IFR Simulation
General overview & Fast Simulation

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IFR Simulation: general overview

- *Full Simulation*
  - *Present version mainly to perform background studies*
- *Fast Simulation*
  - *Tool to study feasibility of new analysis in a SuperB environment*
- *Detector Geometry Working Group: Optimization of the subdetector design*
  - *Other subdetectors use the Fast Simulation. We cannot... (next slide)*
- *Manpower available:*
  - *G. Cibinetto: Detector Geometry, Background*
  - *M Munerato: Full Sim. and Background*
  - *M R: Fast Sim. and Detector Geometry*

IFR Simulation: Detector Optimization

- *It is not possible to use only the Fast Sim. for the IFR detector optimization*
  - *The hadronic interaction at low momentum, crucial to π–μ separation: in particular the later and the longitudinal development of the shower require detailed studies.*
  - *The same fot Neutral Hadrons*
- *Timescale of the DGWG are short: **end 2009**. A complete Full Sim. will not be ready in time:*
  - *Digitization, patter recognition, tracking...*

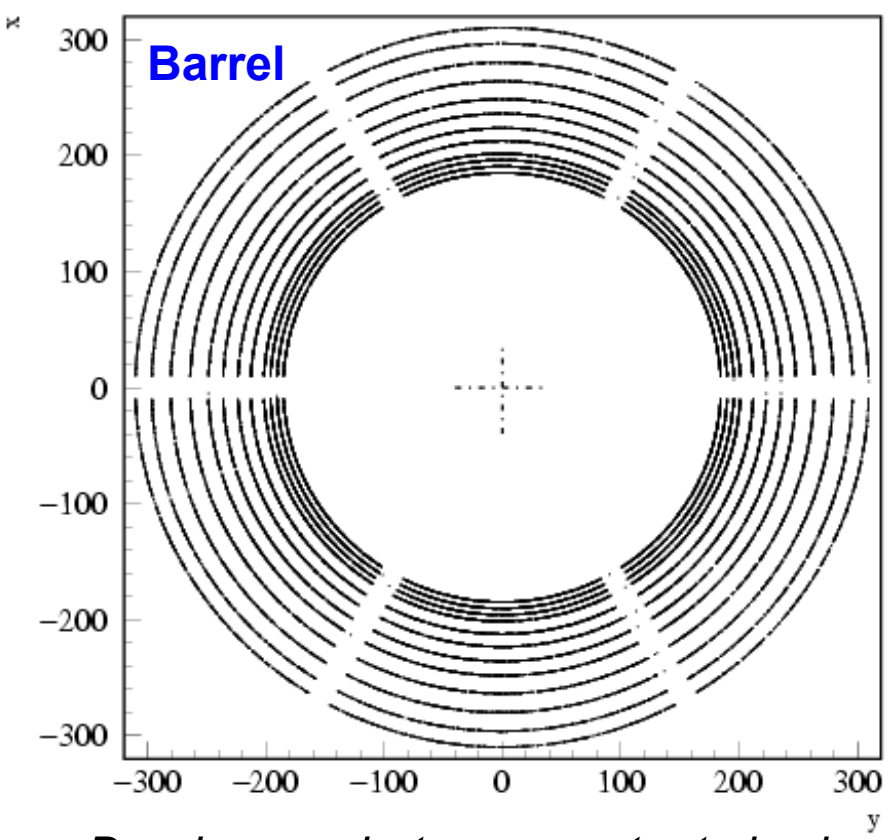
- *Use the Full Sim. geometry only to study the shape of he hadronic shower in a sampling detector*
  - *Parameterize the shower with a functional form in the Fast Sim.*
  - *This is crucial for the Fast Sim itself, but could be used to optimize the detector geometry*
- *Any better idea or suggestion?*
- *This study require to involve the Full Sim. WG in this subject*

