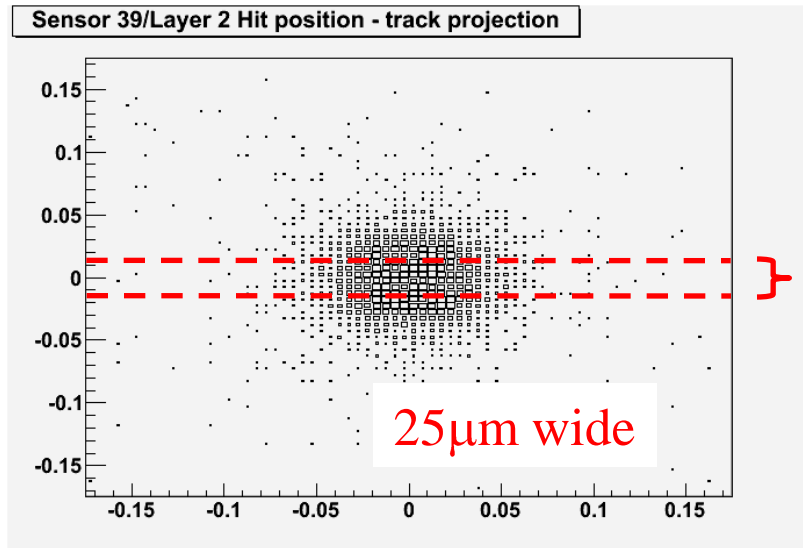


Sensor 39/Layer 2 Hit position - track projection



Division gives efficiency

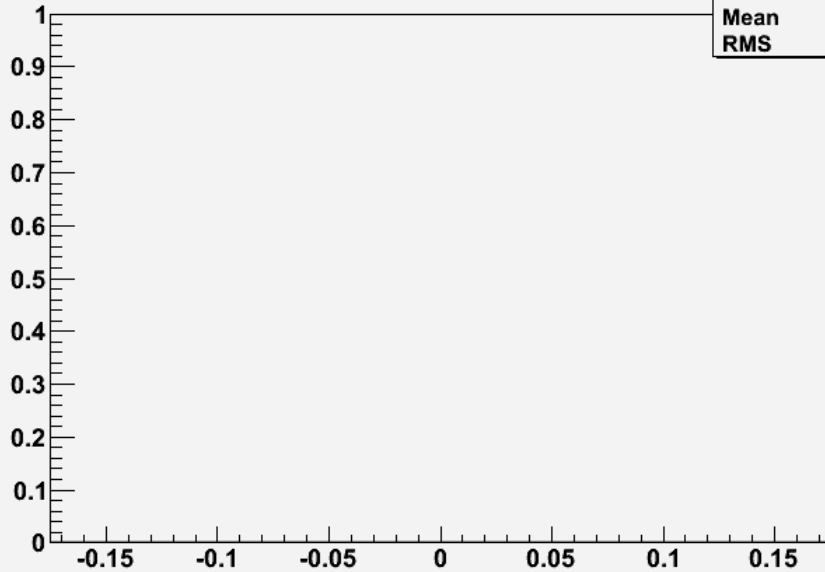
Projections in x and y



Projections in x and y vs threshold

- Run 447790, threshold 130

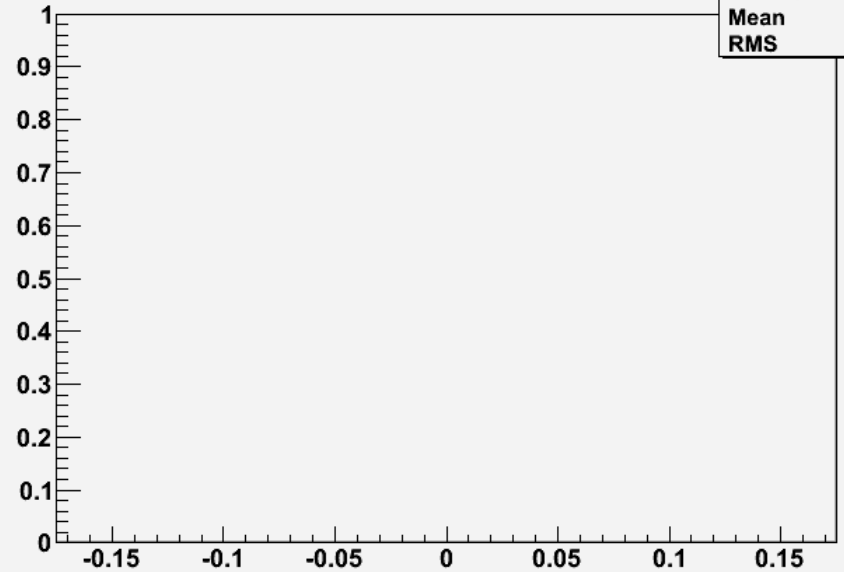
Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2

Entries	0
Mean	0
RMS	0

Sensor 39/Layer 2 Hit position - track projection in y



SBDHitYLayer2

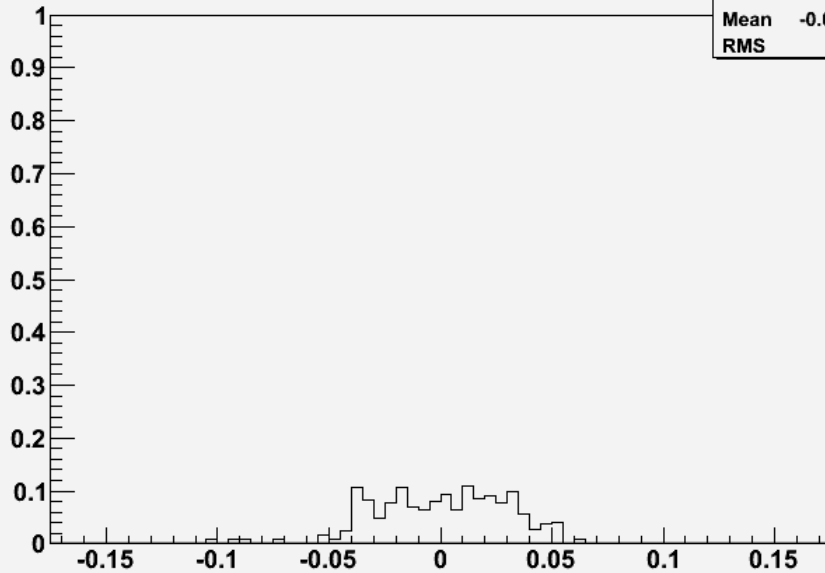
Entries	0
Mean	0
RMS	0

No hits at all!

