Some notes on the Beam Test

G. C. for the Beam Test Team

Outline

- Installation
  - Prototype
  - Other systems
- Detector Operation
- Running experience

The early days

Our office for the first day was the cafeteria, where we fought the DHL for the delivery of the prototype.

Then we started mounting and testing the electronics and DAQ system in the hall of the facility.

The Meson Beam Test Facility

Detector installation

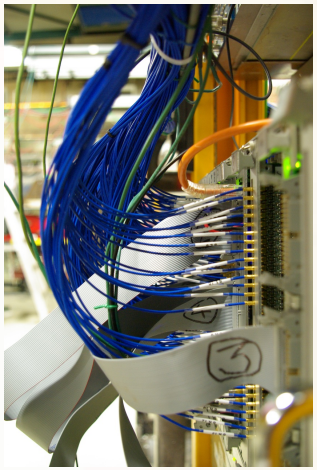
All the electronics located in a rack close to the detector.

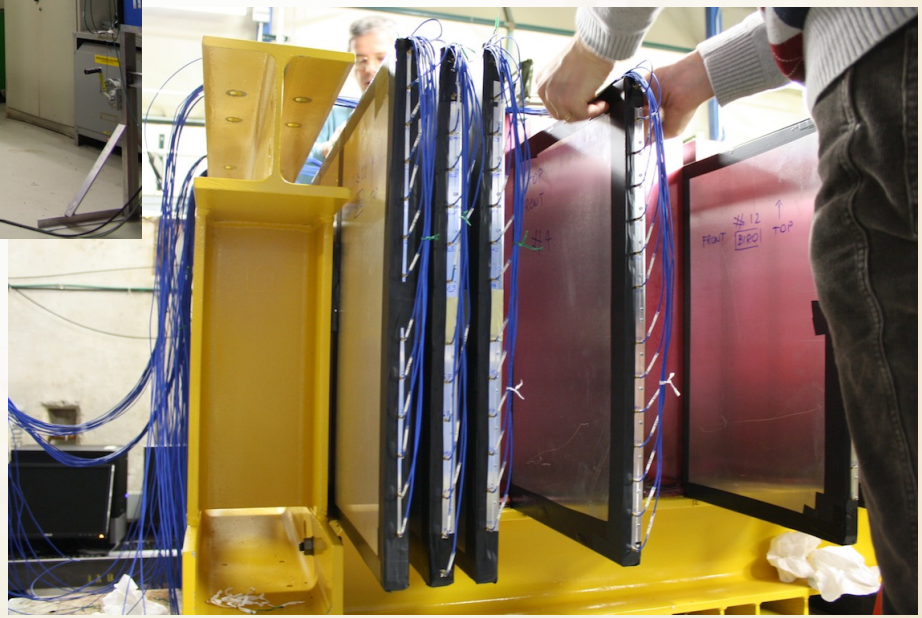
PC for TDC acquisition placed near the rack and remotely controlled with VNC.

The detector installation was smooth.

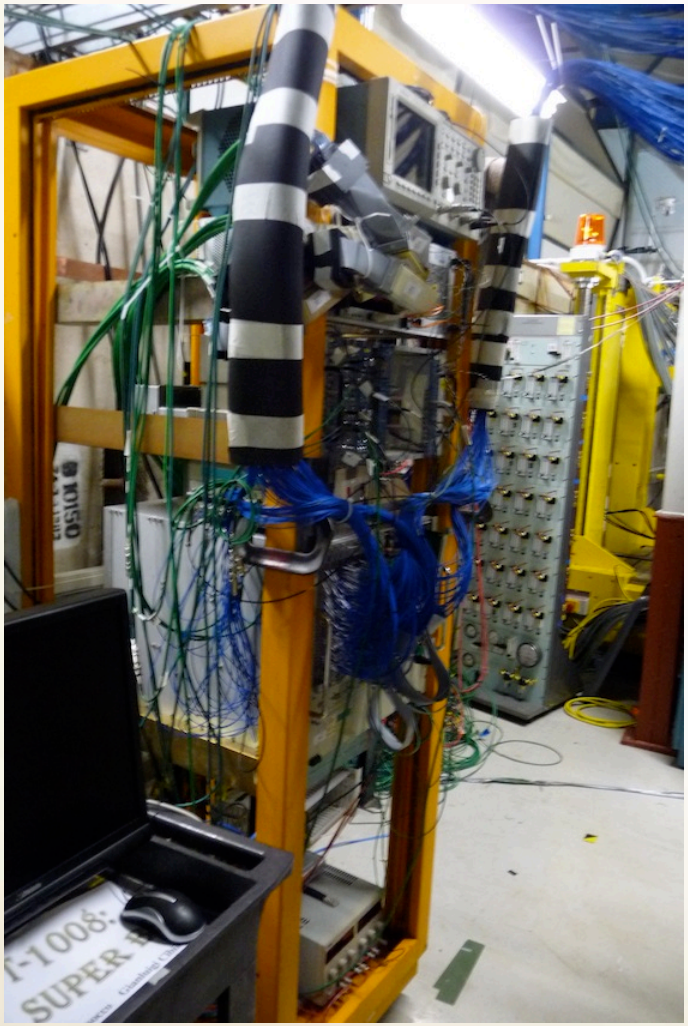
The pizza boxes fitted just right in the gaps! Almost no clearance.

