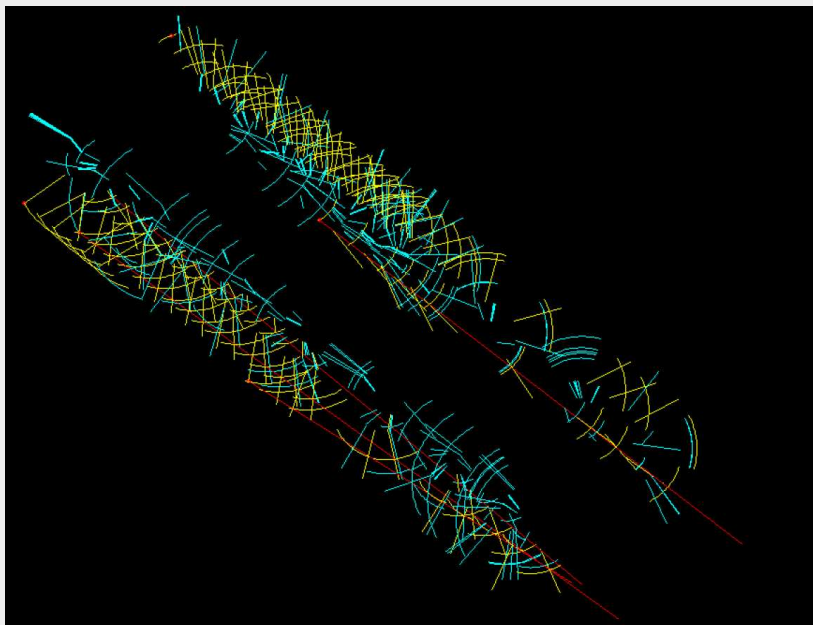


# VELO Data Quality & Monitoring

Eduardo Rodrigues  
University of Glasgow

LHCb Data Quality Workshop, CERN, 17 September 2008

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- *Monitoring*
- *Software*
- *First data studies*
- *Calibration data*

# About monitoring

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## *Online monitoring*

- ❖ Online presenter looking at data as it is taken “on the spot” ...

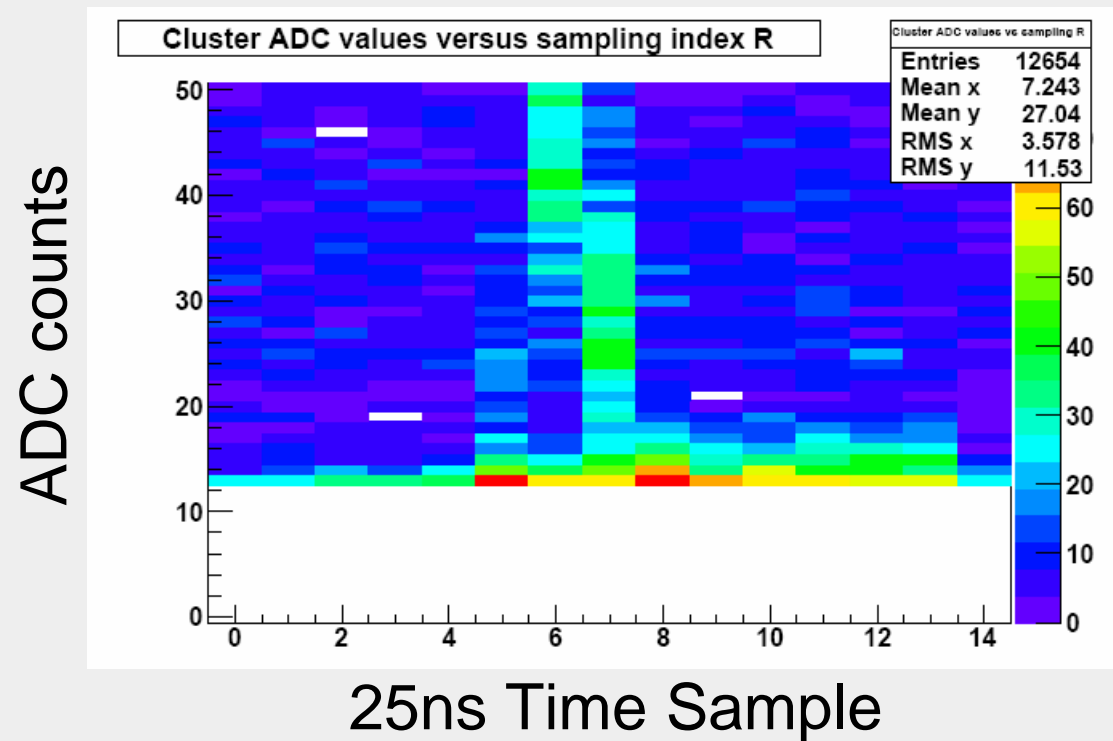
## *“Data taking” monitoring of fresh data from the pit*

- ❖ Offline monitoring
- ❖ Brunel jobs to be run on fresh data to assess data quality
- ❖ VELO shifters will do this at least at the beginning
- ❖ This is likely to complement the DQM as necessary to tag data as “good for physics”
- ❖ Problems will be logged in the “problems database”

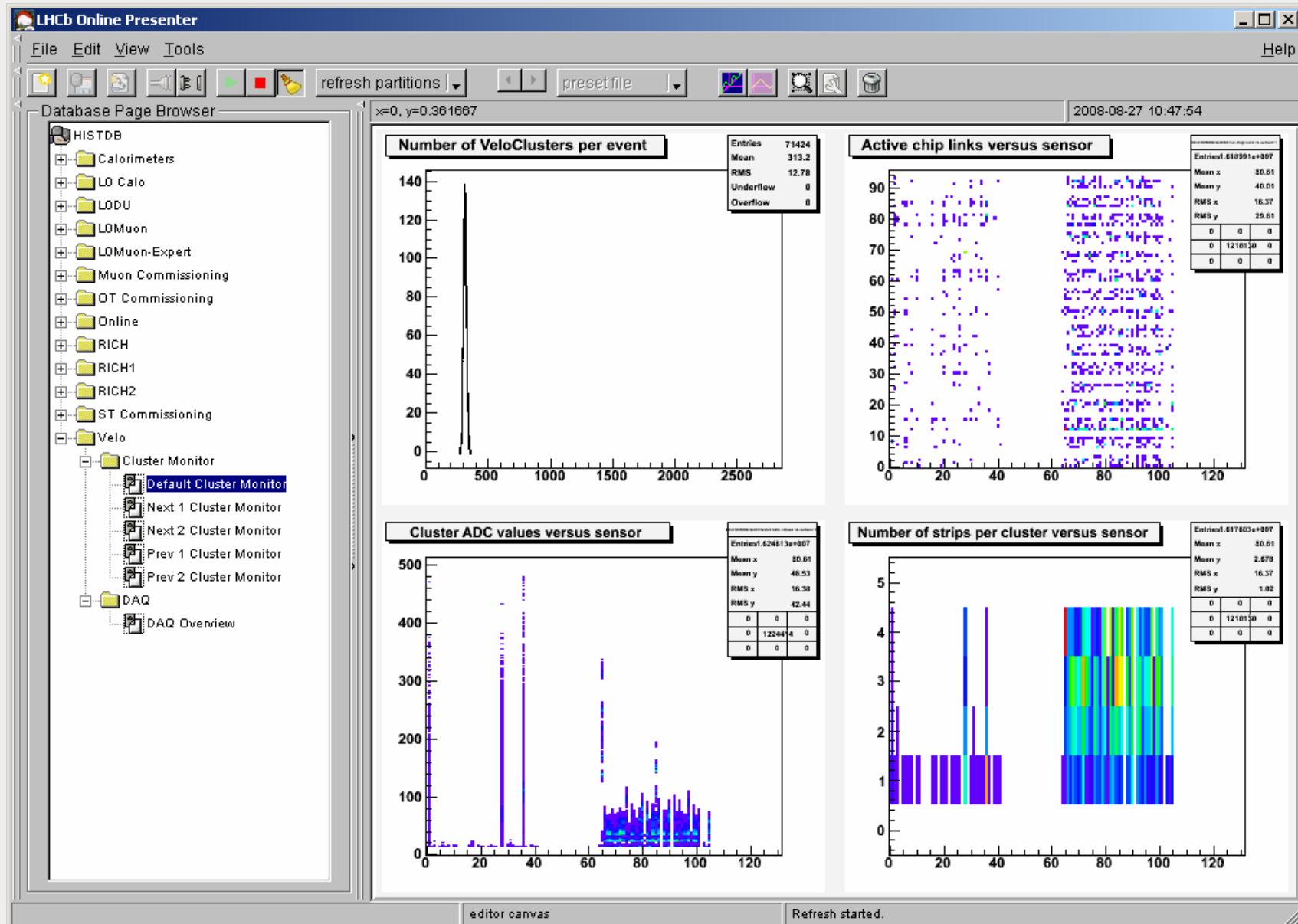
## *Long-term monitoring*

- ❖ Main goal: assess deterioration of VELO performance as time flows ...
- ❖ Likely to use as input results of Brunel monitoring on a run/fill basis