Projections in x and y vs threshold

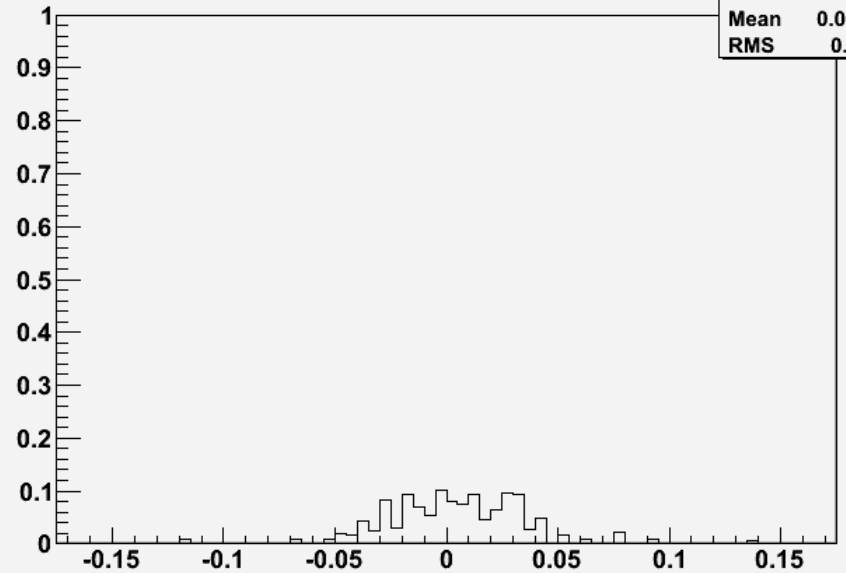
- Run 447789, threshold 140

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2	
Entries	205
Mean	-0.0002406
RMS	0.03008

Sensor 39/Layer 2 Hit position - track projection in y

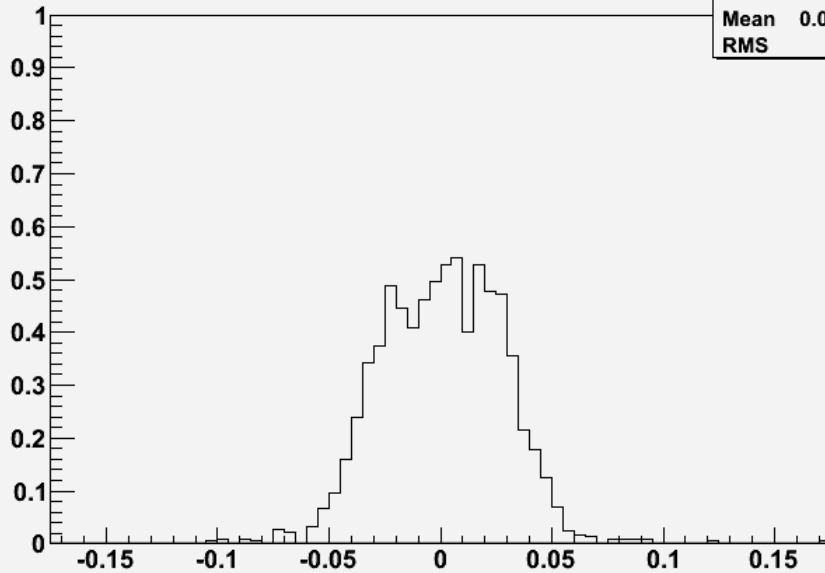


SBDHitYLayer2	
Entries	181
Mean	0.004579
RMS	0.03112

Projections in x and y vs threshold

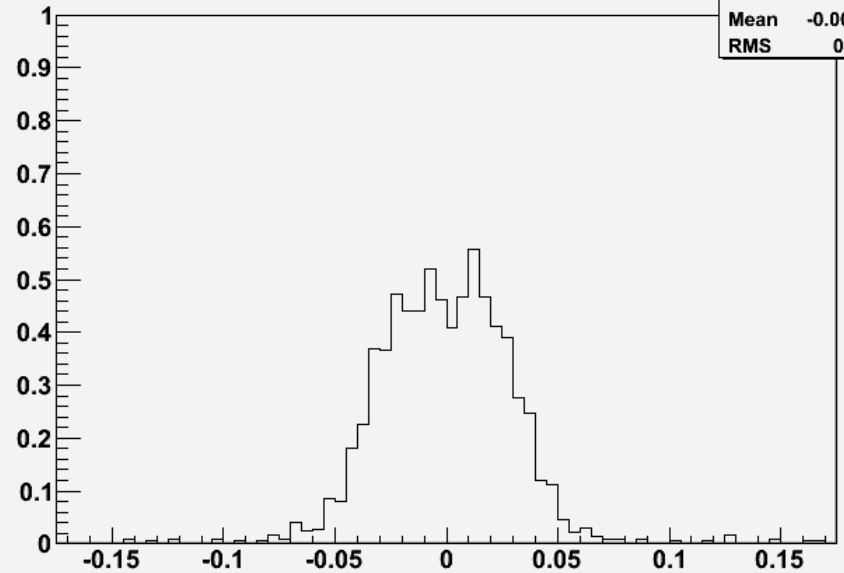
- Run 447788, threshold 150

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2	
Entries	1076
Mean	0.0007935
RMS	0.02761

