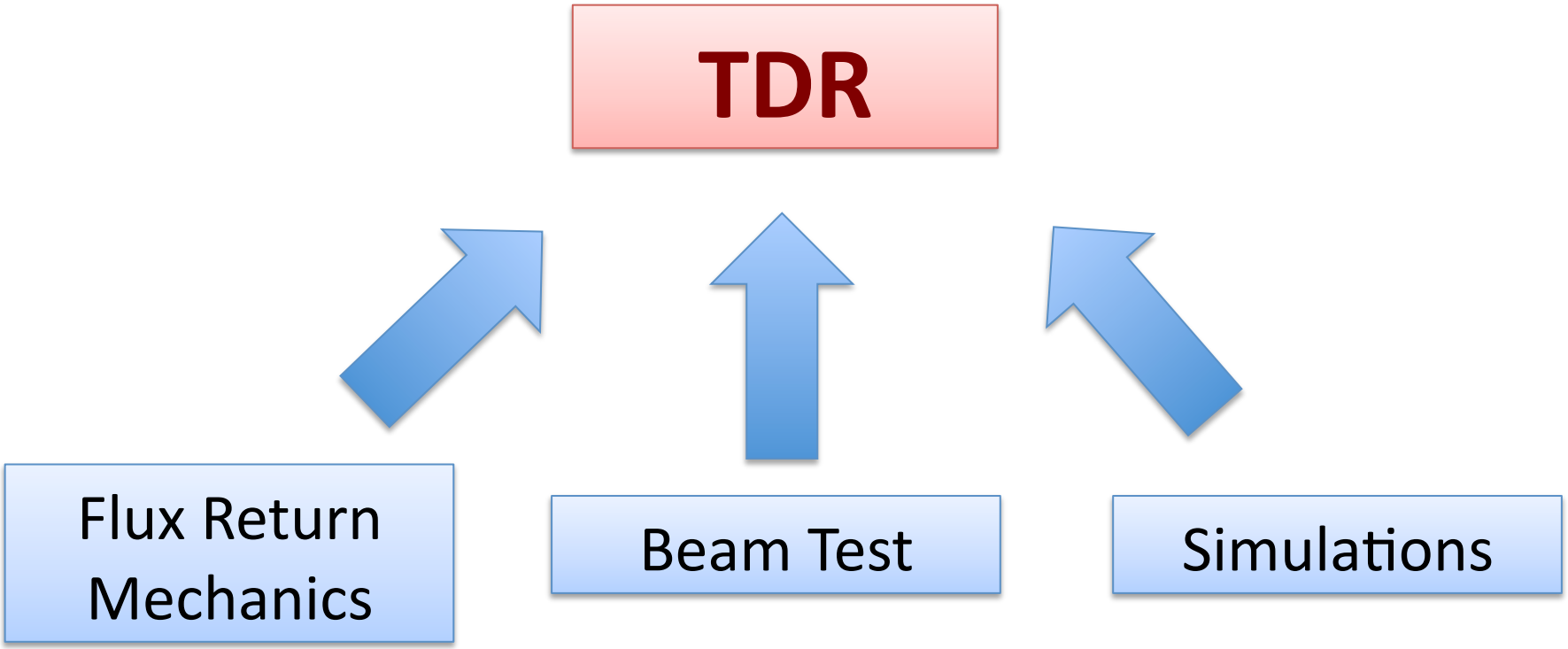
IFR report

G. Cibinetto on behalf of the IFR group

SuperB Workshop – Frascati April 4-7, 2011

Outline



Modifying the Flux return

Current baseline:

IFR recycling + modifications to get cheap but «comfortable» solution

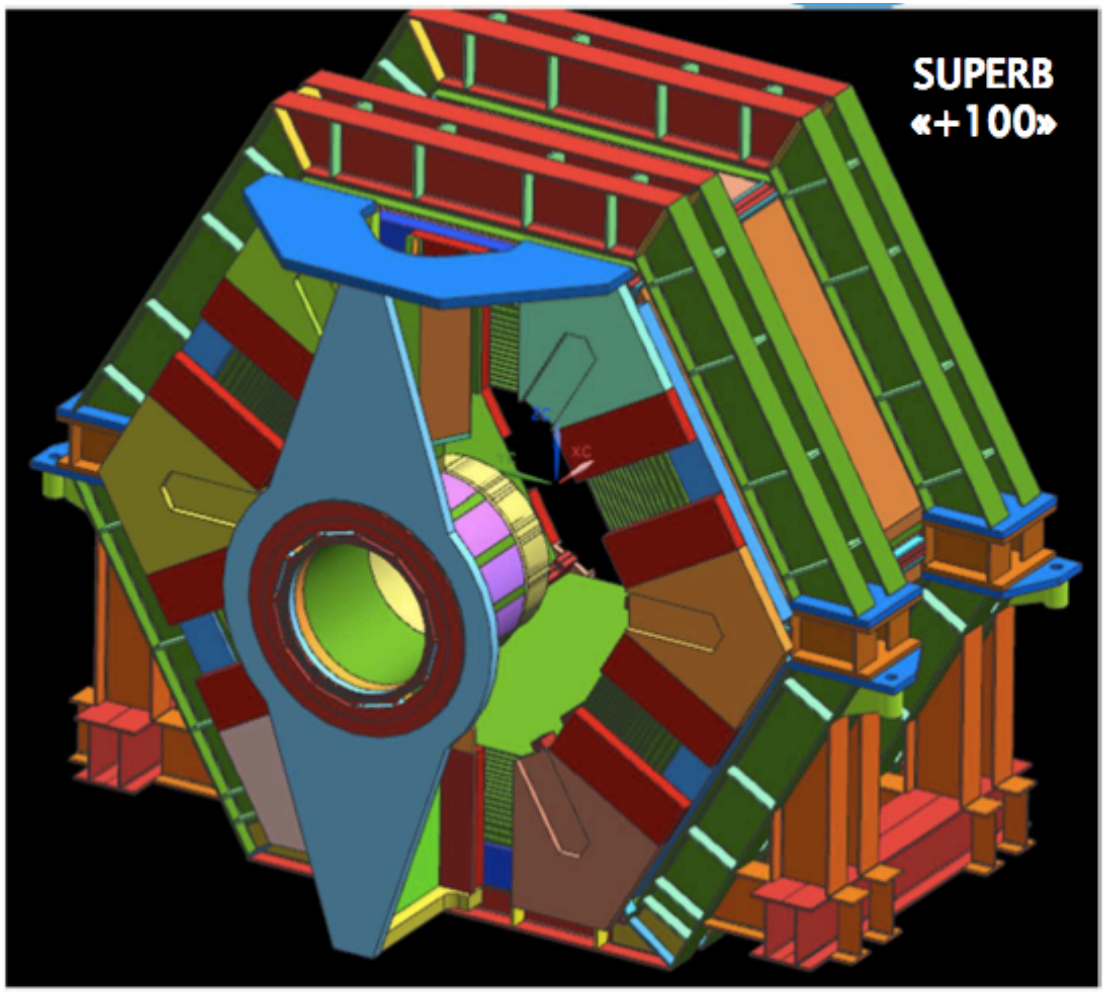
«comfortable»:

IFR thickness comparable to CDR layout: 920 mm

«+100mm» hypothesis:

add 100mm slab «on top» the outer wedges, in order to reach required IFR thickness

2011/04/04



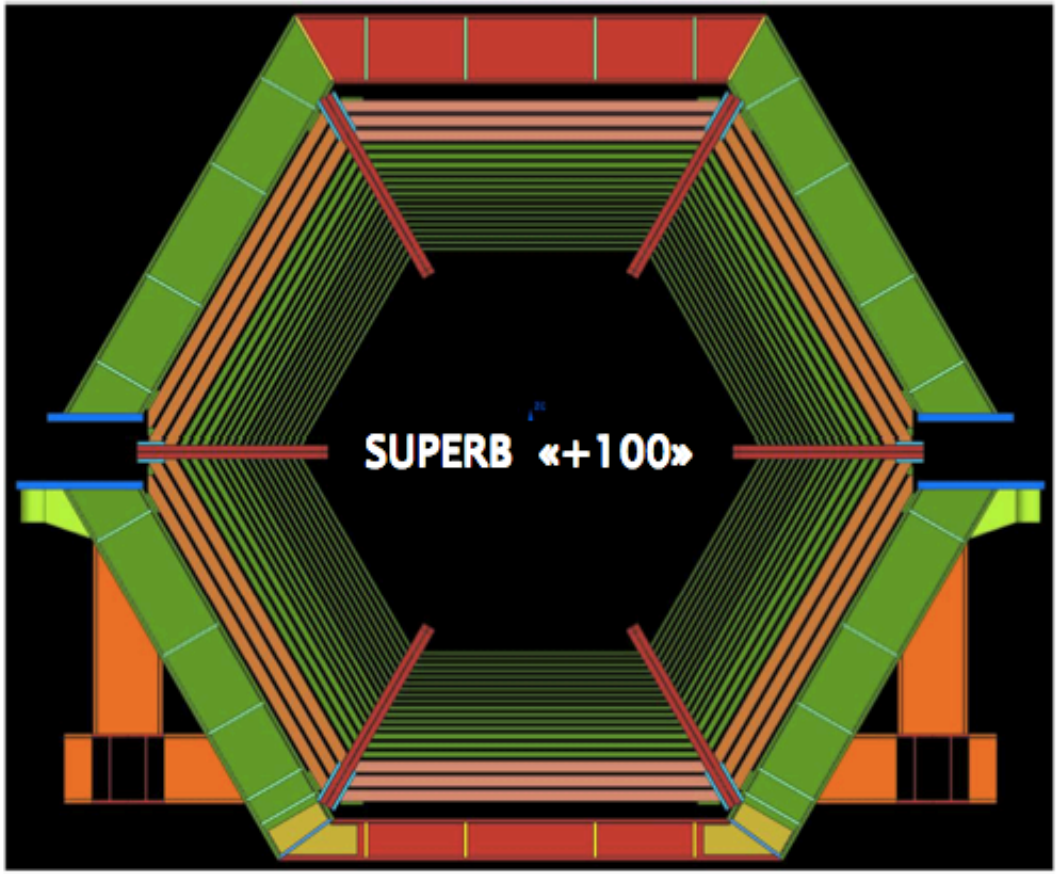
Pros and cons of recycling

Advantages in reusing the Babar barrel IFR:

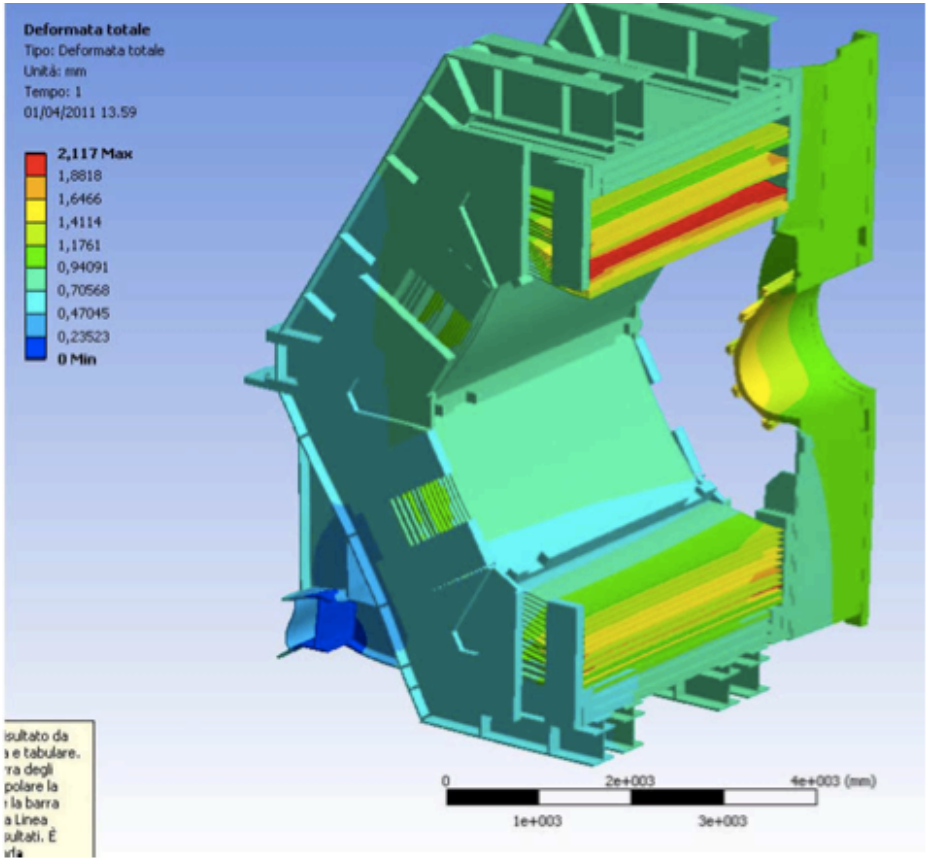
- About 360t of iron wedges available, + cradle&arcs
- About 70t of brass available (means about 135 mm of filter)

