Summary of fast simulation

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for the fast simulation WG

SuperB computing workshop
Frascati, 17 December 08

The goals before the start of the meeting

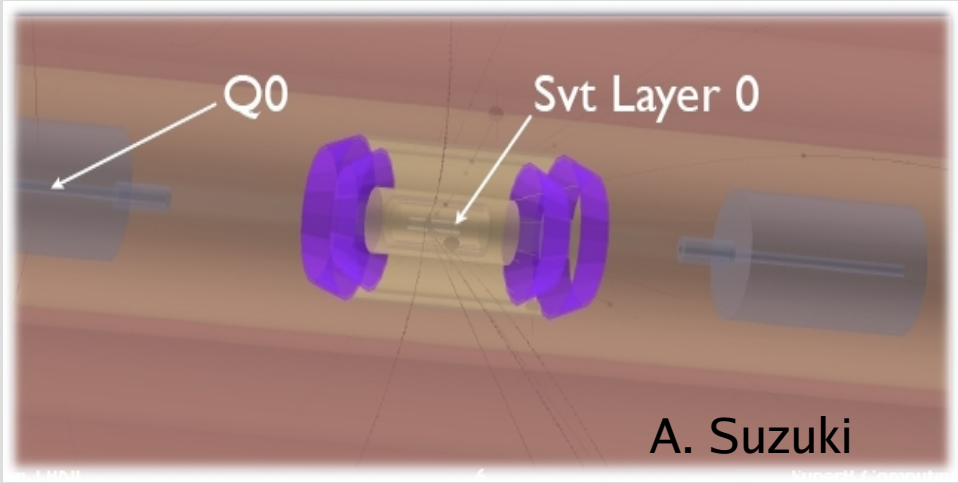
Workshop Goals

- Feedback from physics and users
  - What is needed to make fastsim more useful?
- Coordination with Full Sim
  - Geometry and material description
  - Background frame overlay
- Shower modeling improvements
  - Shower parameterization, fluctuation modeling
  - Detector response to shower
- Particle ID
  - Missing information (dE/dx, Ifr timing?)
  - Selectors for FastSim

D. Brown

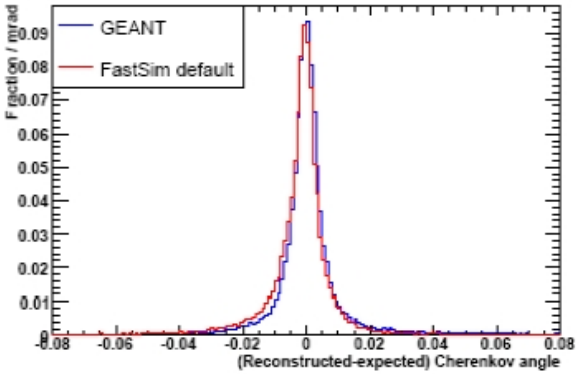
FastSim tutorial

- Led by D. Brown on Monday afternoon, based on FastSim V0.0.1
- Interactive: step by step, with attendants following live instructions.
- From release setup to simulation of B->D*K decays in a tunable SuperB-like environment.
- Use of event display
- Positive experience. Another one at the Feb '09 meeting?

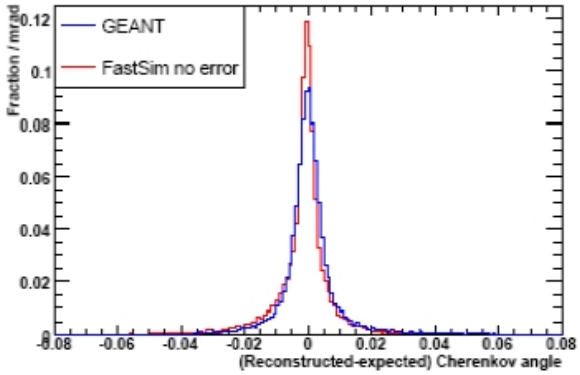


Particle identification

- DIRC:
  - FastSim vs. Full Sim agreement significantly improved



Default distributions.



