

University  
of Glasgow

# Commissioning the Step IV Experiment

**MICE CM39**

**St Catherine's, Oxford, 28 June 2014**

**Paul Soler**

# Commissioning the detectors



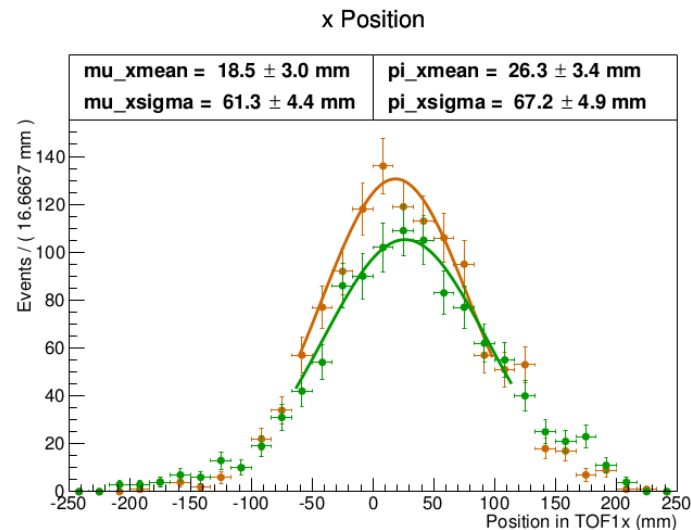
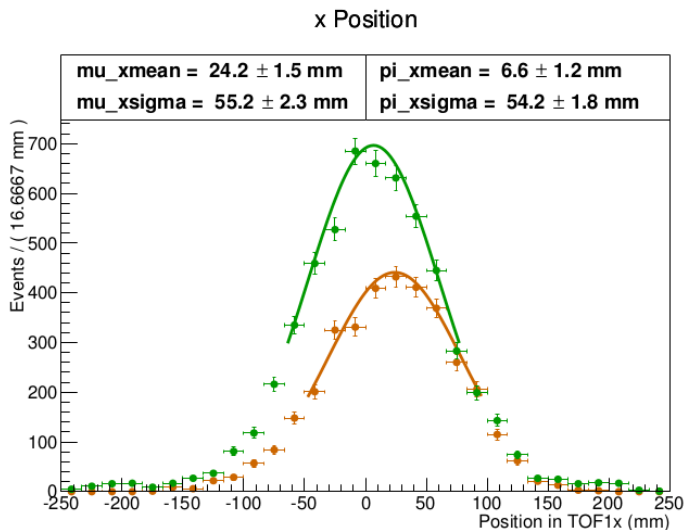
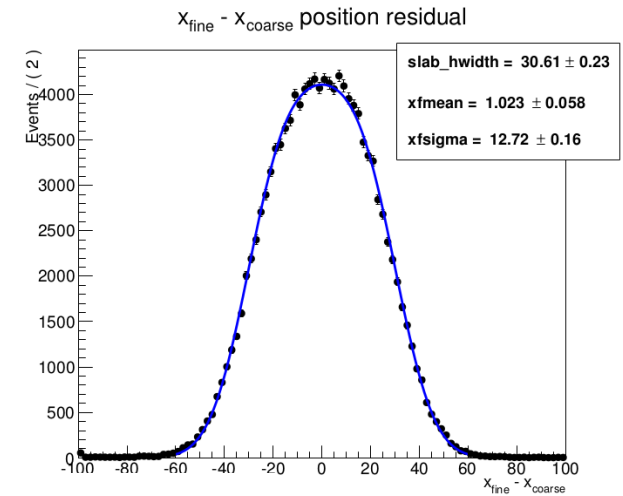
- We have initiated a process to define the commissioning plan for the detector systems
  - Identify all remaining hardware tasks
  - Define operational settings, calibrations, alignments ...
  - Specify software still required for commissioning: monitoring, controls, simulation, reconstruction, analysis
  - Define tasks for each detector to determine commissioning plan
- Write commissioning document by end July

- Remaining hardware: **M. Bonesini**
  - TOF has been installed and working since 2008
  - Main issue: need to assess whether TOF1 can operate in stray field of PRY without further shielding – check simulations to make sure  $<50\text{G}$
  - Make flexible moveable support structure to mitigate potential effect of SS field
- Software:
  - Already in good shape
  - TOF has already been at the centre of all analyses

## □ Calibrations and commissioning:

- No special commissioning
- Calibration well defined and used routinely: ~10 hours data taking with positron running