- ❑ First version running since > 3 weeks (not continuously ;-))
- ❑ Example plot from Friday 22nd August injection tests, when we first observed tracks! :



# Online monitoring (2/2)



# Offline monitoring

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- ❑ **A lot of progress since beginning of August**
  
- ❑ **Monitoring packages fully integrated in Vetra and Brunel:**
  - **VELO monitoring has been introduced in standard Brunel jobs**
  - **Vetra has been updated with latest software**
  
- ❑ **Scripts and macros are being developed to analyse data**
  - **Bits and pieces ready for shifters, ready to be tested**
  
- ❑ **Wiki pages with documentation and HowTo's being written/updated**

# Monitoring software

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## *VeloRecMonitors*

- ❖ New package for “high-level” (= ZS) data
- ❖ Monitoring of:
  - clusters: version in CVS
  - tracks : under development (Sadia Khalil)
- ❖ Extra algorithms included; e.g. for beam position monitoring
- ❖ (Overlaps with monitoring of alignment being discussed with experts)

## *VeloDataMonitor*

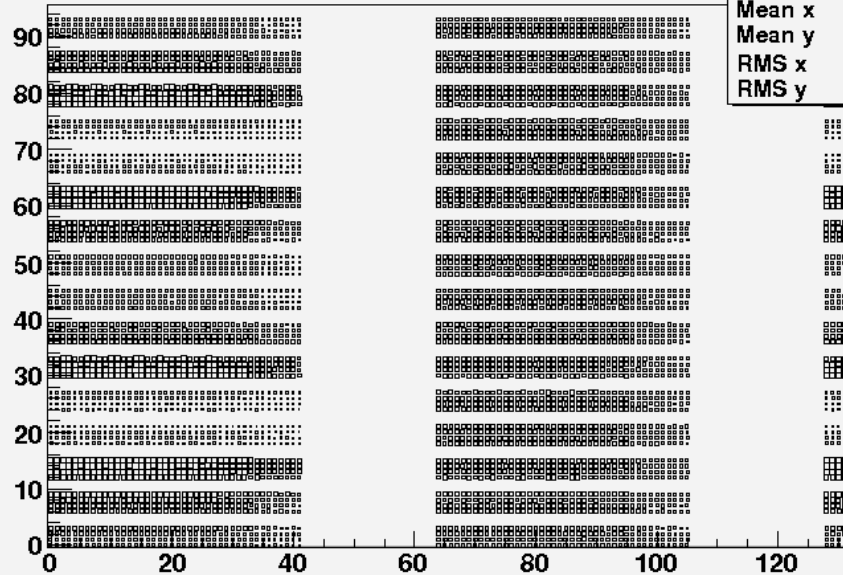
- ❖ Package for NZS data
- ❖ Same as always. Stable

## *VeloClusterDataMonitor & VeloTrackDataMonitor*

- ❖ “Old” monitoring packages presently in “drain mode”
- ❖ Will be totally replaced by VeloRecMonitors
- ❖ But still used for now in the online monitoring

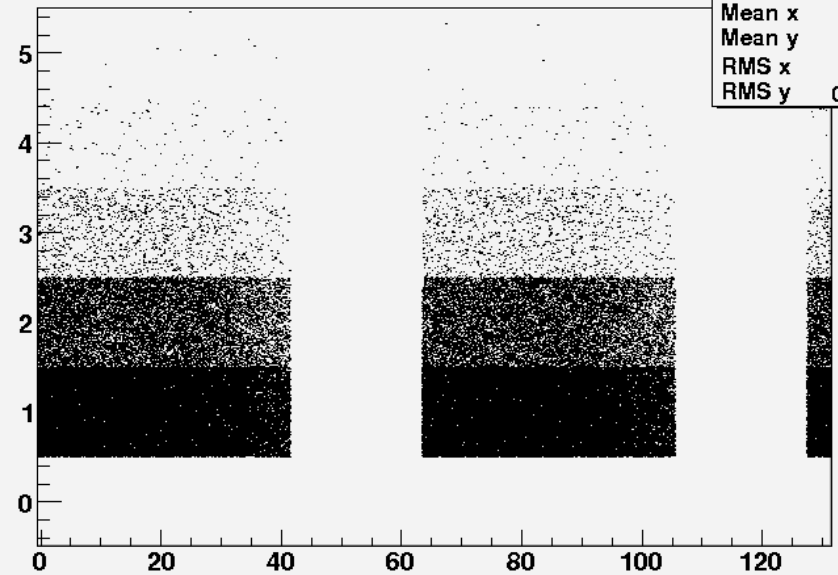
# Example (MC) distributions from VeloRecMonitors

### Active chip links versus sensor



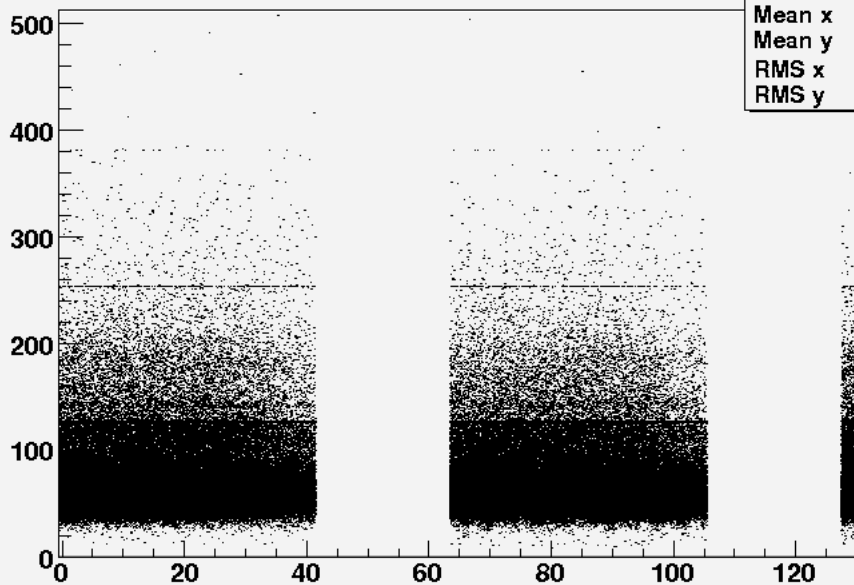
Active chip links vs sensor	
Entries	422111
Mean x	54.58
Mean y	46.5
RMS x	37.34
RMS y	27.62

### Number of strips per cluster versus sensor



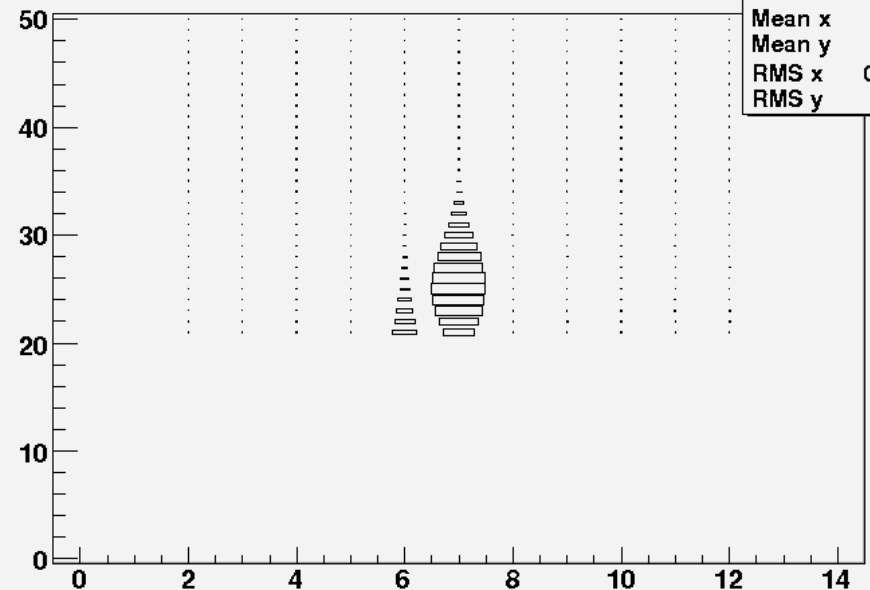
Cluster size vs sensor	
Entries	422111
Mean x	54.58
Mean y	1.269
RMS x	37.34
RMS y	0.4967