No errors - geometric, achromatic, and extra error terms all set to zero.

B.Meadows,D. Aston, R. Andreassen

  - Simulation makes use of BaBar 'RingDictionary'. Possible to 'scale' it to get a reasonable description of the DIRC SuperB baseline.

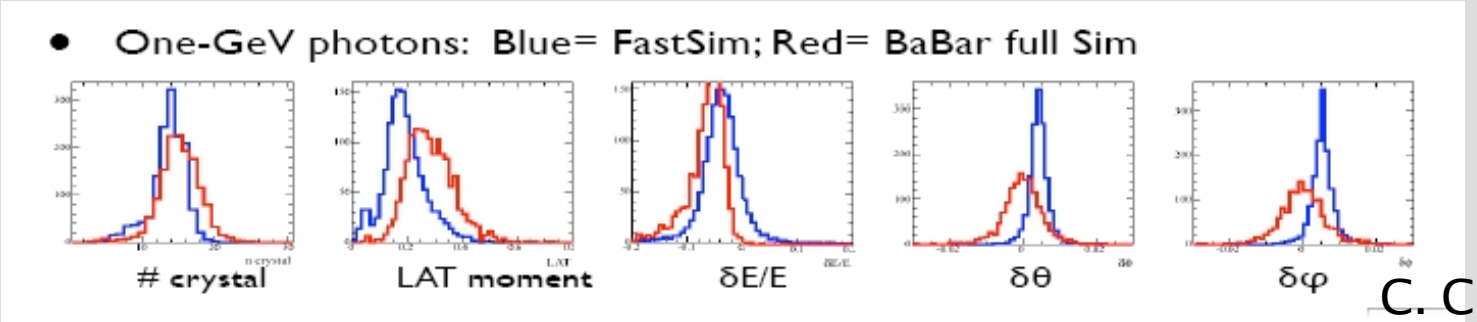
Particle identification

- Other players:
  - Vertex detector, DCH: dE/dx - not yet available
  - EMC, IFR: development of shower simulation in progress (see later)
  - SuperB-specific options: work is starting (also related to the Detector Geometry WG)
- Particle ID is (will be) used through PID selectors
  - They exploit all available information to discriminate between particles
  - Their development is crucial for physics analysis (including tagging) and detector optimization.
  - A team has been formed to develop them. More volunteers are welcome.

Shower modeling

- Big effort to develop an accurate enough description of EM and hadronic showers. Encouraging results with the EM. More difficulties with hadrons (as usual).
- The usual parametrization applies to sampling calorimeter, while our EMC is an absorption calorimeter. We have to invent our way to implement it.

EMC simulation

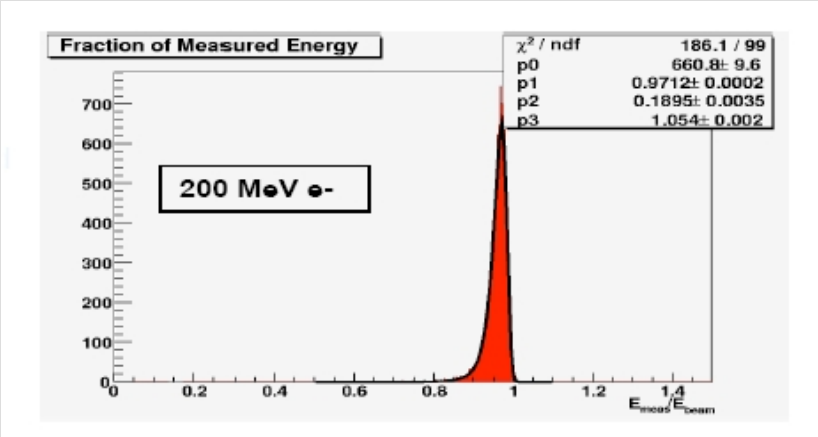
- Use a phenomenological radial dist. of shower to evaluate the average energy deposit on hit crystals. Then fluctuate response of each crystal.
- 