and cabling



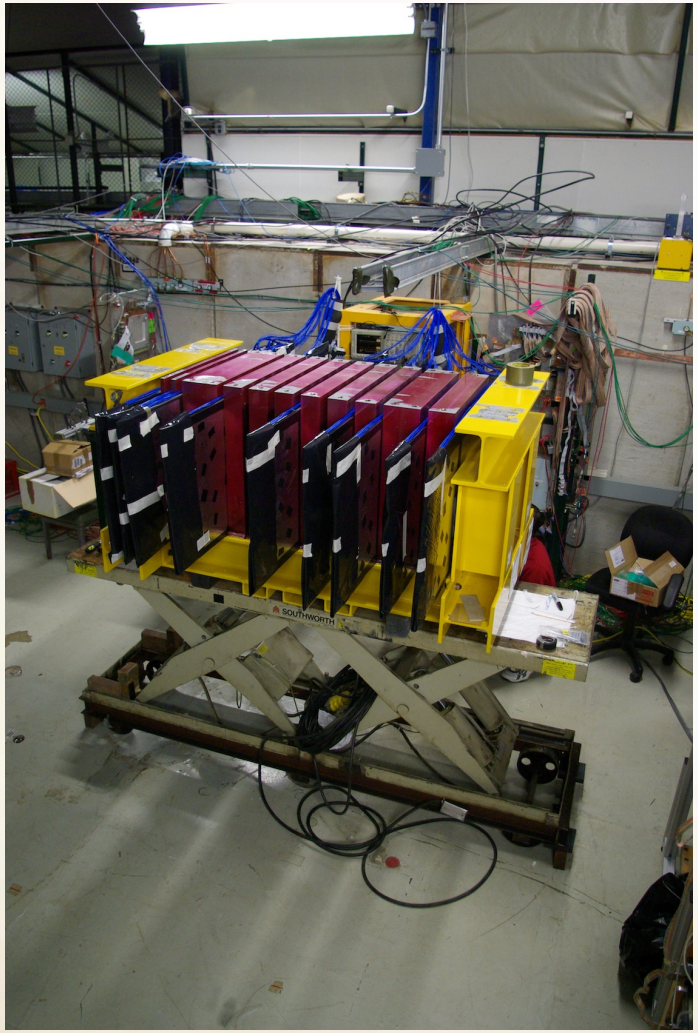


More pictures

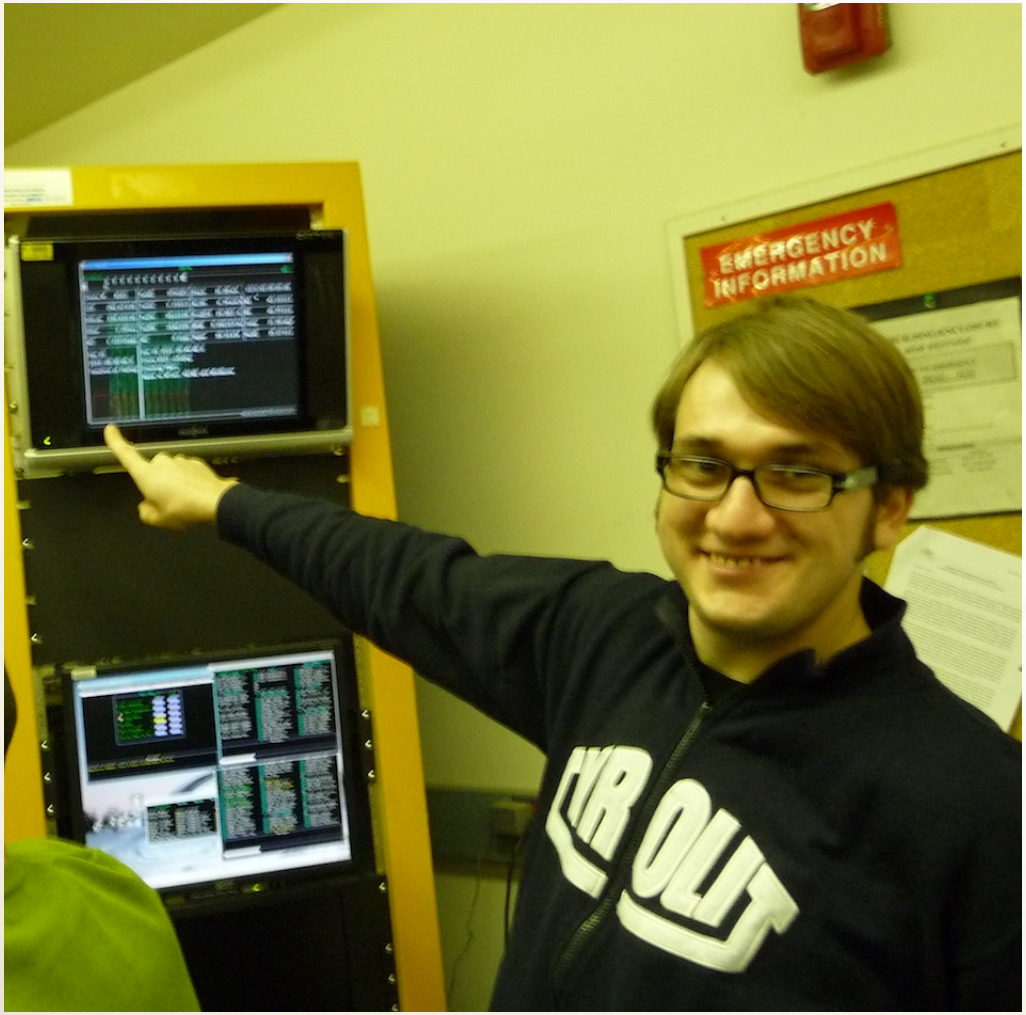


Cabling and light insulation of the boxes

Ready to take data

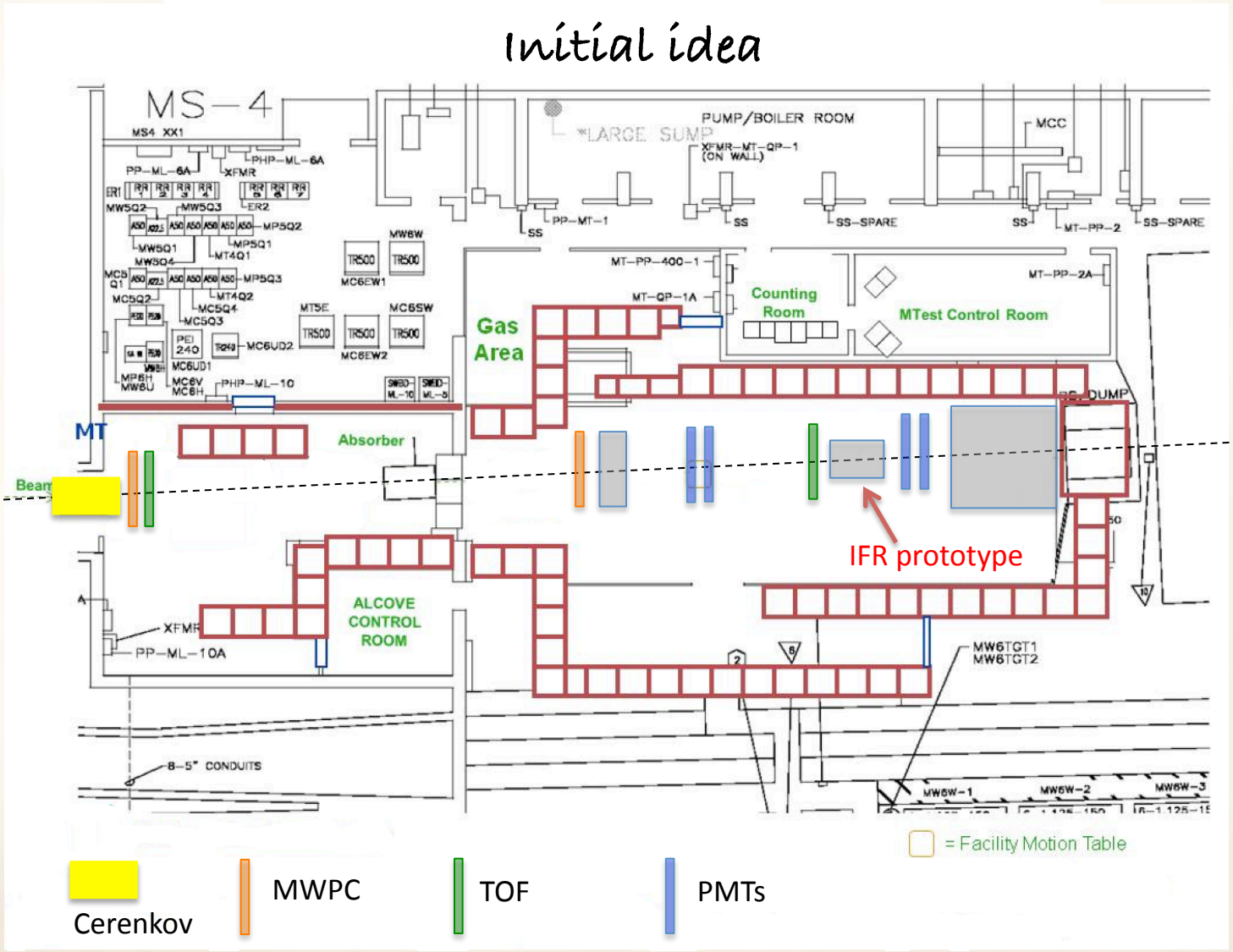


The first beam

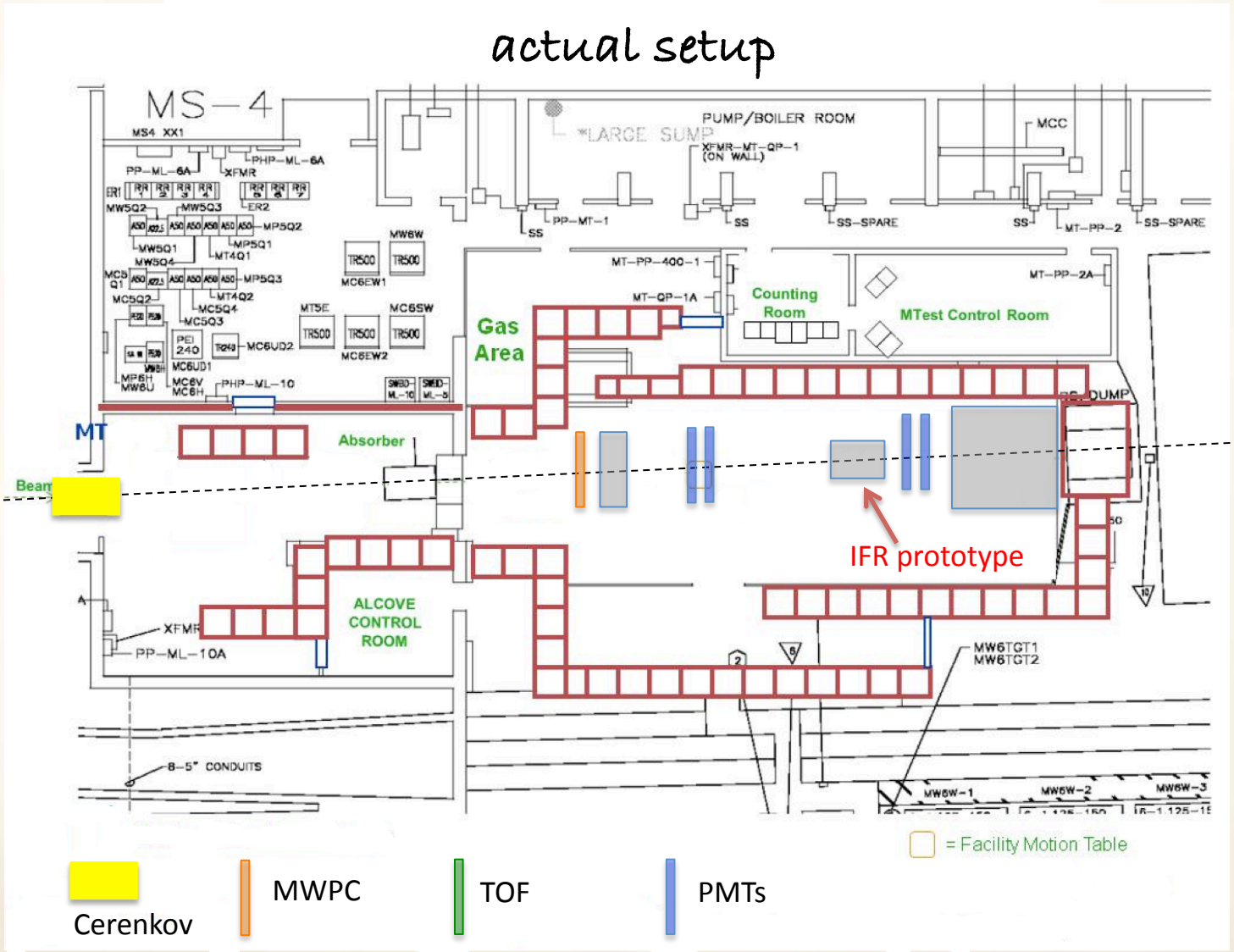


The setup