### Cluster ADC values versus sensor



Cluster ADC values vs sensor	
Entries	422111
Mean x	54.58
Mean y	74.02
RMS x	37.34
RMS y	35.91

### Cluster ADC values versus sampling index

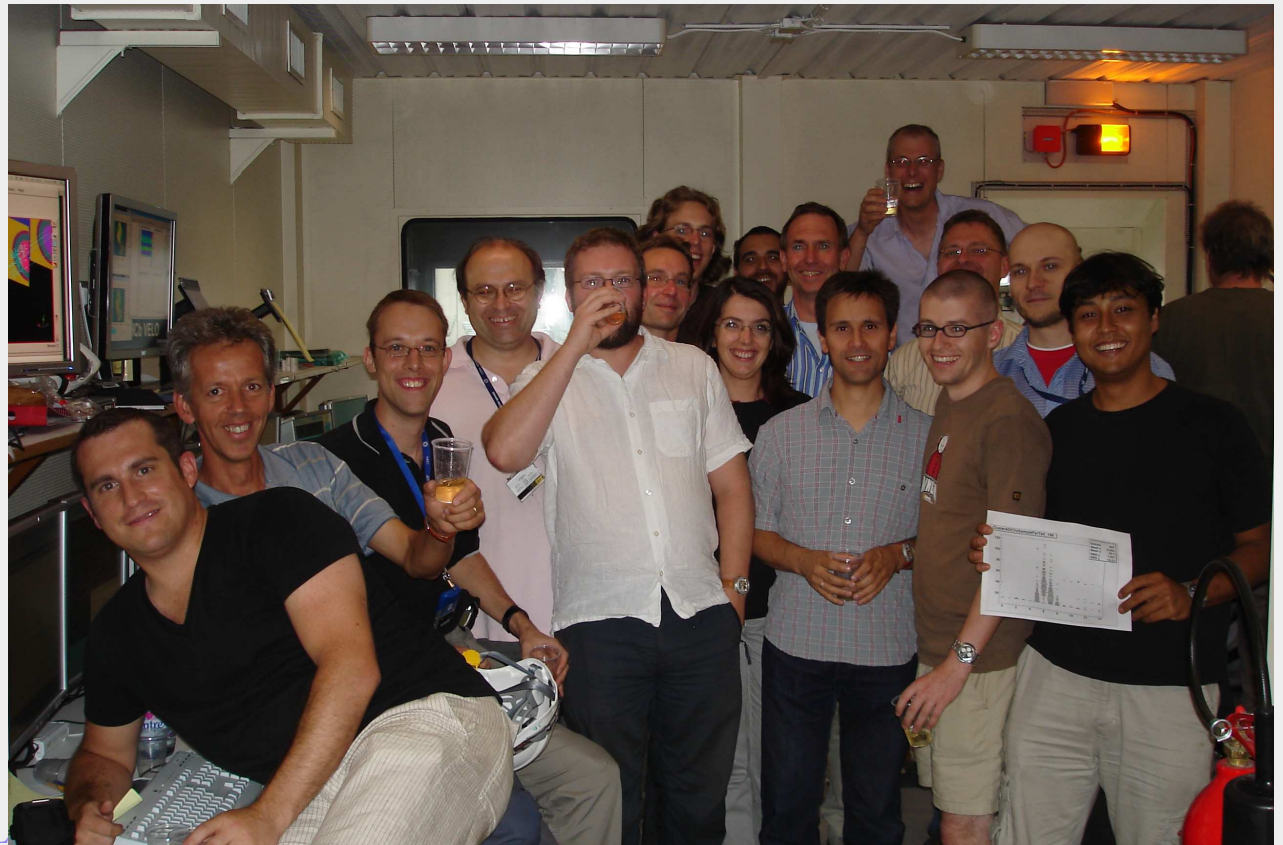


Cluster ADC values vs sampling	
Entries	463657
Mean x	6.925
Mean y	25.44
RMS x	0.3944
RMS y	2.907

# First data – 22<sup>nd</sup> & 24<sup>th</sup> August (1/2)

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- ❑ Friday 22<sup>nd</sup>: 5 modules on A-side, 5 on C-side
- ❑ Sunday 24<sup>th</sup>: all modules powered; TELL 1 readout for 76 sensors (out of 84)
- ❑ Mixture of ZS and NZS+ZS data
- ❑ TELL1 algorithm parameters not tuned
- ❑ ~700 tracks found
- ❑ More details in Silvia's talks at VELO meetings





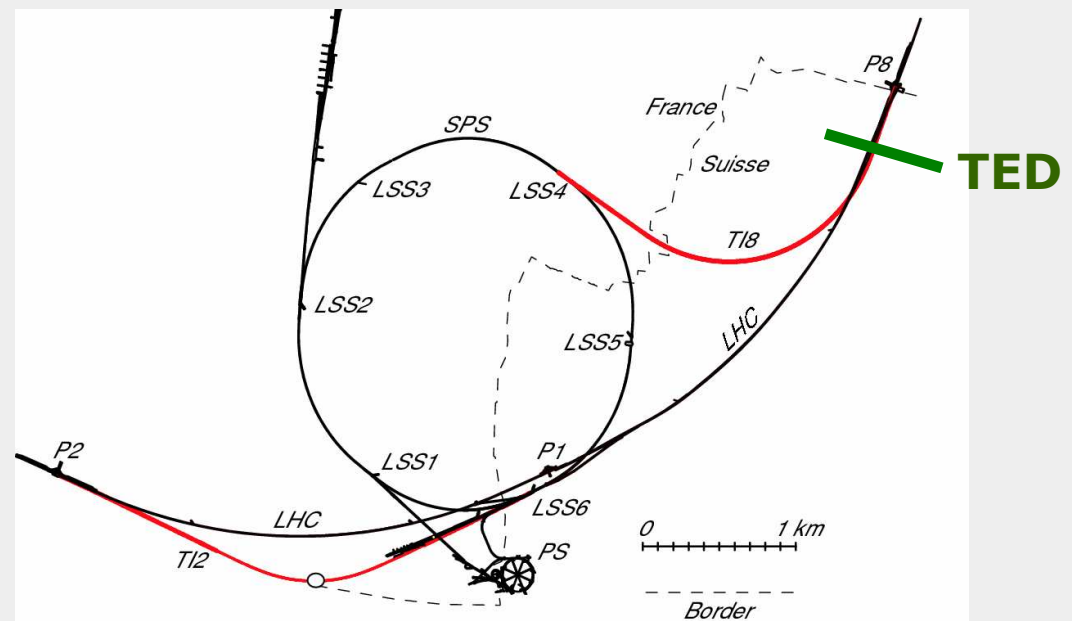
# First data – 22<sup>nd</sup> & 24<sup>th</sup> August (2/2)

