HELSINKI INSTITUTE OF PHYSICS

Finnish CMS-TOB Cosmic Rack

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and Radiation Hardness of Semiconductor Detectors

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Menu of the day

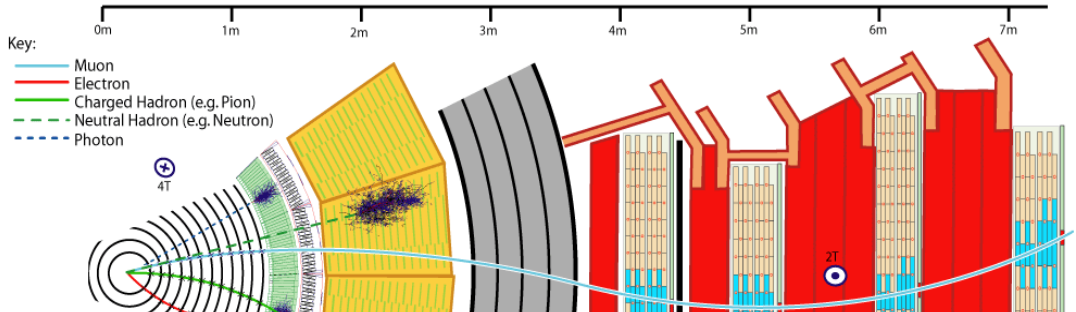
- Introduction

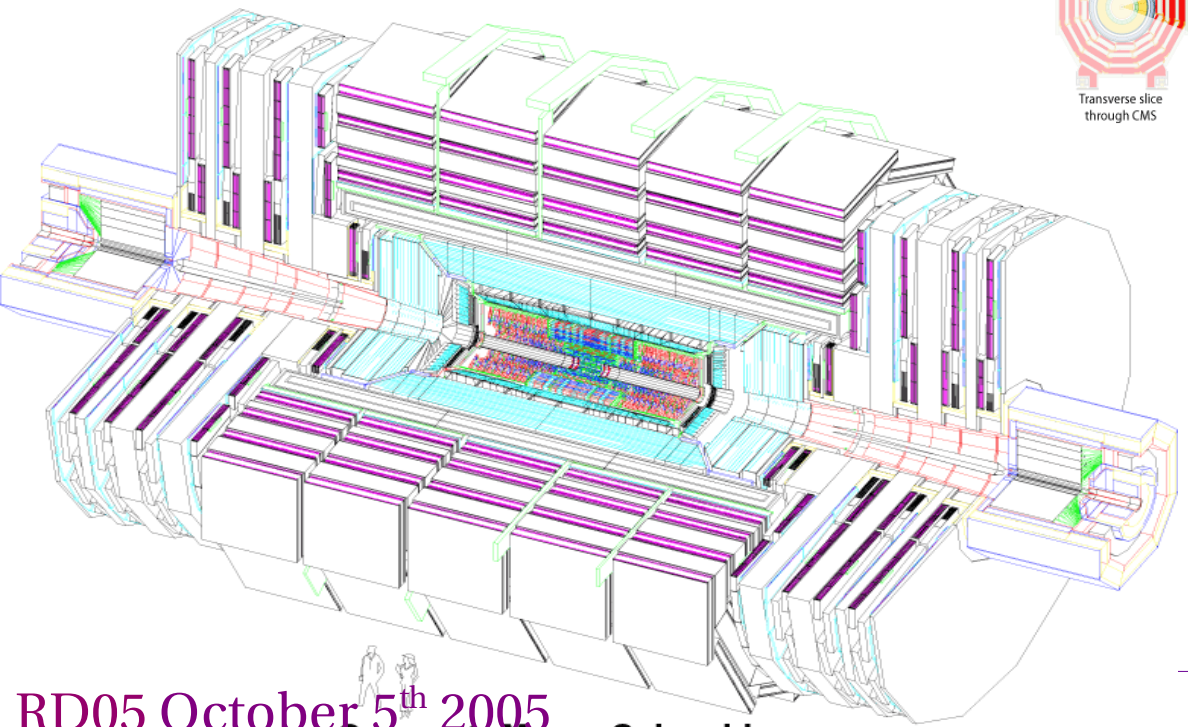
- Hardware configuration

- Trigger + DAQ

- Applications

Compact Muon Solenoid





FinnCRack

The FinnCRack is silicon strip detector based telescope.