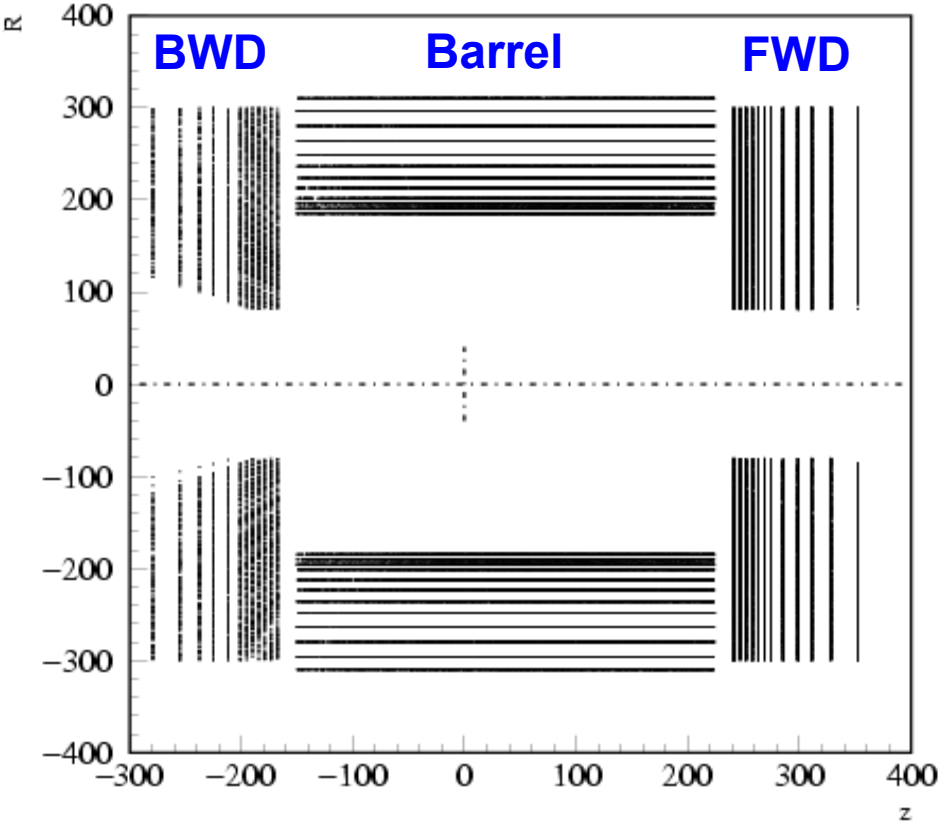
IFR Fast Simulation: Geometry

- *IFR Geometry in the V02 of the Fast Simulation*
  - *Simplified geometry: cylinders (barrel) + rings (endcaps)*

PacSimHit coordinates from a large sample of B->$\mu\mu$ events

BaBar configurations:
- 12 active layers
- absorber Iron and Brass





Dead space between sextants is simulated as hit inefficiency (configurable via xml configuation file)

IFR geometry for the Super B

- *A first SuperB IFR configuration is available in PacSim*
- *According to CDR:*
  - *Reduced number of active layers to 8*
  - *More # of Interaction lenghts (6.5-7.5 instead of 5-6 we have now in BaBar)*
  - *We added more Iron (no brass)*