C. Cheng

- Still needs to improve the agreement with Full Sim, but tuning not fully exploited yet
- (incomplete) to-do-list: tune longitudinal shower profile, track-cluster matching, cluster merging/splitting,...
- Shower library abandoned

forw. EMC simulation (G4)

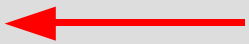
- Geant4 simulation of LSO crystals of forw. EMC
- Parametrization of measured energy from e-/γ



$$F(x) = P_0 e^{-\frac{(x-P_1)^2}{2[P_2(P_3-x)]^2}}$$

S. Germani,C. Cecchi

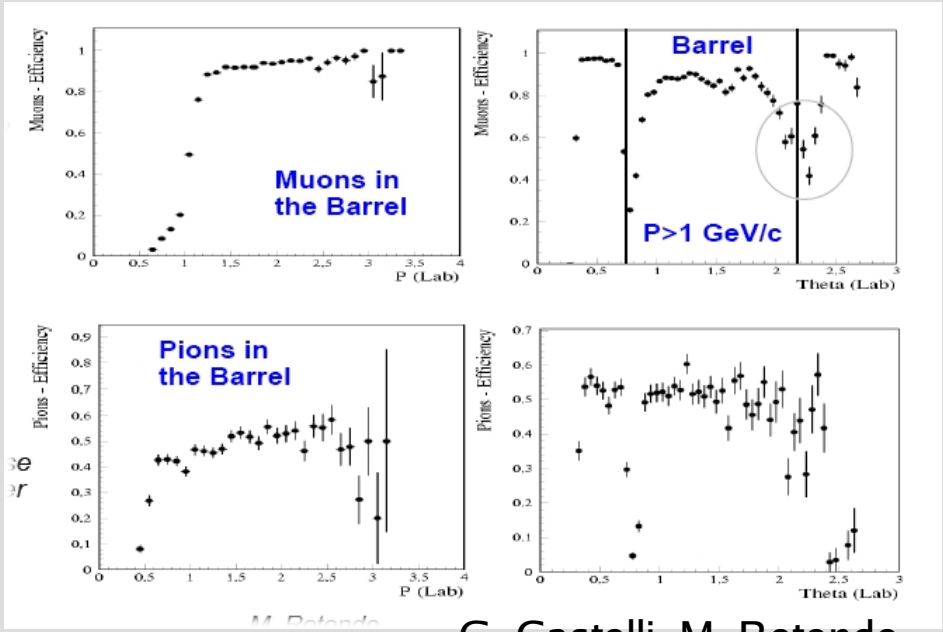
- Next steps
  - Study of the cluster size and transverse shower development
  - Angular resolution
  - Hadron showers
- How to implement the the parameterisation in the Fast Simulatio code ?



Hadronic shower

IFR simulation

μ/π separation based on # of traversed iron layers (>9)

