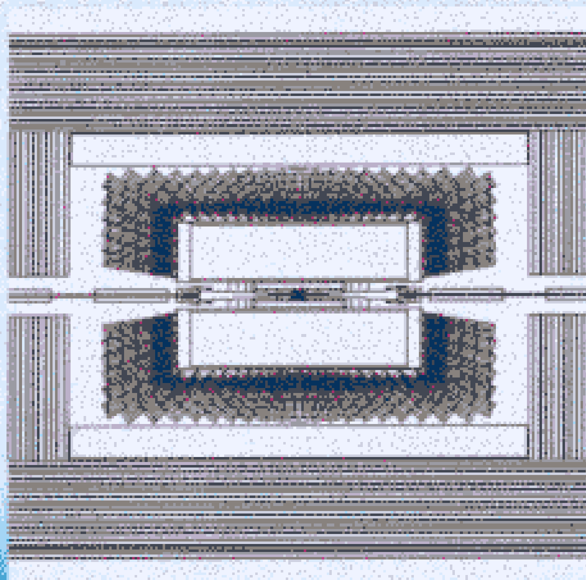
Muon Detection and Identification



- Main guidelines
- Detector options
- Iron segmentation
- *bb* evts performances
- Design figures

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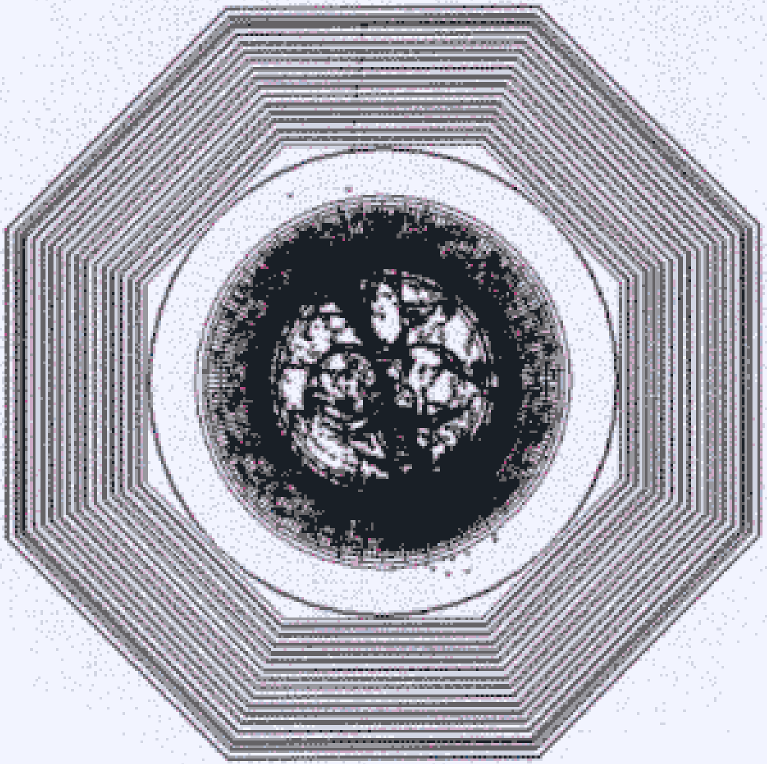
Which kind of μ-identifier

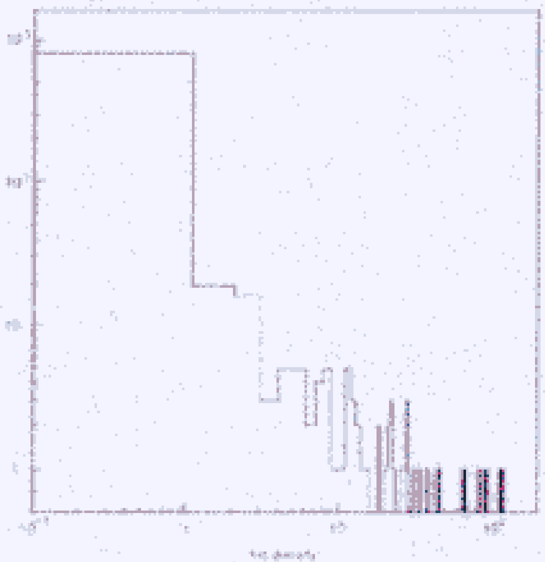
- The relatively benign environment of lepton collisions allow to design a μ-tagger rather than a μ-detector.
  - Association between the inner tracker and the hit strings for penetrating particle is reasonably unambiguous.
  - Even in the tight environment of *qq* jets simulations matching is o.k.
  - No attempt will be then made to measure momentum within this subsystem.

Event Topology



- *bb* @ 500 GeV were chosen.
  - Tight jets
  - Relatively low momentc
  - Muon content on the high side
  - Overall a reasonable compromise.