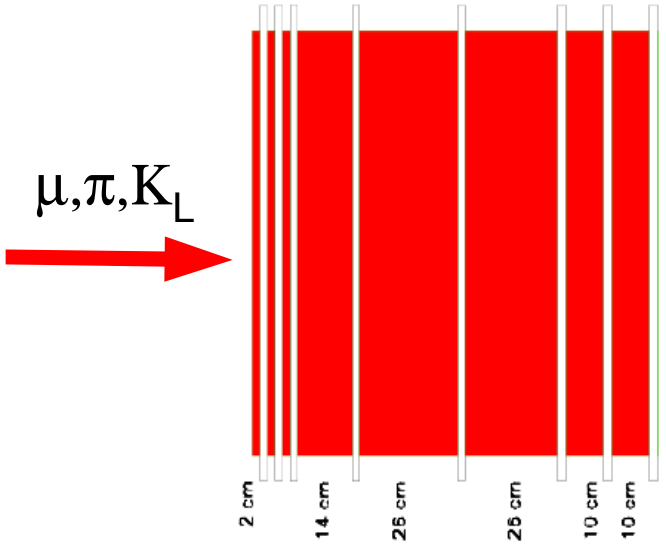
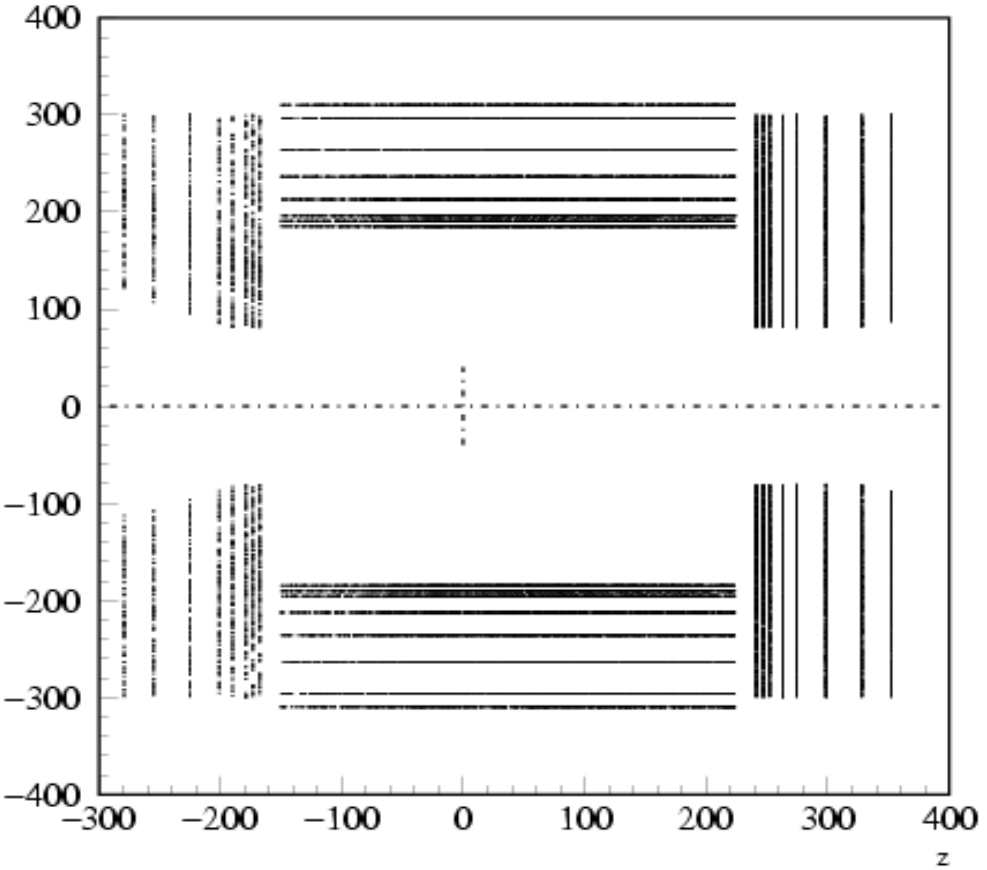


Figure 4-41. *Sketch of the longitudinal segmentation of the iron absorber (gray). Active detector positions are shown in white from the innermost (left) to the outermost (right) layers*

