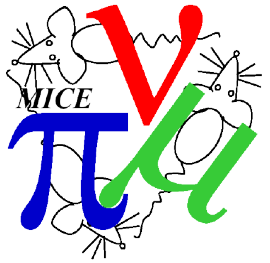


Status of the MICE Experiment

Melissa George

Institute of Physics HEPP APP Conference
Liverpool 08-10/04/2013

Imperial College
London

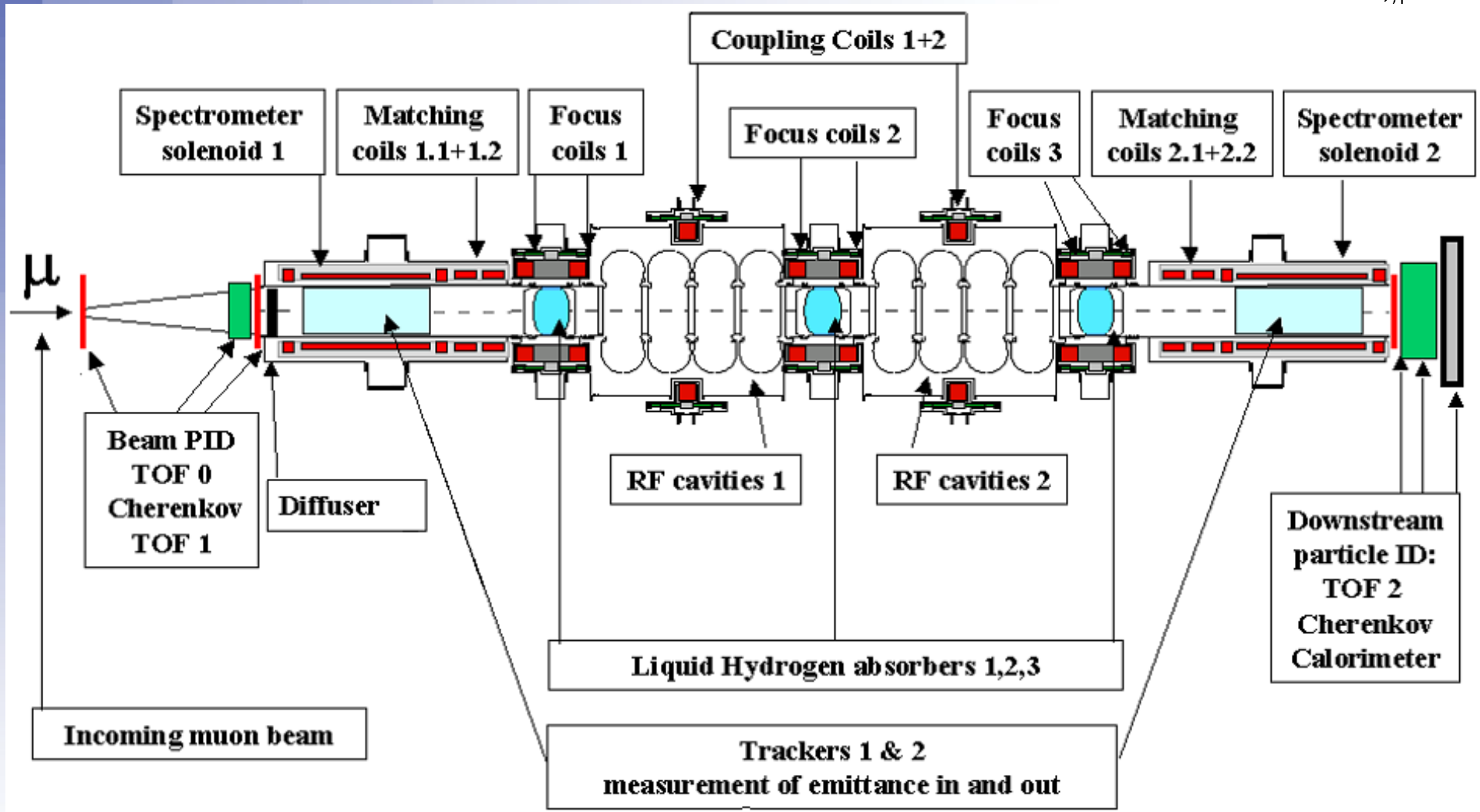
Overview

- The Experiment
  - Purpose
  - Method
- Stages of hardware implementation
- Detectors
- Software and Reconstruction
- Analysis so far (beam)

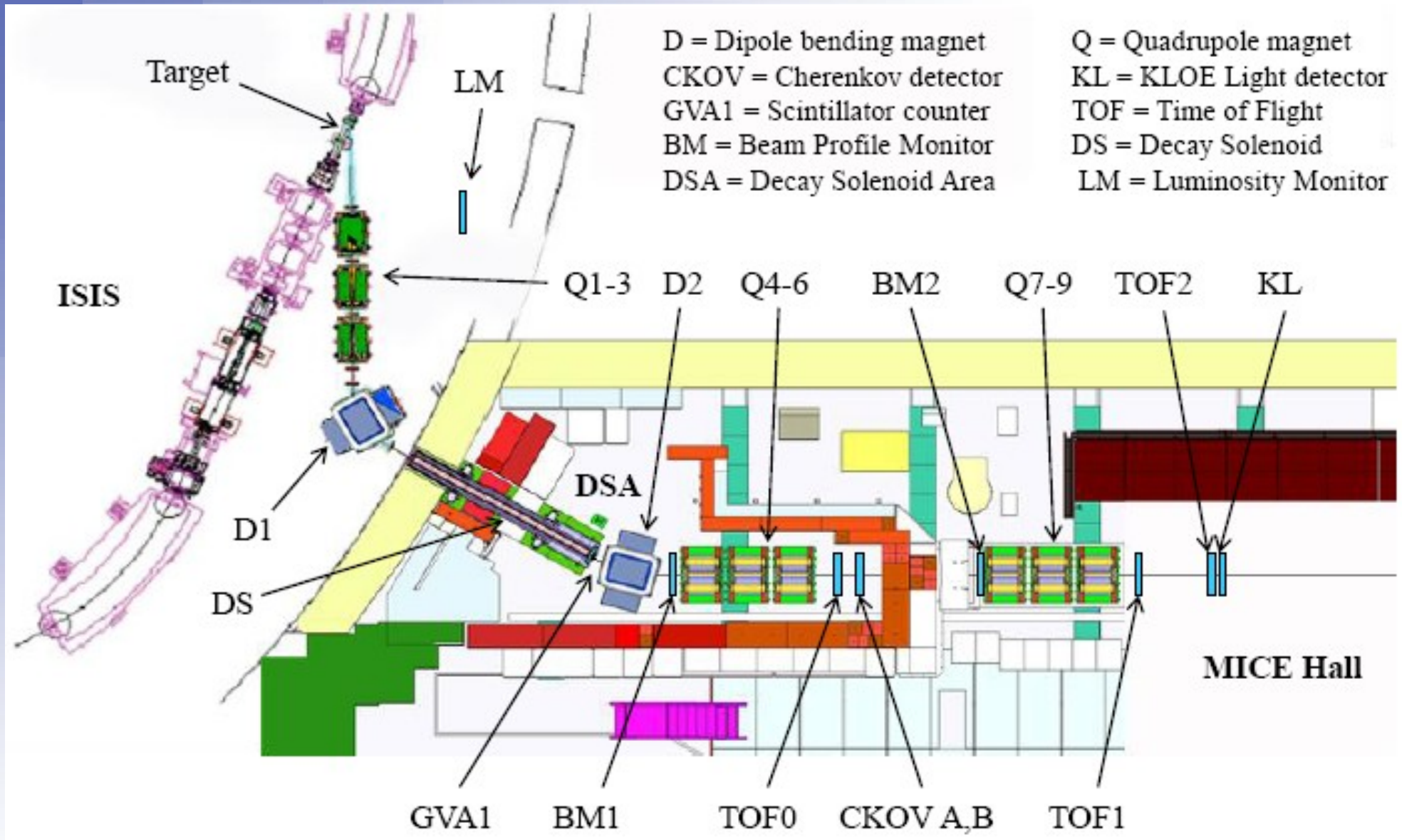
MICE

- Ionisation Cooling of Muons.
  - Emittance of a charged particle beam is reduced
  - Transverse momentum is reduced by accelerating the beam through RF, restoring the longitudinal momentum and hence reducing the transverse.
- Necessary for a muon collider, Higgs factory and Neutrino factory.....
- Titanium target dipped into ISIS beam at RAL.
  - Pions produced in the target decay to muons.