## Beam:

- ❑ 1 shot every 48 seconds
- ❑  $5 \times 10^9$  protons per shot

## TED:

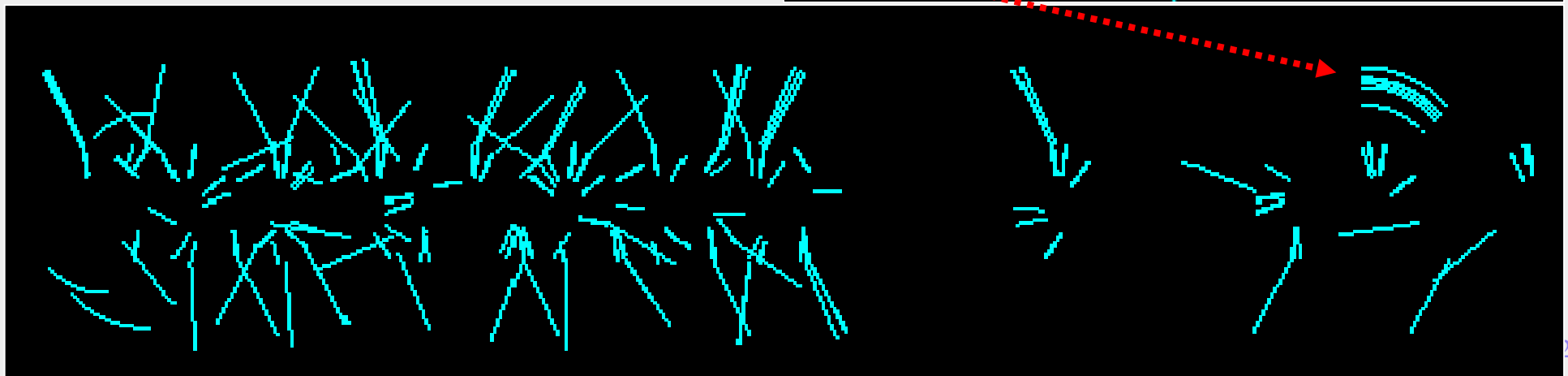
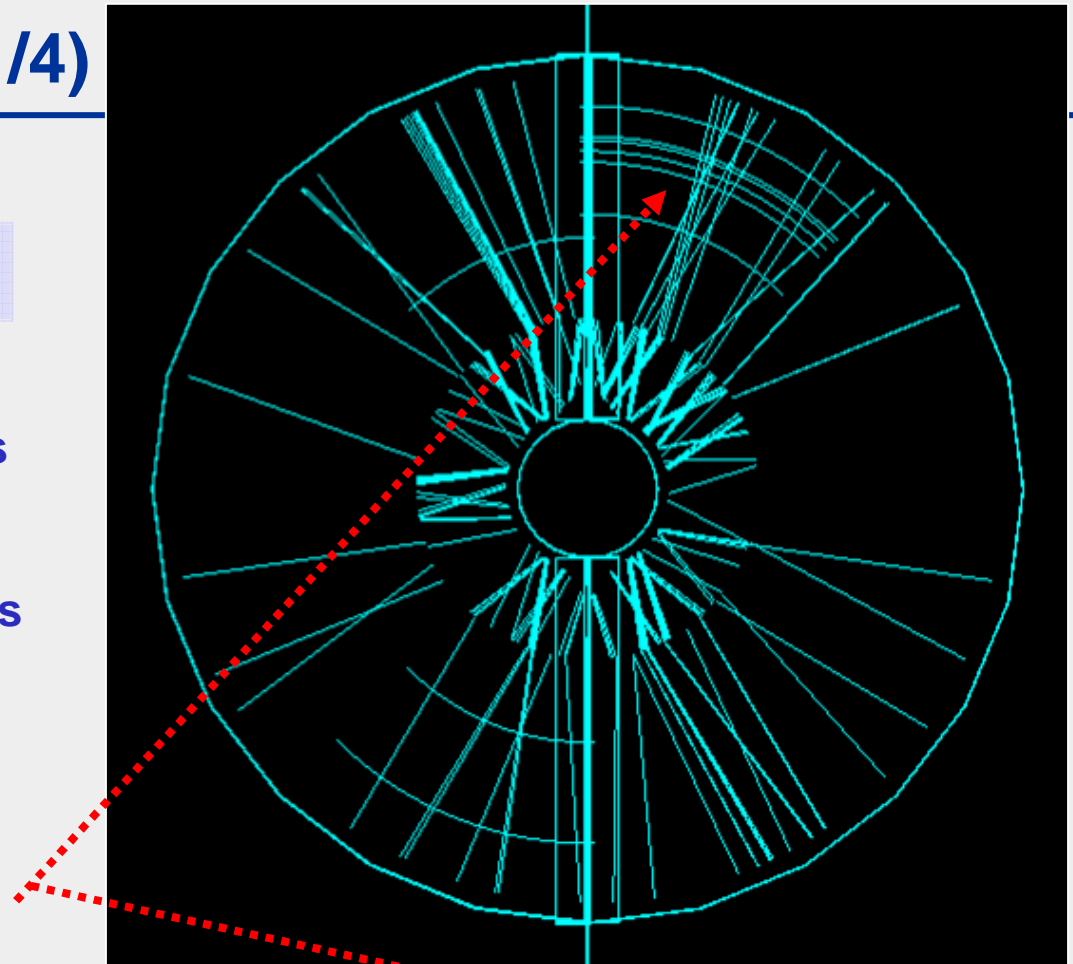
- ❑ Absorber ~300 m from LHCb



## First data – 24<sup>th</sup> August (1/4)

### An event with only noise

- ❑ Most noise strips are on  $\phi$  sensors
- ❑ 1 R sensor has several noise strips
- ❑ Noisy strips have been masked in the analysis

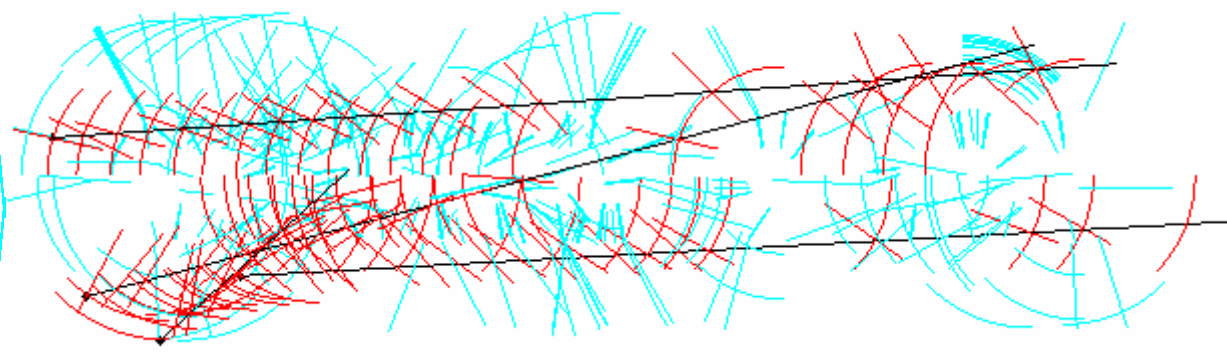
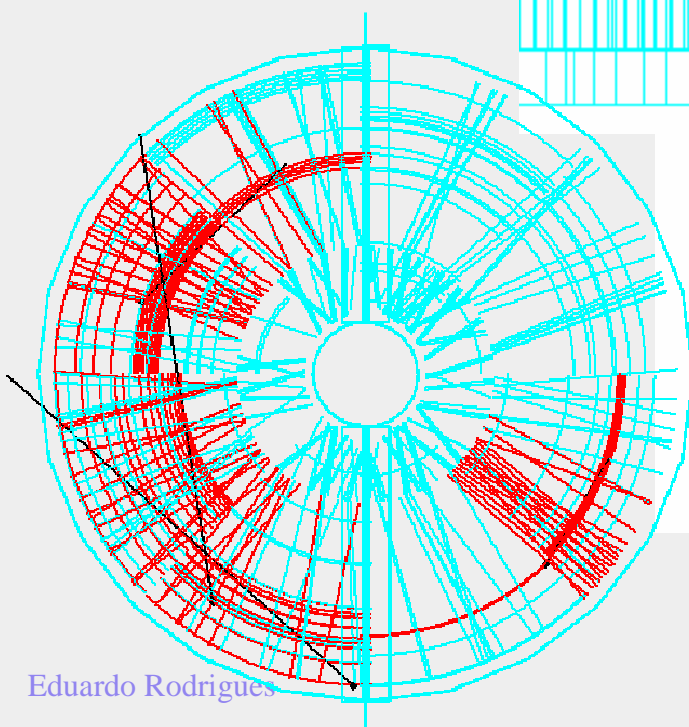
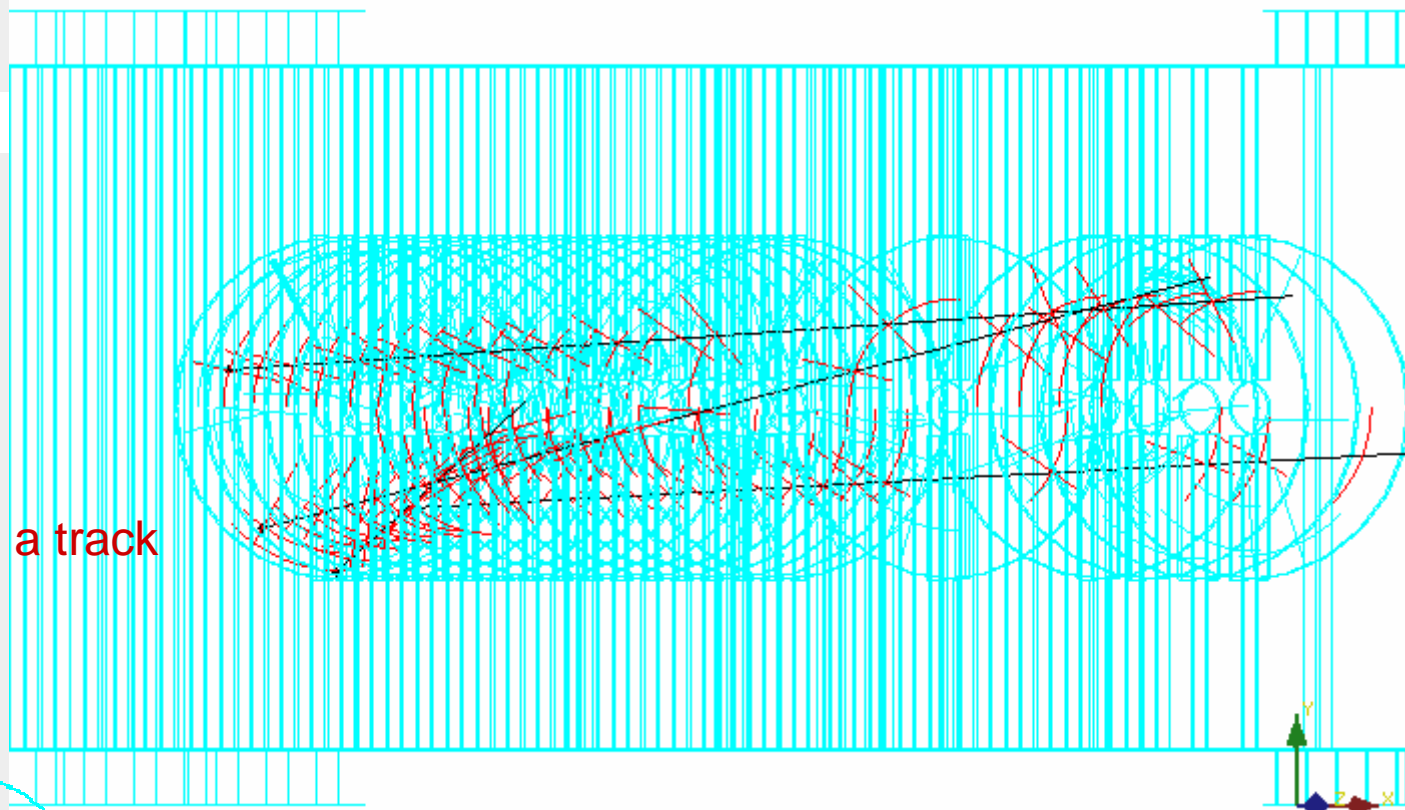


