Status of the MICE Online Systems

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Outline

I. Introduction

II. Data Acquisition

III. Online Reconstruction

IV. Controls and Monitoring

V. Infrastructure

VI. Conclusions

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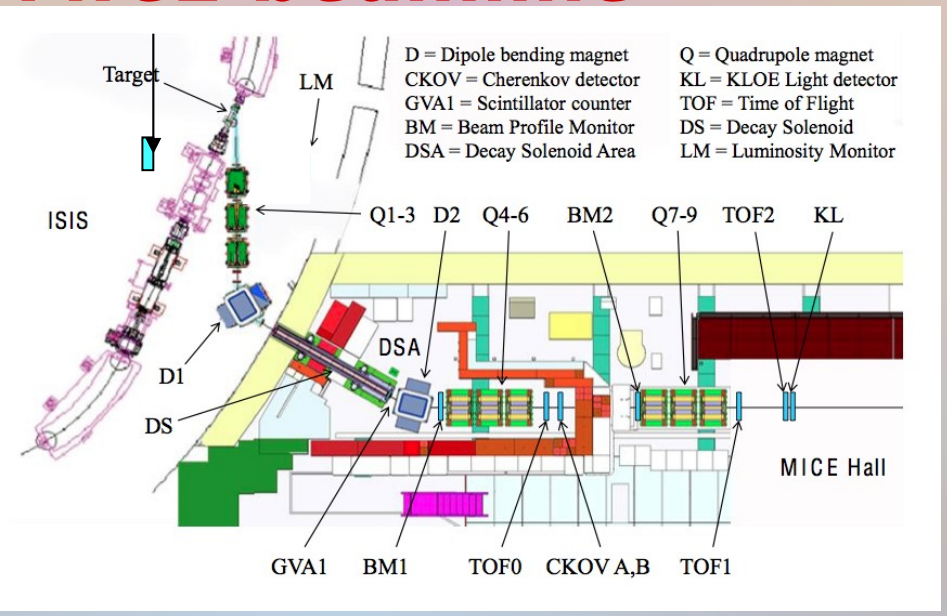
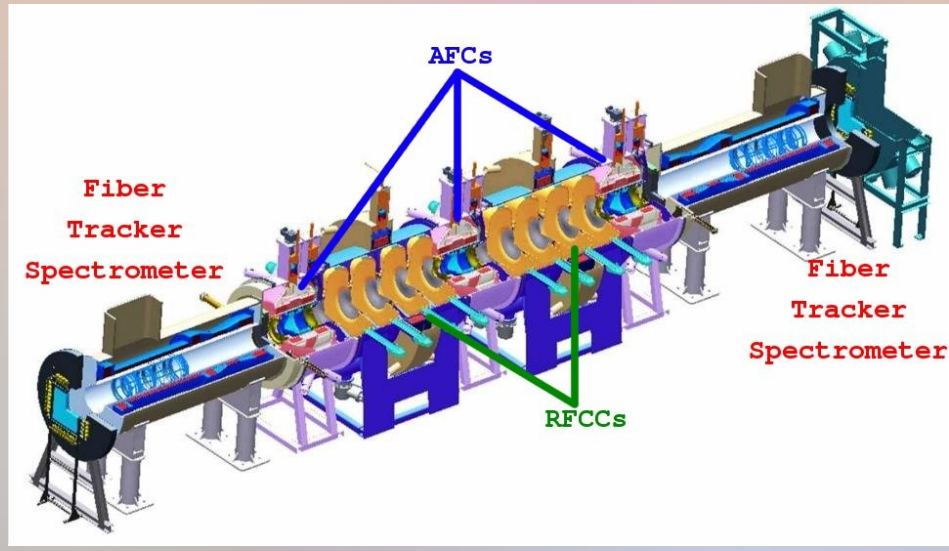
Introduction

- *Beamline – create beam of muons*
- *Particle ID – verify/tag muons (before/after)*
- *Spectrometers – measure ε (before/after)*
- *Absorber (LH_2 or LiH) – cooling*
- *RF – re-establish longitudinal momentum*

MICE beamline





MICE cooling channel

Online Responsibilities

The MICE Online Group creates, maintains, and ensures proper use of all tools (hardware, software, and documentation) within the MICE Local Control Room (MLCR) used by the experiment to efficiently record high quality data. We are responsible for:

- **Data Acquisition (DAQ)**
- **Online Monitoring and Reconstruction (OnMon/OnRec)**
- **Controls and Monitoring (C&M)**
- **Data Transfer**
- **Networking and MLCR Computing**

We also interface closely with systems related to the Online sector including MICE Operations, Offline Software, and Computing

Online Structure

Linda Coney – **head of Online Group**, Online Reco

David Colling – **head of Software & Computing**, GRID PP contact

Yordan Karadzhov – **head of DAQ**, OnMon

Pierrick Hanlet – **head of C&M**, connection to Config DB

Daresbury Lab – C&M - Brian Martlew (head of DL group)

Paul Hodgson – C&M (target)