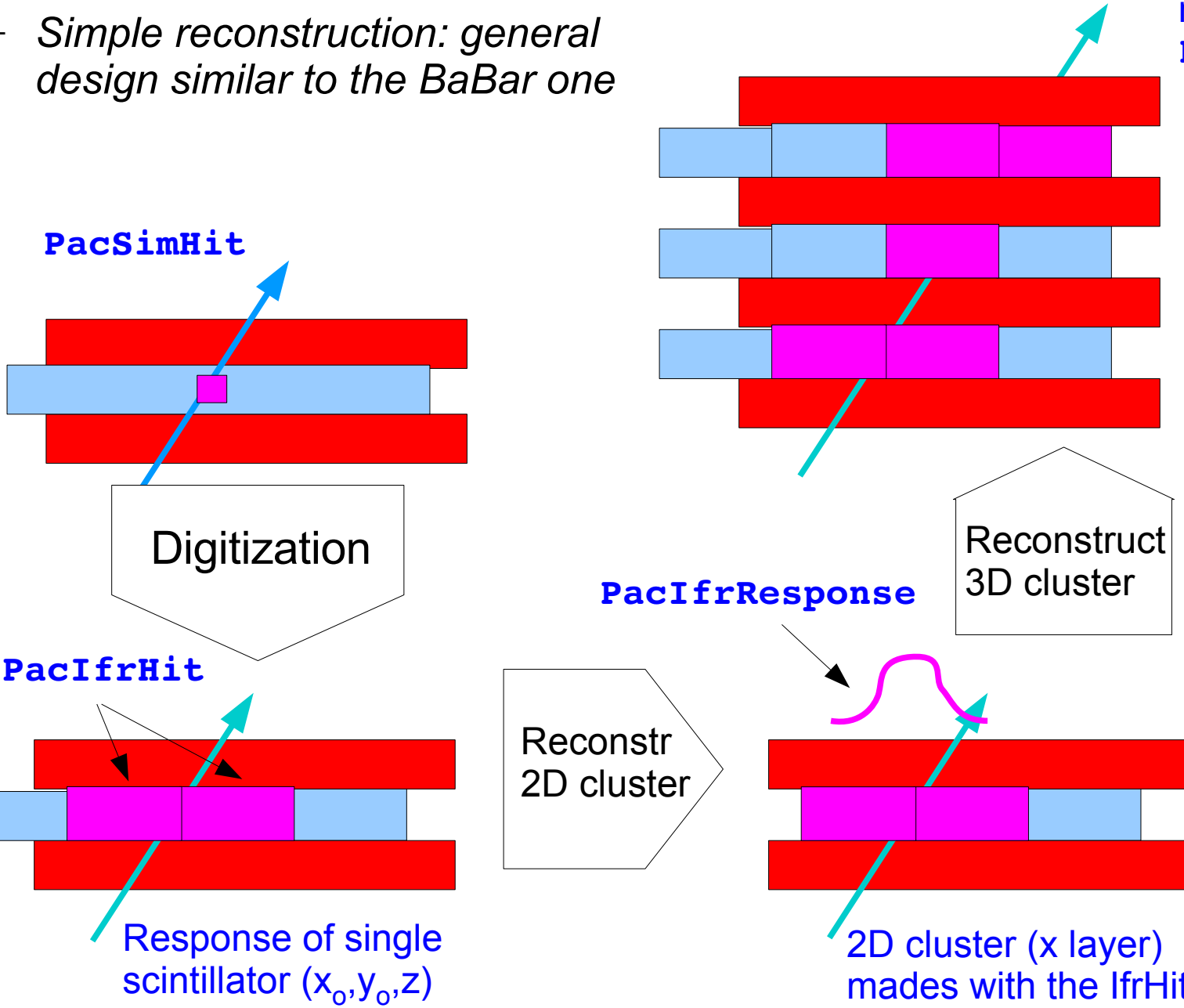


IFR Fast Simulation: interaction

- *IFR in the V02 of the Fast Simulation*
  - *Cylindrical geometry:*
    - *N-gone are available: this geometry will be used for V03*
  - *Outside the coil the magnetic field is modelled with a 0-Field*
    - *Tracks in the IFR are straight lines*
- *Material effects computed each step through the full detector*
  - *(multiple scattering, energy loss...)*
  - *interaction probability for hadrons given by the interaction length*