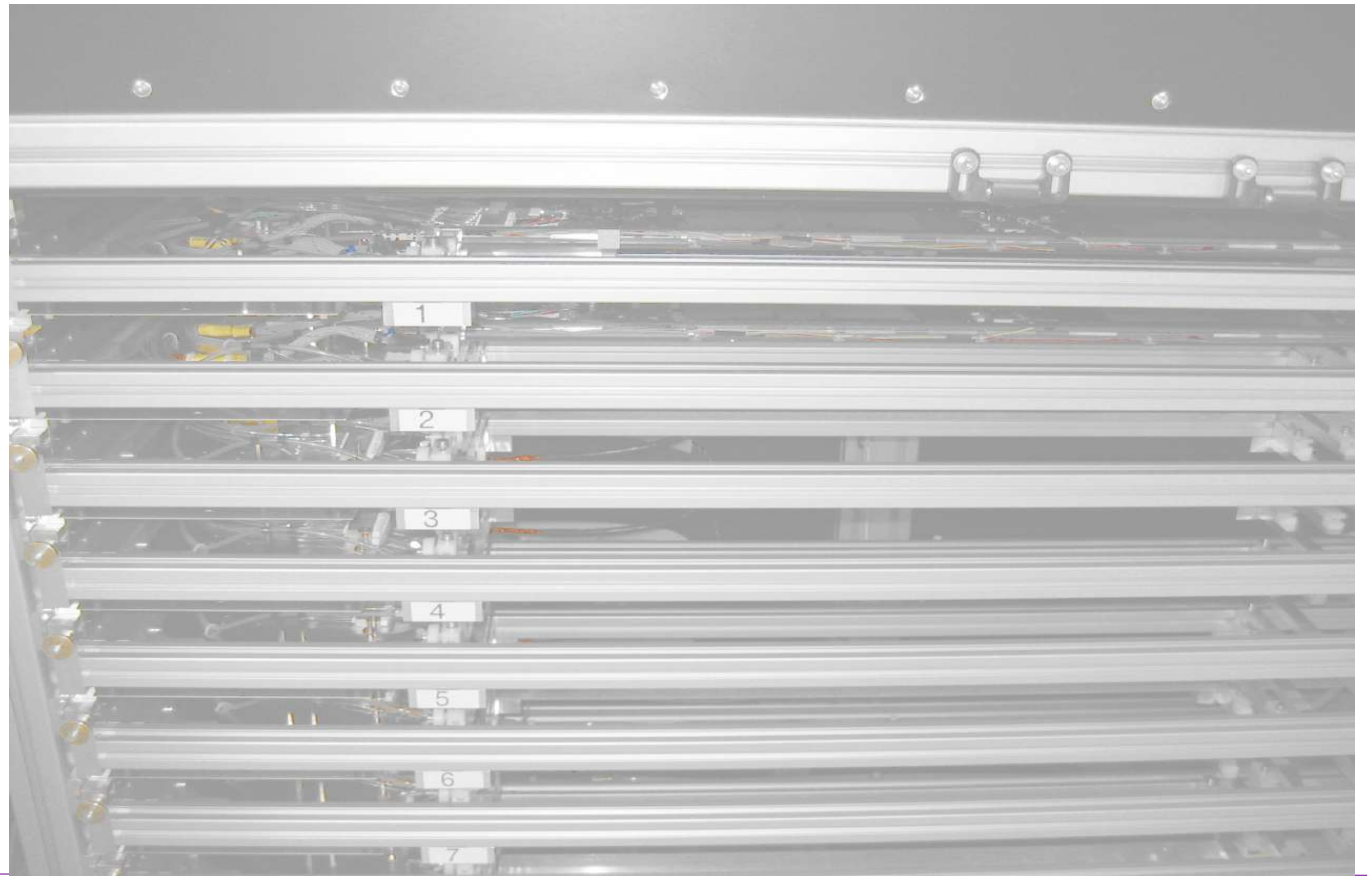
Photograph of two TOB strip detectors bonded to each other. This will be referred as a module pair later on.

FinnCRack

Each Rod contains six detector pairs side by side;

Up to two rods per layer;

Up to ten layers in a CRack.