Matt Robinson – C&M (target,tracker), System Administrator

Mike Courthold – Networking

Henry Nebrensky – GRID, Data Transfer, MICE Data Manager

Janusz Martynikk – MICE Data Mover – Data of Online System

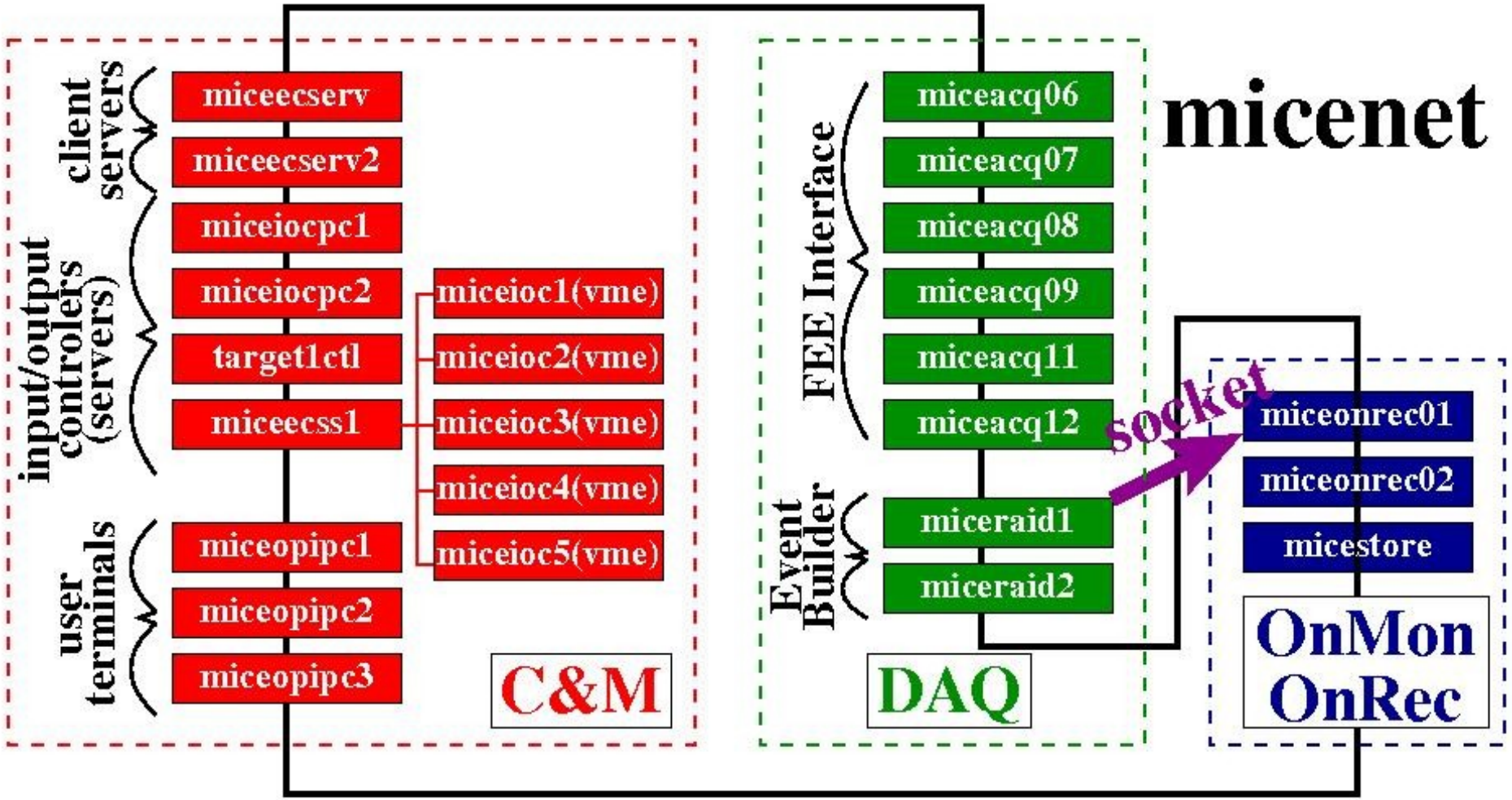
Paul Kyberd – GRID, Contact person for GRID PP

Craig Macwaters – MLCR Network, Hardware, Computing

Antony Wilson – Config DB, MICE PPD IT Contact

Chris Rogers/Chris Tunnell – link with Software Group

Online Structure



Online Group

- New leadership and organization (June '11)
- Redmine used to record/track issues
  - prioritize issues and effort
  - search-able
  - remotely accessible
- Excellent progress → successful Dec '11 run

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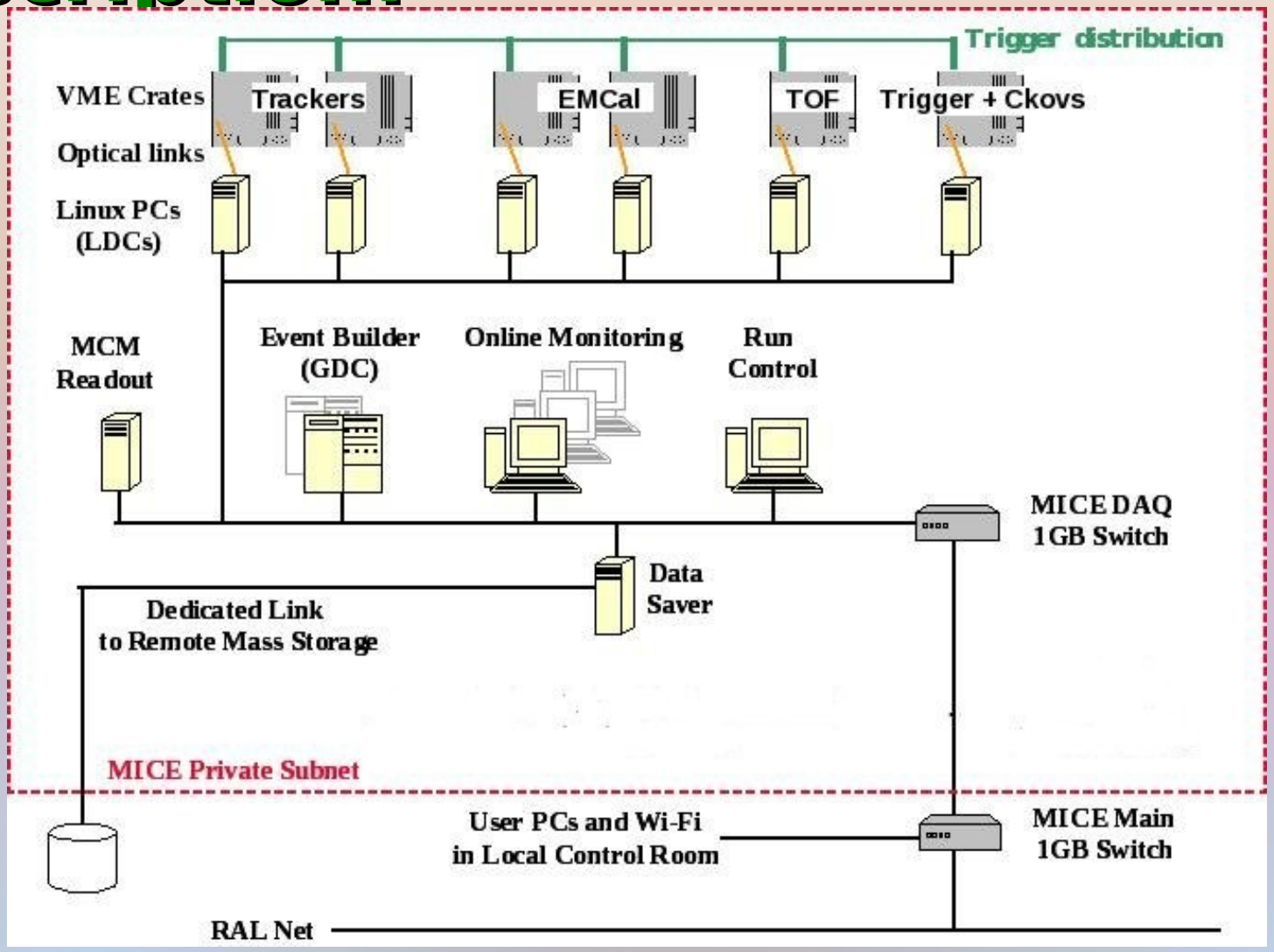
Data Acquisition