MICE


Coupling Coils 1+2
Spectrometer solenoid 1
Matching coils 1.1+1.2
Focus coils 1
Focus coils 2
Focus coils 3
Matching coils 2.1+2.2
Spectrometer solenoid 2
μ
Beam PID
TOF 0
Cherenkov
TOF 1
Diffuser
RF cavities 1
RF cavities 2
Downstream particle ID:
TOF 2
Cherenkov
Calorimeter
Liquid Hydrogen absorbers 1,2,3
Incoming muon beam
Trackers 1 & 2
measurement of emittance in and out

MICE


D = Dipole bending magnet
CKOV = Cherenkov detector
GVA1 = Scintillator counter
BM = Beam Profile Monitor
DSA = Decay Solenoid Area
Q = Quadrupole magnet
KL = KLOE Light detector
TOF = Time of Flight
DS = Decay Solenoid
LM = Luminosity Monitor
Target
LM
ISIS
Q1-3
D2
Q4-6
BM2
Q7-9
TOF2
KL
DSA
D1
DS
MICE Hall
GVA1
BM1
TOF0
CKOV A,B
TOF1

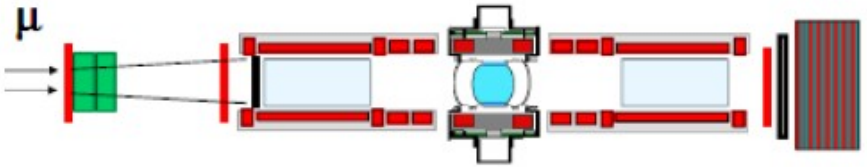
MICE

Provisional MICE SCHEDULE
update: October 2012

Run date:

STEP I

EMR run Q1-Q2 2013

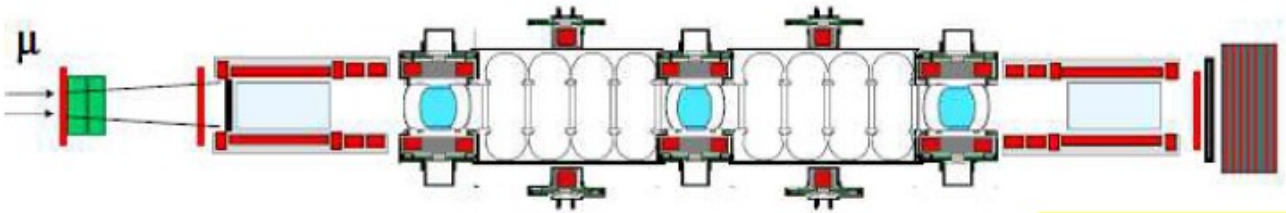


STEP IV

Q2 2014
till
Q4 2015

Under construction:

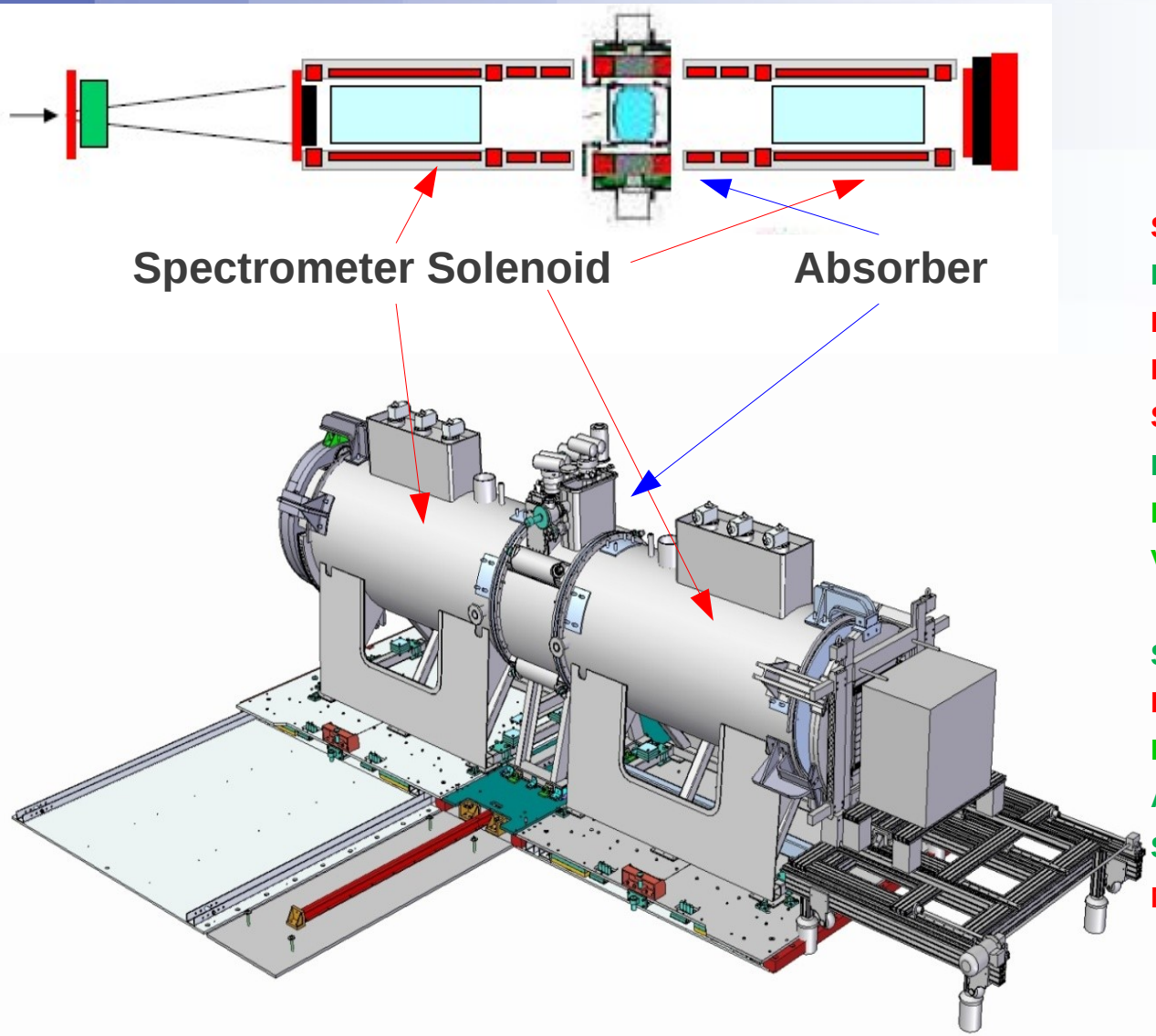
STEP VI



target date Q3 2018
Step V run possible Q3 2017

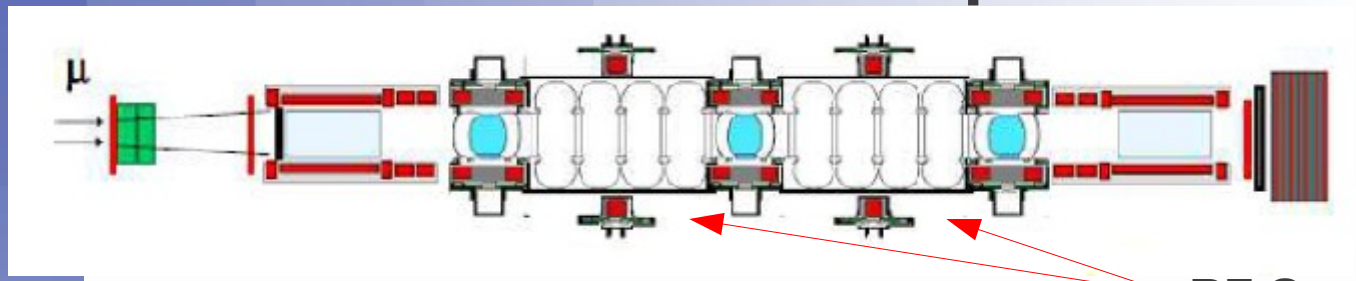
MICE CM34 Alain Blondel

Step IV

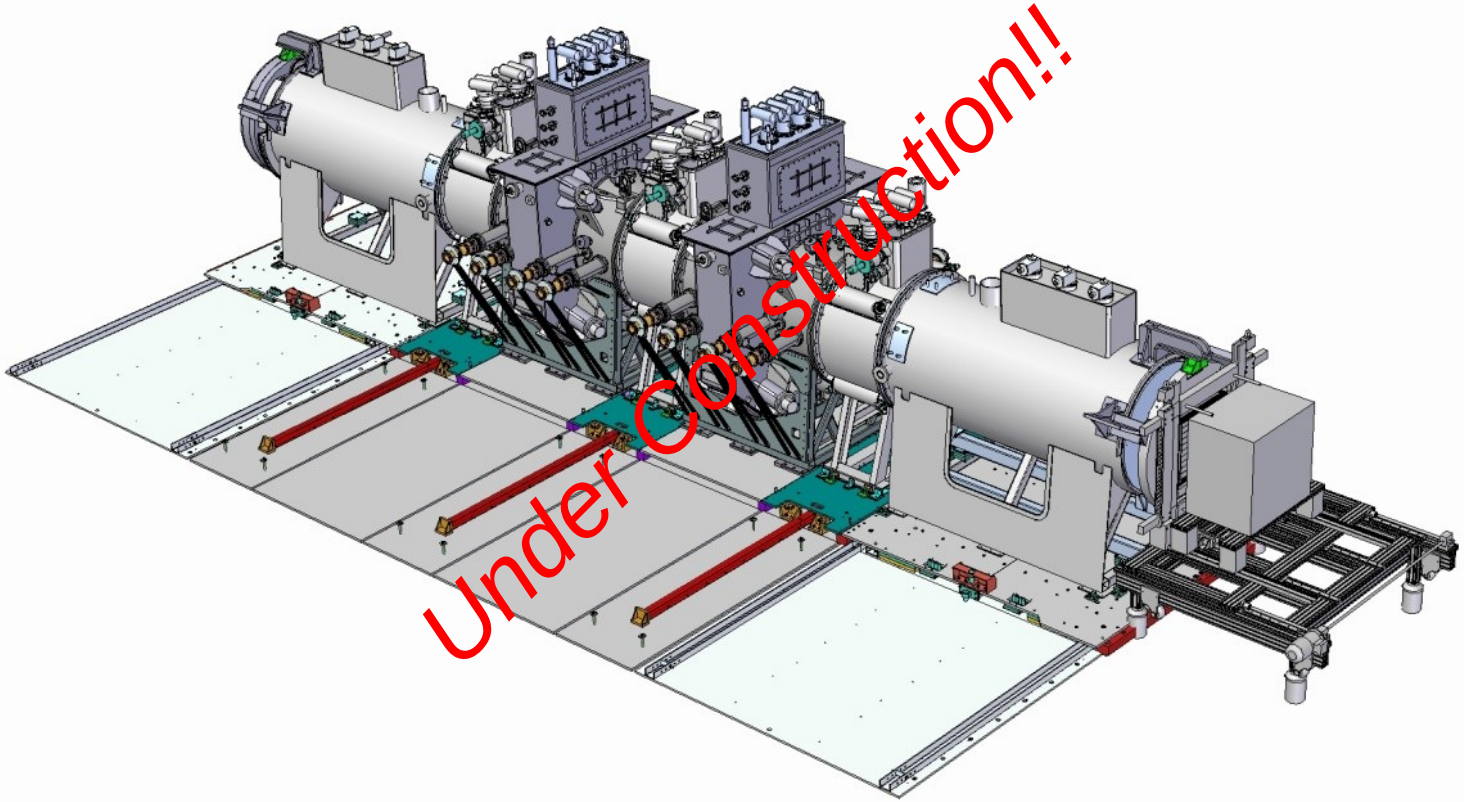


Subsystem	Date
Spectrometer solenoid #1 + #2	Q3 2013
Fibre tracker #1 + #2	Ready
Focus coil #1	Nov ’12
LH2 system A	TBC
Solid absorber(s)	TBC
Liquid absorber	Ready
Diffuser	Ready
Virostek plate & TOF cage assy	Ready
Substation upgrade	Ready
EMR installation	May’13
Radiation shutter	Ready
AFC Moving platform #1	Ready
SS platforms Installation	Ready
Magnetic shielding plan	TBC

Step VI



RF Cavities



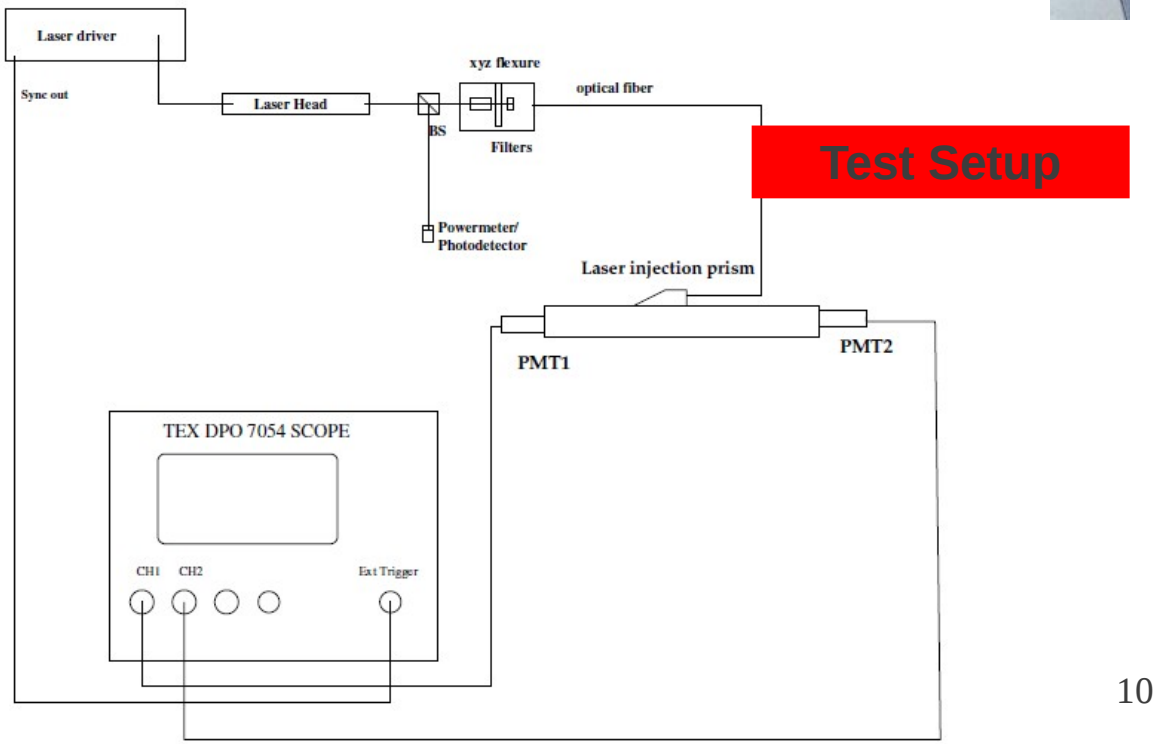
Under Construction!!

Step VI target date....2018

Detectors, Software and Reconstruction

TOF (Time of Flight)

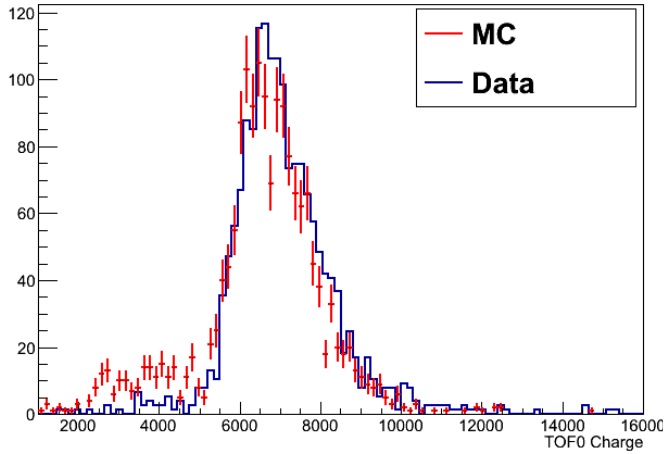
- Has already been built, installed, tested and run.
- Minor modifications are under way to improve the TOF and the MICE hall to accommodate all of the detectors.
- Analysis is ongoing.