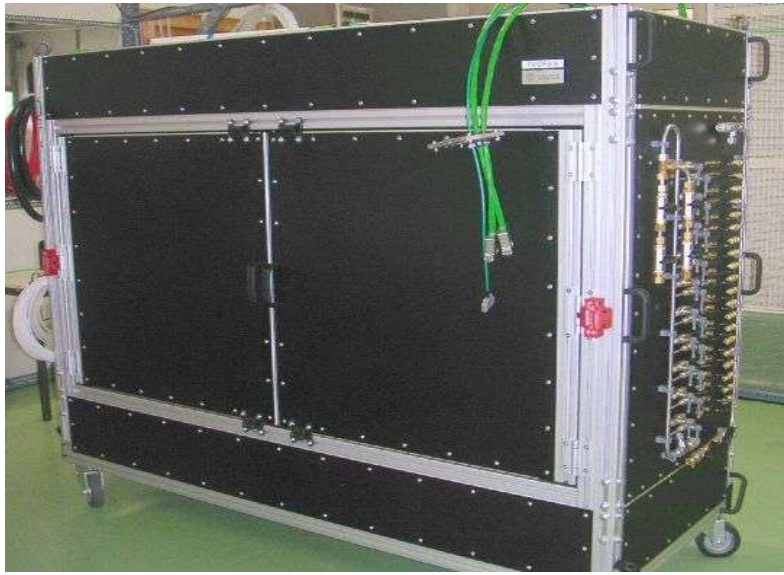


Some rods have two detector sets. One of the sets is tilted, allowing measurement of position in all three dimensions.

The FinnCRack is a device to measure cosmic muon tracks using standard CMS hardware.

- Two very similar instruments available.

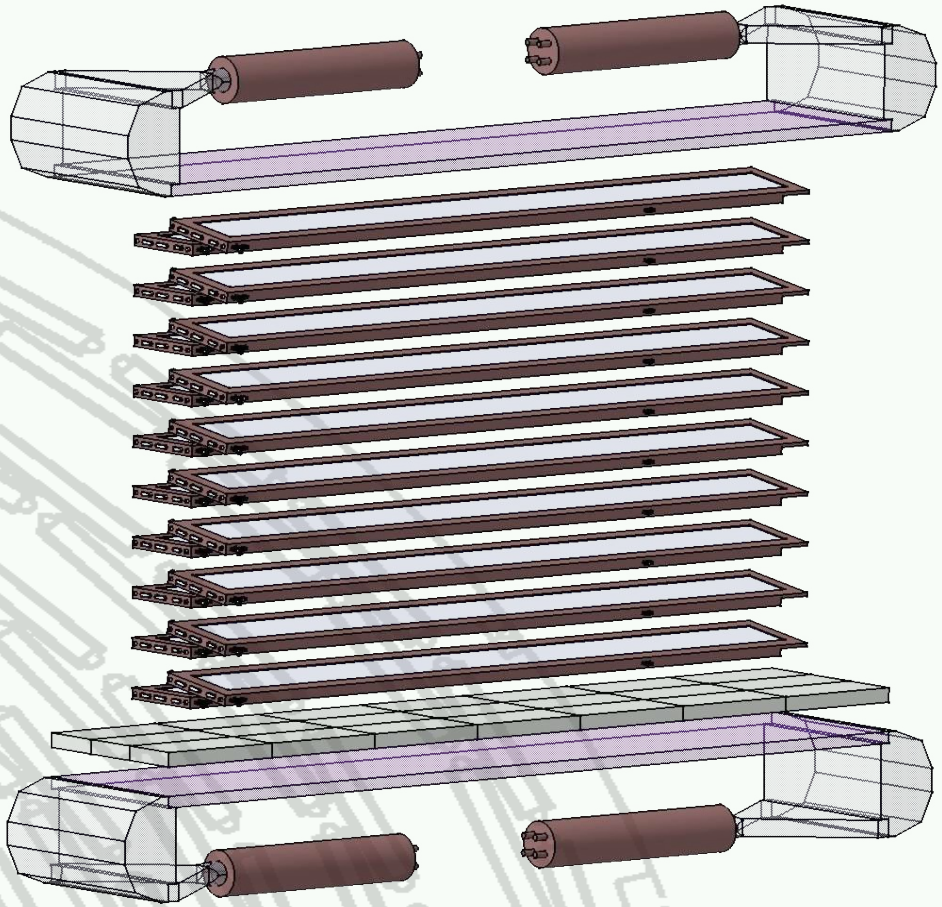
(CERN CRack and FinnCRack)



Availability of two devices increases robustness and facilitates anomaly isolation.