**Run 30933**  
**Event 8**

**Noisy cluster**

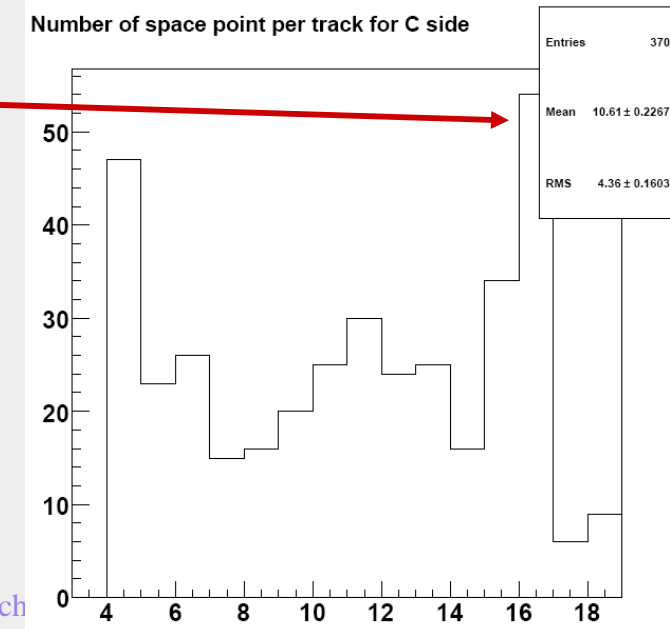
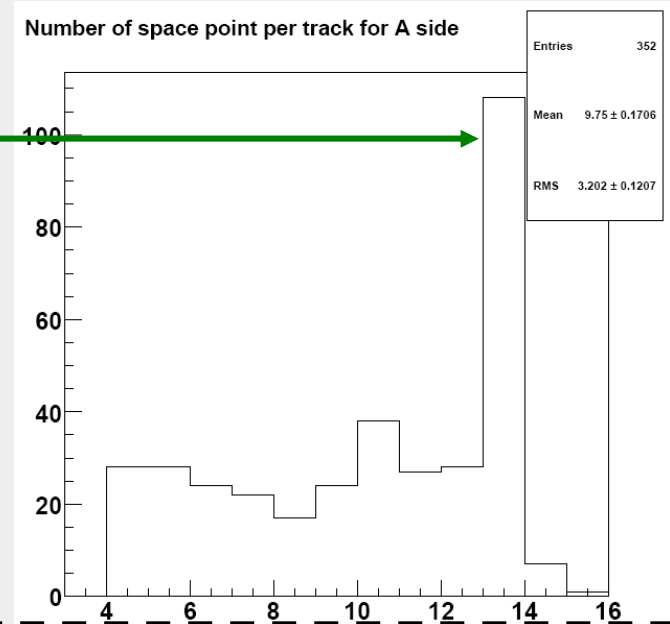
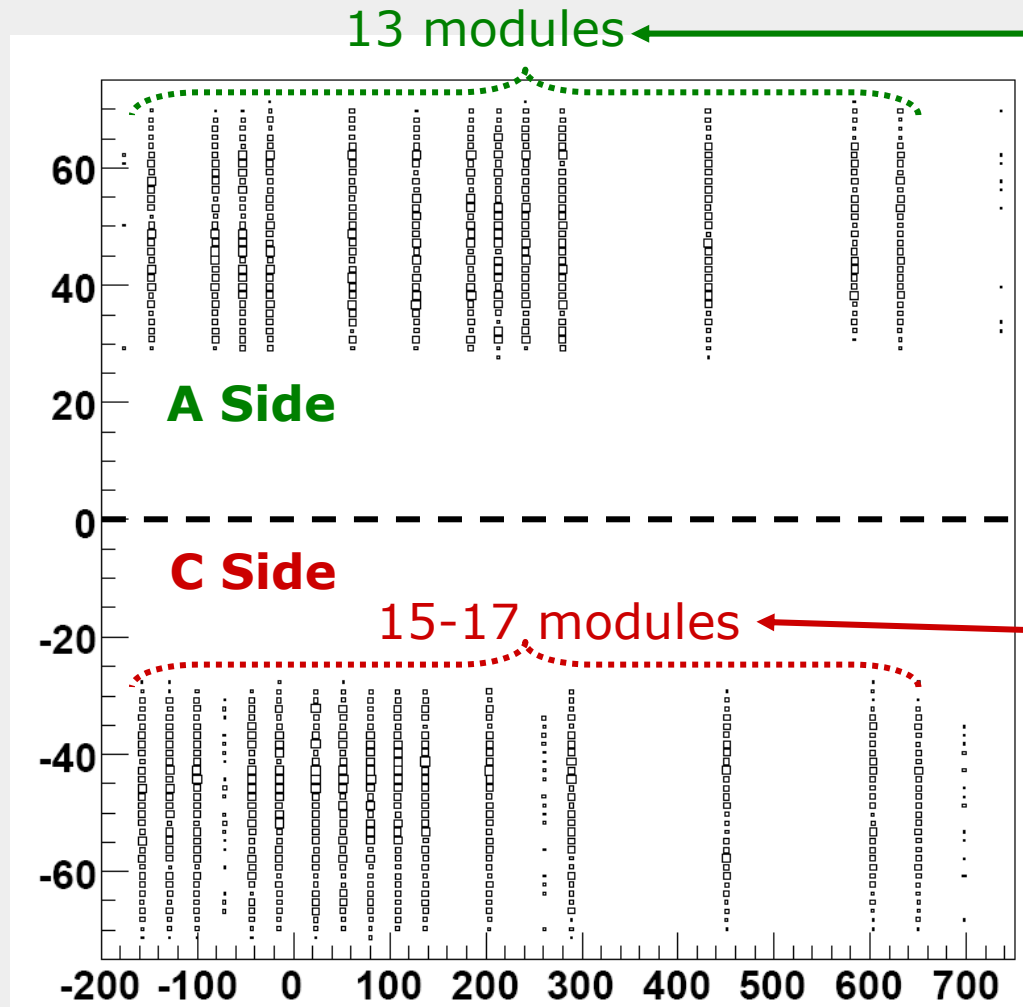
Cluster associated to a track