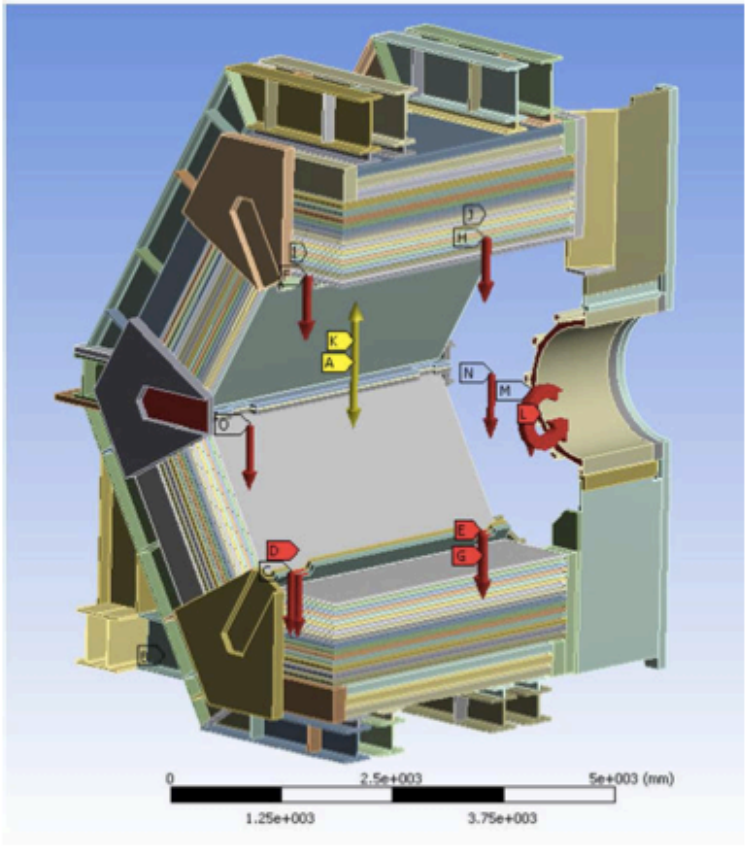
Disadvantages:

- inner wedges too «empty», low filter capacity
- Requires (brass) filling
- All main parts (wedges, cradle, arcs) need modifications
- Transportation

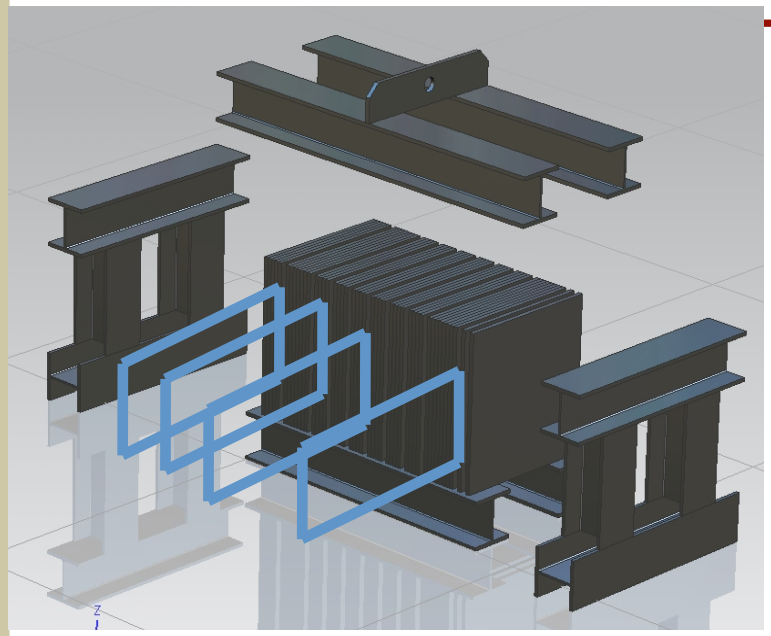


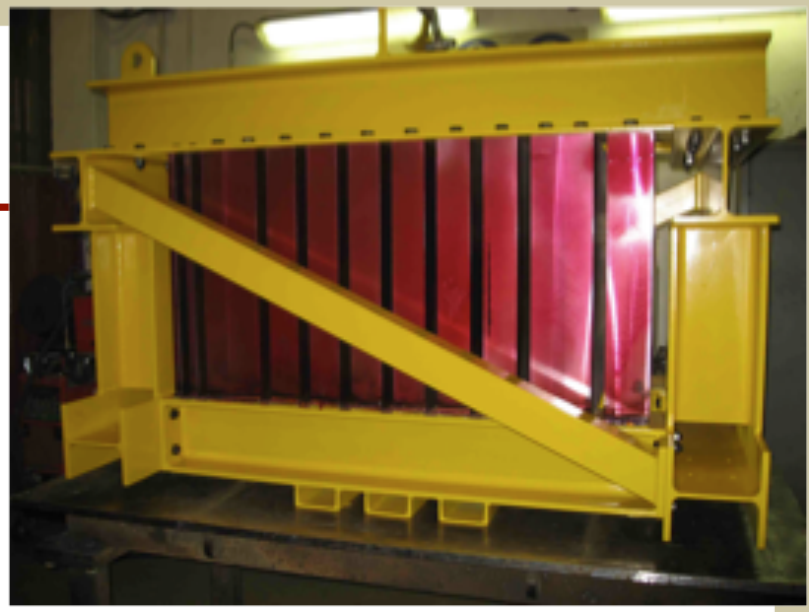
FEA calculation





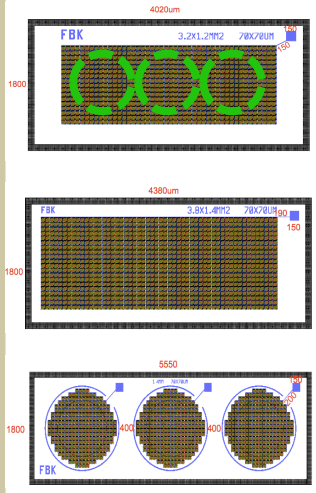
Prototype in a nutshell





- Iron: 60x60x92 cm^3 , 3cm gaps for the active layers

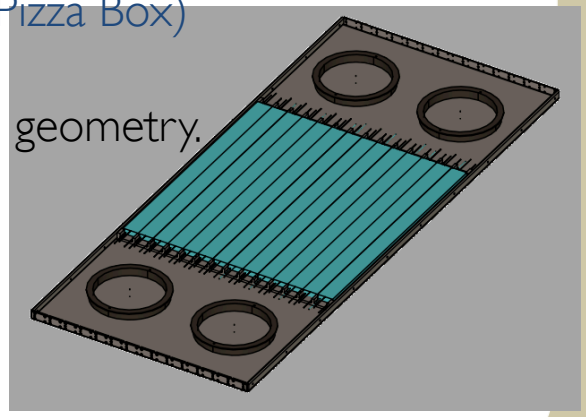
- Readout 9 active layers
  - 4 Layers Time readout (TDC-RO): 112 channels
  - 5 Layers Binary Readout (BiRo) 125 channels