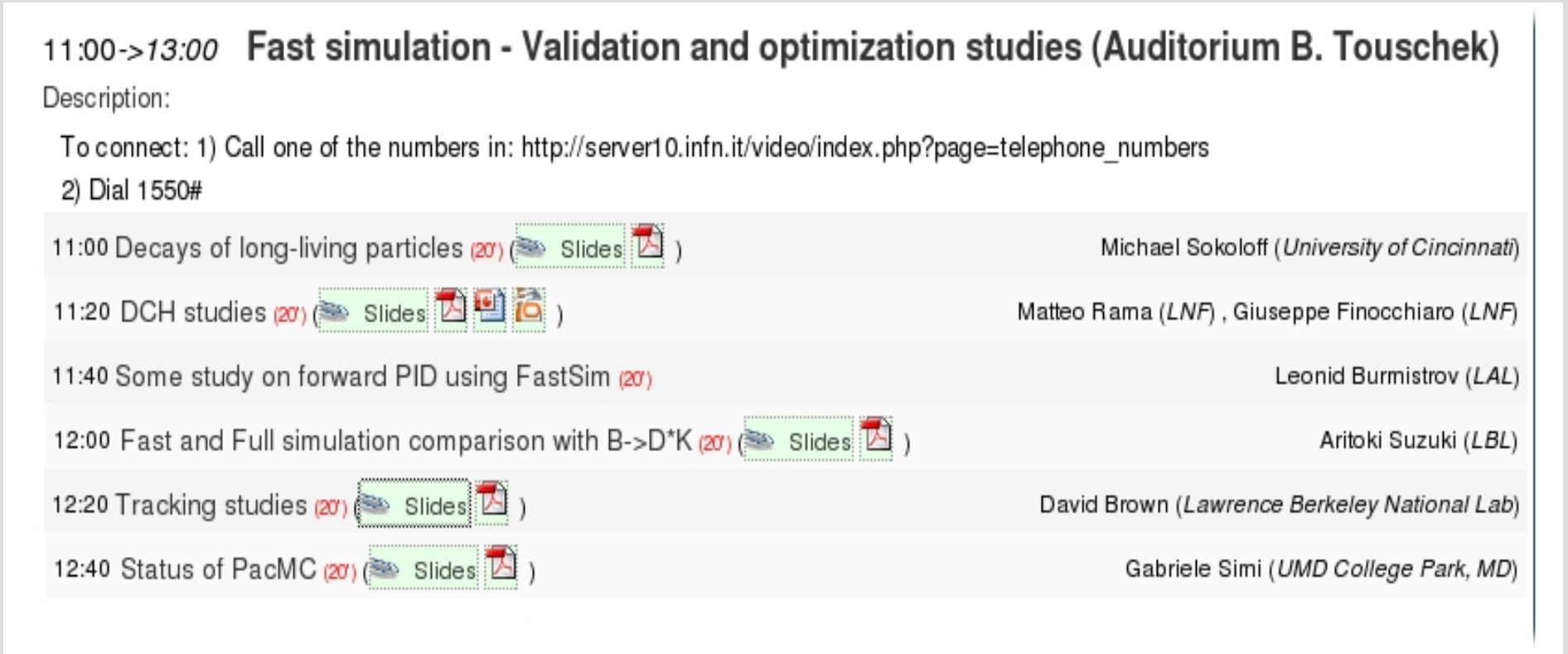


G. Castelli, M. Rotondo

- efficiency too optimistic for μ and too high for π. Need to better simulate the IFR response when a hadronic shower is produced.

Validation

- A session packed with validation studies
- Contributions also from non-developer users



11:00->*13:00* **Fast simulation - Validation and optimization studies (Auditorium B. Touschek)**

Description:

To connect: 1) Call one of the numbers in: http://server10.infn.it/video/index.php?page=telephone_numbers