Sensor 39/Layer 2 Hit position - track projection in y

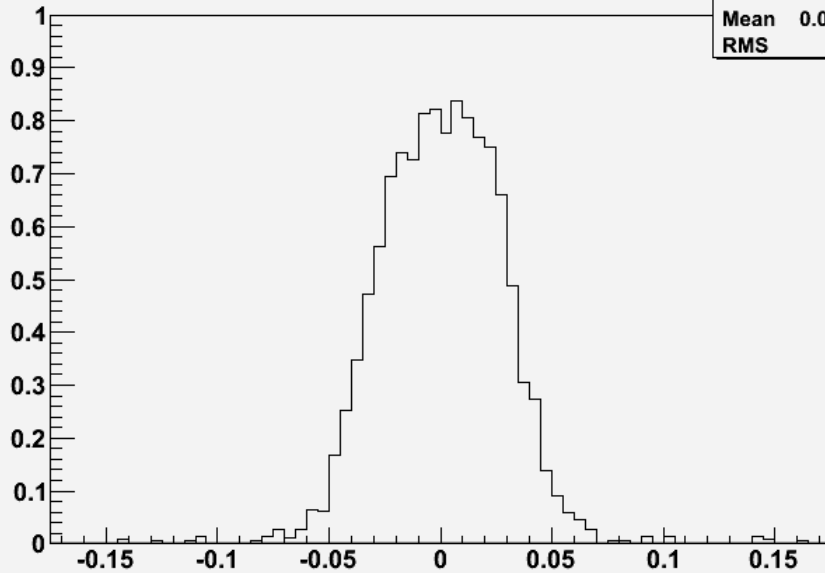


SBDHitYLayer2	
Entries	1015
Mean	-0.0005752
RMS	0.03004

Projections in x and y vs threshold

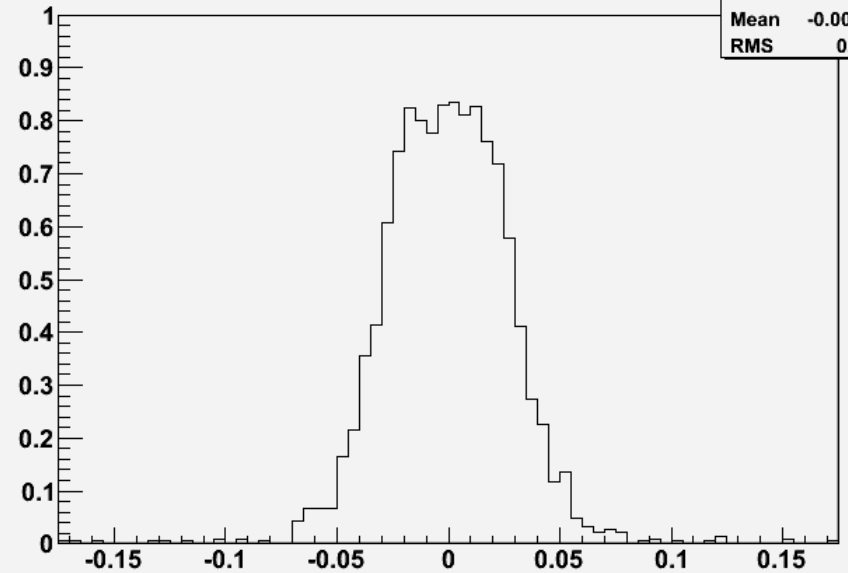
- Run 447787, threshold 160

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2	
Entries	1819
Mean	0.0006106
RMS	0.02761