Initial idea



The setup

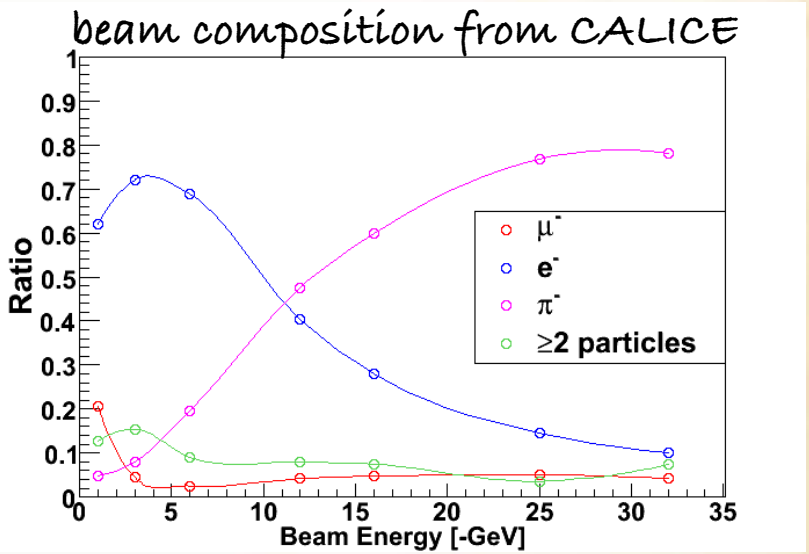

actual setup
MS-4
PUMP/BOILER ROOM
*LARGE SUMP
MCC
Counting Room
MTest Control Room
Gas Area
MT
Absorber
Beam
IFR prototype
ALCOVE CONTROL ROOM
XFMR
PP-ML-10A
8-5" CONDUITS
MW6TGT1
MW6TGT2
= Facility Motion Table
Cerenkov
MWPC
TOF
PMTs

The beam

- We had beam a little later than expected: Wednesday at 10am instead of Tuesday afternoon.
- Despite that we experienced few downtime and the beam was quite stable and usable.
- We obtained also a run extension up to 8pm for three days to compensate the downtime.

The trigger and particle rates

- Using two PMTs and two Cerenkov signals we made different trigger combinations.
  - not electron trigger (default)
  - Muon trigger
  - Pion trigger
  - Electron trigger



- We had some issues due to the reflection of the Cerenkov signals of the electron veto, producing large dead-time.