Description:



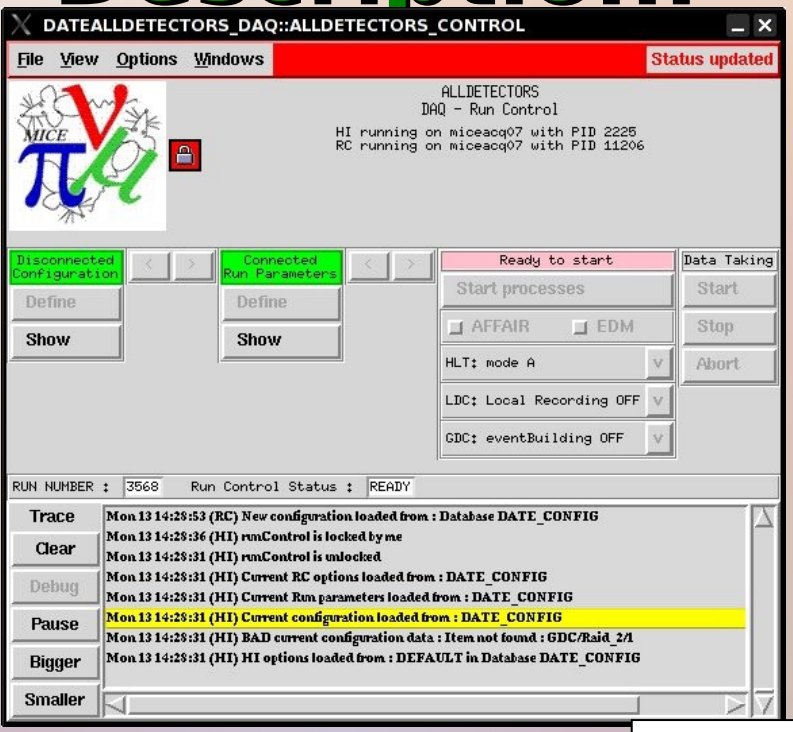
Data Acquisition

DAQ and Trigger requirements:

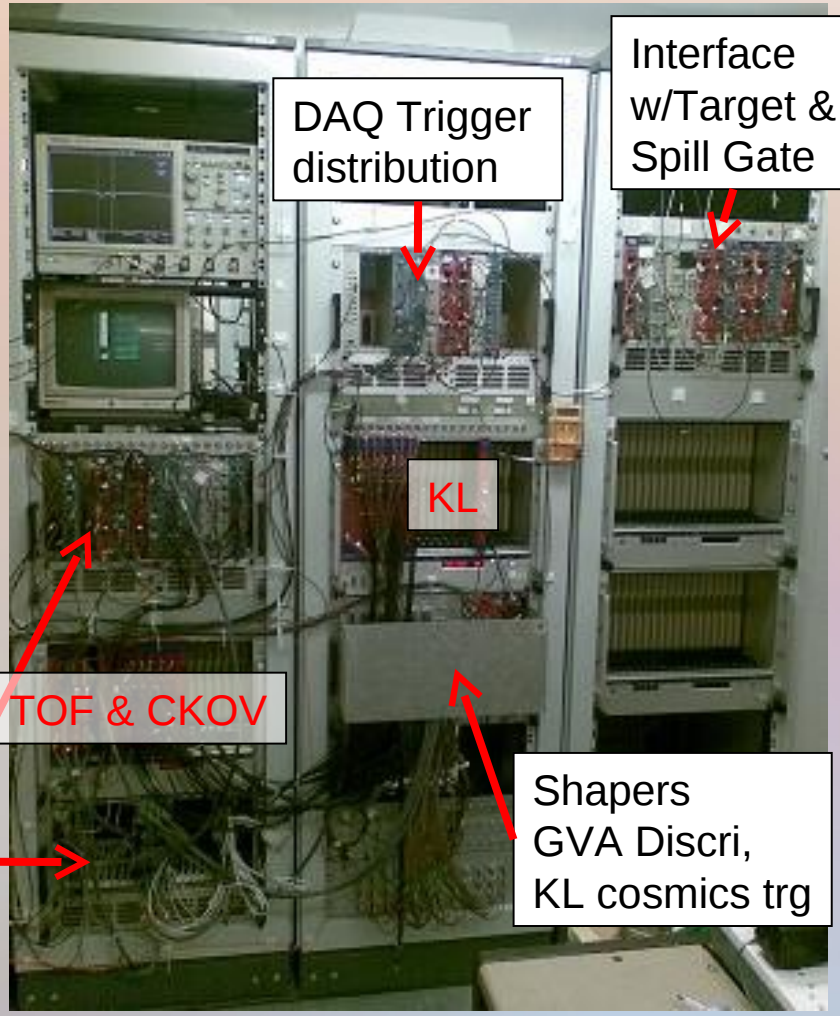
- stable over long-term & maintainable
- non-expert use (documentation)
- 600 particles per 1 ms spill at 1 Hz
- event size ≤60 MB (normally ~30 MB)
- flexible:
  - select FEE to read and trigger
  - run independently of target and RF
- interface with C&M
- interface with OnMon & OnRec