Sensor 39/Layer 2 Hit position - track projection in y

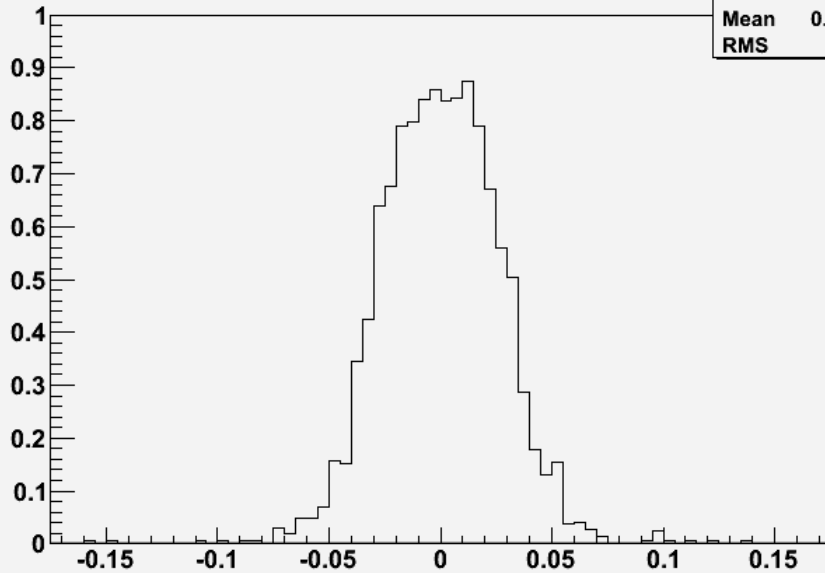


SBDHitYLayer2	
Entries	1745
Mean	-0.0004537
RMS	0.02826

Projections in x and y vs threshold

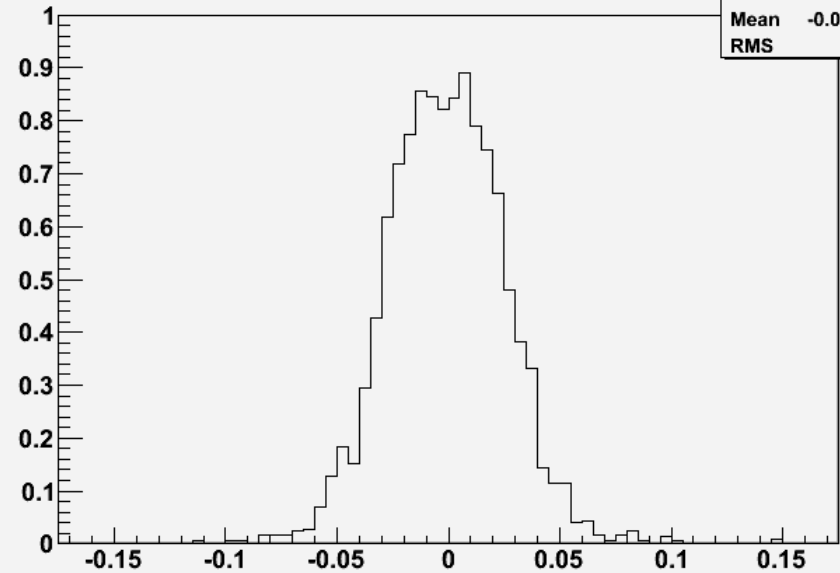
- Run 447794, threshold 170

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2	
Entries	1825
Mean	0.000257
RMS	0.02661

Sensor 39/Layer 2 Hit position - track projection in y

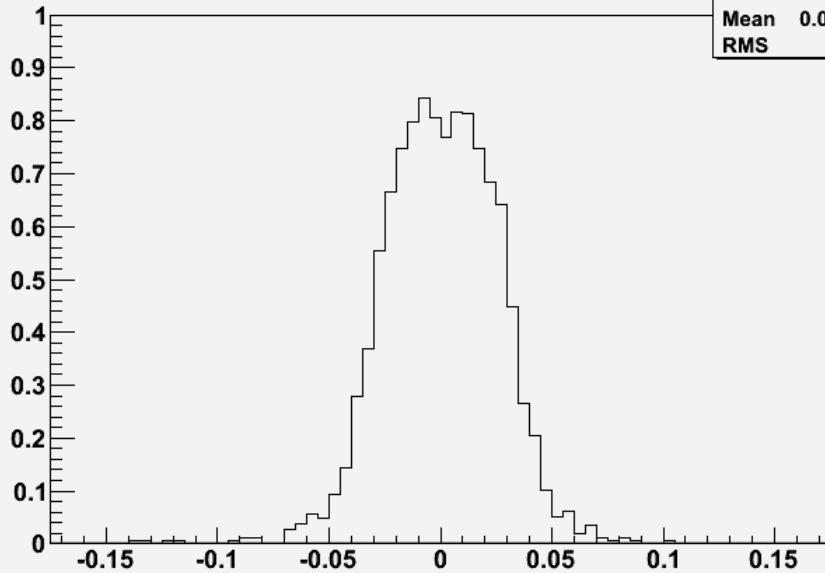


SBDHitYLayer2	
Entries	1832
Mean	-0.0008363
RMS	0.0262

Projections in x and y vs threshold

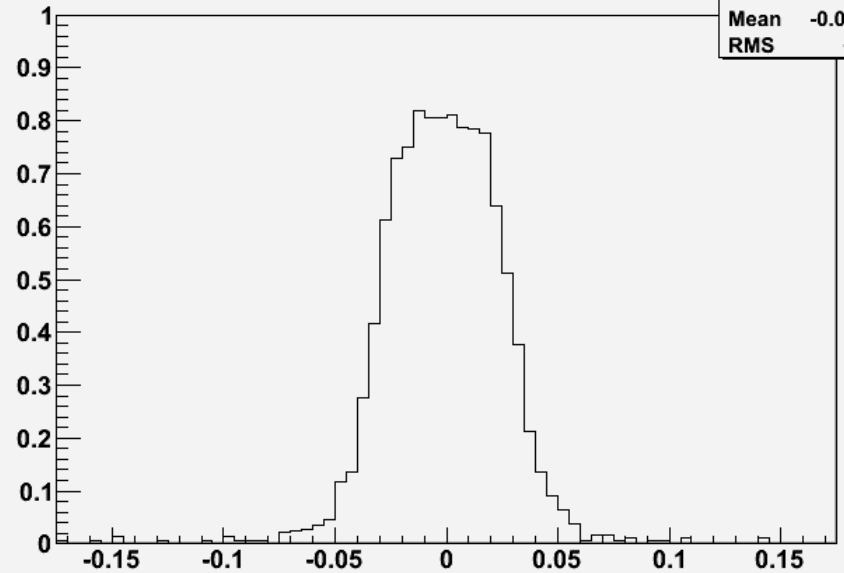
- Run 447793, threshold 180

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2	
Entries	1967
Mean	0.0004959
RMS	0.02521