(One of the) main ingredients: hit density



- Important to choose active detectors
- ...or operational properties

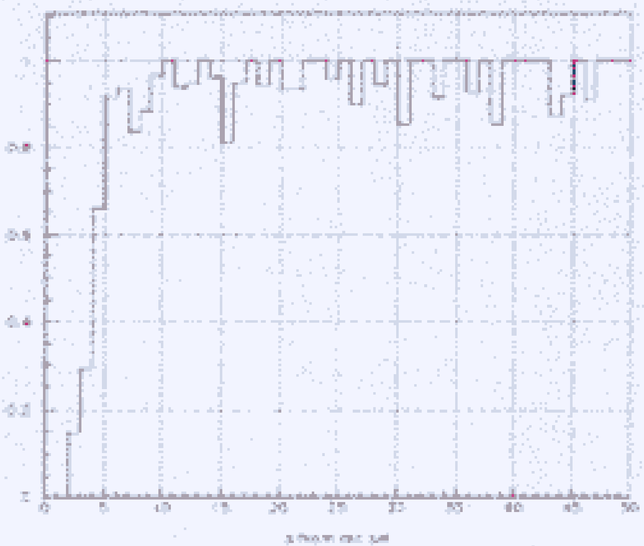
Technology Choice

- Given the reasonably small occupancy expected and the big dimension one has to cover two alternatives have been considered:
  - Plastic streamer tubes
  - Resistive plate Chambers
- Weighting the relative merit of these two technologies my inclination would be toward RPC's

Radiator thickness and segmentation

- The amount of iron needed to close the magnetic flux is 1.5 m .
- The segmentation buys rejection power, at a cost of increasing the active detector area.
- A preliminary design has been carried out segmenting at 10 cm of iron ten times and then adding the remaining 50 cm all together.
- This corresponds to 12/11 planes of detector. (barrel/end-caps)
- The length of the barrel elements would be 14.5 m (long barrel option).
- The design,carried out in this way, turns out to require an amount of active detectors in between the already built systems and what's planned for the LHC apparata.

Performances



- Here is the efficiency vs. p of a configuration that uses 150 cm Fe.

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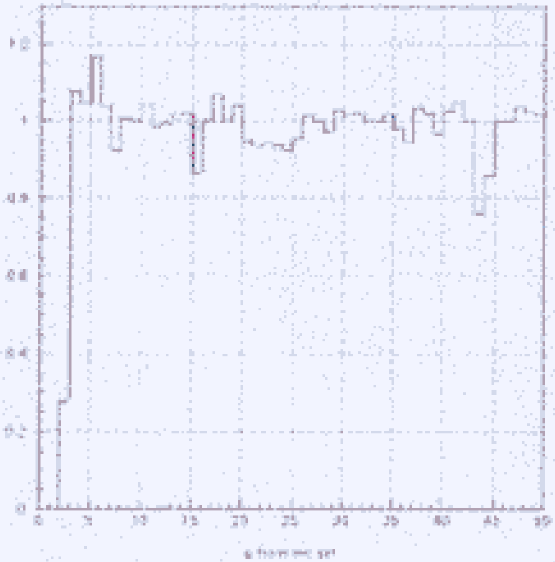
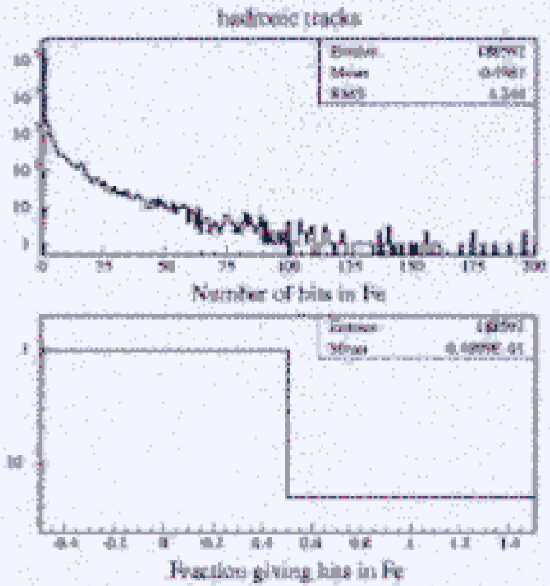
- In high energy μ's identification , efficiency of last planes is at a premium.

Performances (cont.)



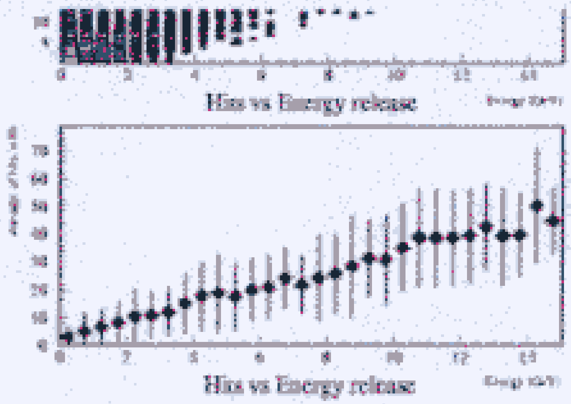
- Here we have the ratio of single μ to bb μ efficiency.
- Within the statistic of the simulation no relevant loss of efficiency can be seen in jetty events.

Do we need calorimetric capabilities ?