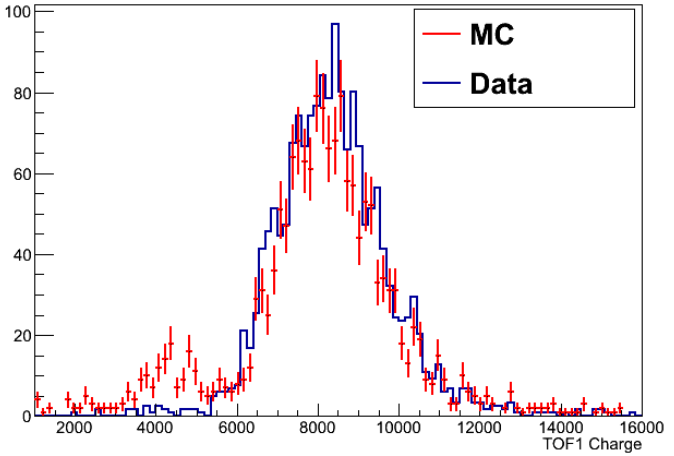


Test Setup

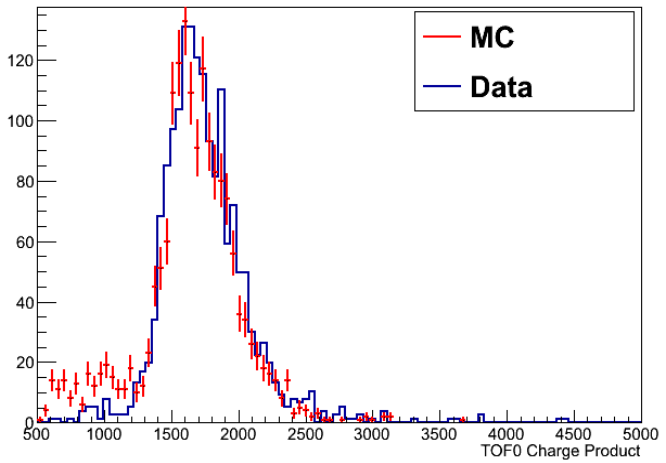
TOF Software

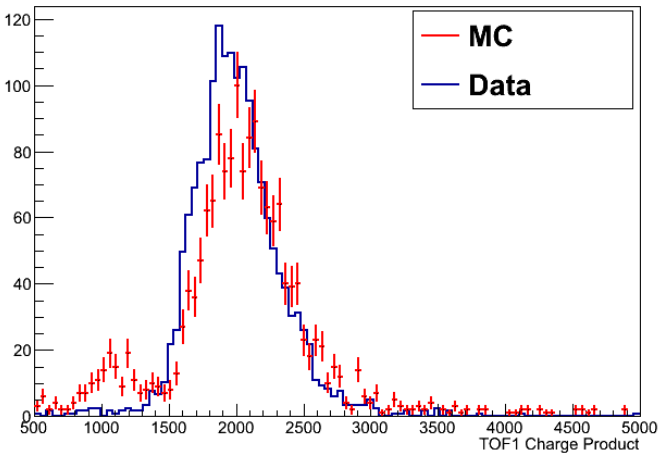
- Software is under development and working well but there is more to be done, including adding efficiency histograms and testing modules.
- MC comparison studies done.
  - Understood offsets for time comparisons
  - Good agreement for charge
  - …





MC: beam 226 MeV/c, data 222 MeV/c





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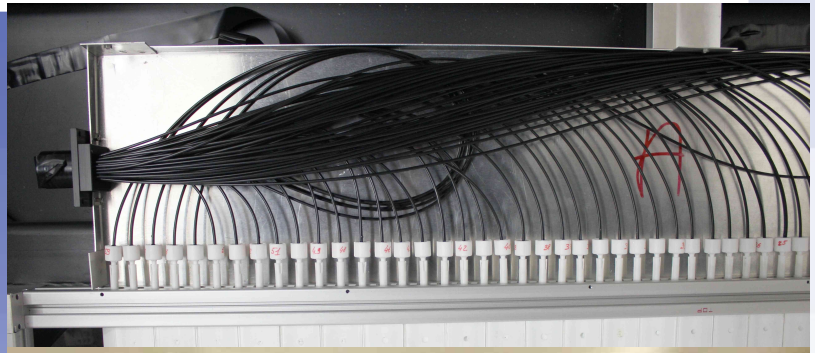
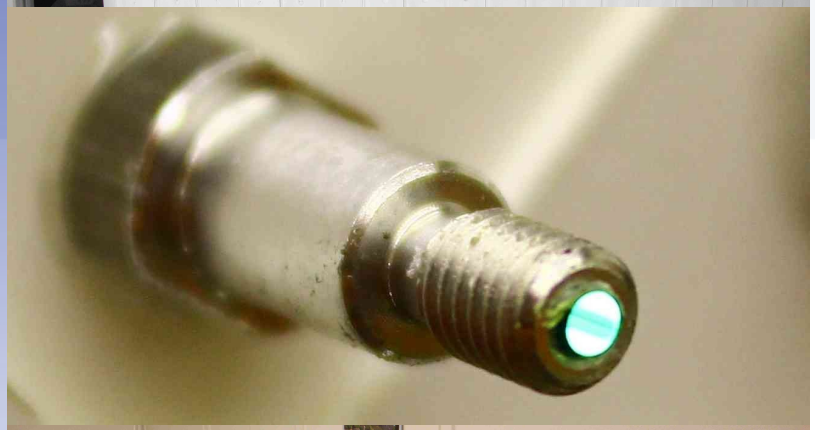
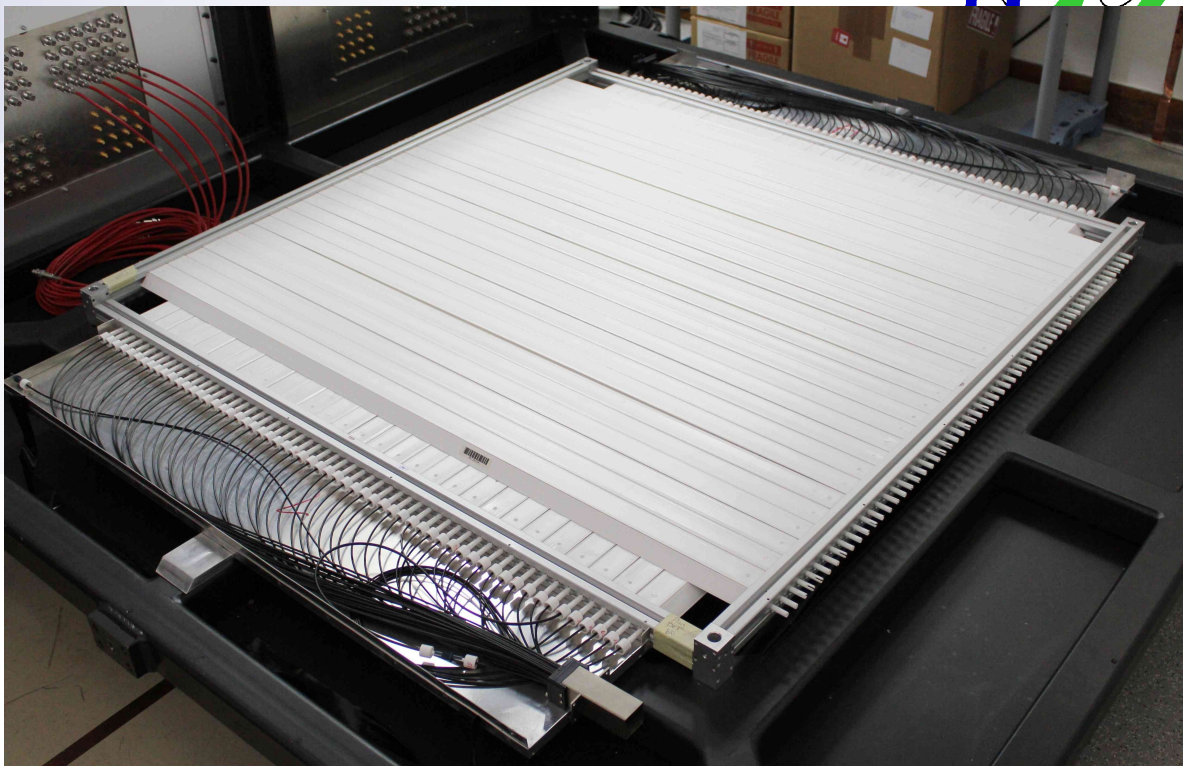
EMR (Electron-Muon Ranger)





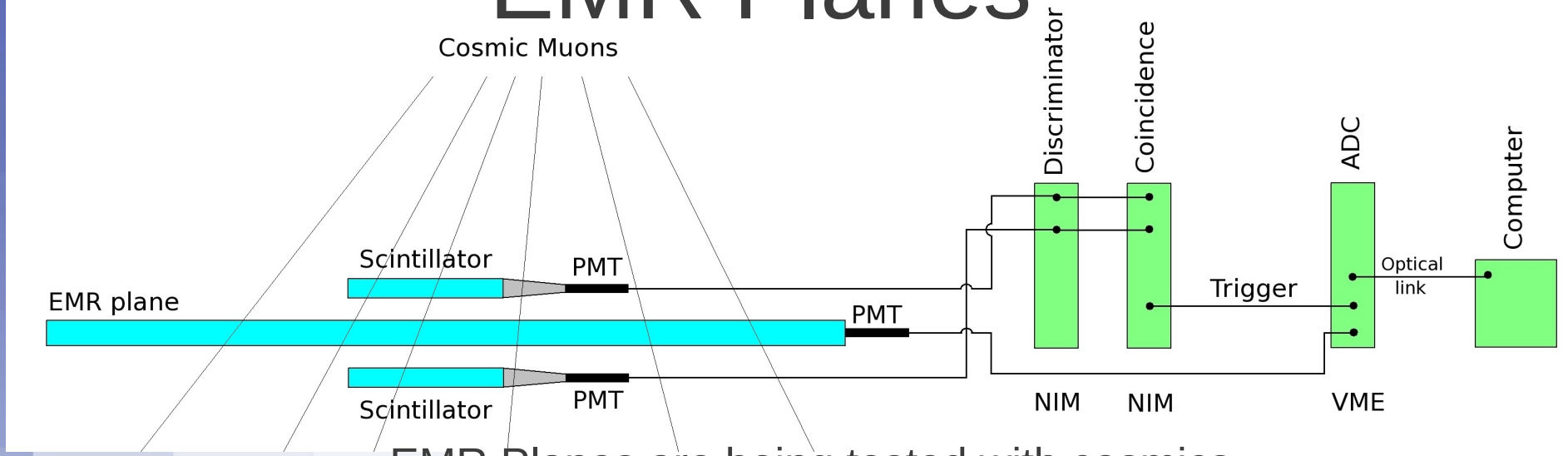


- all the bars ready for assembly
- fibre bundles in production
- construction should be finished by May

Work in Progress...