Sensor 39/Layer 2 Hit position - track projection in y

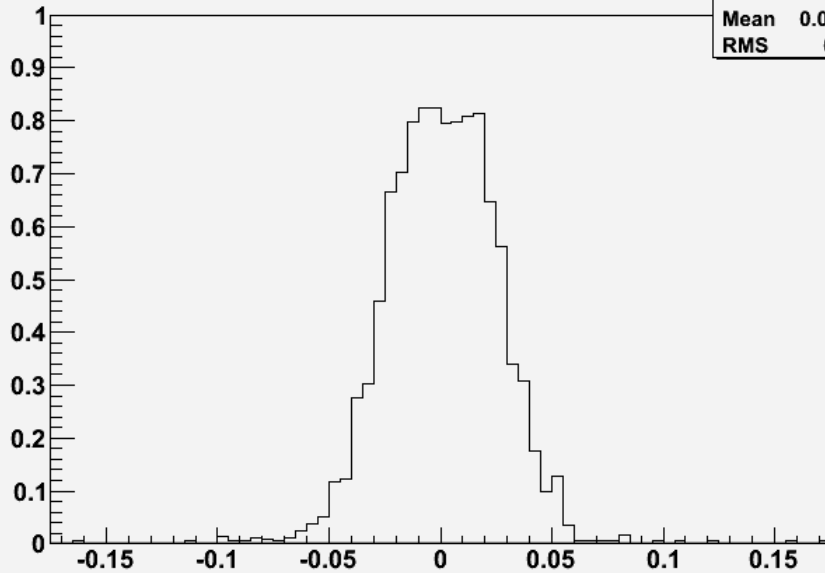


SBDHitYLayer2	
Entries	1871
Mean	-0.001218
RMS	0.0261

Projections in x and y vs threshold

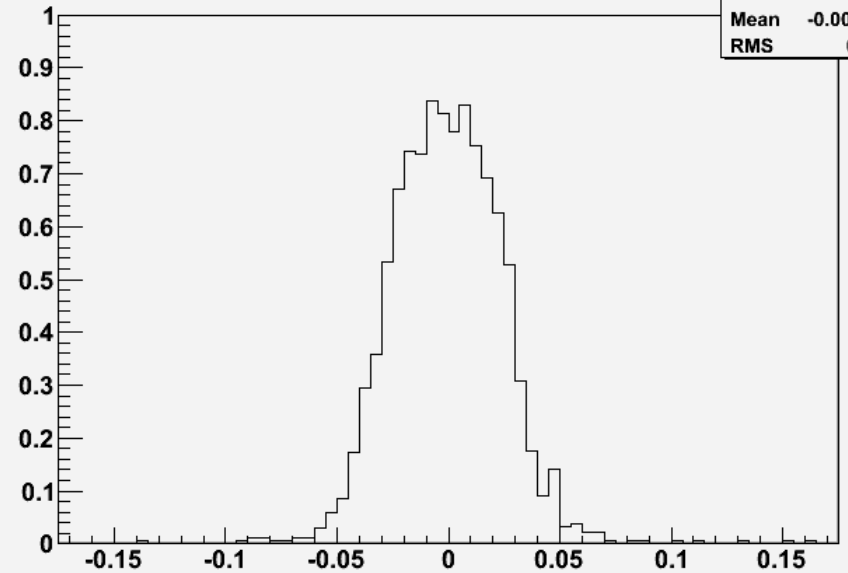
- Run 447792, threshold 190

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2	
Entries	2008
Mean	0.0009342
RMS	0.02532