Track



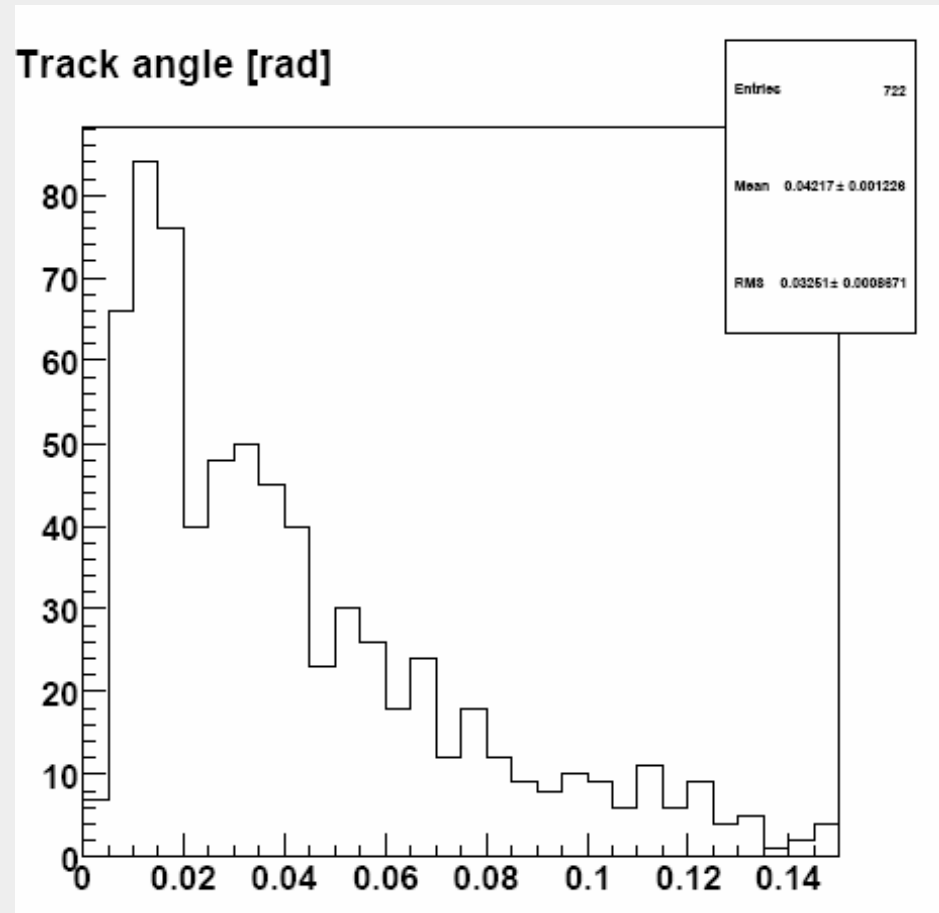
# First data – 24<sup>th</sup> August (3/4)

## Space point distribution for tracks



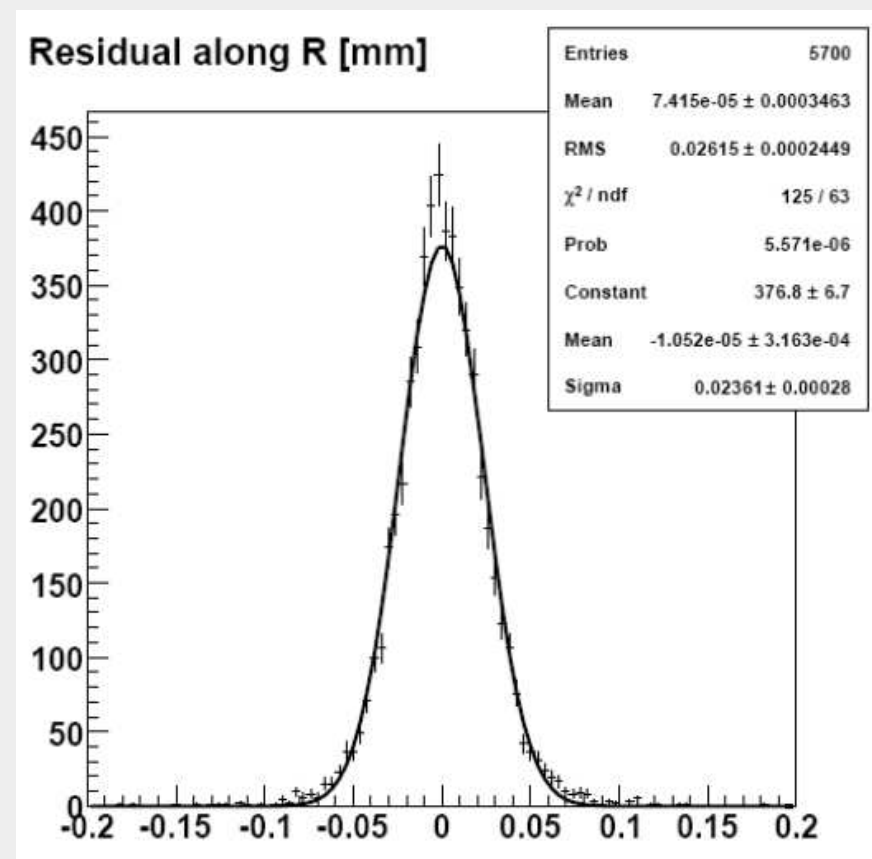
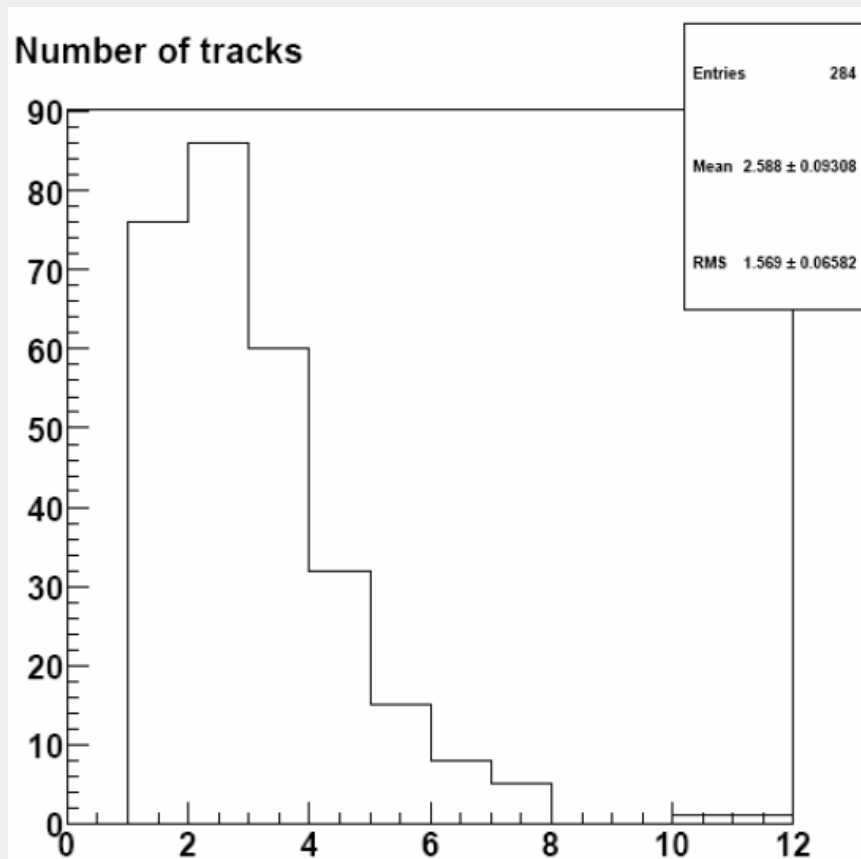
# First data – 24<sup>th</sup> August (4/4)

- Mean angle: 42 mrad
- ~ 15 tracks with angle > 150 mrad
- Max. angle of 280 mrad for 1 track



# September data

- An extra ~800 tracks found
- Residuals looked at
- First go at aligning the VELO