From: Ruslan Asfandiyarov, University of Geneva

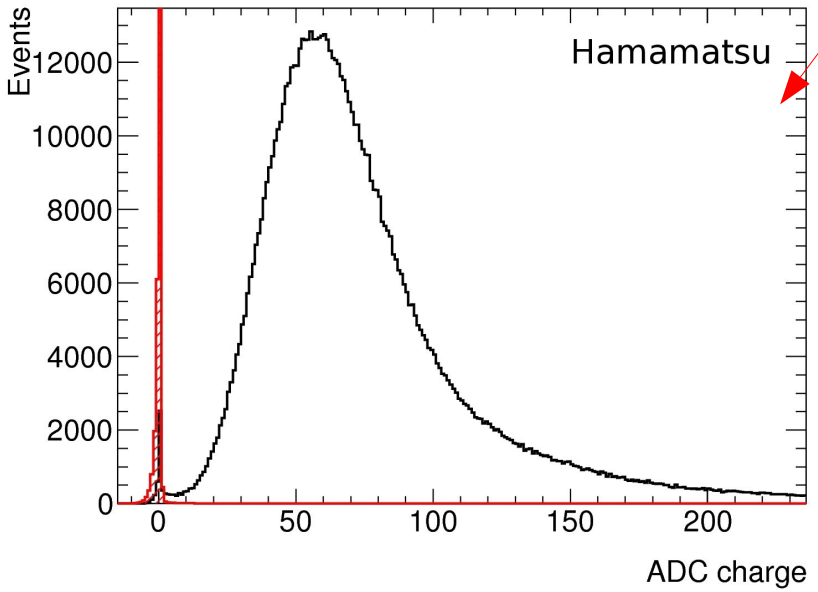
EMR Planes

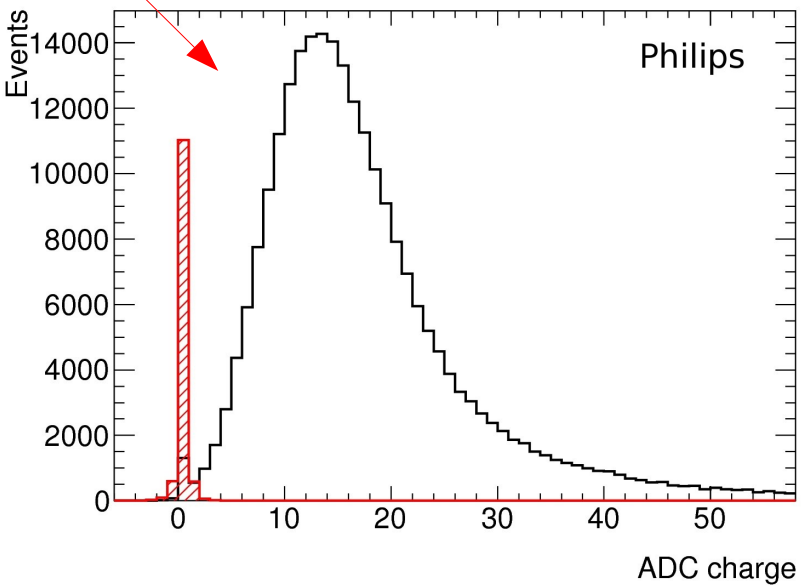


EMR Planes are being tested with cosmics

and

Comparisons between Hamamatsu and Philips PMTs are underway.





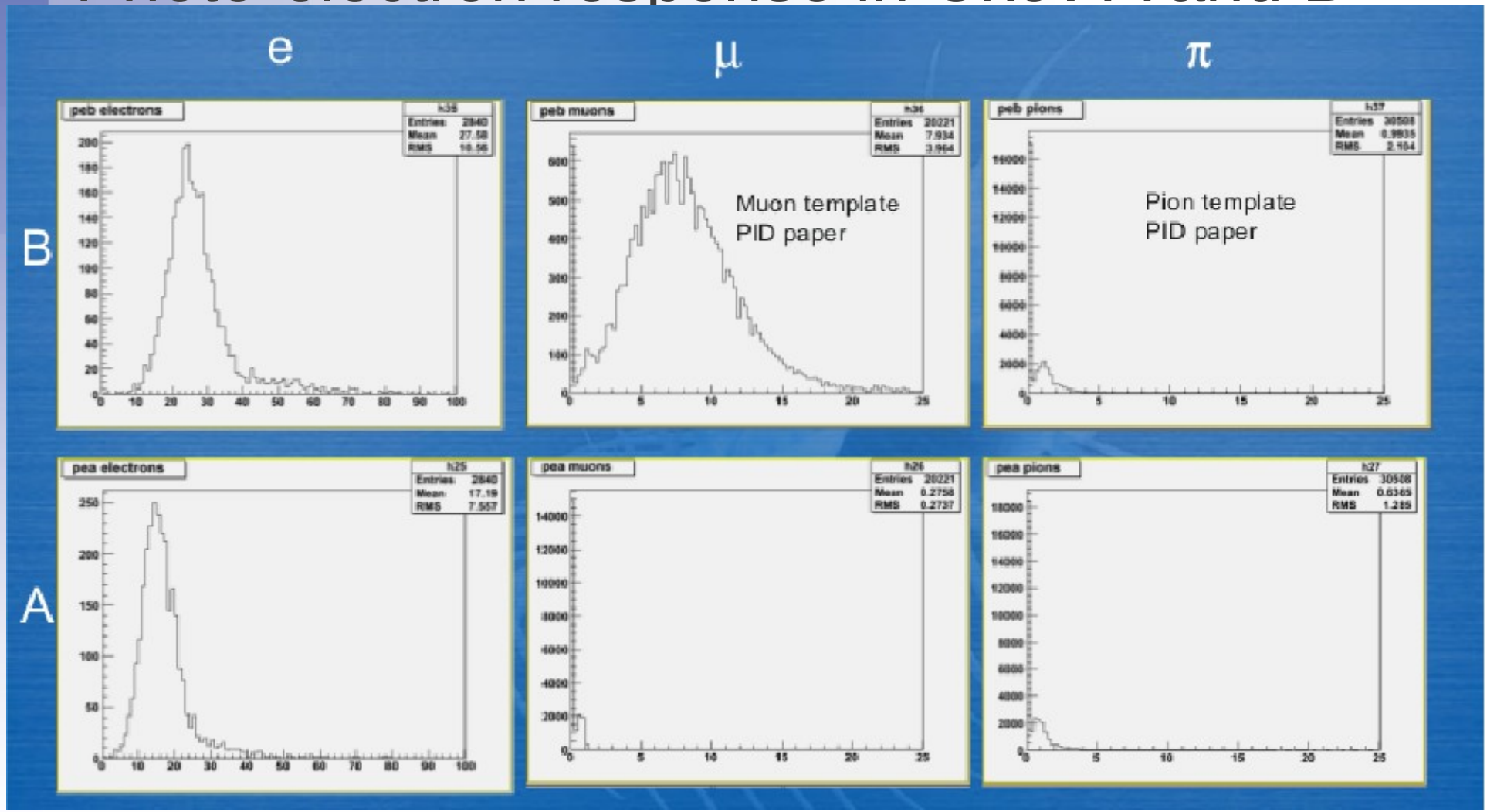
From: Ruslan Asfandiyarov, University of Geneva

Cerenkov

- Cerenkov A and B installed, operational, tested and used for beam analysis.
- Cerenkov A has been upgraded to increase pe yield.