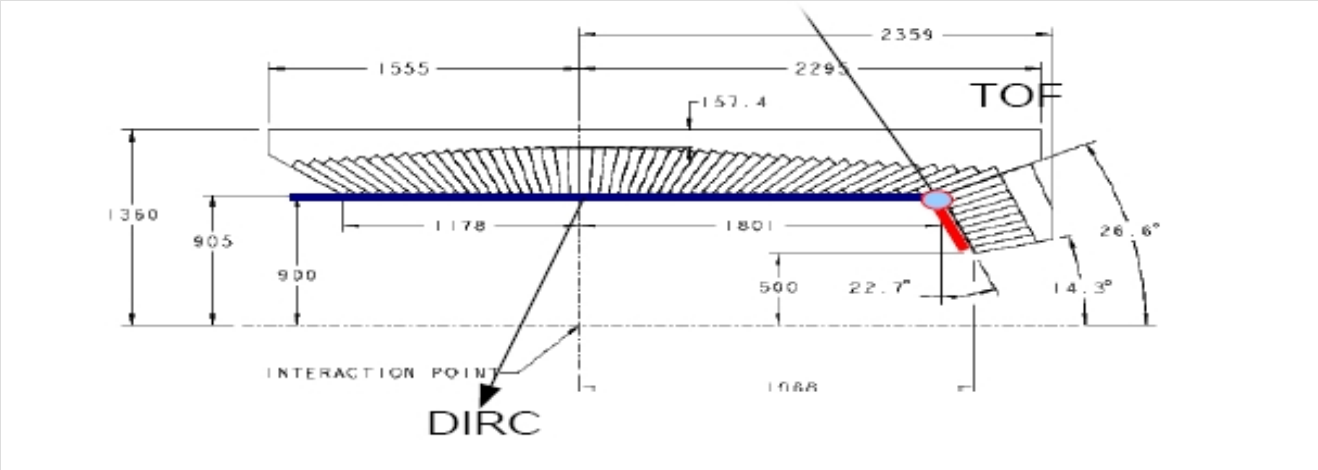
2) Dial 1550#

11:00 Decays of long-living particles (20') (Slides)	Michael Sokoloff (*University of Cincinnati*)
11:20 DCH studies (20') (Slides)	Matteo Rama (*LNF*) , Giuseppe Finocchiaro (*LNF*)
11:40 Some study on forward PID using FastSim (20')	Leonid Burmistrov (*LAL*)
12:00 Fast and Full simulation comparison with B->D*K (20') (Slides)	Aritoki Suzuki (*LBL*)
12:20 Tracking studies (20') (Slides)	David Brown (*Lawrence Berkeley National Lab*)
12:40 Status of PacMC (20') (Slides)	Gabriele Simi (*UMD College Park, MD*)