Data Acquisition

Description:



DATE (ATLAS) framework



Scalars and particle trigger NIM Logic

TOF discriminators and trigger CAMAC Logic

Data Acquisition

Status:

- prototype EMR detector and electronics successfully integrated
- simultaneous readout of both trackers during cosmic ray data-taking using DATE
- communication established linking DAQ, C&M, and CDB – allows monitoring of the DAQ status and archiving of DAQ parameters in the CDB
- new unpacking code

Data Acquisition

Efforts:

- upgrade DAQ – DATE version and OS
- software trigger selection
- incorporate new detectors
  - EMR – spring cosmic run with new DAQ
  - tracker – single tracker station test
- improve system performance
- improve error handling
- incorporate new DAQ computers (LDCs)
- integrate with C&M and CDB

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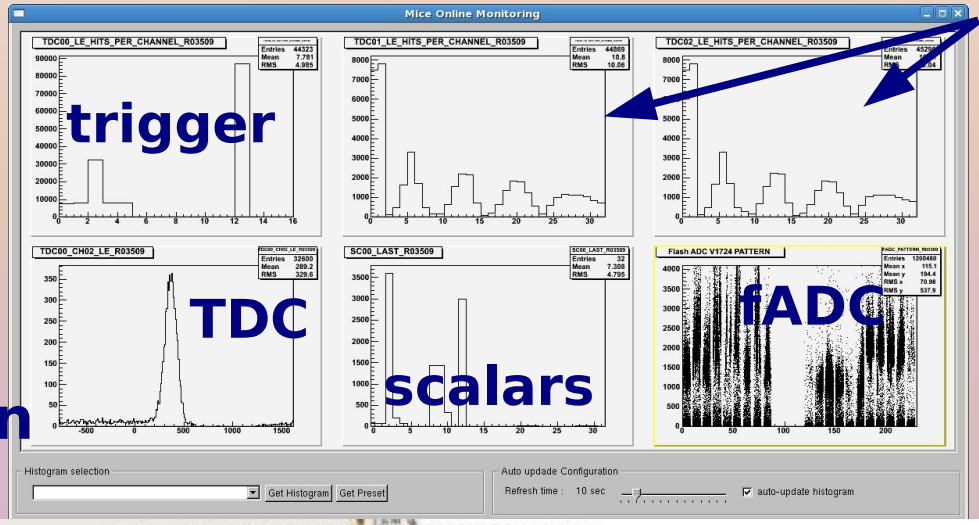
Online Monitoring and Reconstruction

- Two components:
  - Monitoring (OnMon)– DAQ raw distributions
  - Reconstruction (OnRec) – same code as offline reconstruction software
- OnMon and OnRec run over socket
- Now using new MAUS software framework
- Excellent progress → successful Dec'11 run