## □ Alignment TOF with magnets

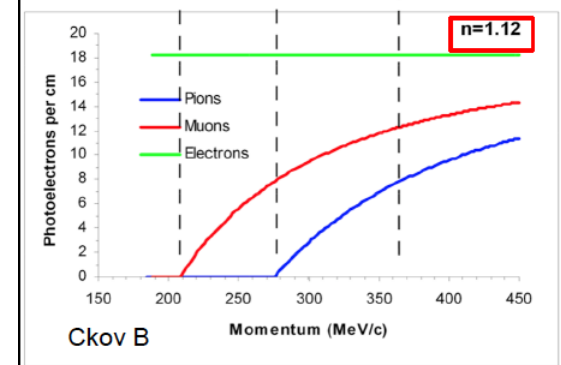
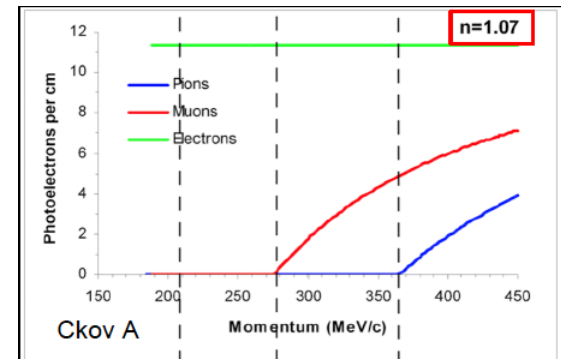


**E. Overton**

# CKOV

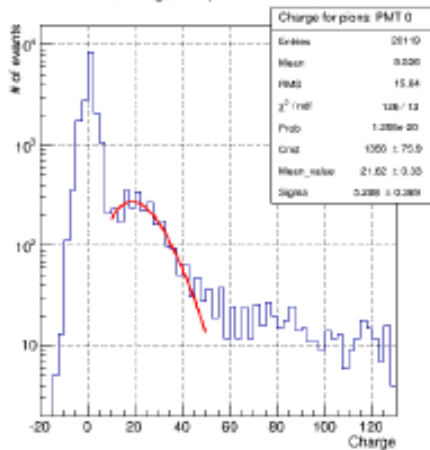


- Remaining hardware:
  - No expected changes
- Software:
  - Digitisation required
- Calibrations: **Hanlet/Cre maldi**
  - Pedestal runs
  - Sub-threshold pions – 1 PE
  - Electron runs: multi-PE
- Commissioning:
  - Equalise gains of PMTs
  - Cherenkov threshold runs