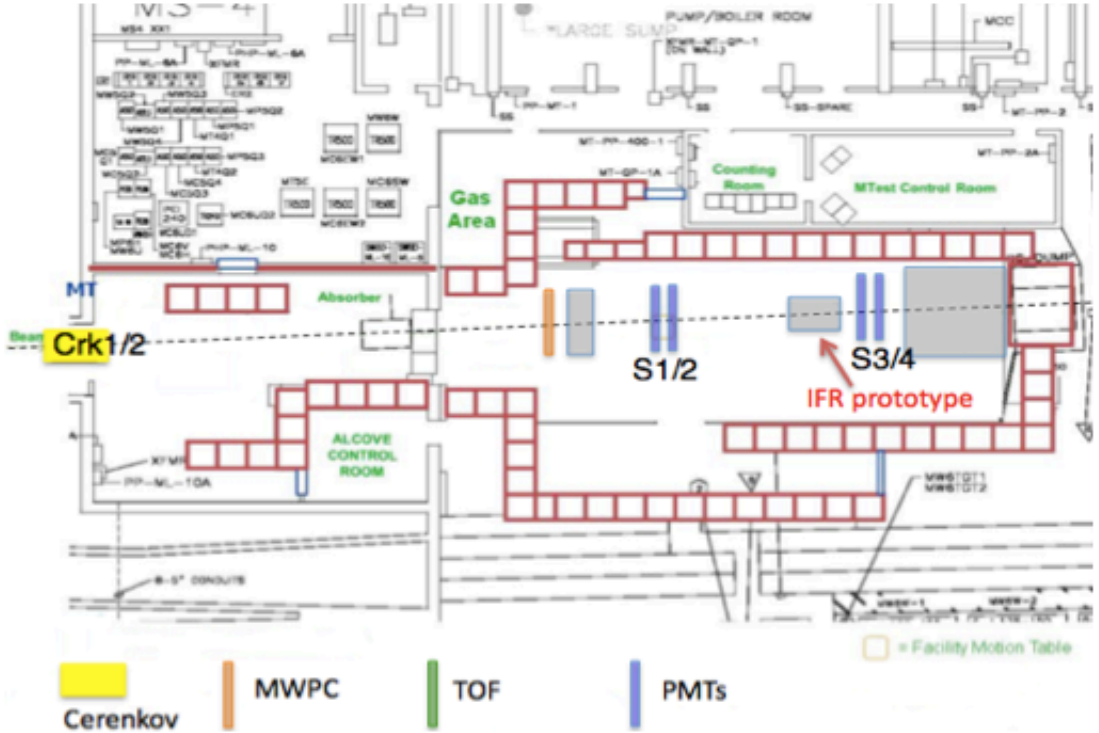
Active layers housed in light tightened boxes (aka Pizza Box)

4 special modules to study different fibers or SiPM geometry.

Tested at Fermilab test beam facility on Dec. 2010 with a muon/pion beam.



Beam test setup



- Scintillator $S_{1\text{-}2}$ used to select events
- Scintillator $S_{3\text{-}4}$ used to evaluate the leak per track

Selection

$$\mu \Rightarrow S1 \times S2 \times \overline{C}_e \times C_\mu$$
$$\pi \Rightarrow S1 \times S2 \times \overline{C}_e \times \overline{C}_\mu$$

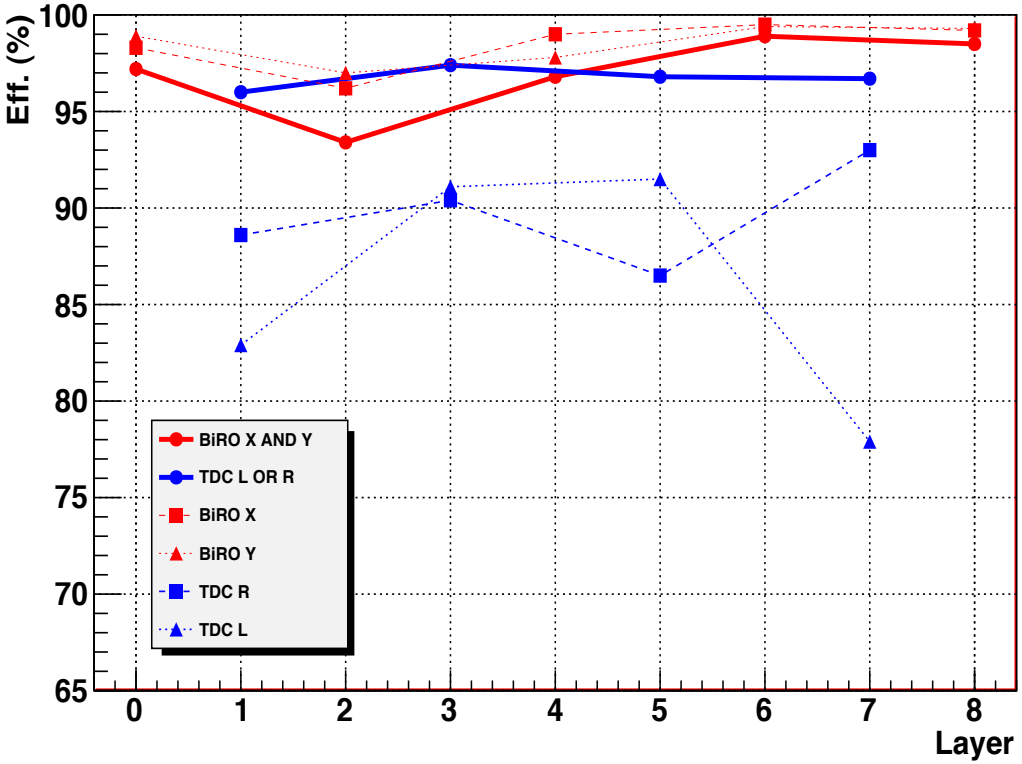
Distance between Crk1/2 and prototype is ~22m, the pion decays are an issue:

- 4 GeV: 8%
- 8 GeV: 4%

Simulation needed to subtract this component

4

Prototype performances: detection efficiency



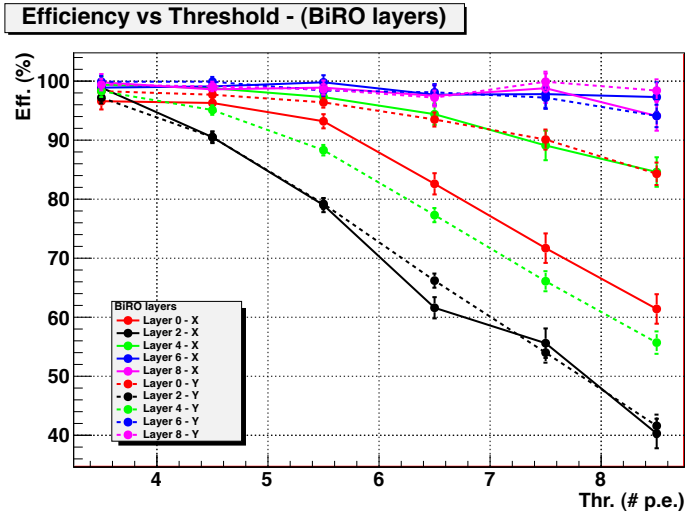
There's an overall agreement with R&D results.