IFR Fast Simulation: design

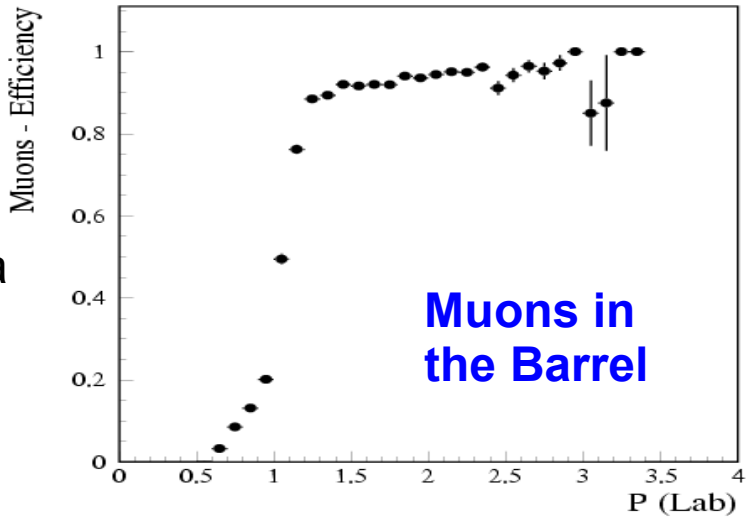
- *Simple reconstruction: general design similar to the BaBar one*

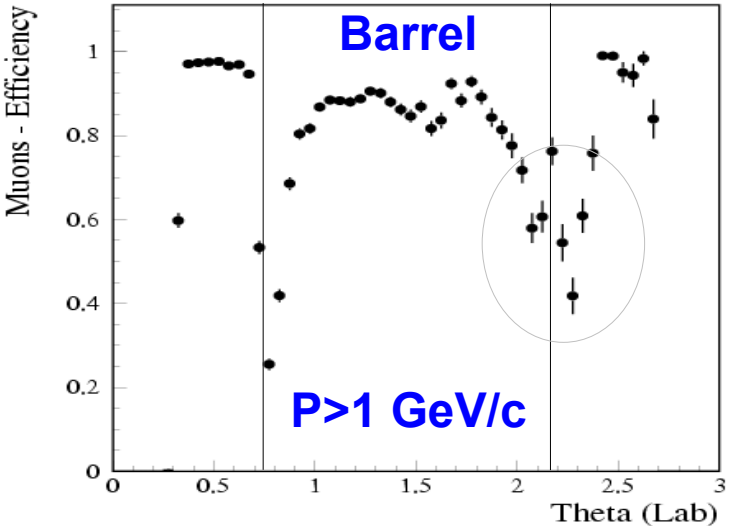


Performances

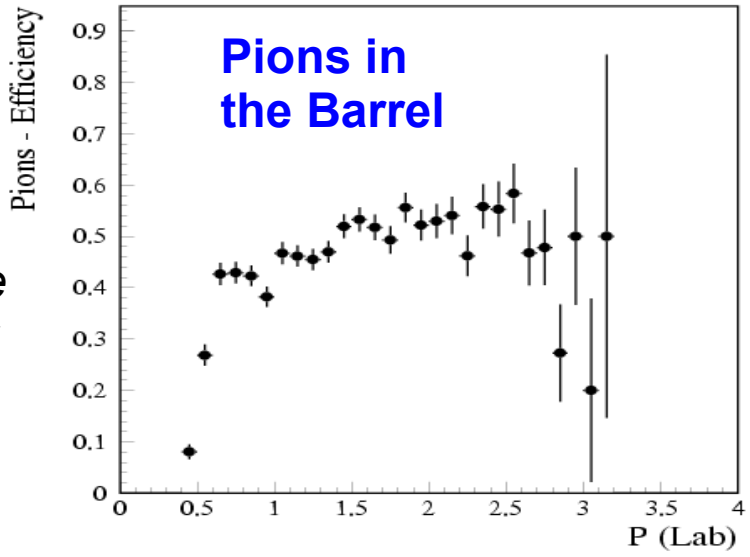
- *mu/pi separation based on the # of traversed layers in the Iron: N>9 Layers*