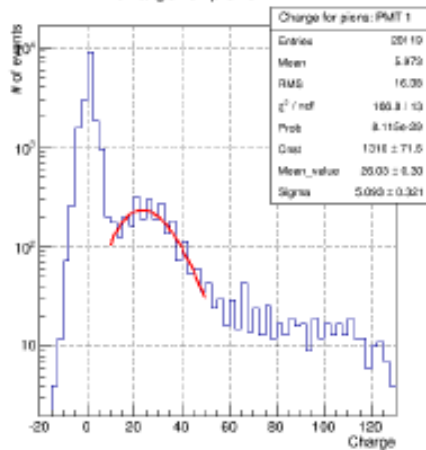


## 1 PE distributions:

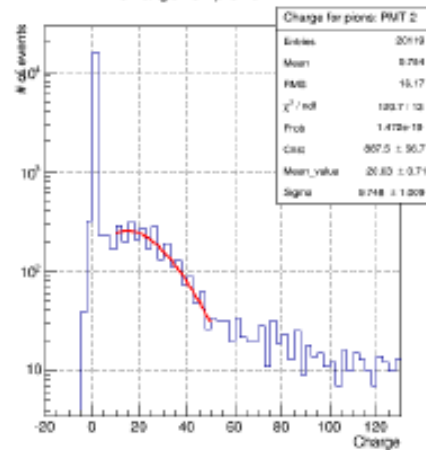
Charge for pions: PMT 0



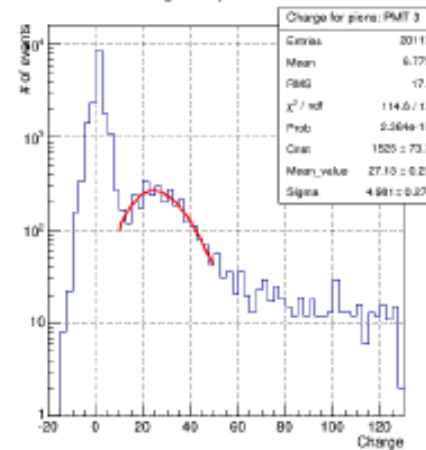
Charge for pions: PMT 1



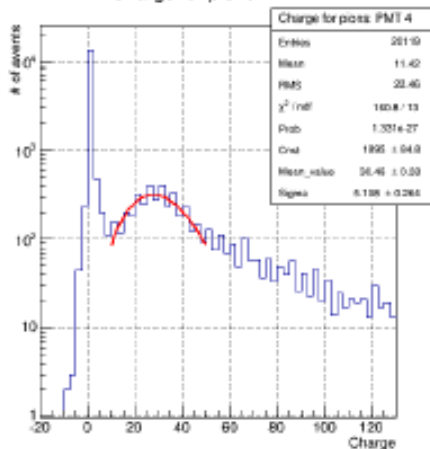
Charge for pions: PMT 2



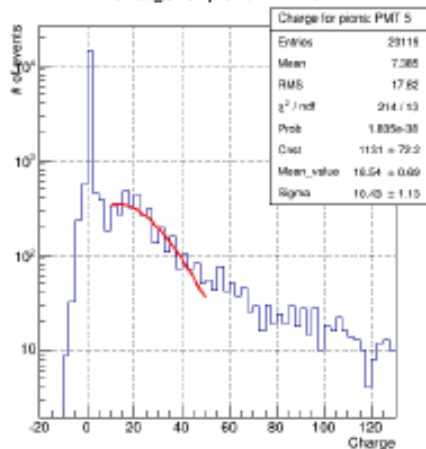
Charge for pions: PMT 3



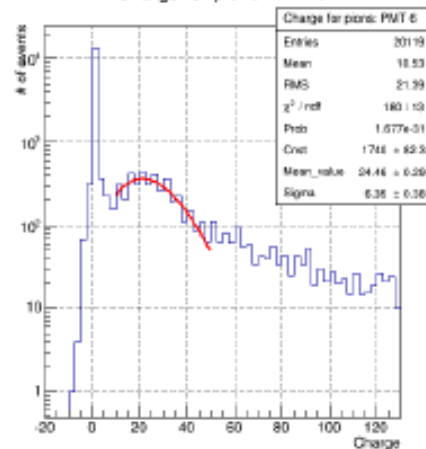
Charge for pions: PMT 4