B->rho γ study

- Ultimate goal is to evaluate how much we gain if we have a forward PID

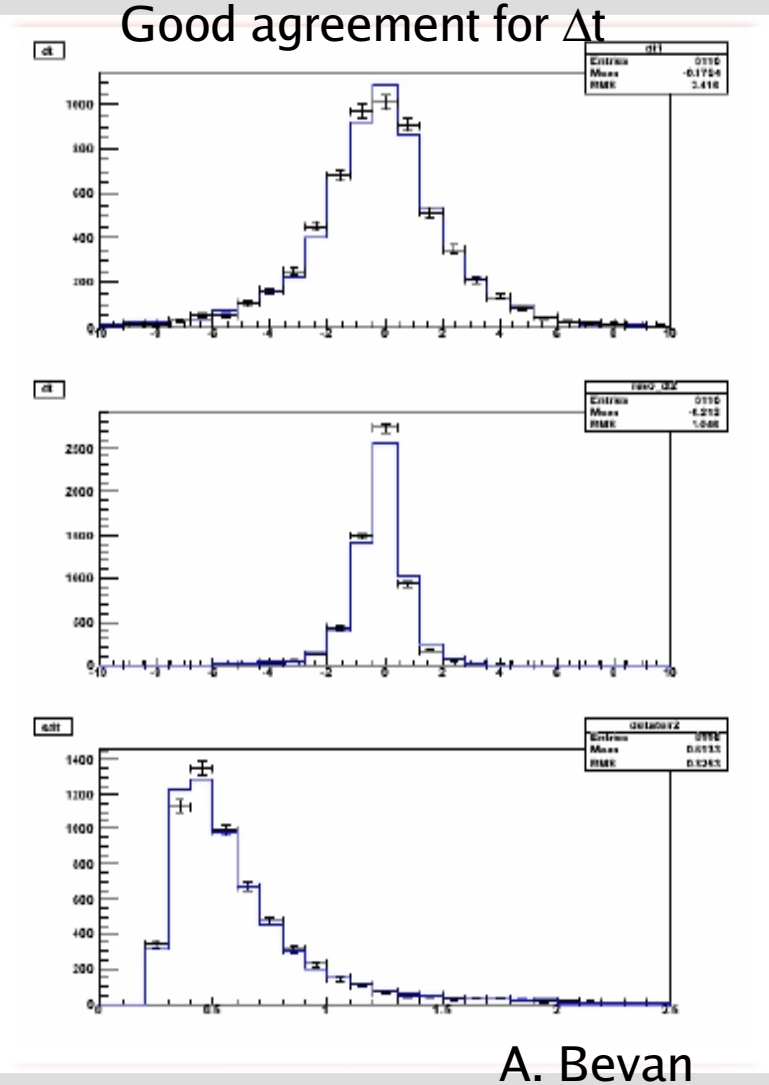
L. Burmistrov, A. Stocchi



- Simulation not implemented yet...
- <u>... assume</u> a eff. and misID value and see what happens to the S/B efficiency
- Ex: to have S/B~7 (B->rhoγ/B->K*γ) needs ~1% K/pi misId

Performance of B->pi+pi-

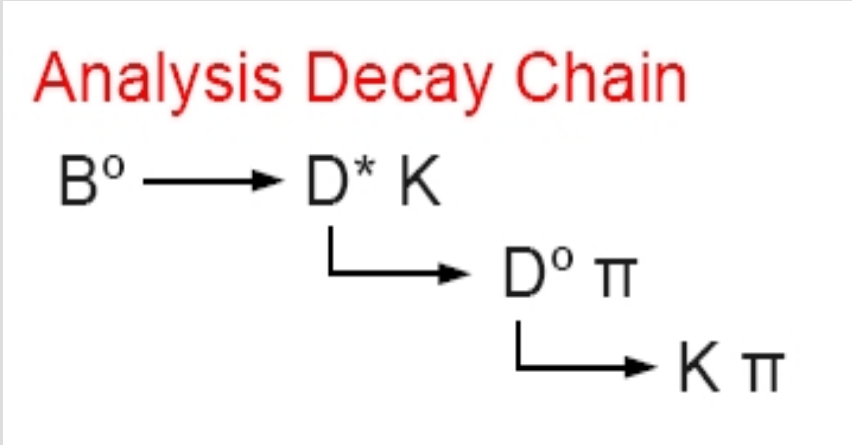
Good agreement for Δt



A. Bevan

- Extensive comparison of FastSim and FullSim (BaBar) using B0->pi+pi-
- Good agreement
- Comparison of BaBar and SuperB baseline configuration
- Need PID selectors to use tagging

Fast and sim cmparison with B->D*+K-



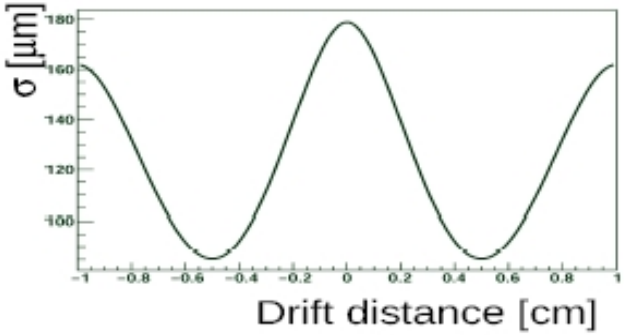
- Agreement of basic kinematics quantities is satisfactory
- First step of a more complex analysis

- Verify more variables on FastSim against FullSim
  - Vertexing
  - Neutral Track
  - etc
- Understand efficiency discrepancy
- Study various detector configuration