Sensor 39/Layer 2 Hit position - track projection in y

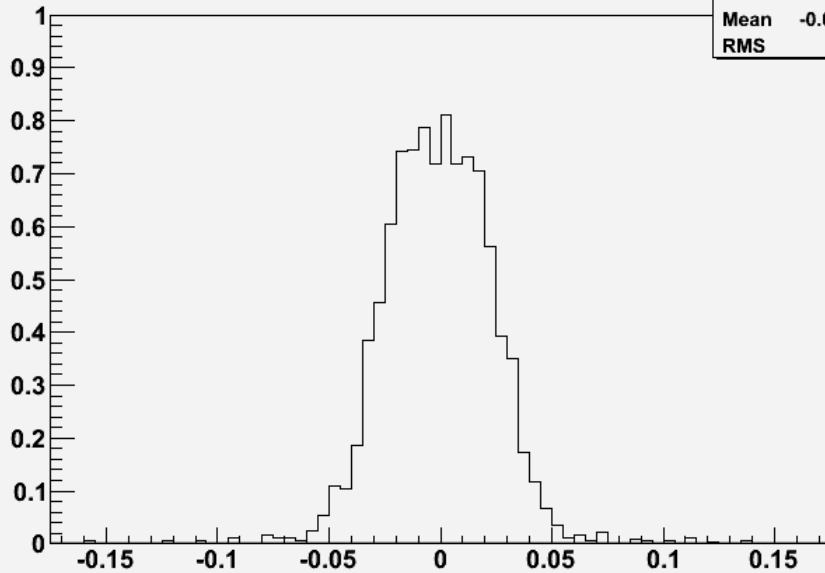


SBDHitYLayer2	
Entries	1918
Mean	-0.0006756
RMS	0.0246

Projections in x and y vs threshold

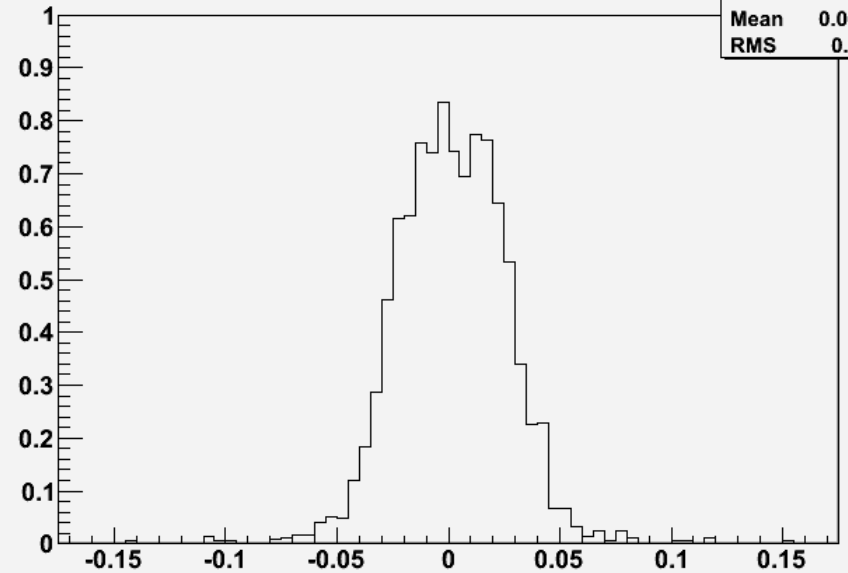
- Run 447791, threshold 200

Sensor 39/Layer 2 Hit position - track projection in y



SBDHitYLayer2	
Entries	1816
Mean	-0.0007988
RMS	0.02434

Sensor 39/Layer 2 Hit position - track projection in x

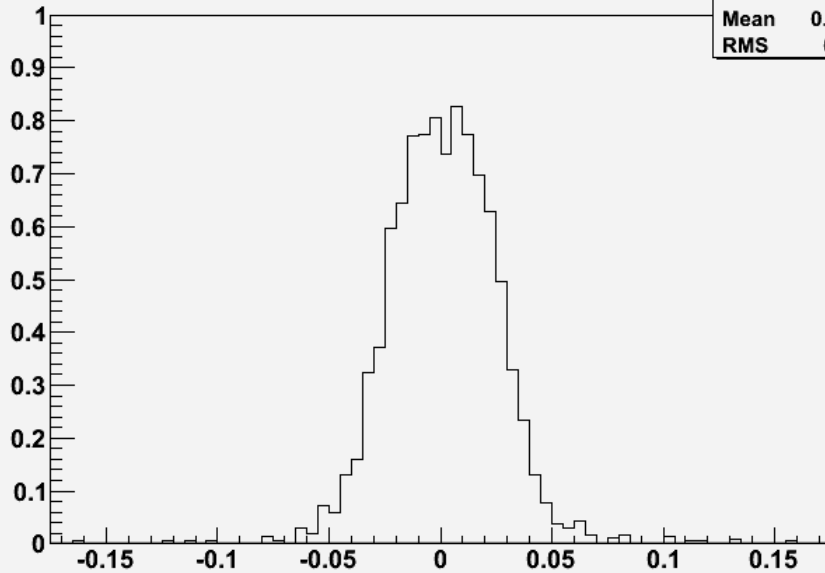


SBDHitXLayer2	
Entries	1873
Mean	0.001578
RMS	0.02505

Projections in x and y vs threshold

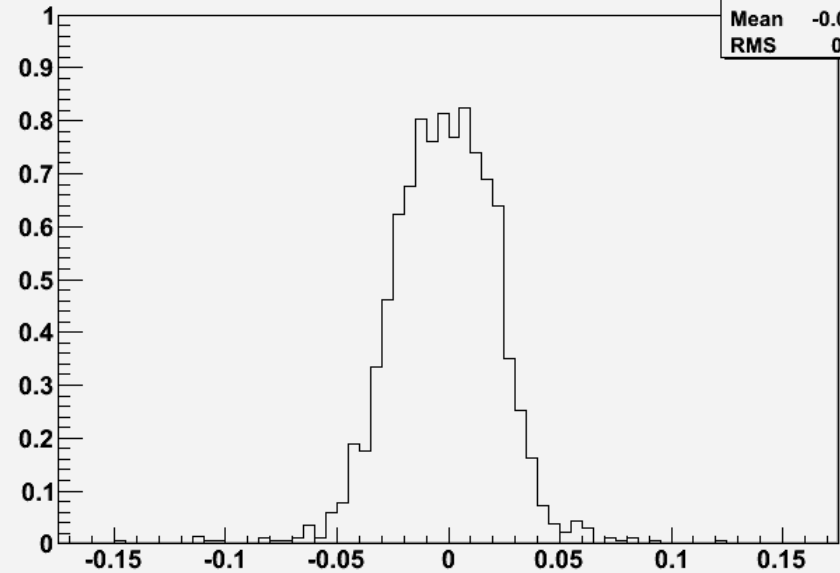
- Run 447952, threshold 210

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2	
Entries	1610
Mean	0.001287
RMS	0.02495

Sensor 39/Layer 2 Hit position - track projection in y

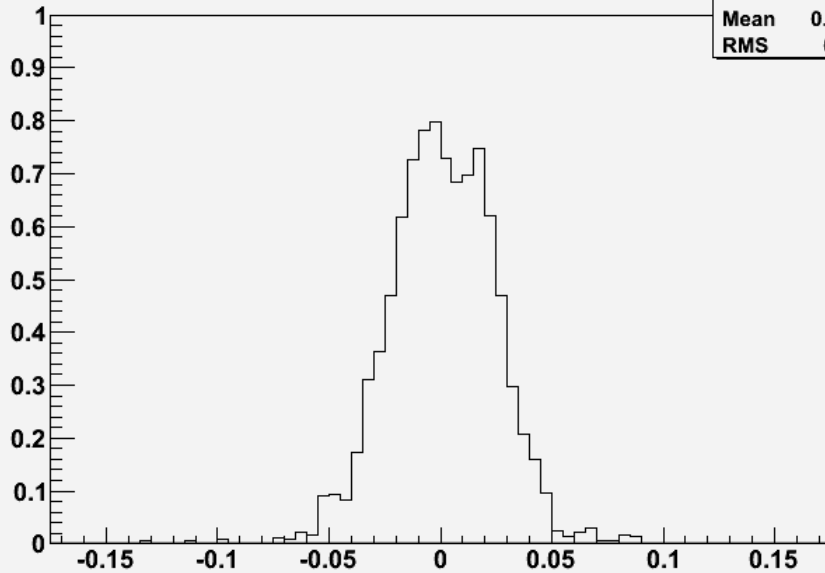


SBDHitYLayer2	
Entries	1602
Mean	-0.001678
RMS	0.02362

Projections in x and y vs threshold

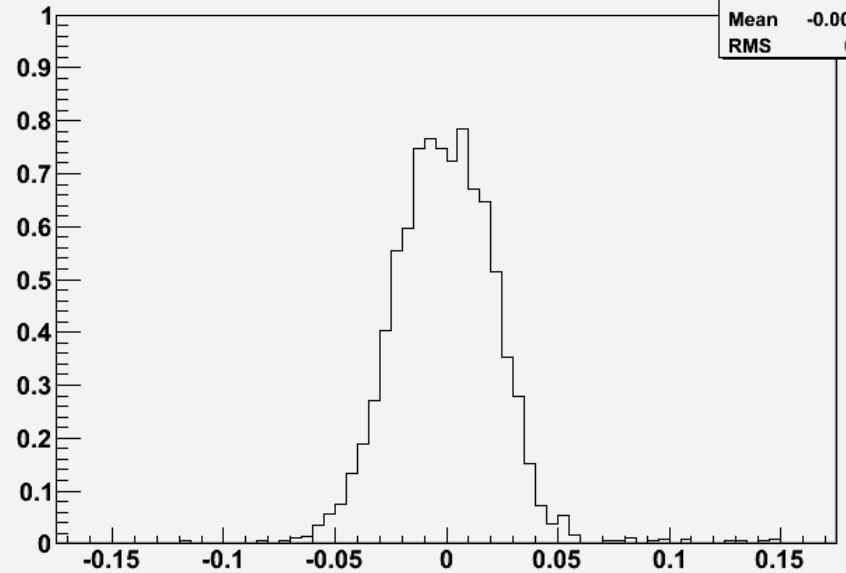
- Run 447954, threshold 220

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2
Entries 1389
Mean 0.001043
RMS 0.02385