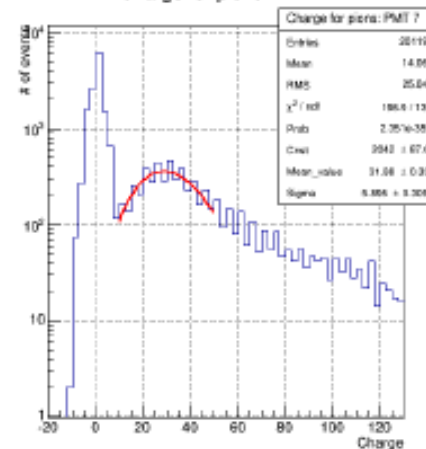
Charge for pions: PMT 5



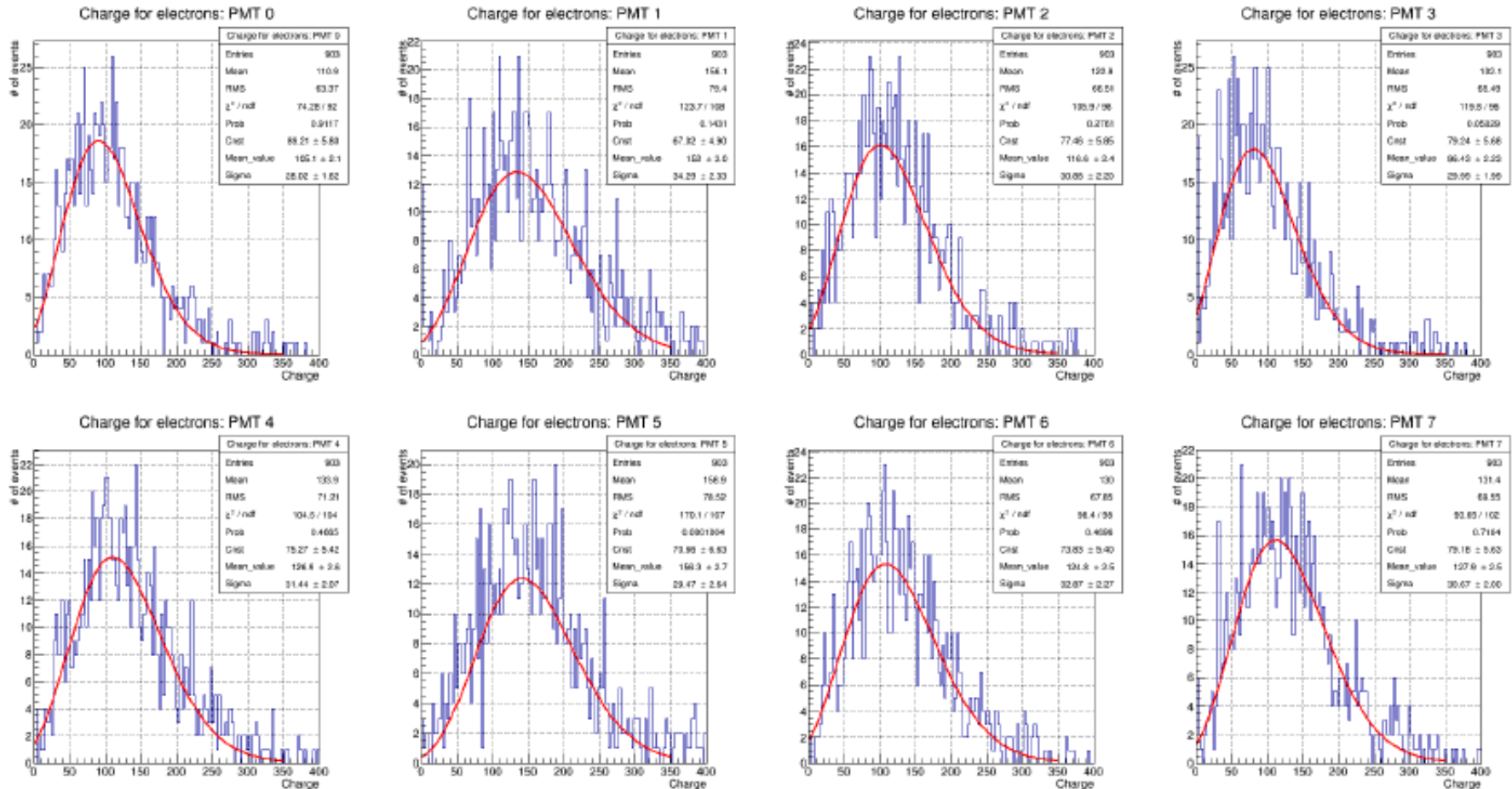
Charge for pions: PMT 6



Charge for pions: PMT 7



## □ Positron runs: multi-PE

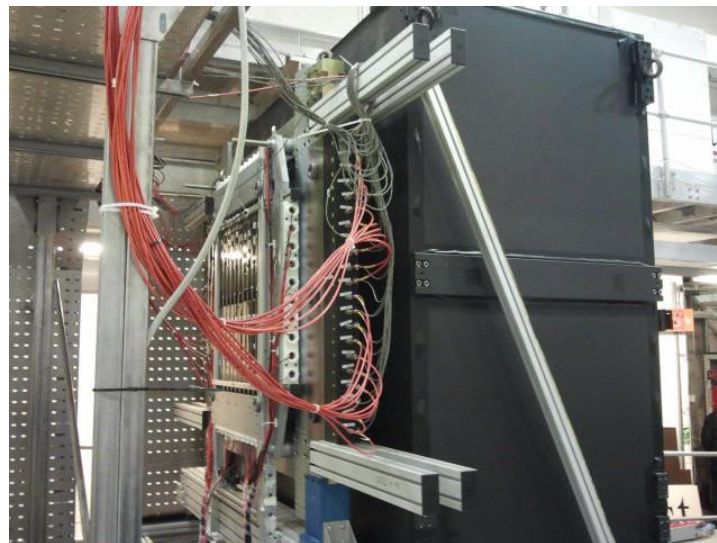


**This procedure to be tested out in tomorrow's run**

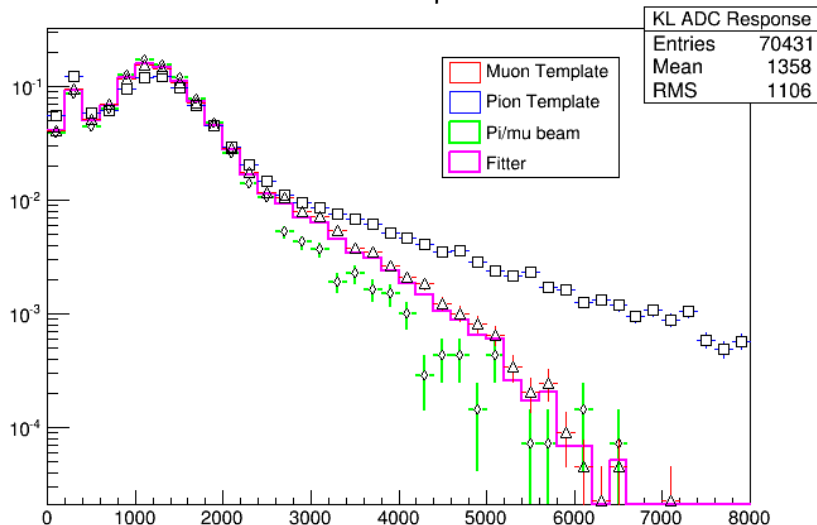


# KL

- Remaining hardware:
  - No expected changes
  - Support EMR, KL – remove iron feet **Orestano**