- We didn't see the expected rates, but the trigger worked fine, the busy logic as well and at the energy we ran we collected enough data.

Particle ID

- Except for the reflections in the signals the Cerenkov worked fine with Nitrogen (i.e. > 4GeV).
- At lower momenta we tried to use the C4F8O but it was probably too cold outside and we couldn't operate the detector properly.
- We spent quite a lot of time doing pressure scans to find the right operating point to maximize the muon rate: experience for the next test.
- Due to lack of time we didn't explore the low energy region so we didn't installed the TOF.

The wire chambers

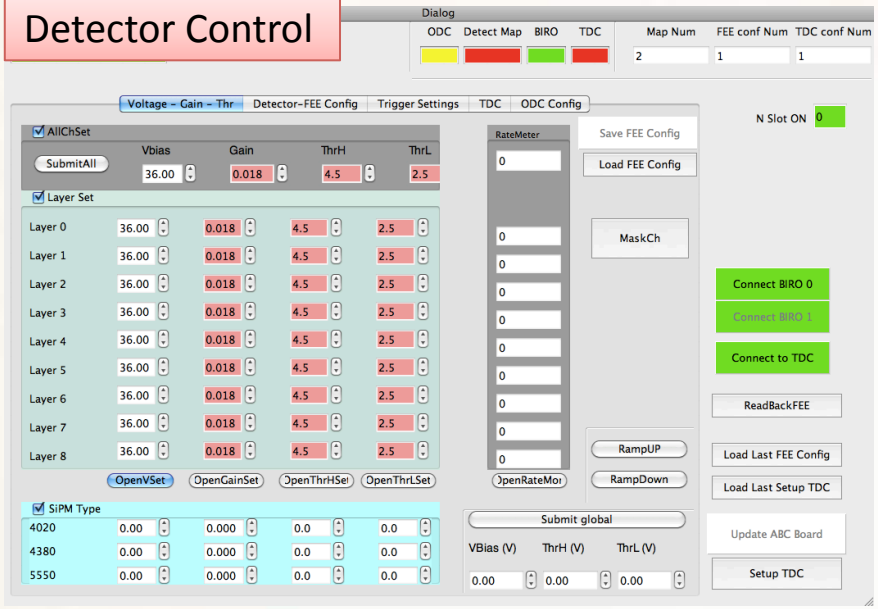
- We had one chamber installed but we couldn't use it to take date since it was causing huge dead-time.
- The expert wasn't there at the beginning of the run and when he came back we already decided to leave the chamber out for this test.
- This has no big impact on the test results.

The prototype

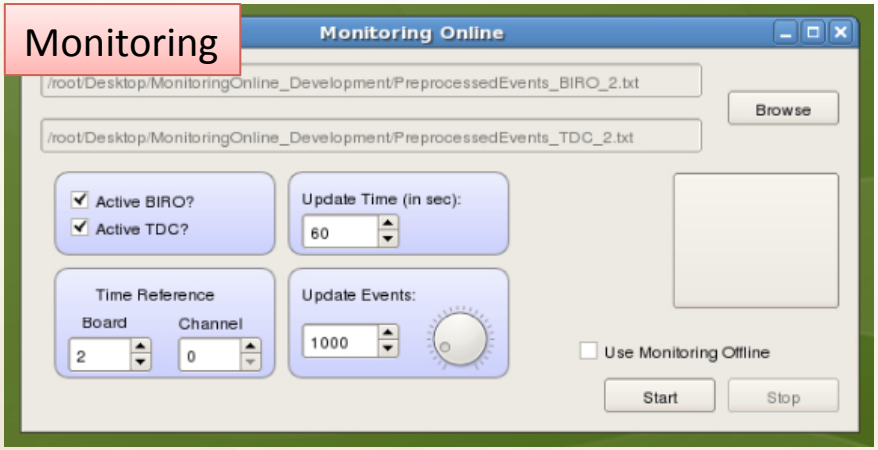
- Our prototype worked very well during all the data taking.
- The two stream (BiRO and TDC) were nicely synchronized.
- We had only a couple of dead channels in the electronics, that died during the installation when we didn't ramp up and down properly the bias voltage.
- Some issue with some TDC channels.
- No big issue of noise (actually we had less noise than in Ferrara).
- All in all a good running experience for our detector.