Efficiency vs threshold plot shows that in most of the cases we have margin to increase the threshold if the noise gets higher.

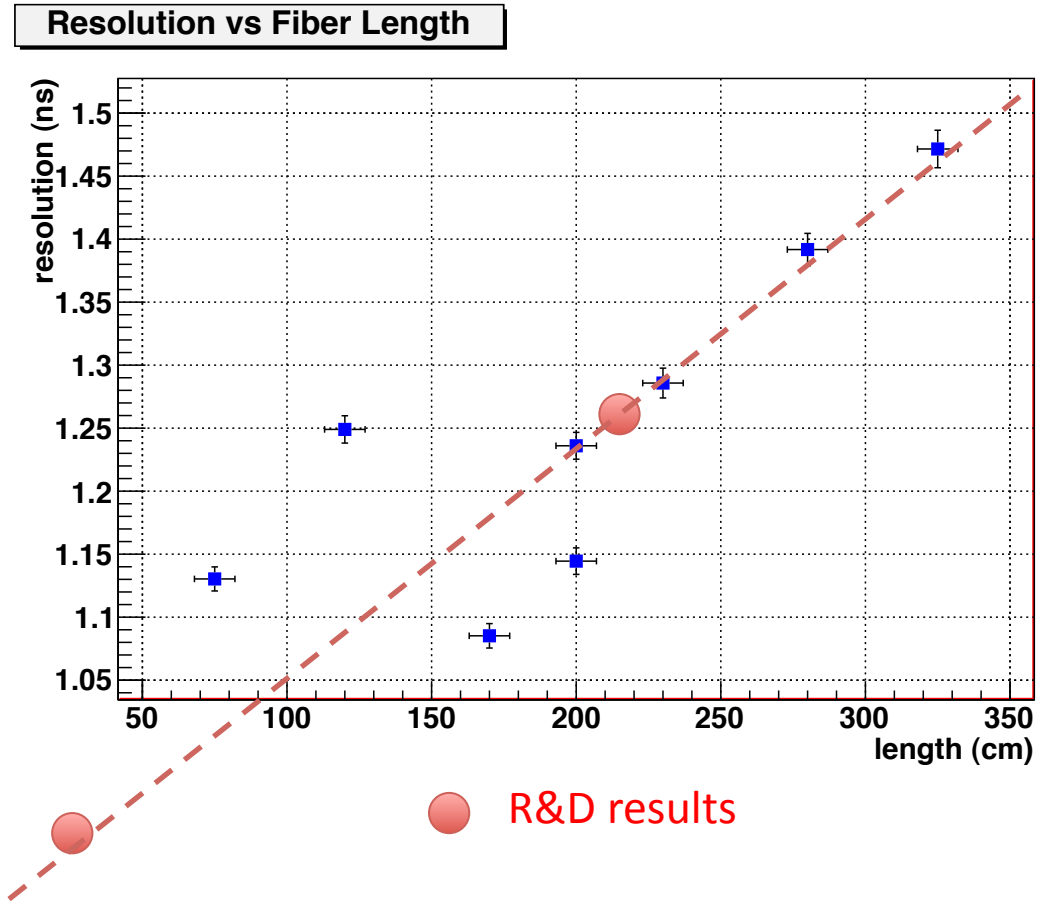
Detection "sandwich" efficiency has been evaluated for both the readout options.

Outstanding single bar efficiency for Binary Readout.

Module detection (solid lines) greater than 95%



Prototype performances: time resolution



Time resolution (for the Time Readout modules) for 4 prototype sections is in agreement with the R&D results.

A couple of section are underperforming and another two are better than expected. This is due to some difference in the bias voltage.

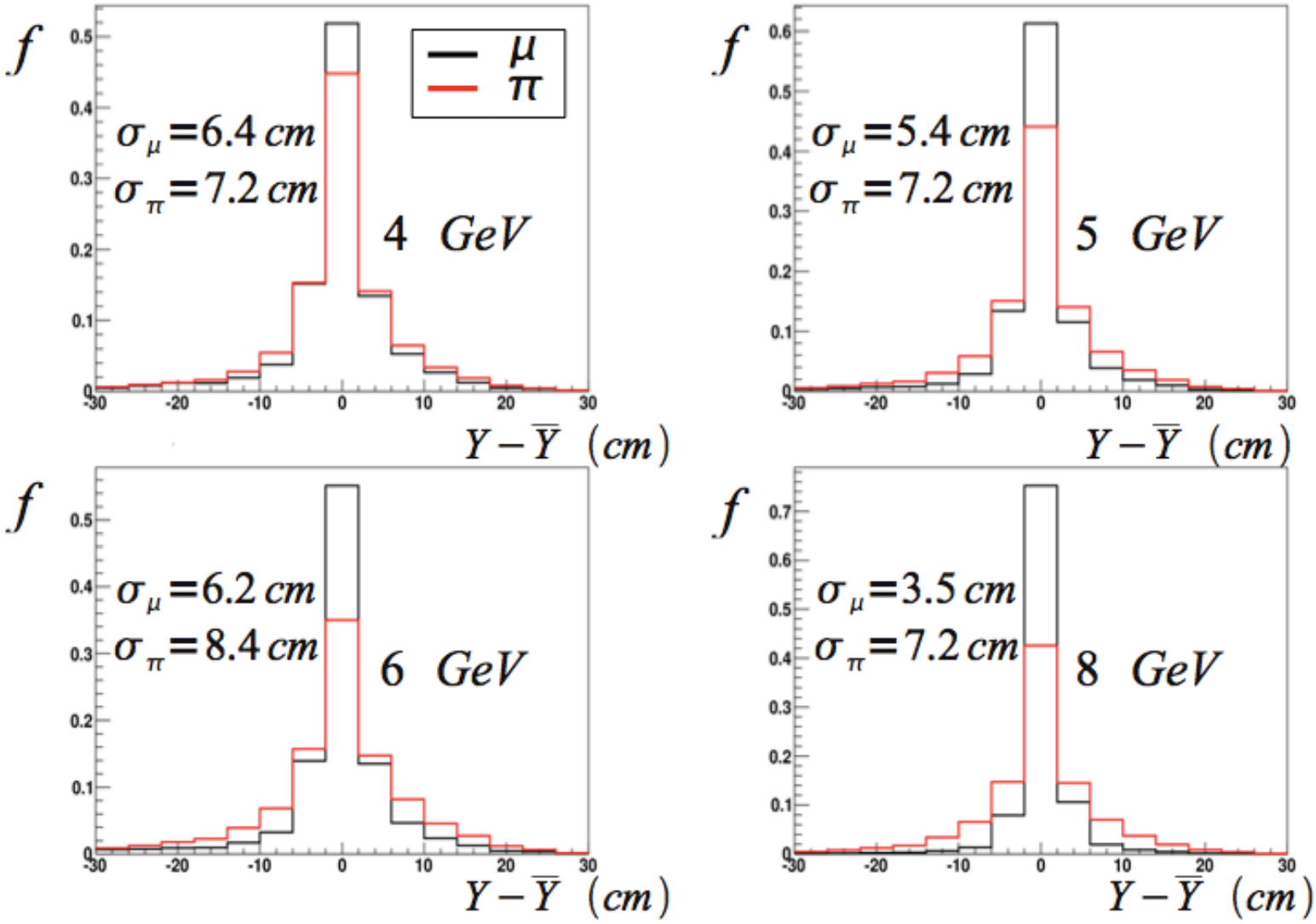
Cosmic runs will be taken in Ferrara for comparison and calibration.