Sensor 39/Layer 2 Hit position - track projection in y

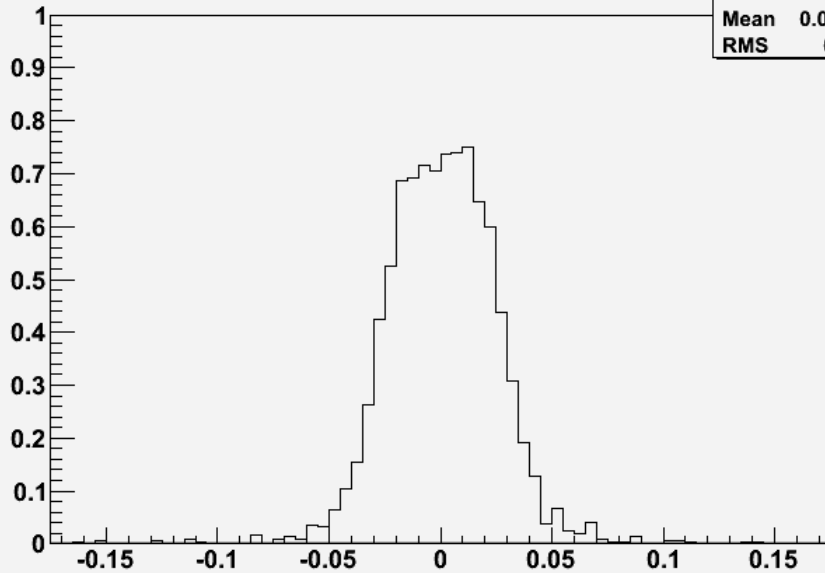


SBDHitYLayer2
Entries 1325
Mean -0.0005162
RMS 0.0239

Projections in x and y vs threshold

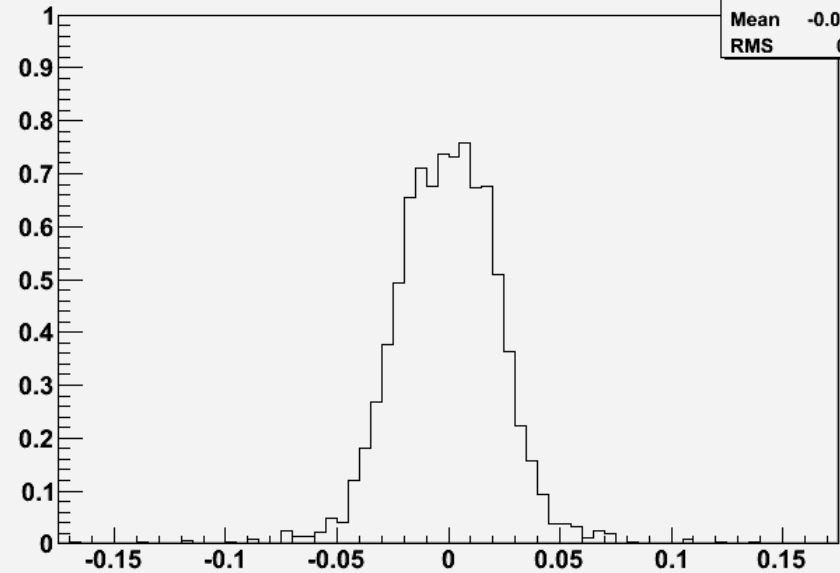
- Run 447956, threshold 230

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2
Entries 2107
Mean 0.0008912
RMS 0.02477