The online system

Detector Control

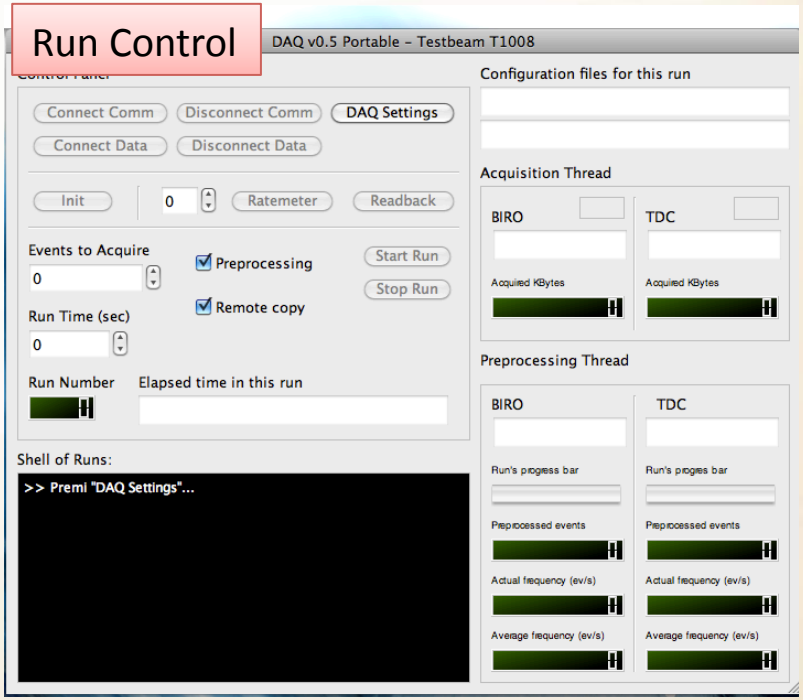


Monitoring



- DAQ and online worked properly (when no developers were around to test new "features").
- Thumb up also for the developers.

Run Control



The test

Things to learn…	…they depend on (parameter to change)…	… and need (number of events)	
Detection performances (efficiency, dark count, occupancy)	SiPM settings (gain, thr)	Even 10 kevents per conf: very fast at high momentum	Completed including special modules
Tracking performances (time resolution, track reconstruction, multiple tracks detection)	Mainly SiPM settings	~50 kevents, we can change parameters only with high rate (i.e. high momentum)	Completed including special modules
Particle ID (muon pion separation)	Mainly beam momentum and absorber configuration but also on SiPM settings	~500 kevents distributed over the entire momentum range (1GeV – 5GeV)	Done only at high momenta (≥ 4 GeV)

The test

Day	Conf	First shift	Beam energy	Second shift	Beam energy	After beam
Wed	CP1	Beam tuning and DAQ/ trigger test	8 GeV	Trigger setup	8 GeV	trigger installation and other maintenance
Thu	CP1	Cerenkov scan	8 GeV	Steady run	8 GeV	
Fri	CP1	Cerenkov scan	5 GeV	Steady run	5 GeV	Change gas in the Cerenkov
Sat	CP1	scan with C4F8O	3 and 4 GeV	Cerenkov scan (N)	4 GeV	
Sun	CP1	steady run	4 GeV	steady run	4 GeV	
Mon	CP1	steady run	5 GeV	steady run	6 GeV	insert special modules
Tue	CP1 special	steady run	8 GeV	steady run	8 GeV	dismount

My outlook

What's now

- Take pure quality muons with cosmics run and compare with what we have in the data.
- Improve and optimize DAQ, monitoring and detector control. An online event display will help to check what we are acquiring.
- Develop offline code.
- Test MPPC module.
- Fully understand the operational feature and peculiarities of our prototype.
- Account more time for the next beam test and be sure to have more support from Fermilab.

Some questions to help making a plan

- Assemble new pizza boxes (?). Are we happy with the present layout? (SiPM, fibers, scintillators)
- What about a pizza box with irradiated SiPM?
- Do we have enough time and manpower to develop our own TDC?
- Can the double hit resolution of the TDC be an issue for the time readout?

Two thumbs up for the crew