N. Gagliardi and M. Rotondo

Initial approach to muon ID capability

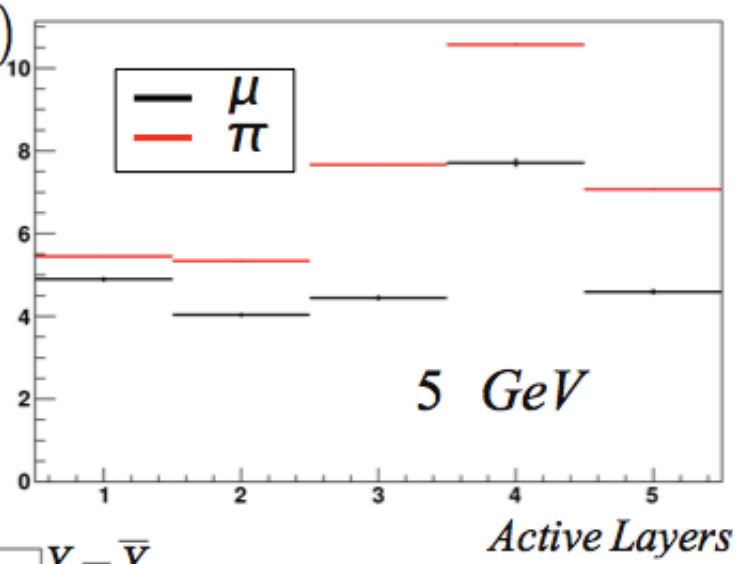
- Total number of hits/layer and transverse shape for pions, strongly related to the hadronic shower shape;
- Last layer is a quantitative clear measurable quantity related to the pion punch-through;
- Evaluate the hadronic shower leak using scintillator S3-S4;
- Time development of the signal in IFR for muons is in the sub-ns regime, and extend to 50ns and more for hadronic;

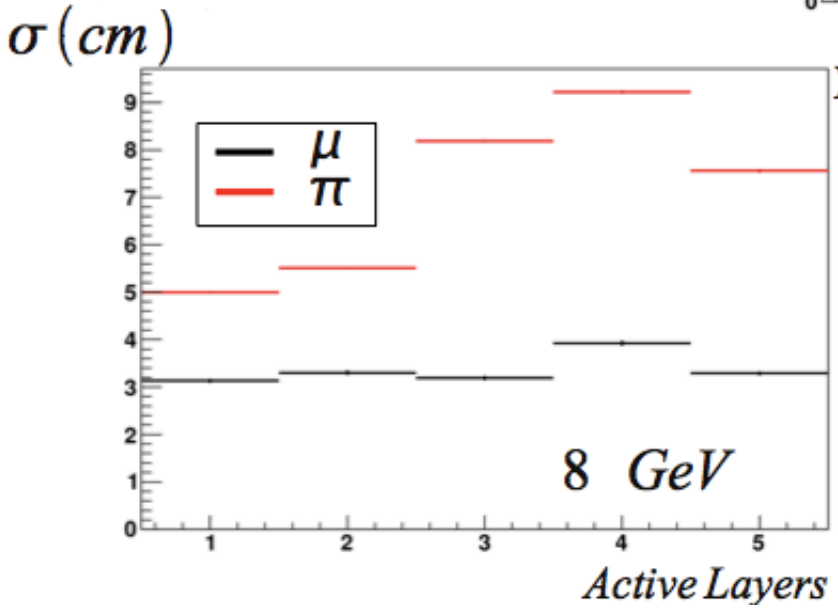
Track transverse shape

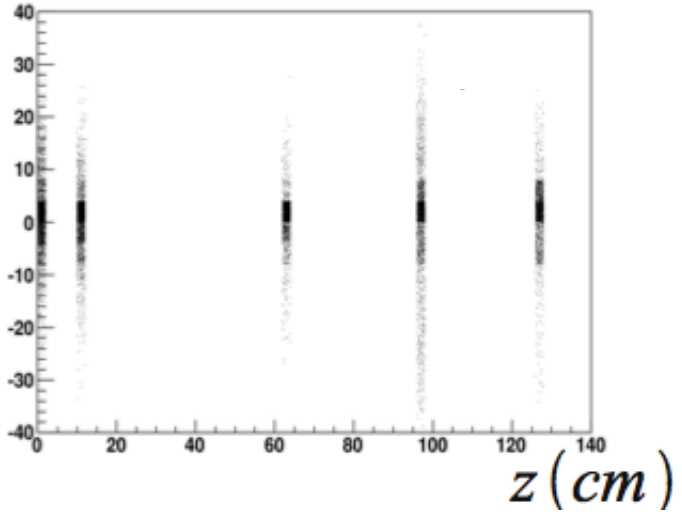


Transverse development vs layer

- Y distribution RMS as function of active layers
- Differences between muons and pions are clearly visible
- Layer6 noisy ?