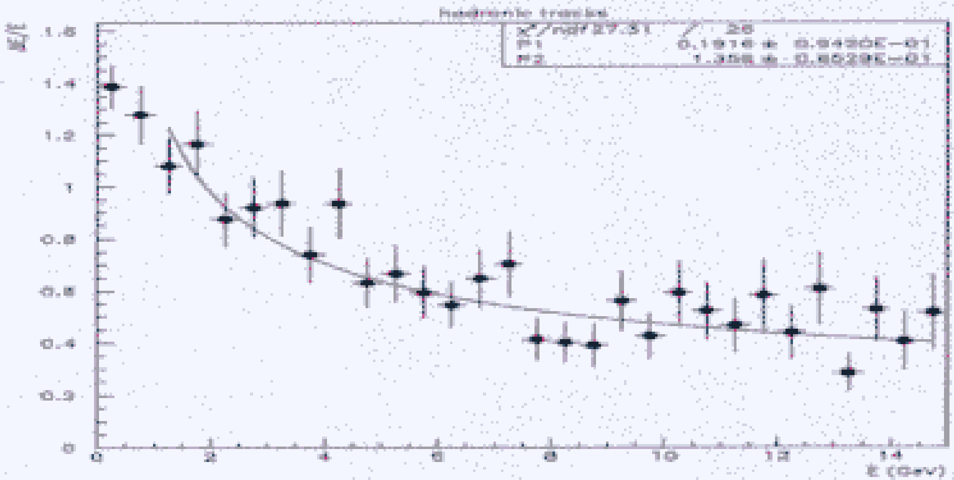
- In our *bb* sample, (5000 evts) 4.9% of the tracks left energy in the muon filter,
- The total sample analyzed contains roughly 200,000 tracks.

Measuring energy



- Here is the correlation between the energy at the entrance of the muon system and the # of hits generated in the system itself.
- The correlation is reasonably straight and leads to an overall resolution of …

Energy resolution



Few figures concerning iron

- The iron would be shaped in octagonal form.
- Practicality in construction and assembly suggests to use the long barrel configuration.
- Barrel length will be 14.4 m., broken out in three pieces: 3.7 7.0 and 3.7 m. respectively.
- Joining of the barrel pieces done in a slanted way, pointing away from the I.P.
- End-caps would as usual be pie shaped with an outside radius of 3.8 m and an inside radius of .4 m.

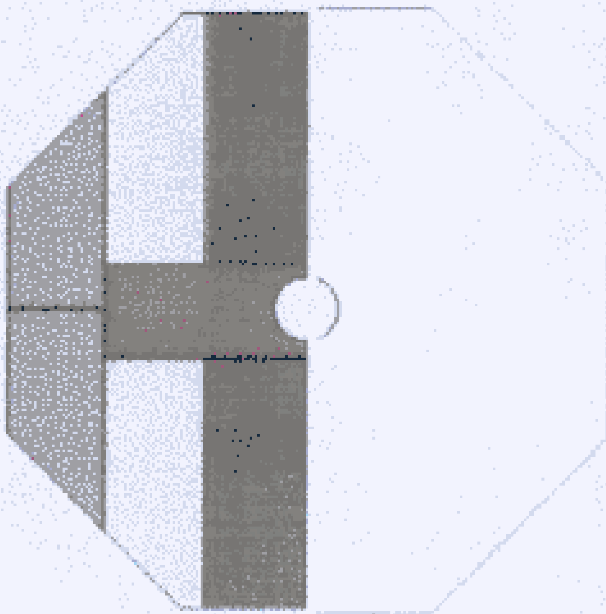
Barrel chambers

- One way to fill the gaps with EXISTING TECHNOLOGY for what RPC's are concerned:
  - Max ch's dimension 1.3x3.2 m^2

⇓

  - Use 12 ch's for the long barrel slots: 1.15x1.57...2.38
  - Use 2x6 ch's for the short barrel slots: 1.22x1.57...2.38
- Total area roughly 5000 m^2.

End-caps chambers



- Here is a possible chamber layout for the end-caps.
- The criterion used here was to maximize the # of ch's with one max. dimension.
- One layer filled with 14 modules; 7 different shapes would be needed.
- Relatively small area 23.5 m^2/layer.

Wrap-up figures

- The μ-identifier in the design sketched above will consist of :
  - 12 planes of (RPC) detector: area ~ 5000 m^2 (barrel)
  - 11 planes of (RPC) detector: area ~ 500 m^2 (end-caps)
- Assuming strips ~ 3 cm wide, alternating read-out directions in the various planes, a total of 70,000 (one bit) discriminators channels should be implemented.
- Should one decide to implement calorimetry and read out with projective towers 25x25 cm^2 , 2500 ADC channels would be needed.
- TDC 's with a granularity 16 (32) times coarser than the overall electrodes granularity would imply 5.0 (2.5) KTDC ch's.
- Electronics performances required might vary according to the regime one would use, costs must be assessed accordingly.

Costing

Scaling from systems either built or under construction:

RPC modules ~ 600 Keuro

Electronics ~ 500 Keuro

Ancillary eq. ~900 Keuro.

Adding a 10% contingency the overall cost would be 2.3 Meuro.