- Software: digitisation and data tuning ongoing



KL ADC Response





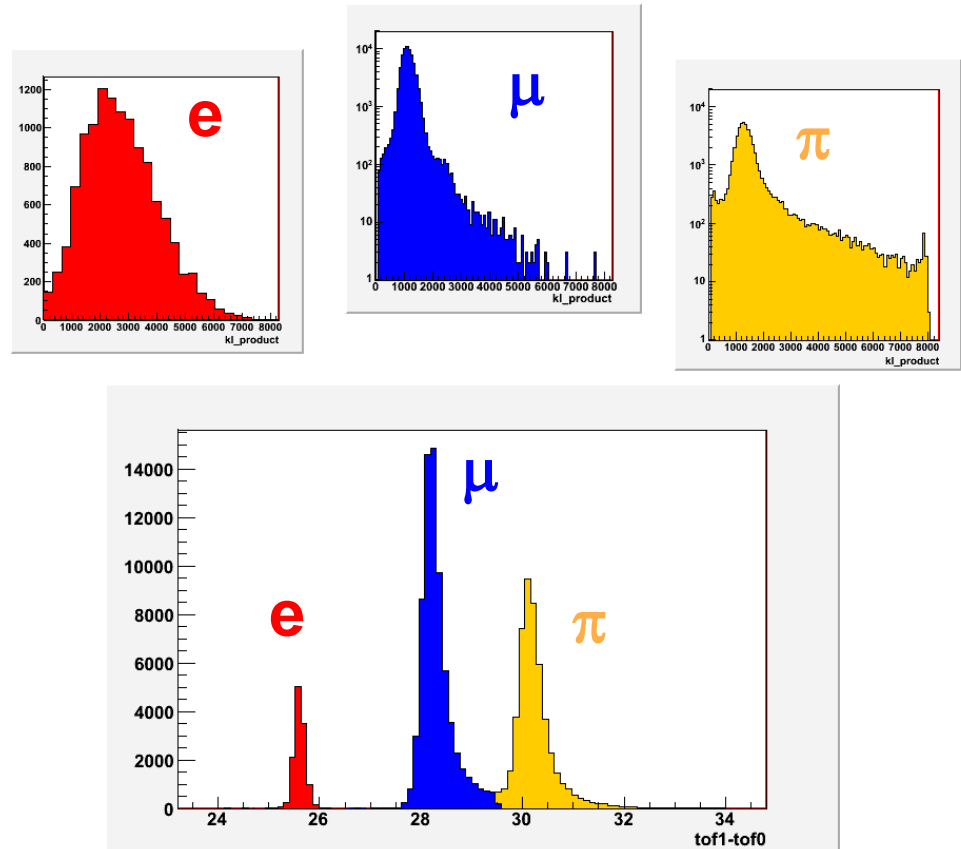
## □ Calibrations:

- KL pedestal stability with cosmics (trigger TOF2)
- Validate response of electrons, pions, muons

Orestano

## □ Commissioning:

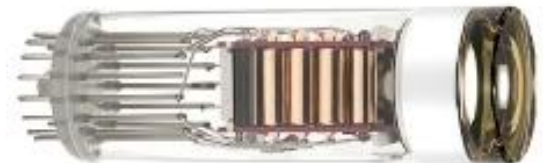
- No special commissioning
- Monitor pedestals and monitor gains through particle response