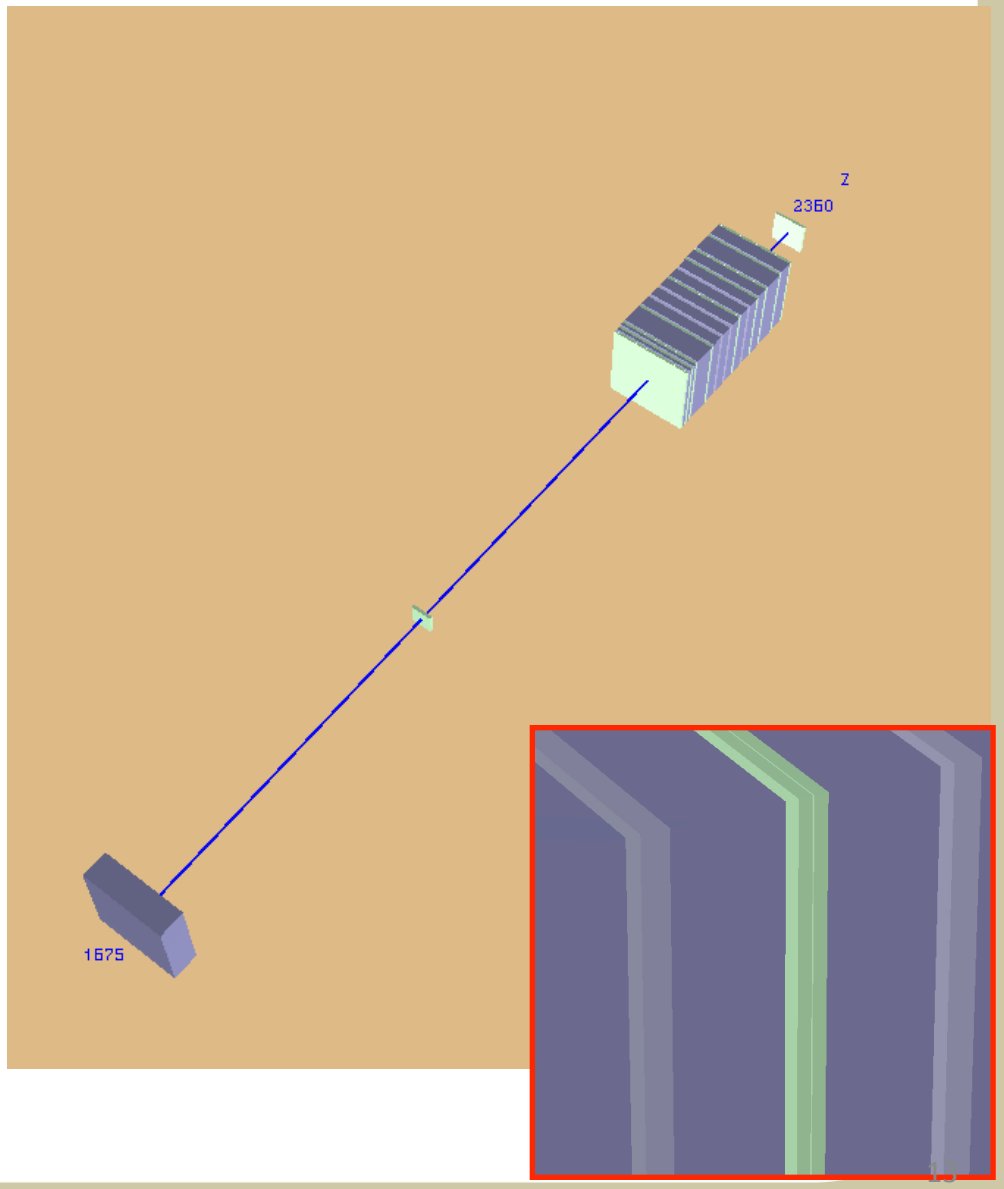






Beam test Monte Carlo simulation

- Bruno (Full Sim) is used to simulate the Beam test setup
  - Iron plate in front of the stack
  - trigger scintillators before and after the prototype
  - IFR prototype
- Two ways interaction Data-MC
  - MC is used to understand detector acceptance and to study some particle contamination;
  - Data are use to tune the MC hadronic shower description
- Generated samples of mu, pi, $e^{\pm}$
- Beam composition studies in progress
- Then we need to modify/upgrade/ implement reconstruction code that is quite different wrt the one developed so far in the Full Sim.



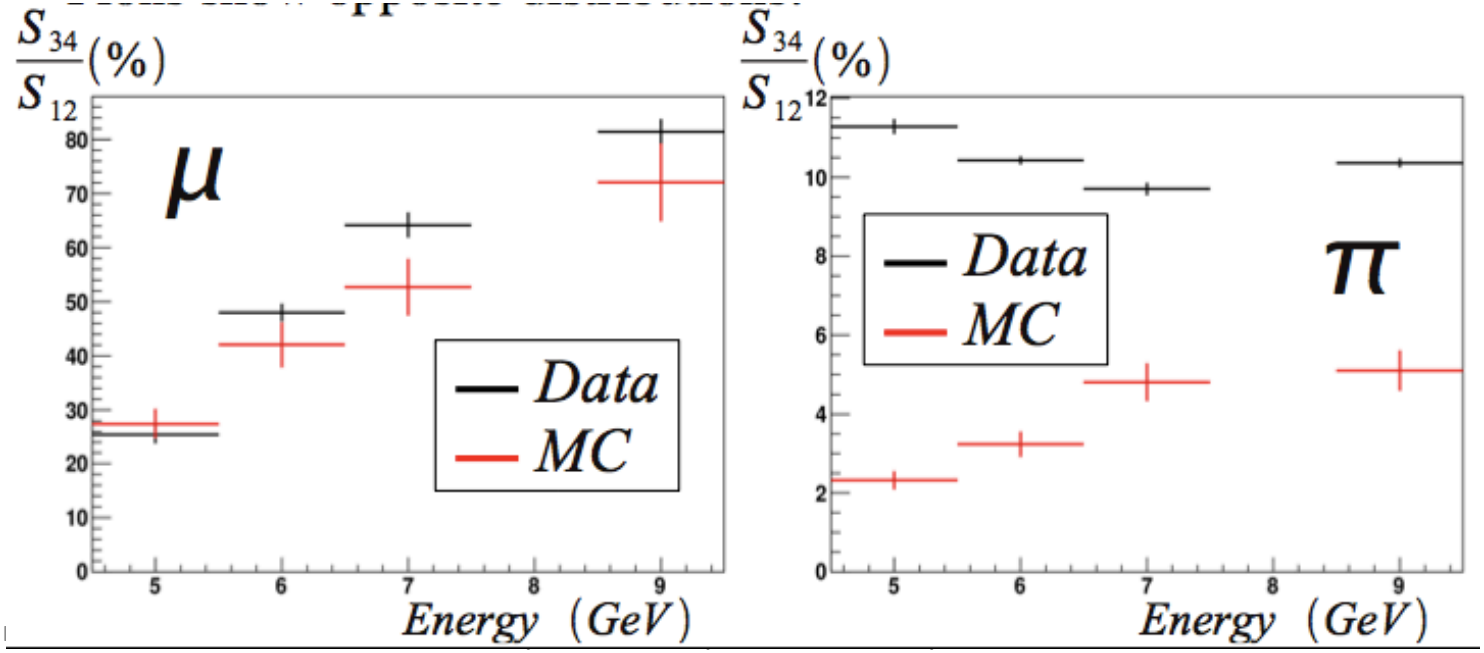
Data – MC comparison

•Try to estimate the contamination of muons in pions sample and vice versa using MC;

•Implement a better simulation and reconstruction of the prototype

•Muon fraction are quite compatible within the errors;

•Pions show opposite distributions.