Sensor 39/Layer 2 Hit position - track projection in y

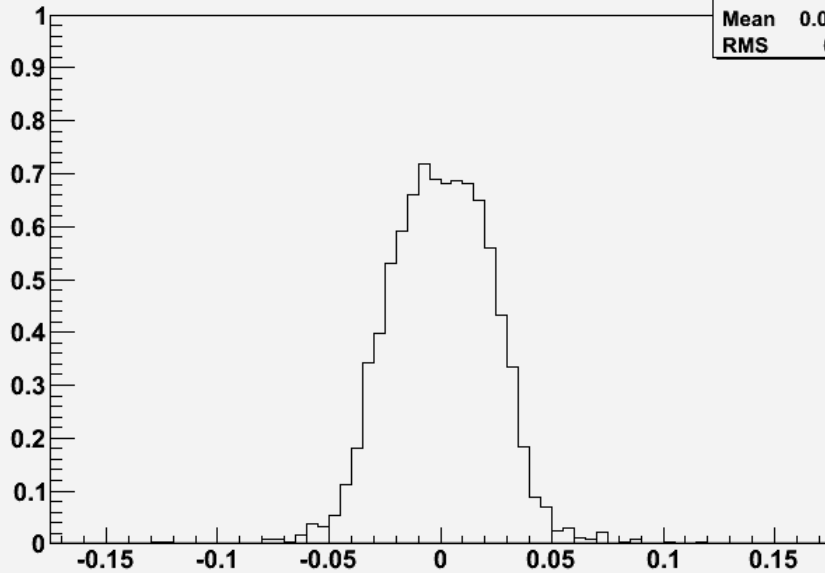


SBDHitYLayer2
Entries 2057
Mean -0.0003848
RMS 0.02372

Projections in x and y vs threshold

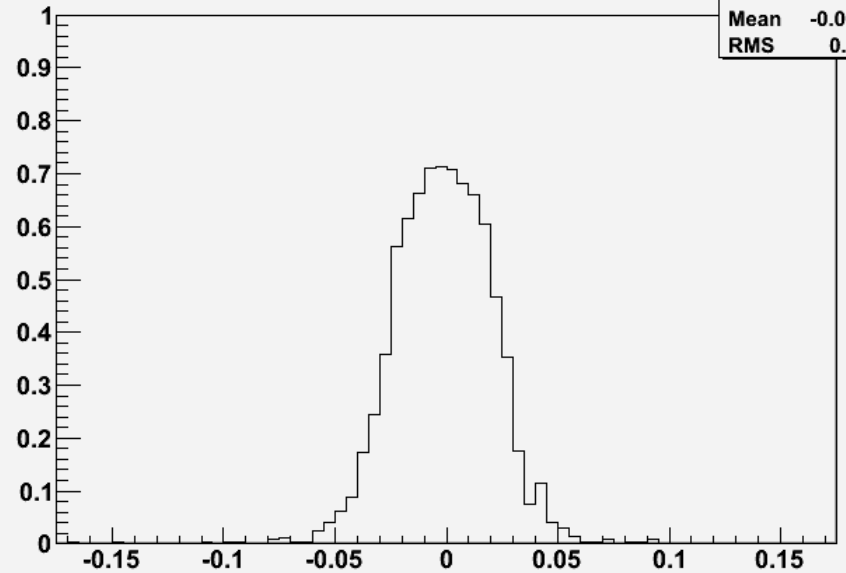
- Run 447958, threshold 240

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2
Entries 2340
Mean 0.0002942
RMS 0.02319

Sensor 39/Layer 2 Hit position - track projection in y

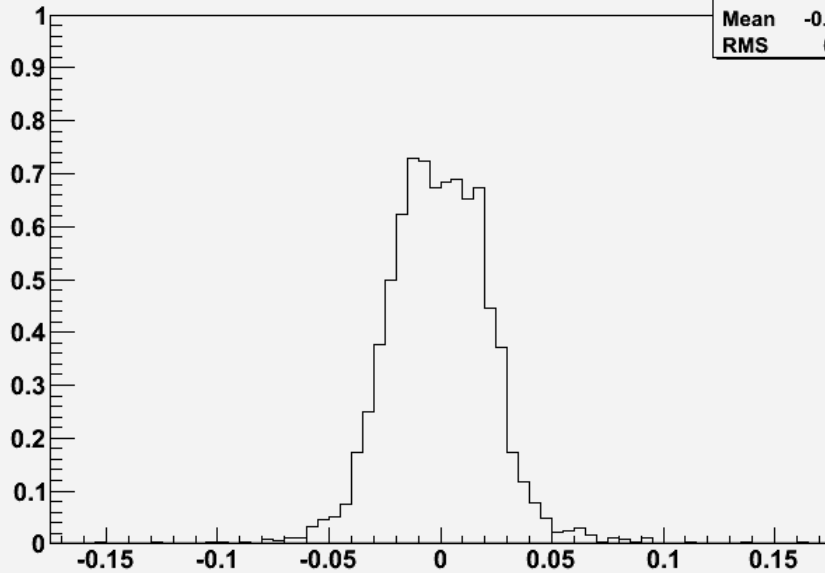


SBDHitYLayer2
Entries 2080
Mean -0.001444
RMS 0.02225

Projections in x and y vs threshold

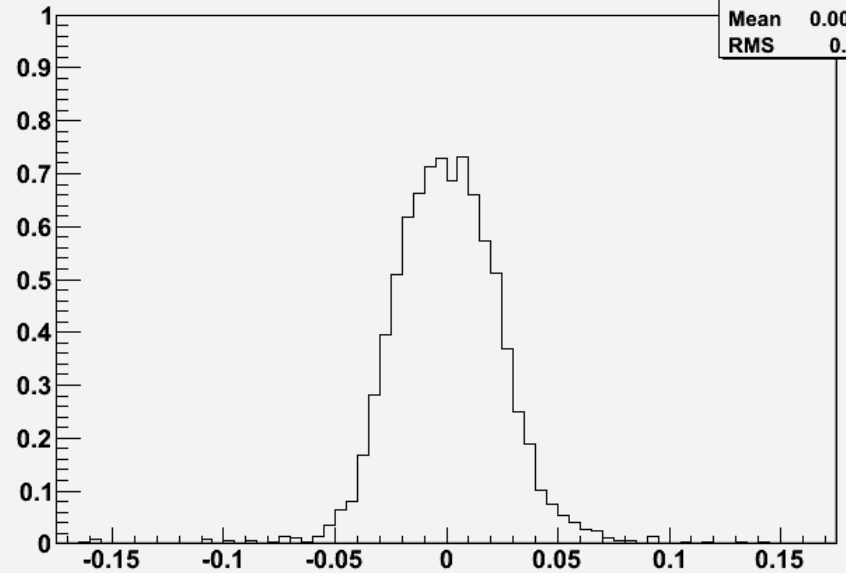
- Run 447960, threshold 250

Sensor 39/Layer 2 Hit position - track projection in y



SBDHitYLayer2
Entries 2151
Mean -0.000647
RMS 0.02345

Sensor 39/Layer 2 Hit position - track projection in x



SBDHitXLayer2
Entries 2266
Mean 0.0004811
RMS 0.02479

Conclusions

- Major part of previous (apparent) **inefficiency** due to scintillator/sensor overlap
 - Overlap is ~65% with first two scintillators
- Need to find a method to measure **bad track rate**
 - Not yet started
- Efficiency does not monotonically **decrease** with threshold
 - Low thresholds have very low efficiencies
 - Presumably due to memory filling
- Efficiency does not fall off fast at **high thresholds**
 - Did not take data above 250 TU
 - Insufficient range for our studies?