## □ Hardware commissioning:

**Drielsma**

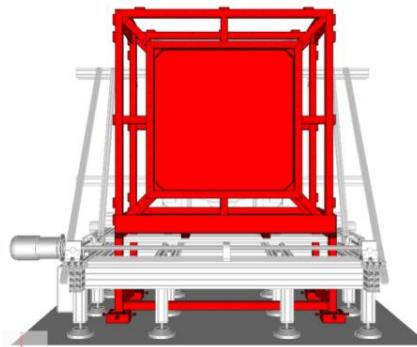
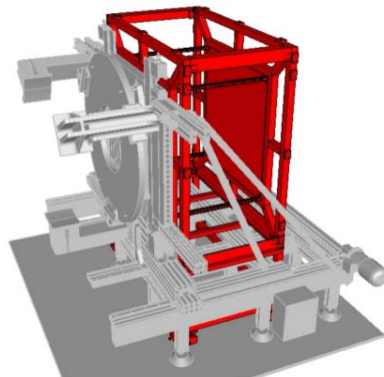
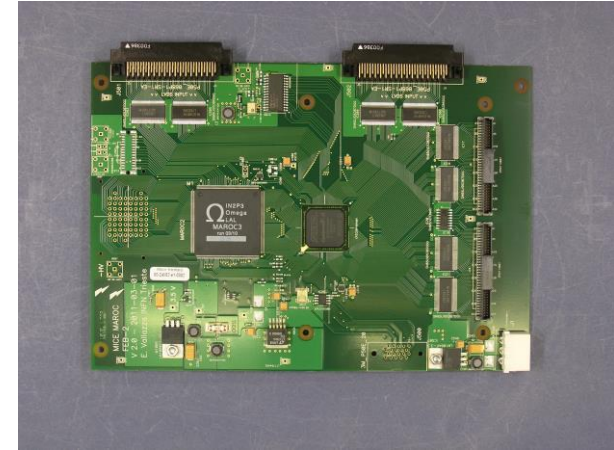
- MaPMT readout: 4 channels dead (0.15%)
- Clear fibre luminosity: 95% fibres within 20%
- Mismatched fibres: 2 out of 2832 channels
- Crosstalk:  $R_N < 0.5\%$ ,  $R_Q \sim 4.5\%$
- Signal efficiency: 99.57%
- High voltage scans to reduce inefficiency – Oct 2014
- Move electronics to approved rack – Oct 2014
- Replacement of 55 Philips XP2972 for new Hamamatsu R6427 PMTs – Oct 2014



## □ Hardware commissioning (cont.):

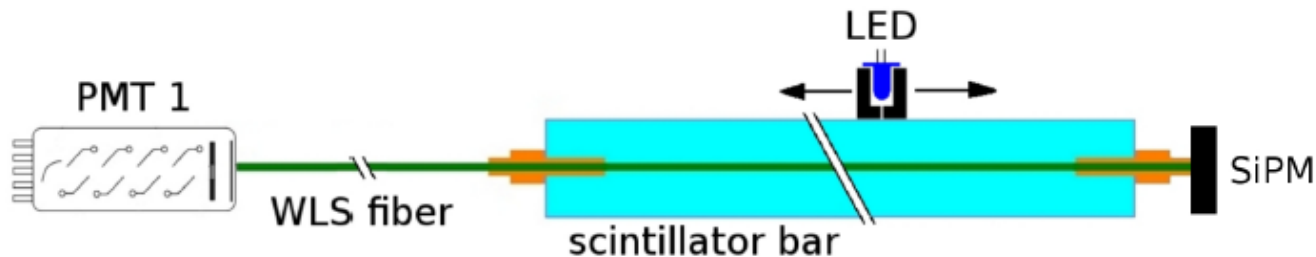
**Drielsma**

- Replace faulty front-end boards
- MAROC optimisation
- Installation temperature and humidity sensors in EMR box and electronics
- Reinforcement EMR structure due to 800 kg steel



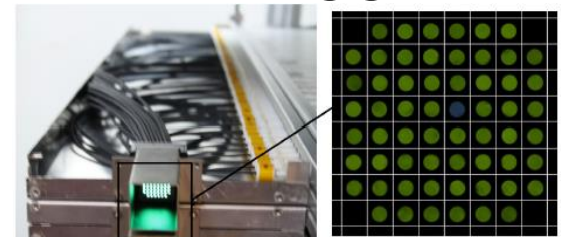
## □ Software commissioning:

- Integration of EMR code into MAUS ongoing
- Add noise and decay particles to data structures
- Integrate reconstruction code
- Implement digitization and tune for photon production, transport efficiency, attenuation, quantum efficiency, non-uniformity



- Improve track reconstruction: position, triangular geometry, muon tagging, energy deposition, PID

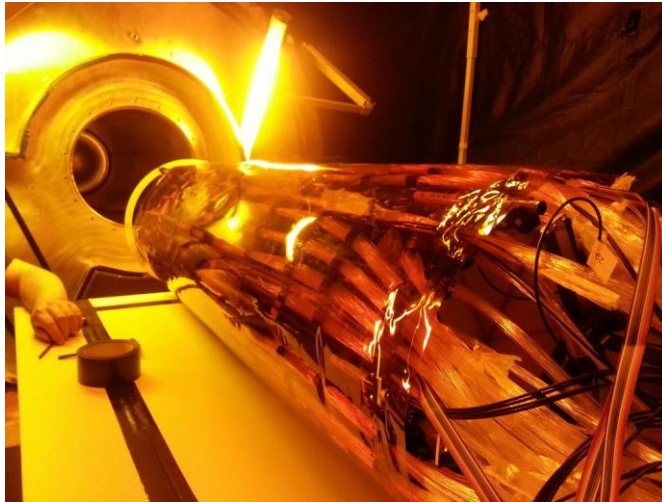
- EMR data acquisition:
  - Calibration flash ADC and MAROC configuration after power cycles
  - LED monitoring
  - Three modes of running: beam, cosmics, LED
  - Controls and monitoring – big job
- Calibrations:
  - Three weeks of continuous cosmics running to calibrate 2832 channels with TOF2 as trigger
  - LED monitoring for PMT gains
- Documentation:
  - Operating instructions and technical note



# Tracker



- This is the detector that requires the most work
- Remaining hardware: **More details: M. Uchida talk**
  - Installation of downstream tracker: to be finished by end July
  - Tracker hall integration:
    - Detailed schedule of work
    - Full installation: 17 March 2015

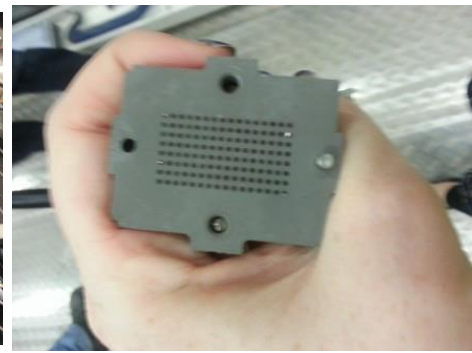




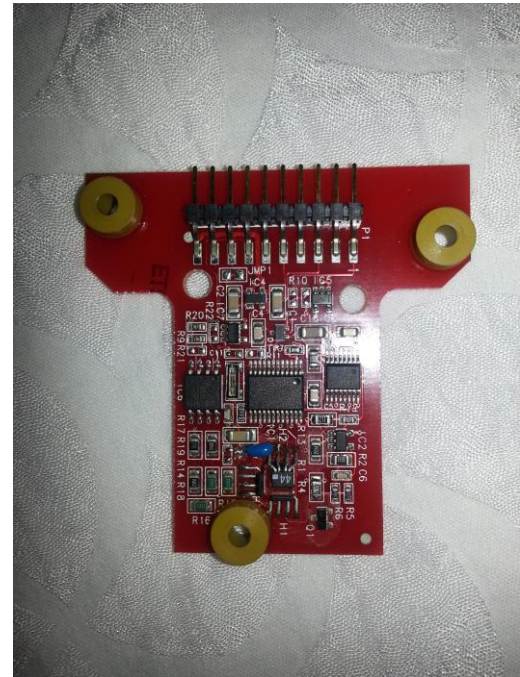
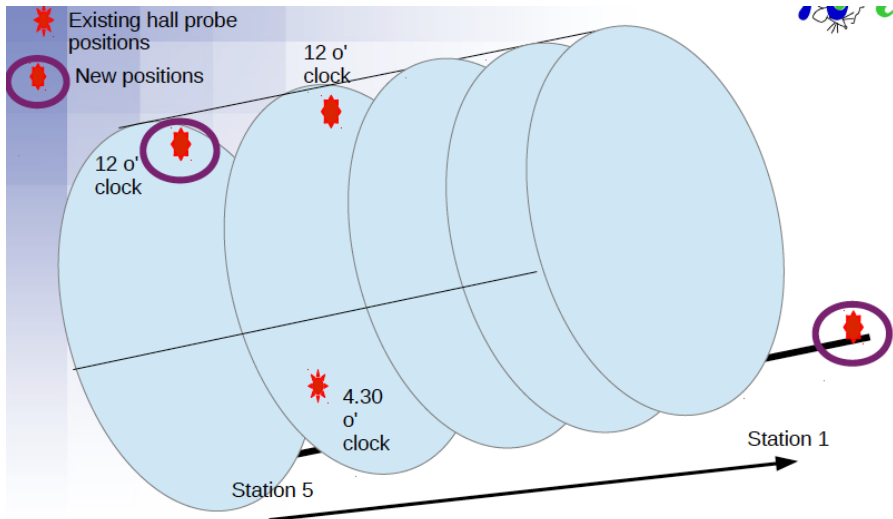
# Tracker