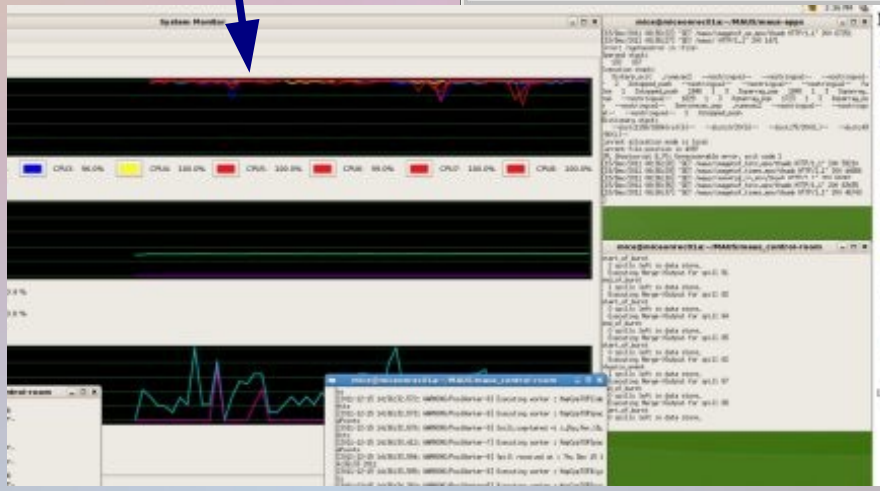
Online Monitoring

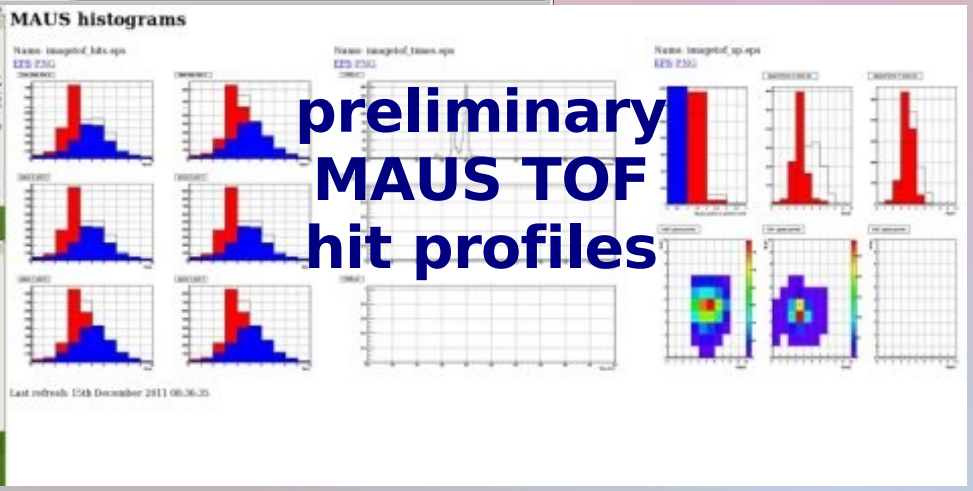
- new unpacking software

TOF hit profiles



CPU monitor parallelization



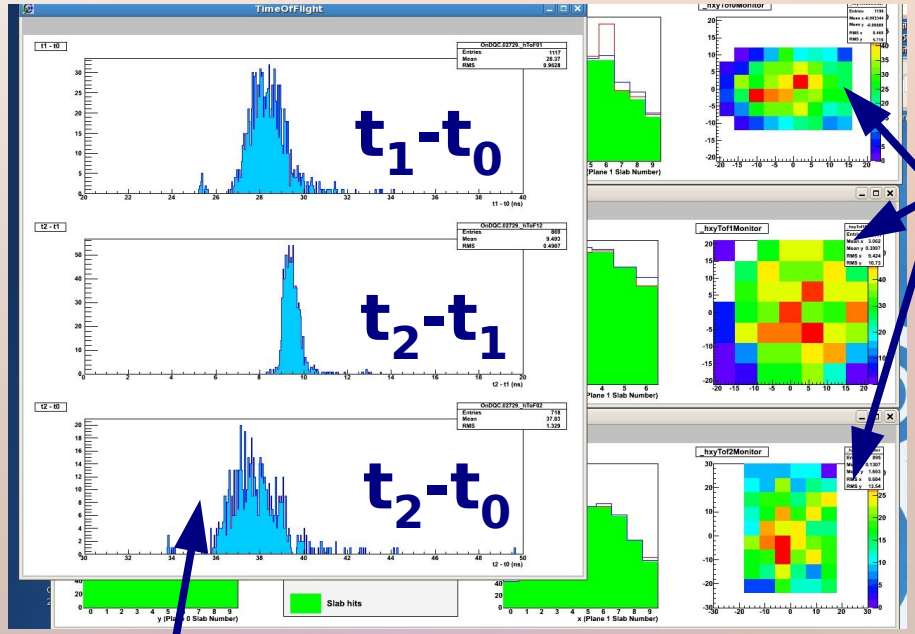


preliminary MAUS TOF hit profiles

Online Reconstruction

- real-time physics & detector functionality
- TOF, KL, & CKOV detector readout
- beam dynamics parameters
- time-of-flight distributions for PID
- data transfer out of the MLCR (Online responsibility limit) automated
  - archives of all online plots
  - data transferred to public webserver