CERN CRack is the older of these two and the team was of great help in FinnCRack commissioning. We look forward to to continue the fruitful co-operation.

Geometry



The CRacks contain up to

10 layers

2 rods / layer

2 scintillators, 4 PMT's

PMT -> Photomultiplier Tube
CRack -> Cosmic Rack

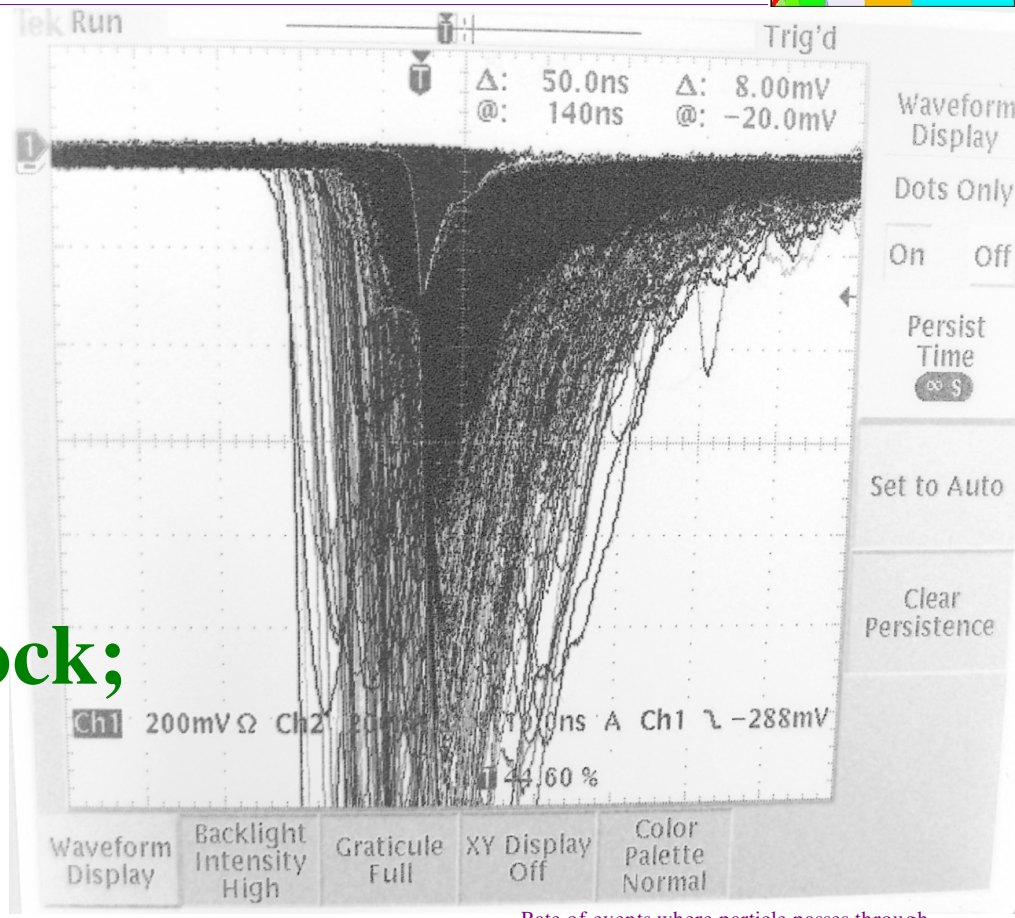
Triggering

Concidence from 4 PMT's

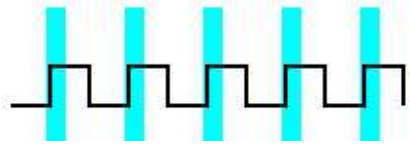
Possibility to synchronize arrival time with 40 MHz clock;

Narrow gate leads to poor trigger rate.

Large gate -> Peak mode to minimize damage



Rate of events where particle passes through a detector in all occupied layers depends on geometry, and tends to be below 1 Hz without gating.