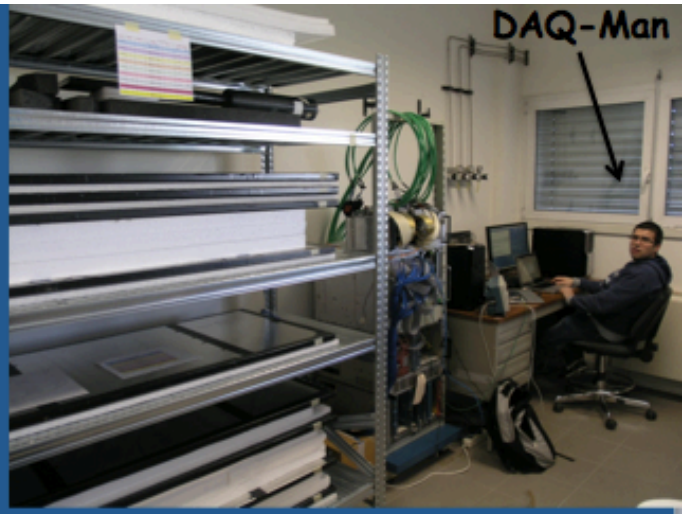
What we already learned for the next test

- A new beam test is scheduled for next July (3 weeks).
- Some setup improvements are needed
  - Iron was too far from the prototype
  - A pure pion sample is needed and easy to obtain.
  - Use a faster device (e.g. TOF) as time reference for the prototype time measurements.
  - Use the MWPC in the data stream to have a better control of the beam position

Prototype cosmic run in Ferrara (I)

Prototype installation in Ferrara

- The prototype is now installed and re-connected in Ferrara
- The configuration is the same as in Fermilab:
  - Same Pizza Box configuration (CP1 now)
  - Distances among PB are the same as in the prototype
  - No Iron
- DAQ setting up under way
- The plan is:
  1. Restart everything exactly as it was at Fermilab
  2. Use a stable configuration to take cosmics overnight
  3. During the day make changes/improvements in order to optimize the system for the next test beam



Prototype cosmic run in Ferrara (II)

Plans for cosmic data taking

- We plan to take cosmic data overnight

- At the very beginning triggering with the upper and lower-most layers, mainly for debugging purposes

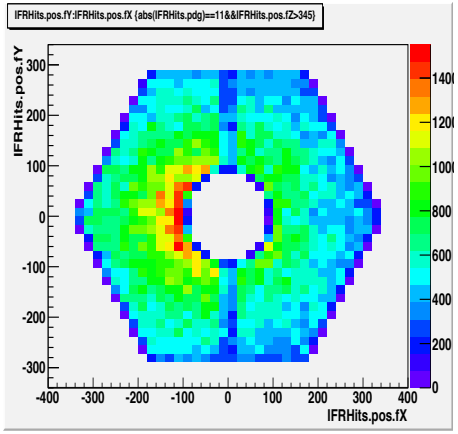
- As soon as we reach a stable condition, switch to an external scintillator trigger and measure:

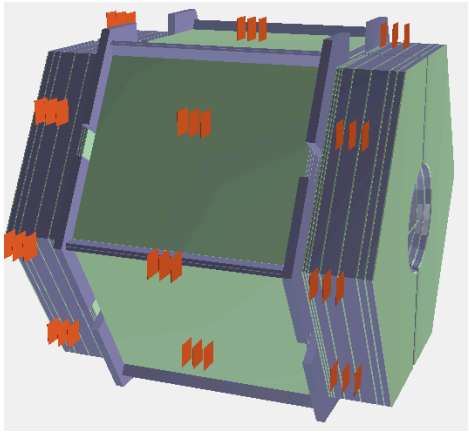
    1. Efficiency and time resolution for different SiPM bias voltages (to understand a strange behaviour of some PB @ the testbeam)
    2. Number of p.e./mip for the different combinations of scintillator-fibers-SiPM (at the testbeam not enough time…)
    3. Test the special module with MPPC (not tested at the Dic. testbeam)

- Comparison with testbeam data

Other hot topics not discussed here

- Background studies



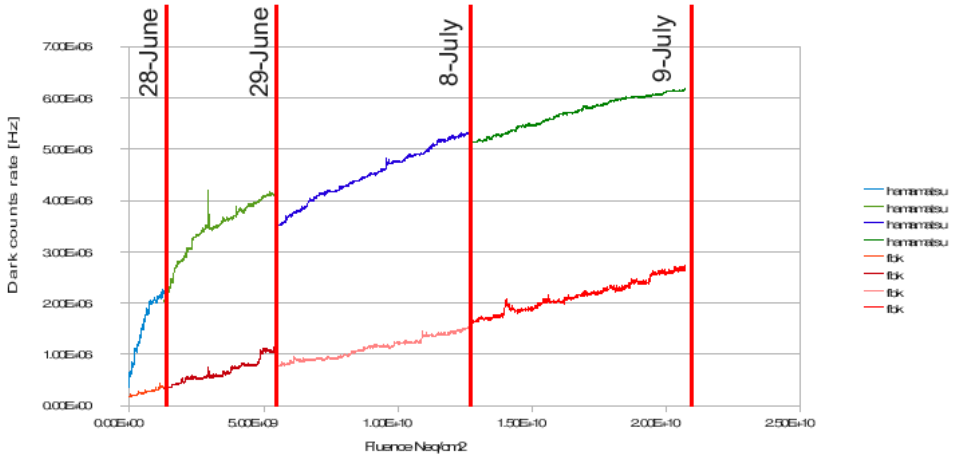


- Preparation of a 4m long scintillator prototype in Ferrara

  W. Baldini

- SiPM irradiation test in LNL

  F. Dal Corso



Conclusions

- We had a very productive workshop mainly focused on data analysis of the December test beam and plan for the July one.
  - Performance results are good and in agreement with (if not better than) the R&D results.
  - Muon ID capability study is ongoing; of course a lot need to be done in order to understand the beam composition and some prototype feature.
- Cosmic ray setup is under preparation, the prototype will run with cosmics for two months.
- Flux return mechanics design is ongoing, we'll start writing a draft summarizing pros and cons of the different options.