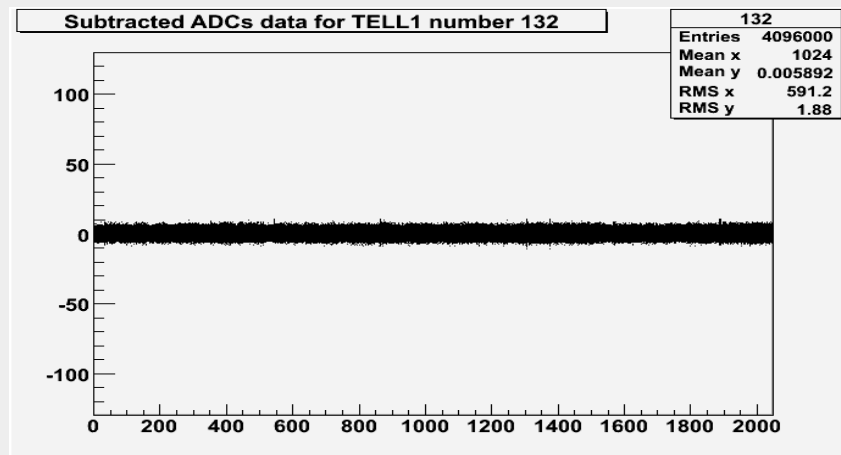
- ❑ **A range of data samples are required to commission and monitor the VELO, both with and without beam, critically including NZS data**
  - Data to be taken by shifters on a regular basis

## Examples:

- ❑ **Beam data (with NZS)**
- ❑ **Generated data in TELL1s, without beam**
- ❑ **Test Pulses in FE chips, without beam**
- ❑ **Beam data**
- ❑ **Noise runs, without beam**
- ❑ **IV Scans of detectors, without beam**
- ❑ **CCE of a test detector, with beam**
- ❑ **CCE of all detector with beam**

# Need for NZS data

- ❖ **NZS data is critical to understanding the VELO**
- ❖ **Reprocessing the small sample of NZS data available through the TELL1 emulation verifies that the data quality is improved by doing this – see previous slides**
- ❖ **New Vetra version from Tomasz is able to tune settings of: pedestals, Beetle header cross-talk, clustering thresholds**



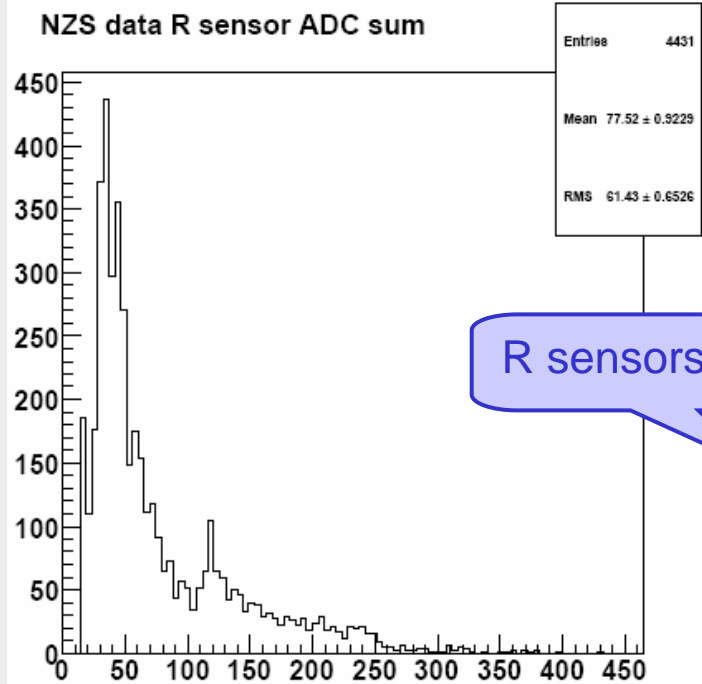
*Noise data after  
correct pedestal subtraction*

- ❖ **Other lower-priority algorithms (MCMS, FIR) being worked on (see presentations by Gwen and Valentin at VELO meetings)**
- ❖ **Current ZS data is taken with all thresholds set to constant values. Fixing this is a priority, Kurt is working on the uploading of the tuned parameters**

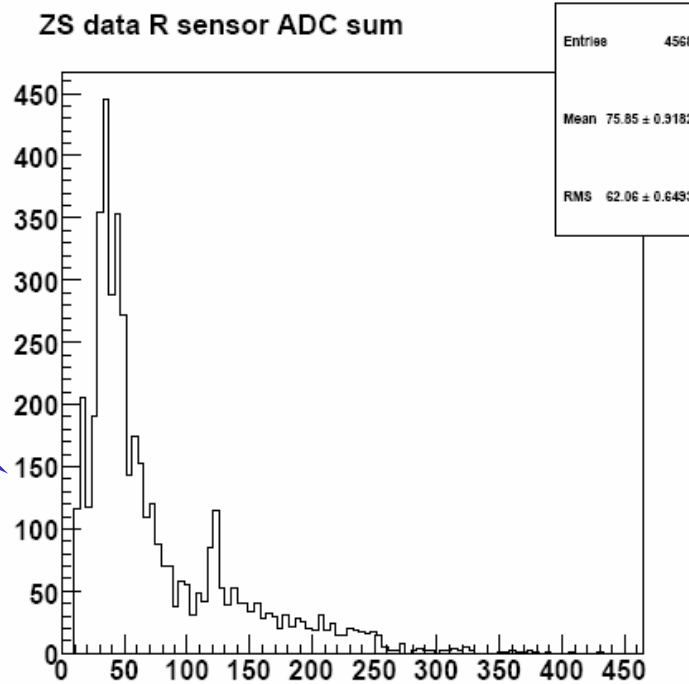


# First studies with NZS data (1/4)

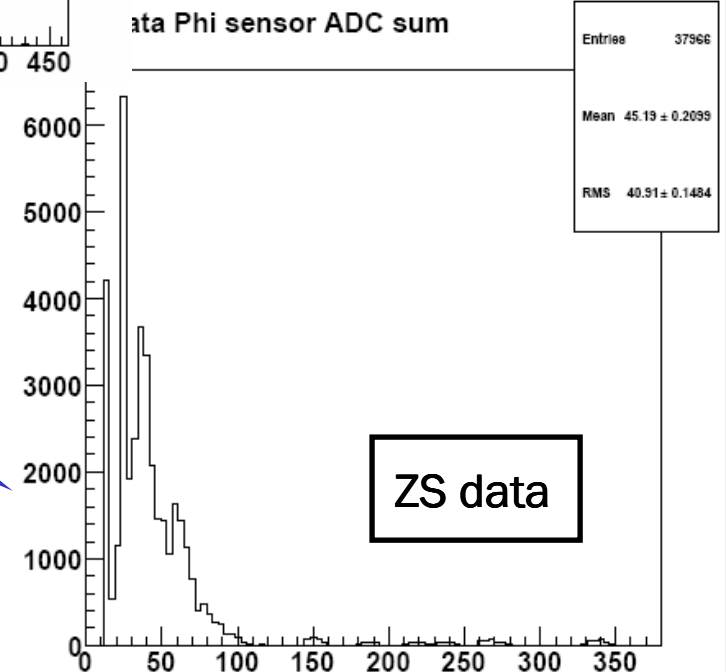
Silvia Borghi & Tomasz Szumlak



R sensors



ata Phi sensor ADC sum



$\phi$  sensors

NZS data

ZS data

ADC counts

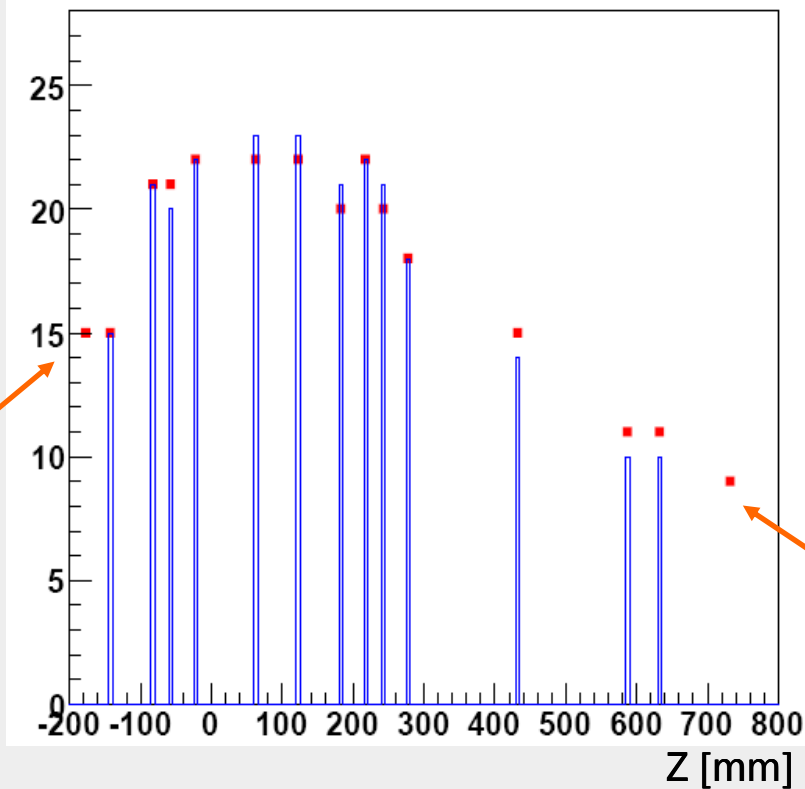
# First studies with NZS data (2/4)