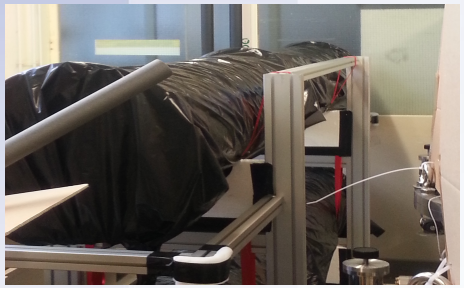
Cerenkov PID

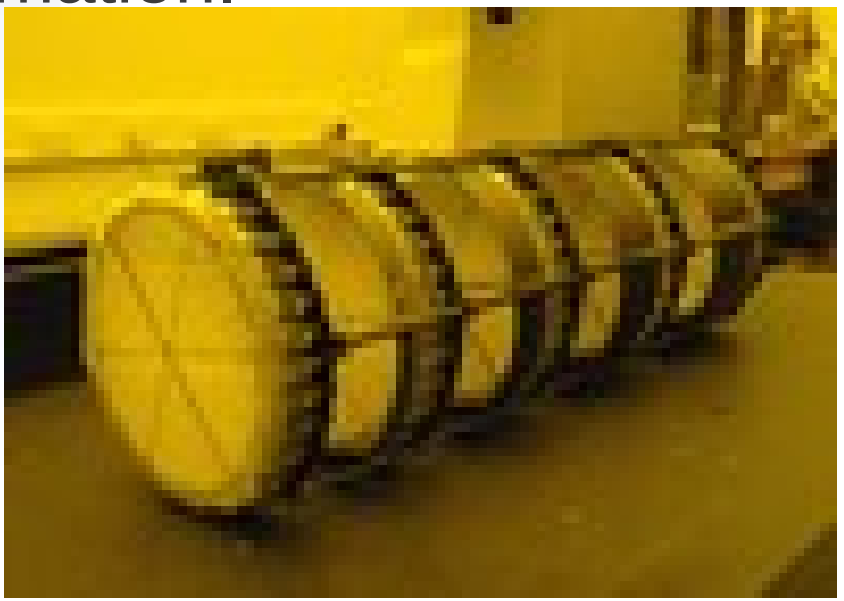
Photo-electron response in Ckov A and B

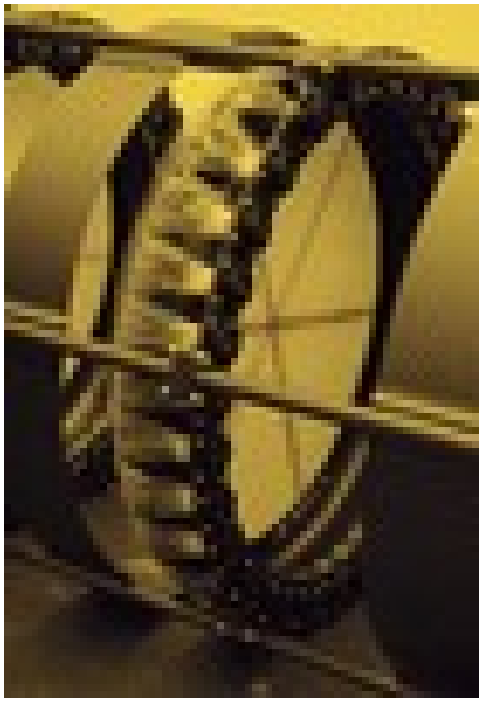


Tracker

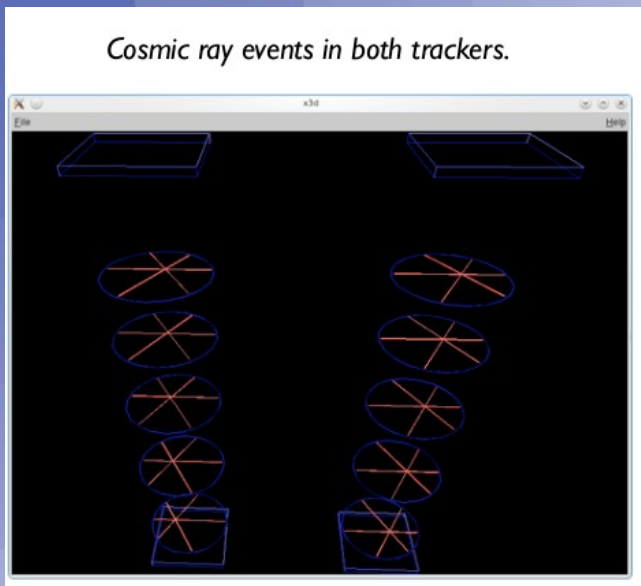
- Tracker system built and tested and is in storage.
- Work has begun to
  - upgrade system,
  - perform checks on wave guides,
  - improve LED testing and DAQ implementation of timing information.

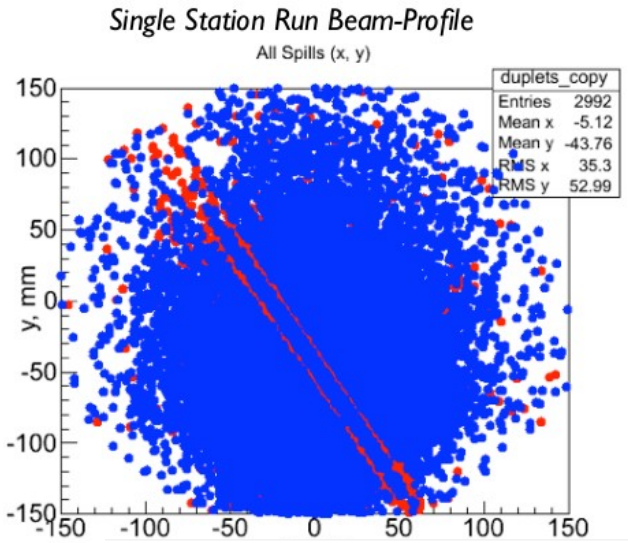






Tracker

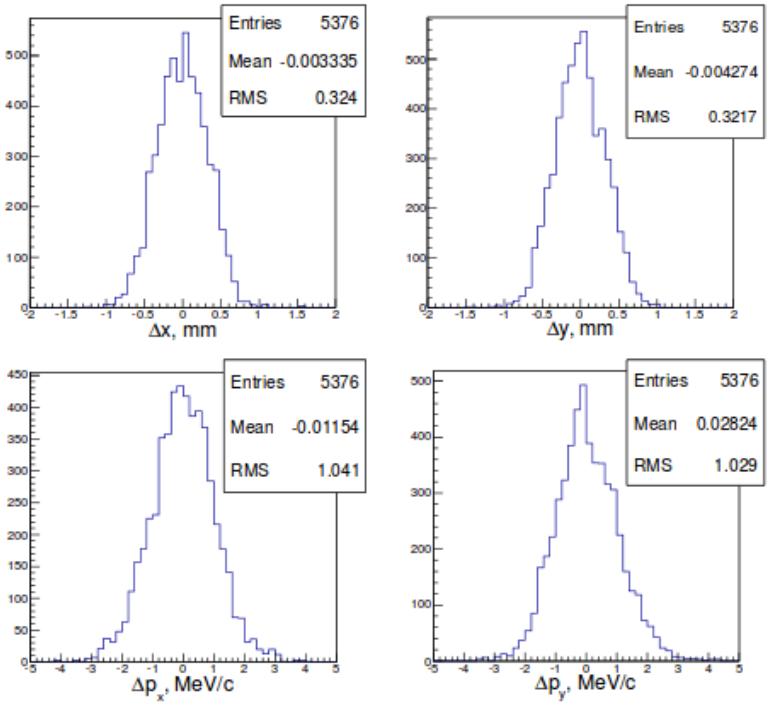




Lowest levels of reconstruction tested with real data. (cosmics 12/11 and single station run 5/12)

Resolution of the Reconstruction

Current results: (beam 4d emittance = 4; $E_\mu = 200 MeV/c$)