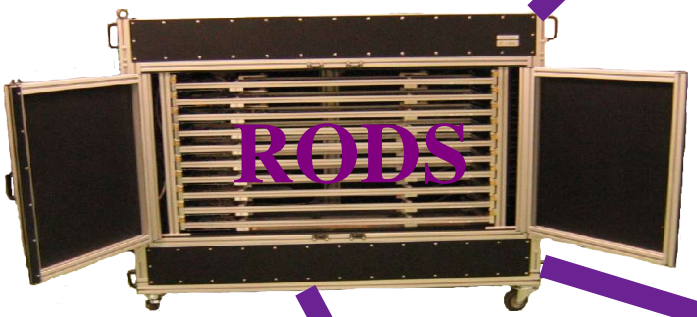


Gating: synchronizing random events to 40 MHz clock

PMT: Photomultiplier Tube

Triggering & DAQ

The Data Acquisition HW:



RODS

FED

FEC

TSC

Trigger

FEC -> Front End Controller
TSC -> Trigger and Sequencer Card
FED -> Front End Driver

Data Acquisition

Data acquired using Release32 of the CMS DAQ by Laurent Mirabito.

- Modular Design
- Runs in spill mode:
  - *Acquire data
  - *Transmit data
  - *On-line analysis & storage

  -> Room for improvement

DAQ can be operated off-site without AFS.

There are several versions of Release32; May 2005 version was used in these runs
The team has two installations, one for development and a stable one for long runs
Switch between installations requires a reboot of the PC's
the two installations are completely separated

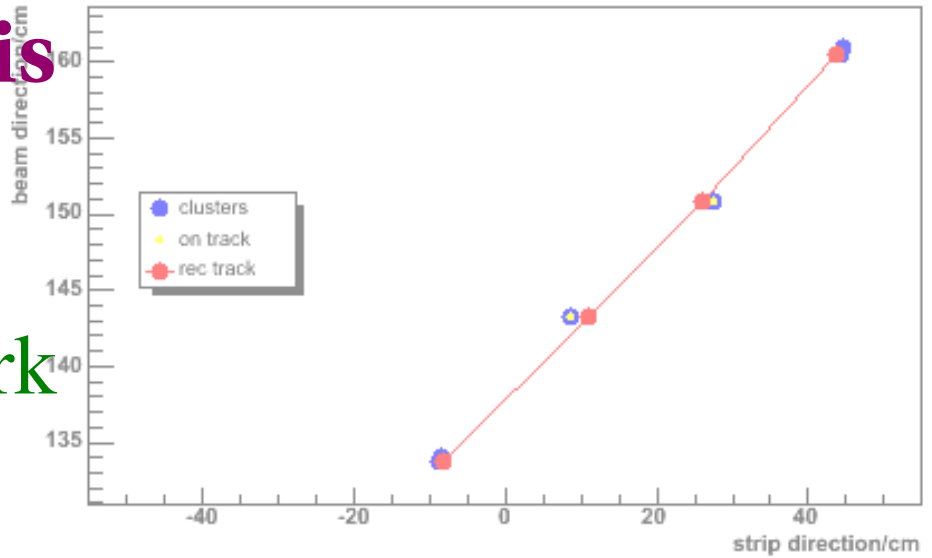
DAQ -> Data Acquisition

AFS -> Andrew File system, a distributed FS which is used extensively at CERN.

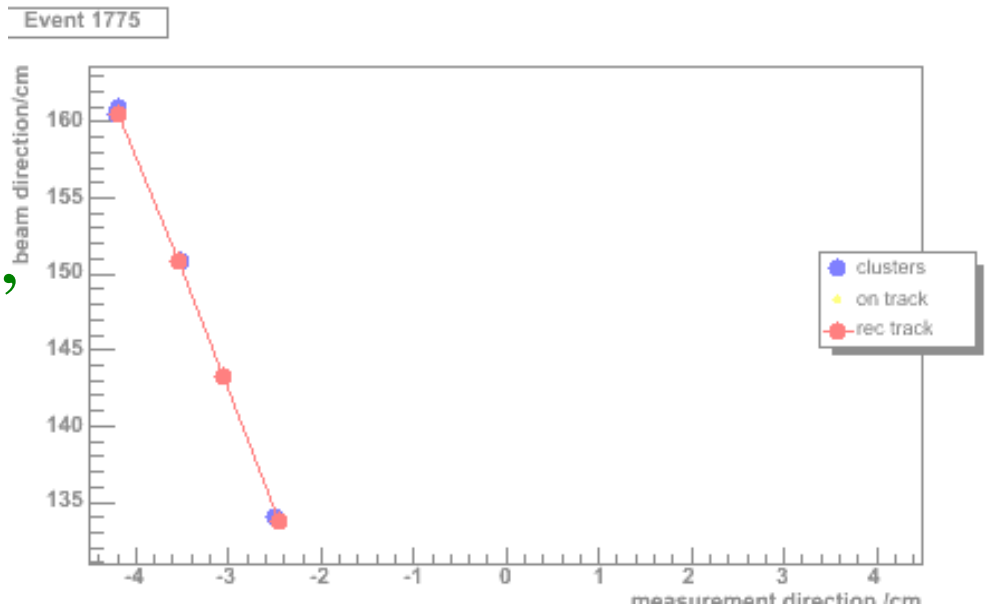
Data Analysis

- Data analysed using standard CMS reconstruction framework (ORCA)