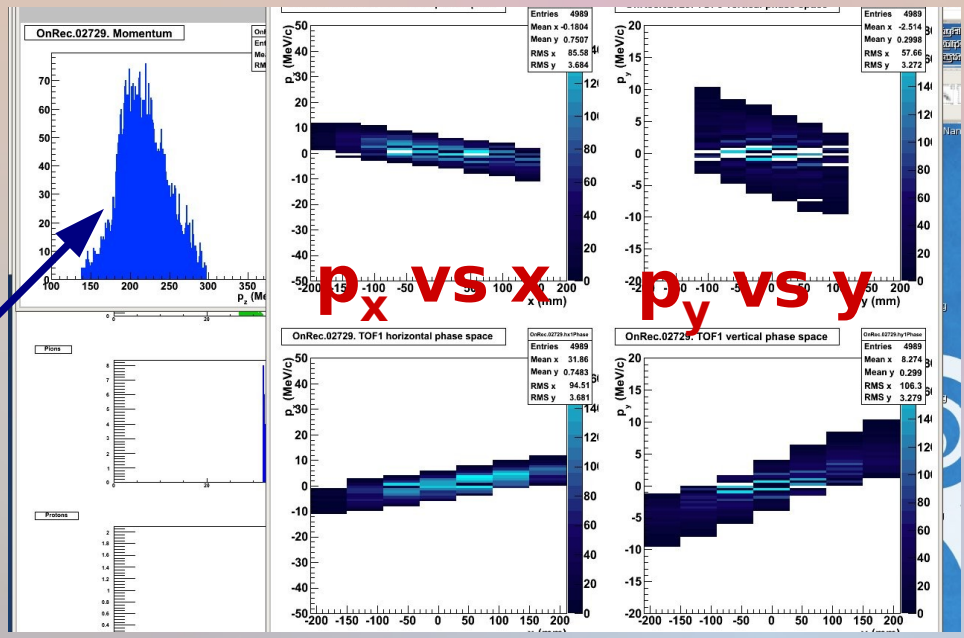
Online Reconstruction



TOF 2D profiles

Δt distributions

trace-space distributions



p_x vs x

p_y vs y

μ momentum

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Controls & Monitoring

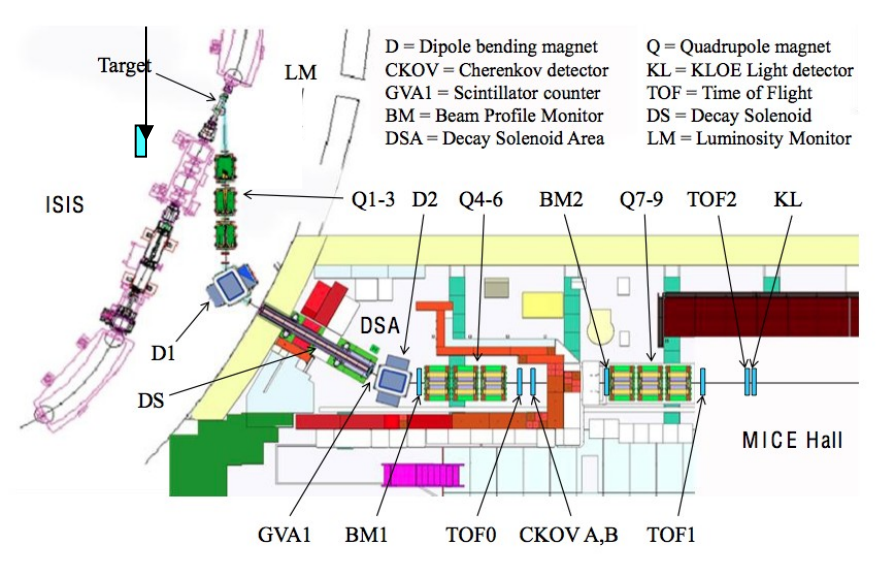
Purpose:

- **Controls refers to:**
  - **user interface to equipment**
  - **proper sequencing of equipment**

- **Monitoring serves to:**
  - **protect equipment (early notification)**
  - **protect data quality**
  - **user monitoring**

Controls & Monitoring

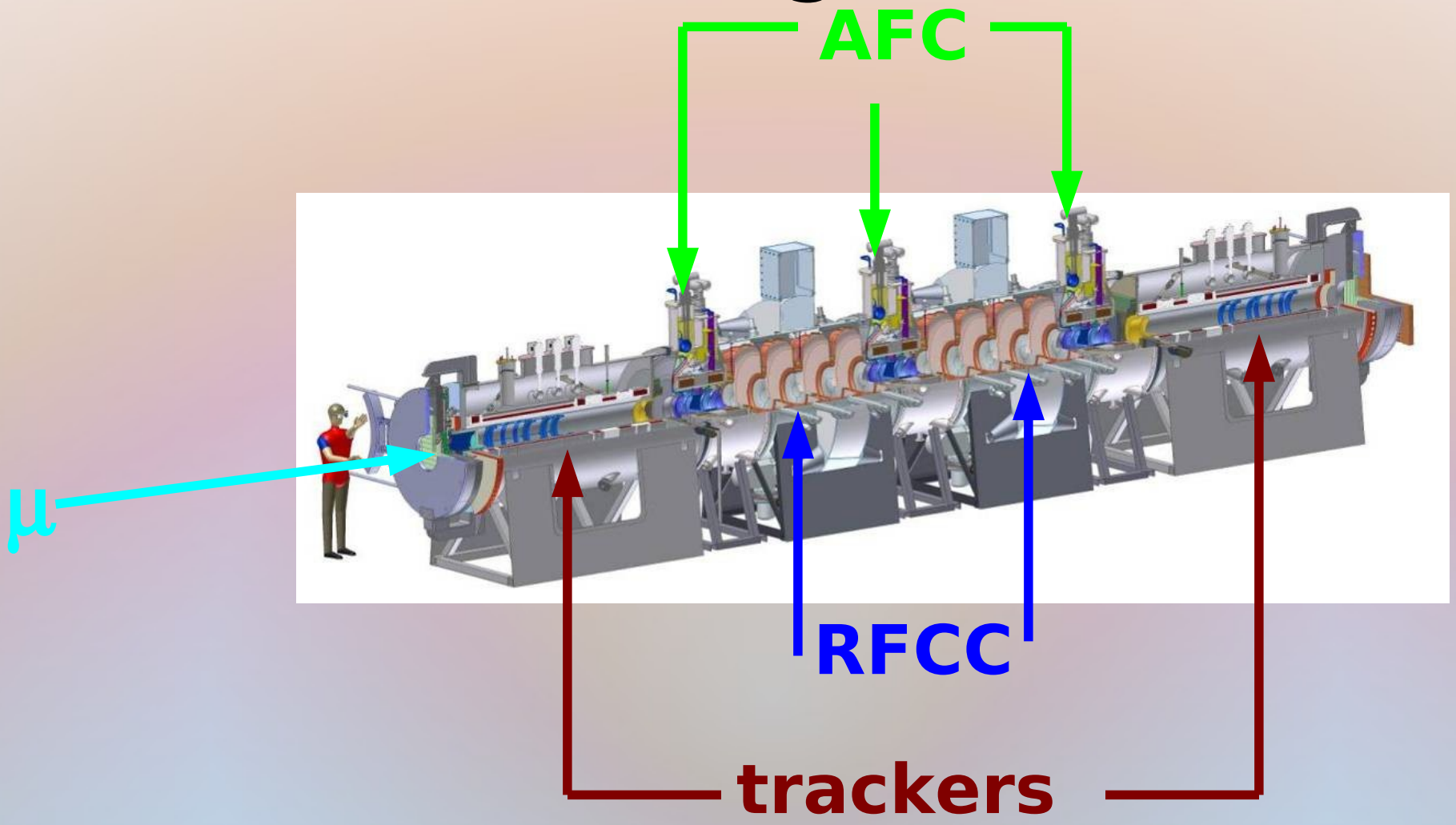
Status and immediate needs:



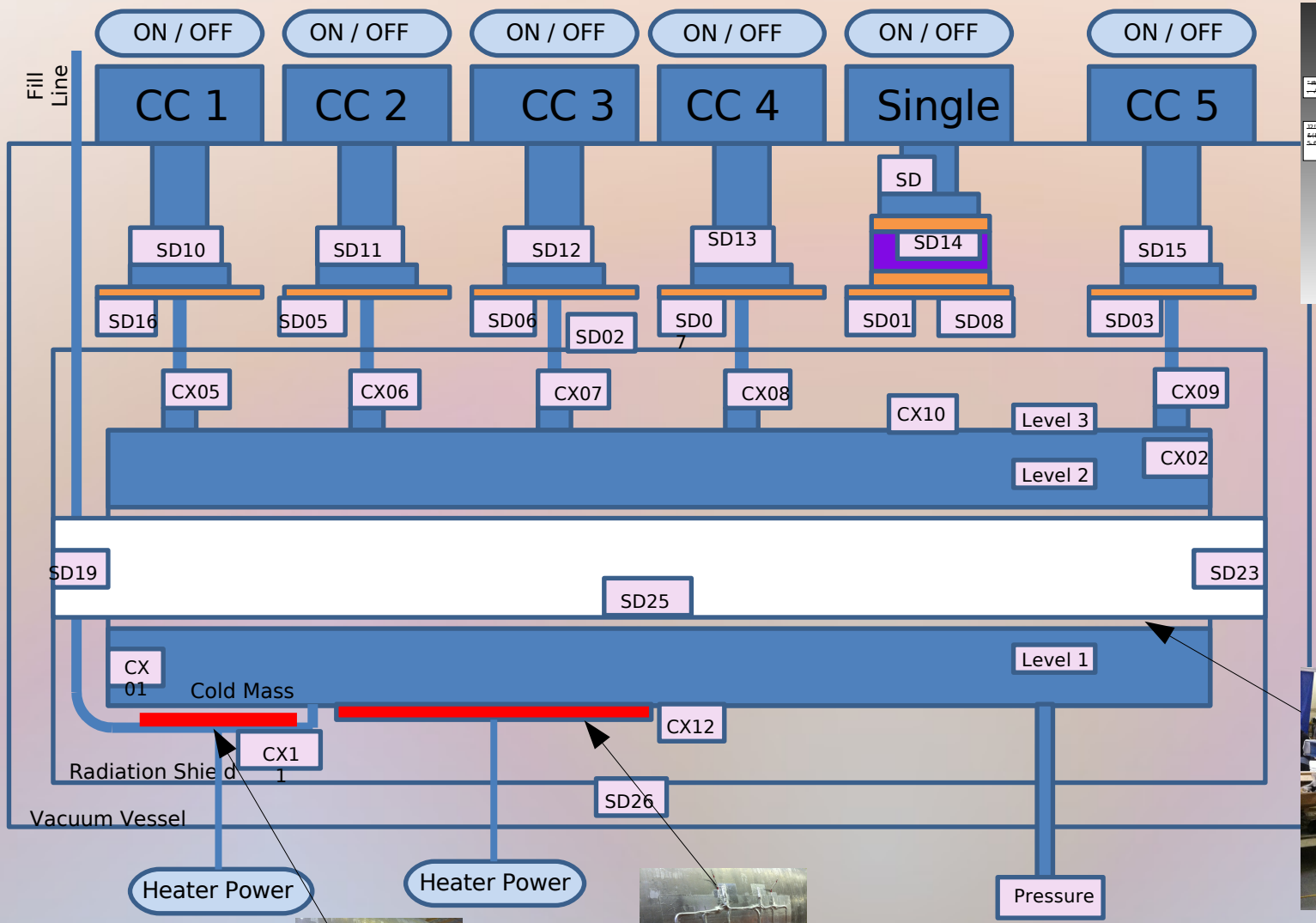
- Step I complete
  - Beamline
  - Particle ID – PID
  - Alarms, archiving, external gateway
  - Experimental hall environment
- SS and FC acceptance testing
- Run Control

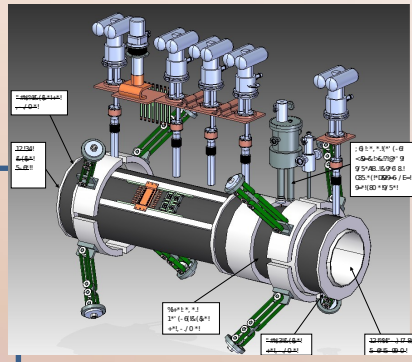
Controls & Monitoring

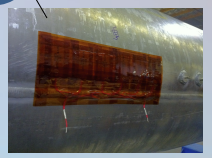
Next focus – cooling channel:

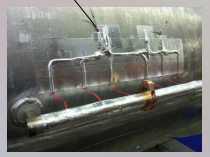


Controls & Monitoring









Controls & Monitoring

quench protection (FNAL)

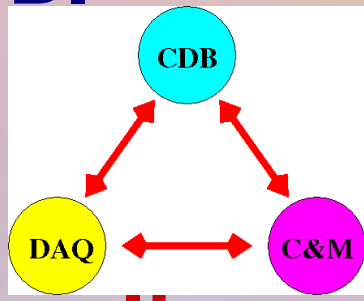
standalone C&M (DL)

power supply (LBNL)