A. Suzuki, D. Brown

First DCH studies with FastSim using B0->pi+pi-

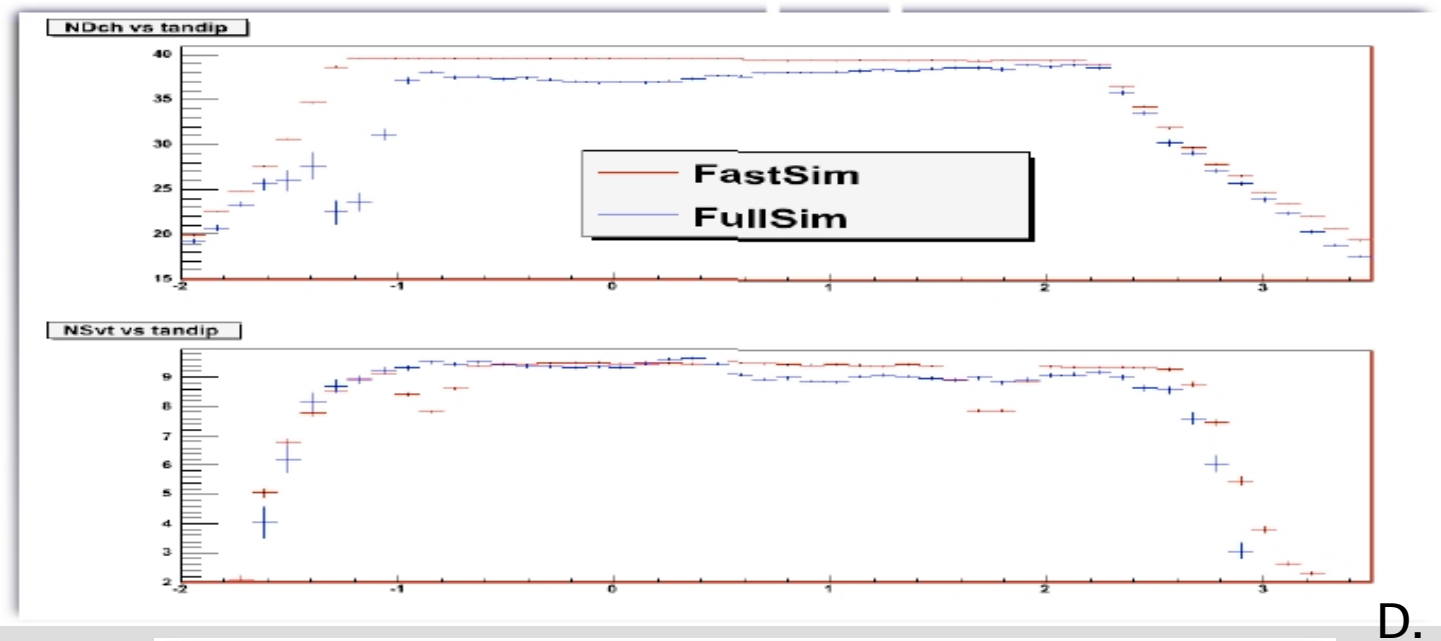
- Compare ΔE and pt resolution with different DCH configurations
  - Default BaBar 'averaged' Gas+wire ('averaged'=homogeneous Gas+wire 'material')
  - Recomputed 'averaged' material (differences found!)
  - Gas and wires as distinct materials
  - As above, but with 2x # of DCH cells
  - More realistic (space dependent) hit reso function



G. Finocchiaro,M.Rama

Tracking validation

- Wide spectrum of validation tests related to track reconstruction. Just one example:



D. Brown

- PacSim tracking is reasonable
  - Some problems with Dch, Svt configuration
  - Svt hit resolution could be improved
- Comparisons are straight-forward
  - Add to standard QA tests?

Physics and FastSim

- Identified 7 golden channels for physics and also challenging from the detector point of view. Ex: B->Xsγ, B->tau nu, etc.
-
- Start from the physics case to see how the detector should (ideally) be
- Work related to activity of the Detector Geometry working group (1st meeting after this session)

PacMC development

- Decay of 'stable' particles:
  - ...like K, π, μ.
  - With the new code we'll have, for example, a kaon which hits the detector and at some point decays to a μ which can interact, too.

M. Sokolof, G. Simi

- Re-design of PacMC package
  - Core package to go from PacTrk to the 'BtaCandidate' (the object which represents a particle)

G. Simi

Summary

- Fruitful meeting for FastSim: initial goals have been met
- New activity on PID selectors started
- Still open issues on shower simulation. This is a difficult task which will require additional work and ideas
- First-time major input from users
- In a number of case FastSim is already performing well

- Interesting joint session where we discussed about the relationship between Fast and Full sim concerning detector description and machine bkg simulation. See D. Brown's talk later