CERN CRack was the pioneer with physics tracks



- Standard ORCA assumes cylinder symmetric geometry, some patching is needed.



- SS rods complicate seeding.

ORCA -> Object-oriented Reconstruction for CMS Analysis
SS -> Single sided. These rods that contain only 6 module pairs, and therefore provide hit lines insead of points
Patching instructions available at http://mweber.home.cern.ch/mweber/CosmicRack/getOrcaNew.pdf

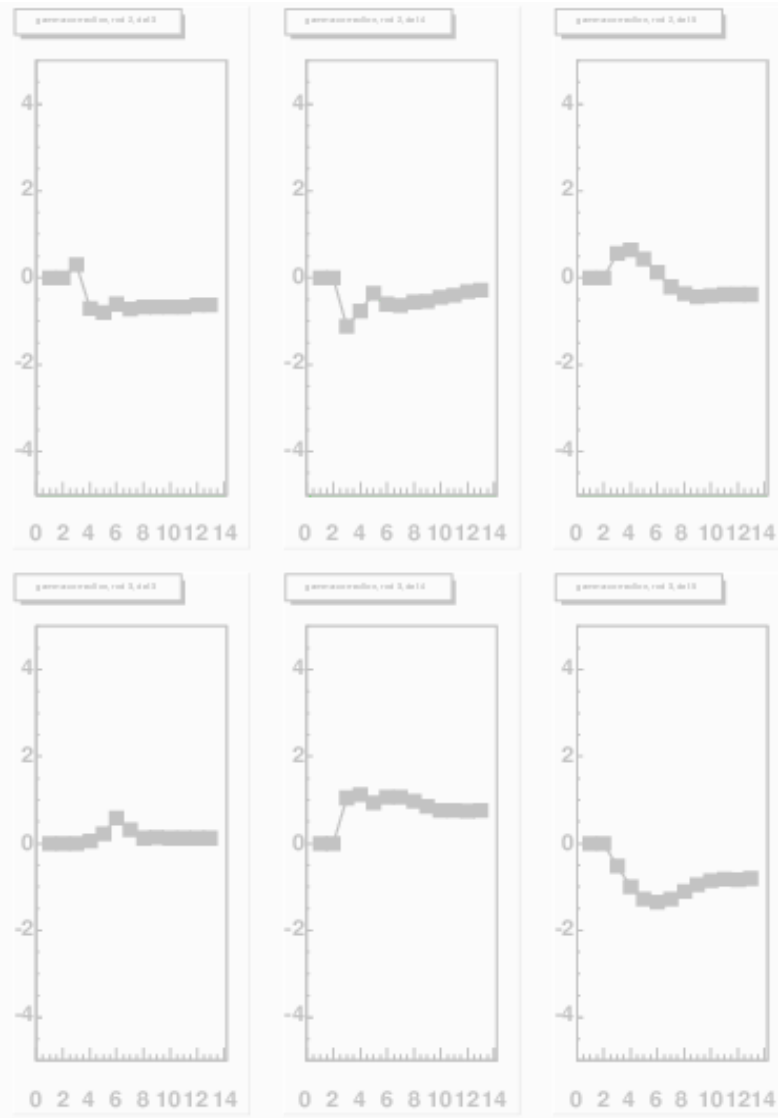
Data Analysis

- Data is visualised using ROOT

ROOT provides

* quick and powerful histogramming tools, and

* a C++ shell allowing futher analysis of the data.



Example figure produced with ROOT package. This figure shows the movement of six detectors in an interative alignment process.

Topics

Topics

- **CMS Hardware related issues**: crosstalk, cluster shape, noise.

- Close collaboration with the CERN CRack.

- As TOB will be located in the middle of CMS, the CRacks provide easily accessible test benches for analysing unexpected behaviours, if such arise.

- CRack environment will be controllable -> study of temperature / humidity / noise related problems.