## Number of space points per station

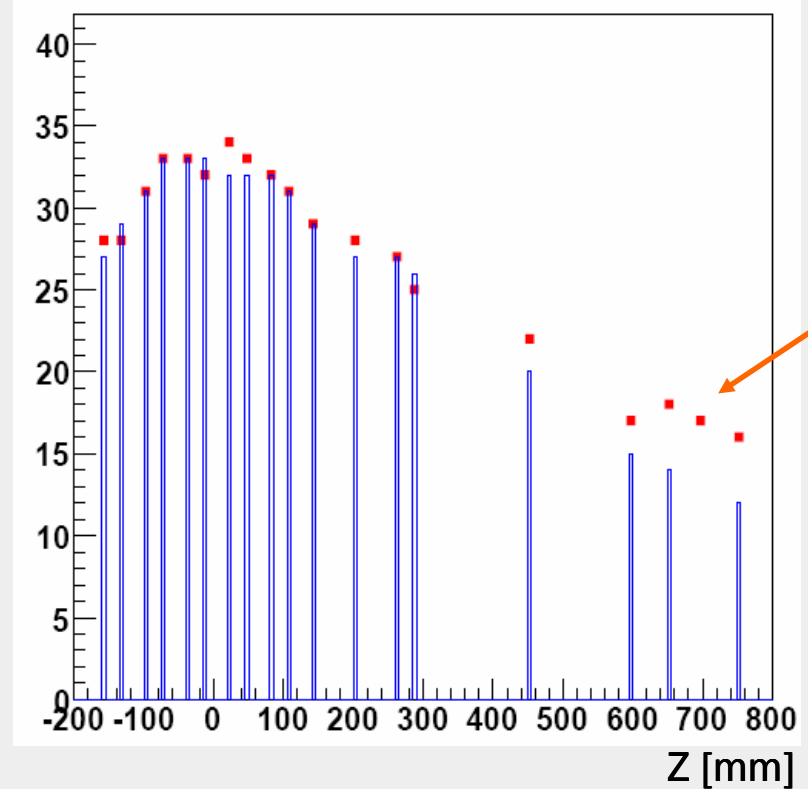
Blue: ZS data

Red: reprocessed NZS data

A Side Station



C Side Station

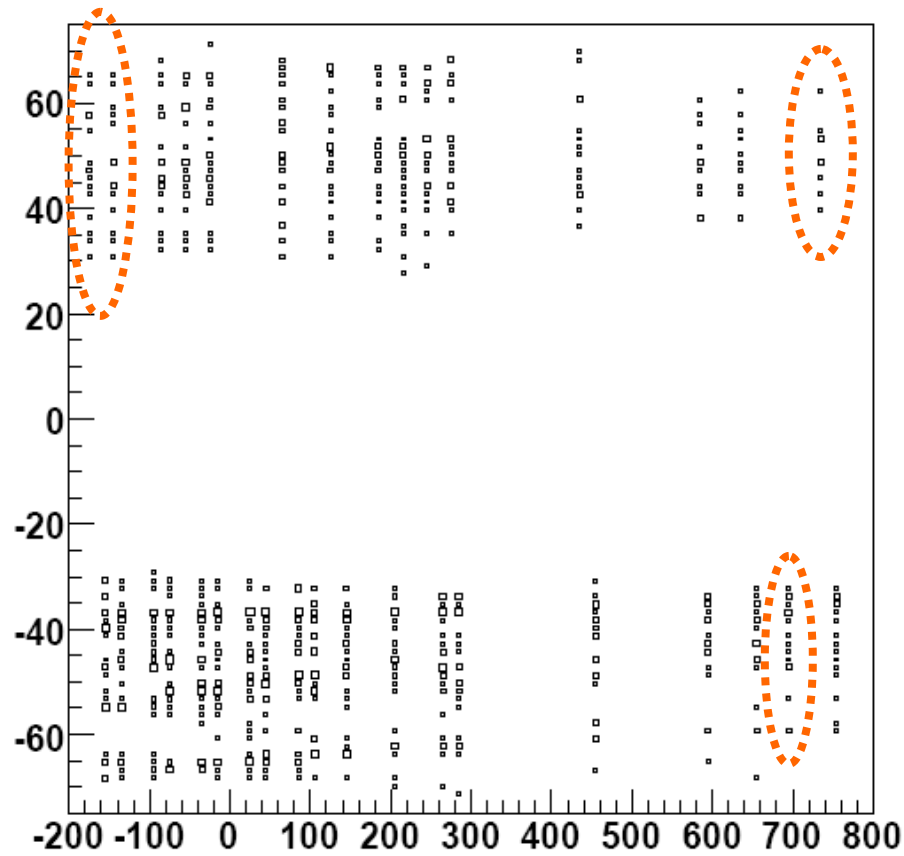


# First studies with NZS data (3/4)

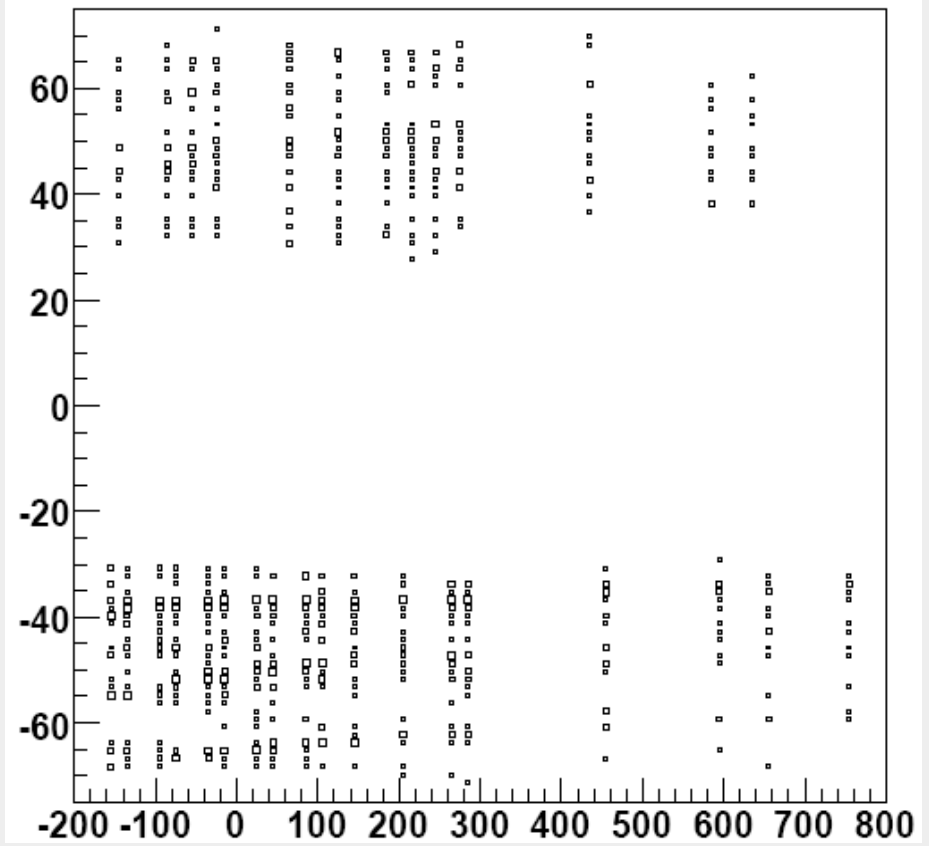
NZS data

ZS data

X coord vs Z coord [mm][mm]



X coord vs Z coord [mm][mm]



# First studies with NZS data (4/4)

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## ZS data:

- ❑ <# tracks> ~ 3.7
- ❑ <# spacepoints per track> ~ 11.9

## NZS data:

- ❑ <# tracks> ~ 3.8
- ❑ <# spacepoints per track> ~ 12.6

# Outlook

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- ❑ **First data taken with the VELO ... and ~1500 tracks fitted overall!**
- ❑ **Monitoring packages improved and getting mature**
- ❑ **Shared between online and offline monitoring**
  
- ❑ **Online monitoring deployed**
- ❑ **Tools for offline monitoring under development**
  
- ❑ **All in all, a lot of good progress**