- Hardware commissioning:
  - Lightguide fibre QA



- Magnetic field inhomogeneity:
  - Hall probes inside trackers
  - 4 probes per tracker: ready to install





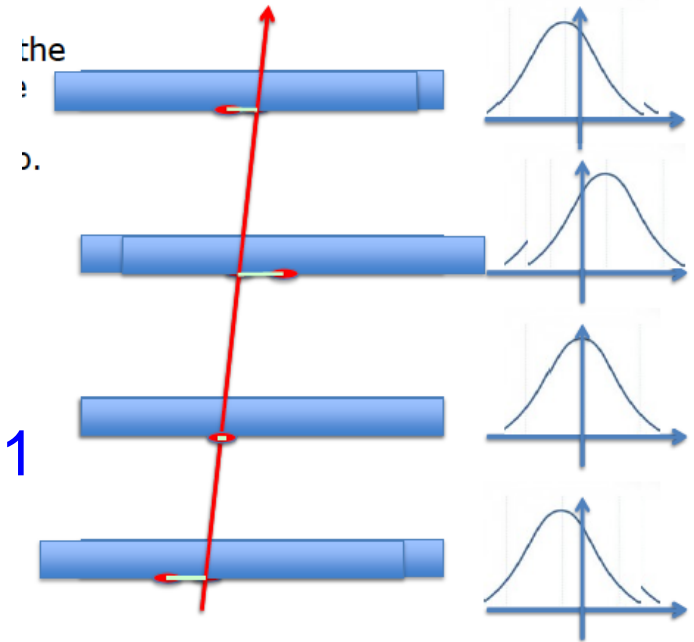
## □ Alignments:

- Misalignments within trackers and between trackers.

Start from survey points: 1-2 mm

- Use track-based alignment to achieve final precision:  $\sim 300 \mu\text{m}$
- Millepede global algorithm developed for AIDA:

<http://aidasoft.web.cern.ch/node/31>



- Software: already in place and working **A. Dobbs talk**
  - MAUS API now fully integrated with SciFi
  - Data structure cross links now fully implemented
  - DAQ data now integrated fully into the Data structure
  - Tests expanded, integration tests now cover Kalman and Pattern Recognition separately
  - Adding smearing to digitization
  - Online monitoring plots are being defined
  - Sort out CDB geometry and calibration
  - Fix Kalman filter for negative particles
  - Reconstruction based on likelihood
  - Trigger Monte Carlo
  - Documentation still needed

## □ Commissioning:

### M. Uchida talk

- Readout commissioning – no beam, random, cosmic and LED triggering for VME based trigger – 2 days
- Calibration – no beam runs with LED varying bias, discriminator and TDCs – 4 days (bias) + 4 days (discriminators) + 4 days (timing) = 12 days
- Timing commissioning – starting with LED and moving to beam to ensure integration and veto period align with arrival of particles – 5 days
- Alignment checks – no field straight tracks to reconstruct actual alignment of tracker in reference frame – 5 days
- **TOTAL: 24 days**

# Commissioning Plan Document



- I will set up a document that will become the commissioning plan document for each detector, with relevant sections:
  - TOF: Maurizio
  - CKOV: Lucien
  - KL: Domizia
  - EMR: Alain/Francois/Yordan
  - Tracker: Melissa/David Adey/Alan Bross/Adam Dobbs
- General editor: PS
- Timeline: end July ready for reviews