(will be means that this part is still on to-do list.)

Topics

Software development platform for Run Control.

This project allows us to use the resources at another site for development of hardware oriented software for CMS use.

Topics

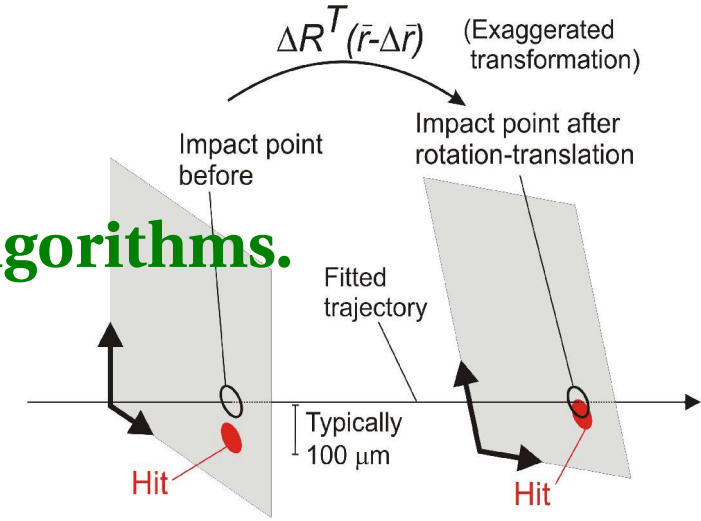
Study of detector alignment and alignment algorithms.

- Alignment is highly prioritized in the beginning of the experiment

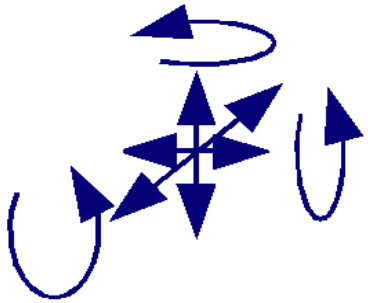
- Preparation with only simulated data not sufficient

- Parallel tracks enable aligning of 1 or 2 parameters

- Cosmic muons have wide angle distribution compared to testbeam data, enabling full 6 parameter alignment.



Alignment of one translational and one rotational parameter



3 rotations and 3 translations to align.

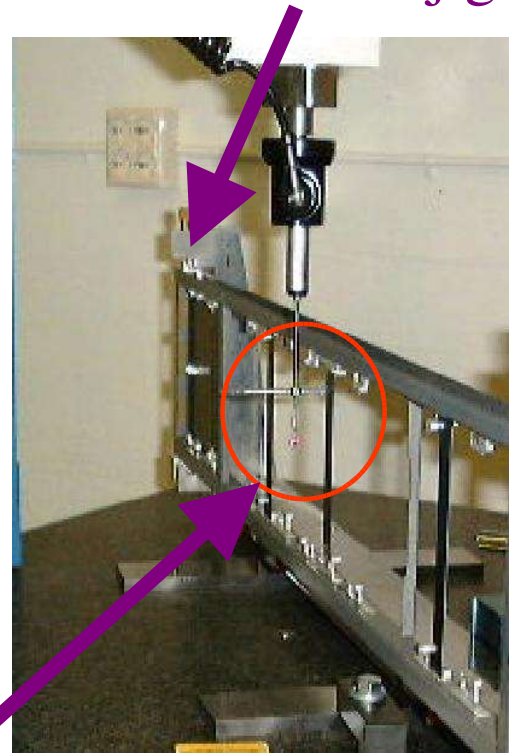
Topics

Study of detector alignment and alignment algorithms.

- Independent CRacks do not interfere with CMS integration activities

- Independent way to x-check earlier module position measurements and to estimate position uncertainities .

Figure on the right hand side shows the setup measuring rod precisions.



Topics

Reference platform for sensor research: Czochralski silicon

New material -> detectors have to be fully characterized
-> requires tests with particles.

Using beams as reference:

- Beam time is expensive.
- Limited availability; the test cannot be done when wanted
- Continuous access to reference allows iterative processes and speeds up the development cycle.

- Room for several reference detectors, if needed.

Topics

Recruitment platform for next generation physicists.

We plan to invade the CERN with even more top quality staff candidates.

Take home:

2 Cosmic reference devices available;

Possible to provide tracks with standard CMS software and hardware;

Documentation available soon !

This presentation has ended two slides ago.

Thank you for your curiosity.