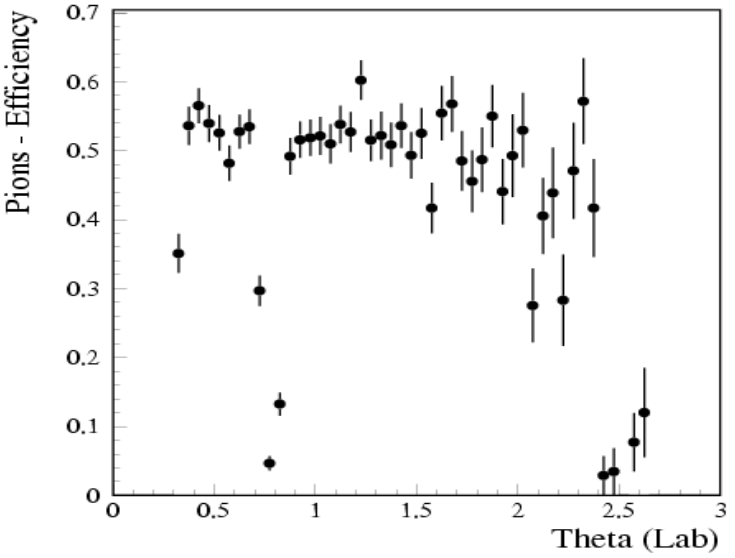
Muon efficiency too optimistic, but the general features (shape of the efficiency versus theta and p) are in reasonable good agreement with the expectation





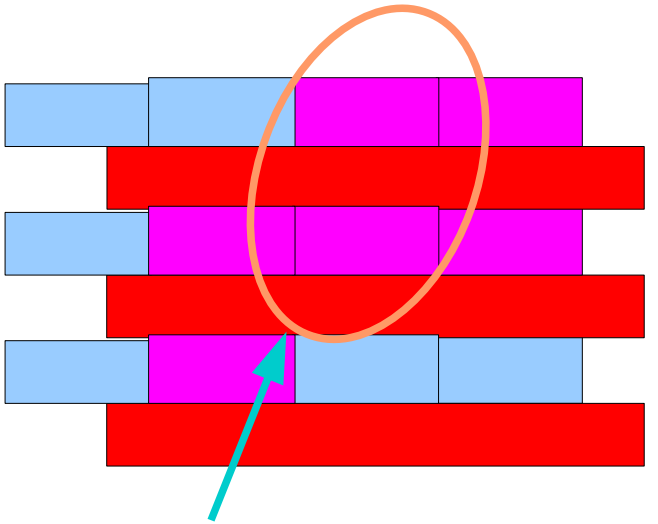
Pions efficiency is too high!
We need to better simulate the IfrResponse when a hadronic shower is produced





Hadronic Showers

- *When a hadron showers, PacSimHits are created within the IFR, with shower informations available (David Brown talk):*
  - *Longitudinal development is parameterized (actual range is properly fluctuated)*
  - *For now, we do not take any other action for hadronic showers!*
- *Priority: better simulate the detector response to hadron showers and optimize the shower parameters in segmented environment*
  - *A relevant aspect is the lateral development: some measurements (for E>10GeV) are available (Barreiro et al. DESY 89-171, 1989).*
  - *Generate (fluctuate) mutiple PacIfrHit per layer, according to the transverse development*
  - *This will affect*
    - *the average size of the 2D cluster*
    - *the chi2 of the fit to the IFR tracks*



Next PacSim (V03) version

- *Properly fill the IfrQual object with all the relevant quantity*
  - *Up to now only the number of penetrated layers is filled*
- *IFR response to hadronic showers*
  - *Optimize the shower developemtn parameters*
- *Perform a fit to the 2D clusters with a straight line*
  - *Evaluate the matching between the fitted helix of the track and the track in the IFR, at the coil*
  - *Fitter chi2 and the matching are crucial to properly discriminate between muons and pions*
- *Start to look at the K_L*

Conclusion

- ***Output of the workshop***
  - *Optimize the manpower available*
  - *Prioritize the various activities on the IFR Simulation:*
    - *Fast Simulation*
    - *Detector Optimization activities: fast-full sim interplay*
      - *# of interaction lenghts*
      - *Spatial resolution, baseline: 4cm x 20cm*
      - *Transverse segmentation: better identify the neutral hadrons*
      - *Esplore the possibility to have a cylindrical active layer outside the EMC*
    - *Background studies: require the full sim, can affect the Geometry*
- ***Further manpower will be very very welcome***
  - ***Timeline is short!***
- *Any idea?*