Controls & Monitoring

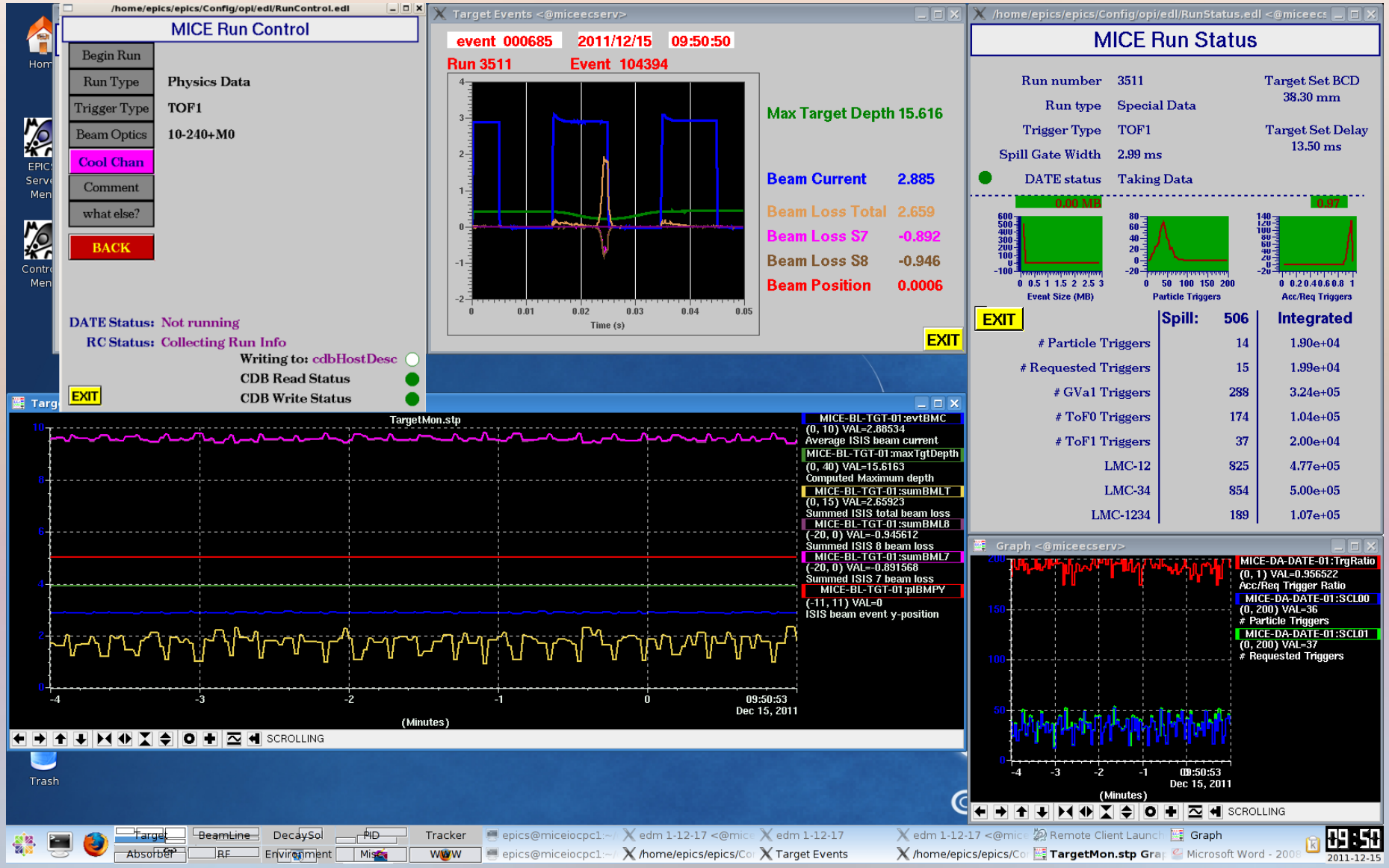
MICE is a *precision* experiment:

- **measure a muon cooling effect to 0.1%**
- **imperative – control *all* systematic errors**
  - **ensure data taking parameters of all of the apparatus in MICE be carefully recorded/restored to/from the CDB.**



To accomplish this, the target DAQ, the experiment DAQ, controls for beamline elements, MICE state machines, and PID have been integrated with the CDB into a single "Run Control" process.

Controls & Monitoring



Controls & Monitoring

Other aspects and future:

- FC – similar to SS *(due at same time!)*
- RF tuners – MTA single 201MHz RF cavity
- MICE Hall services control
- EMR test
- Target & Tracker controls upgrade
- LH_2
- RF

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Infrastructure

I. **Dedicated system administrator!!!**

II. **Necessary improvements made to the online system infrastructure:**

- **Hardware vulnerabilities were assessed, leading to the replacement of several DAQ crates and the purchase of spares**
- **Easily-swapped-in computers have been prepared in the event of key machine failure**
- **All hardware damaged during an unexpected power surge in early 2011 has been repaired or replaced**

Infrastructure

- An upgrade of the OS for all online computers has been initiated using two test computers added to the MLCR network to facilitate a controlled migration
- Operations and Online systems documentation has been reviewed, updated, and posted

Online Future

- March run for online software tests
- June run for EMR and single station tracker
- Present foci:
  - C&M for Step IV
  - DAQ for EMR (June)
  - DAQ for single tracker station (June)
  - continued involvement from software group for online reconstruction
- online accelerator physics analysis tools

Summary

- *Online group restructured June'11*
- *Online Systems in place*
- *Step IV work progressing well*
- *Evolving needs being recognized and met*

Backup slides

Controls & Monitoring

Procedure for a data taking run:

1. query: run & trigger types, beamline, etc
2. query: C&M for MICE states, verify compatibility with requested run
3. query: CDB for beamline and particle ID settings for requested run configuration
4. determine apparatus readiness (states) and initiate setting beamline and PID parameters
5. query target DAQ for actuation number, target depth and delay
6. give pertinent information to experiment DAQ and initiate arming procedure
7. inhibit C&M from allowing any changes
8. user initiates run, Run Control reads experiment parameters and stores them in CDB
9. end of run, query for final actuation number, sum scalers, and write end of run values to CDB and to experiment DAQ