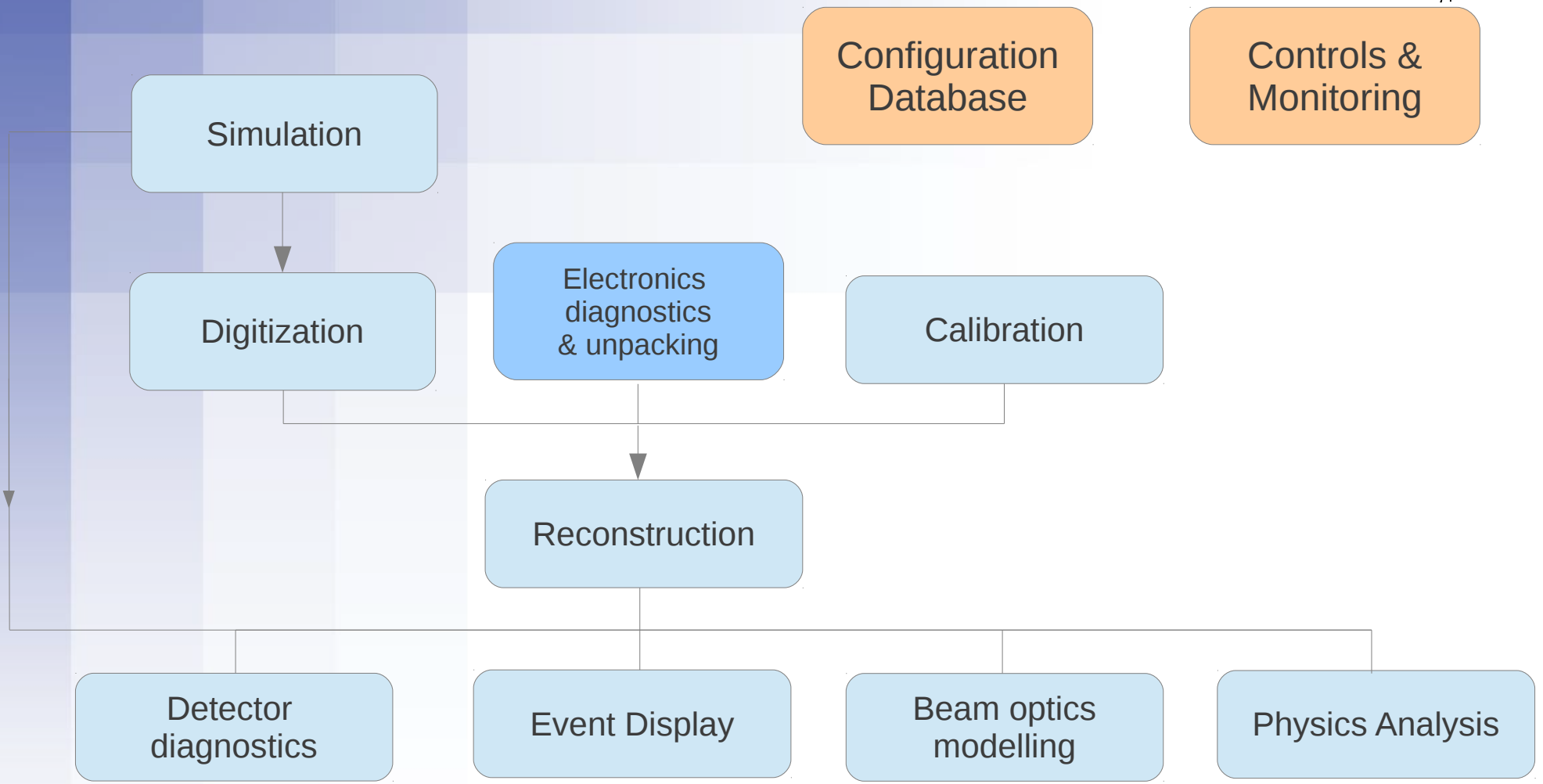


- Software and analysis in an advanced state.
- Work ongoing.

From: Ed Santos, Imperial College

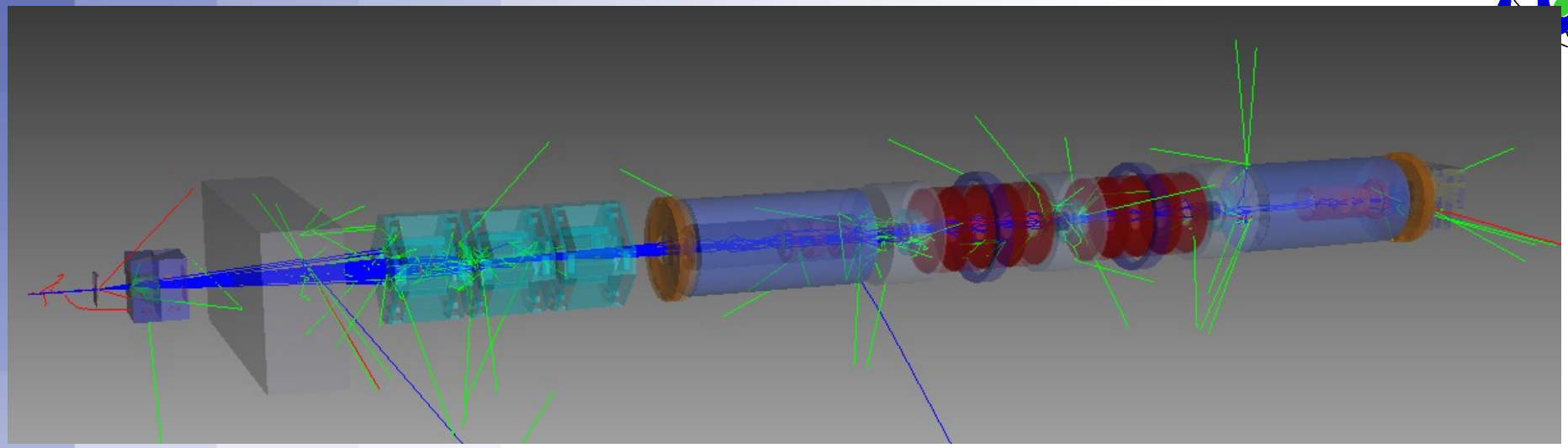
Imperial College London
Melissa George

MAUS Overview

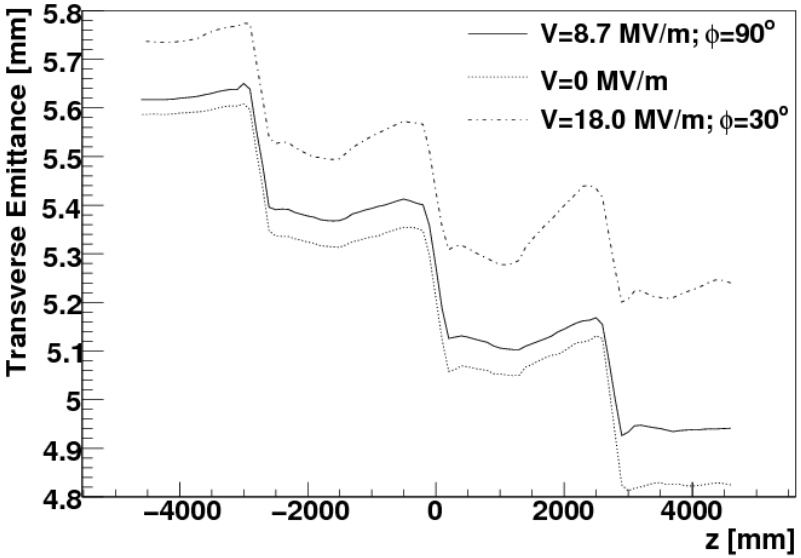


From: Chris Rogers, RAL

Simulation

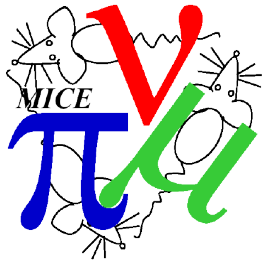


- Monte Carlo raytracing simulation
  - Custom field map models
  - Physics processes and tracking handled by GEANT4



From: Chris Rogers, RAL

Offline Reconstruction



- MAUS installed at RAL Tier1 for Offline Reco
- Automated process waiting for new raw data files when a new data file appears, makes Offline Reco and run-specific Monte-Carlo job using latest approved MAUS.
- Uses fast-response queue at RAL Tier1.
- Automatically runs MAUS jobs, creates output tarballs, saves them to Grid disk and tape.
- Future:
  - Batch Offline Reco
  - Automated Data Mover at end of each run
  - Improved handling of certificates

Analysis

Beamline PID

- Paper in progress
  Watch this space..

Spoiler Alert!!

Beamline PID

- Paper in progress
  Watch this space..
- Pion contamination of muon beam ~1%

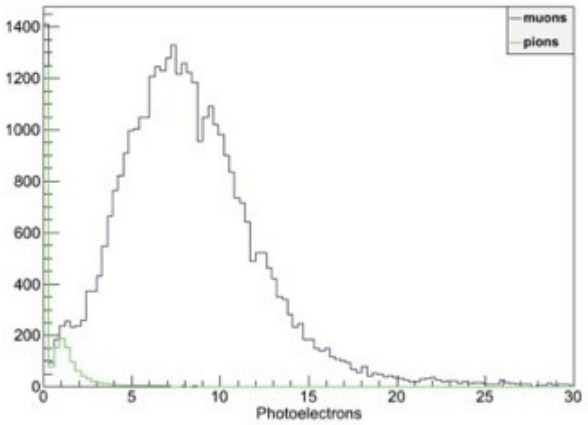


Figure 7. The photoelectron yield for muons and pions in the momentum range p =(230-280)MeV/c in Ckov b taken from a calibration run where muons and pions are selected by time-of-flight method.

5. Conclusions

A preliminary estimation of the π contamination in the MICE μ beam, based on the MC simulations and the TOF informations only, gave on an event-by-event basis a value around 1 % .

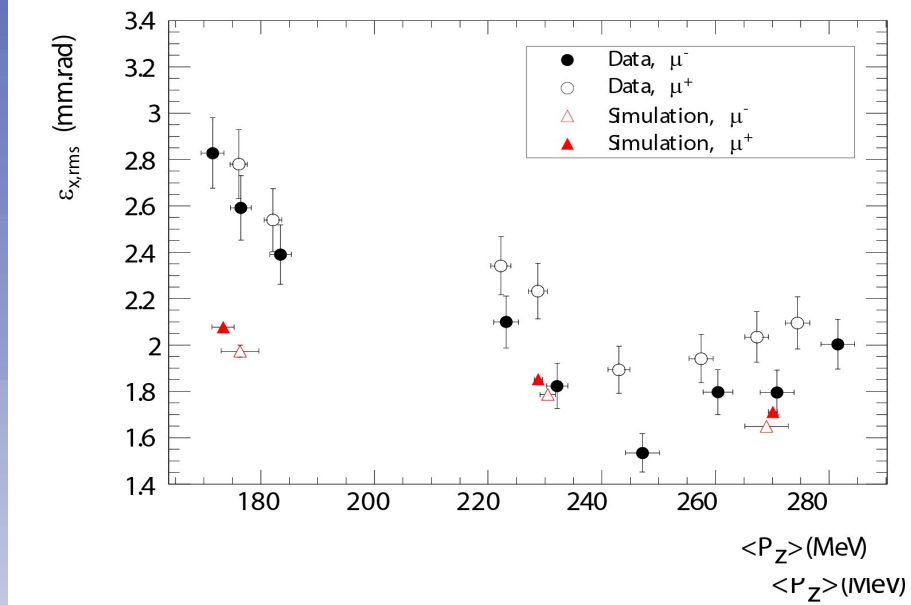
The pion contamination in the MICE muon beam has been measured on a statistical basis comparing the KL product response to calibration beams, in which the time–of–flight of the particles is used to discriminate muons from pions. Two techniques have been developed for the comparison, one using only the high KL product tail, one extending the comparison over most of the KL spectrum. The two approaches give comparable results and are both consistent with a pion contamination reaching at most the 1% level. This result has been cross-checked with a method based on CHKOV and TOF informations, that gives a result compatible within errors.

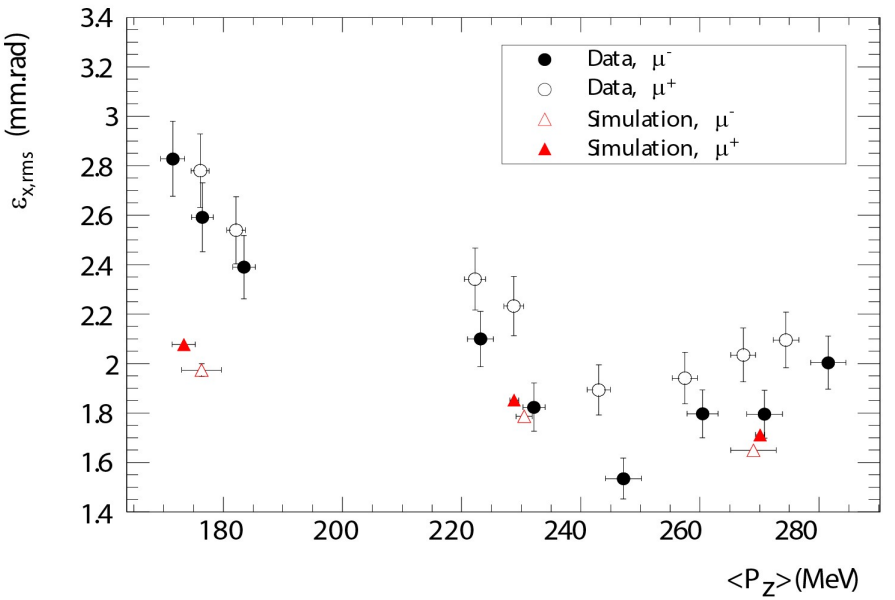
Imperial London

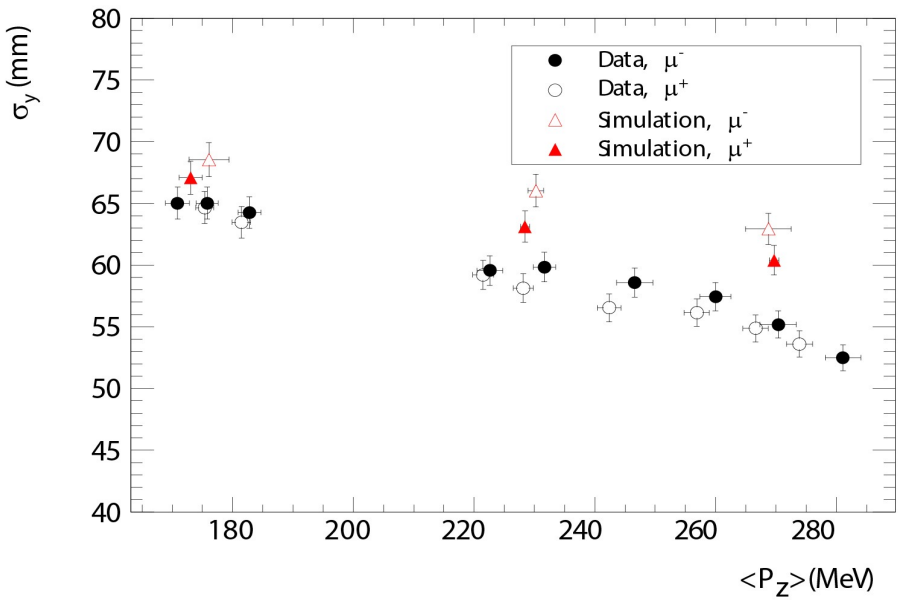
Beam size

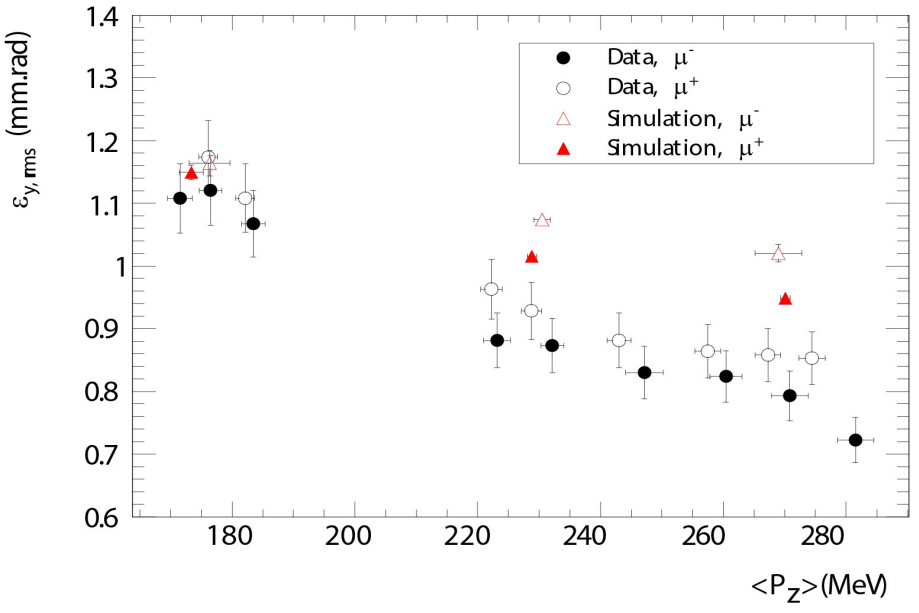
Beam Emittance

Paper in the pipeline.....

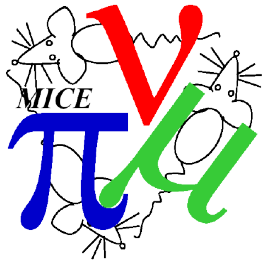








Conclusions



- MICE will reduce the emittance of a muon beam by 10% and measure this to 1%.
- MICE will be implemented in three stages
  - Step I is already complete.
  - Step IV involving two spectrometer solenoids and an absorber is on target.
  - Step VI full mice which includes three absorbers and two RF cavities, by 2018.
- Detectors are for the most part built, have been run and tested and in some cases are being upgraded. (EMR is under construction)
- Software
  - MAUS software suite is advancing well.
  - All detector software is implemented and development is ongoing.
  - Offline Reconstruction is performed automatically on new raw data files.
- Analysis of the beam under way.
- 2 papers in the pipeline.

MICE construction is well under way and stage IV is on target for 2013-2015 run.