(Fast) Simulation Tools

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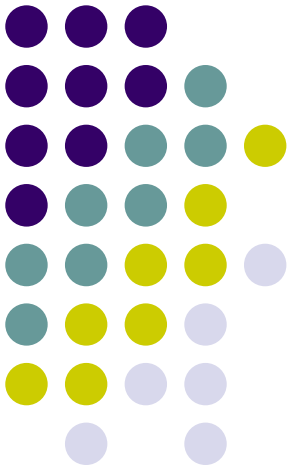
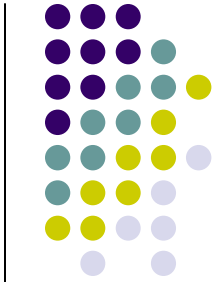
For the Fast Simuation group

SuperB workshop
La Biodola, Isola d'Elba
3 June 2008



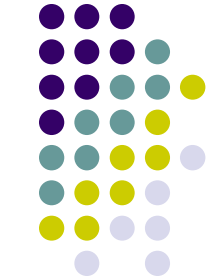
Outline



Geant4 simulation presented in previous talk.
I will focus on the development of the fast simulation of SuperB.

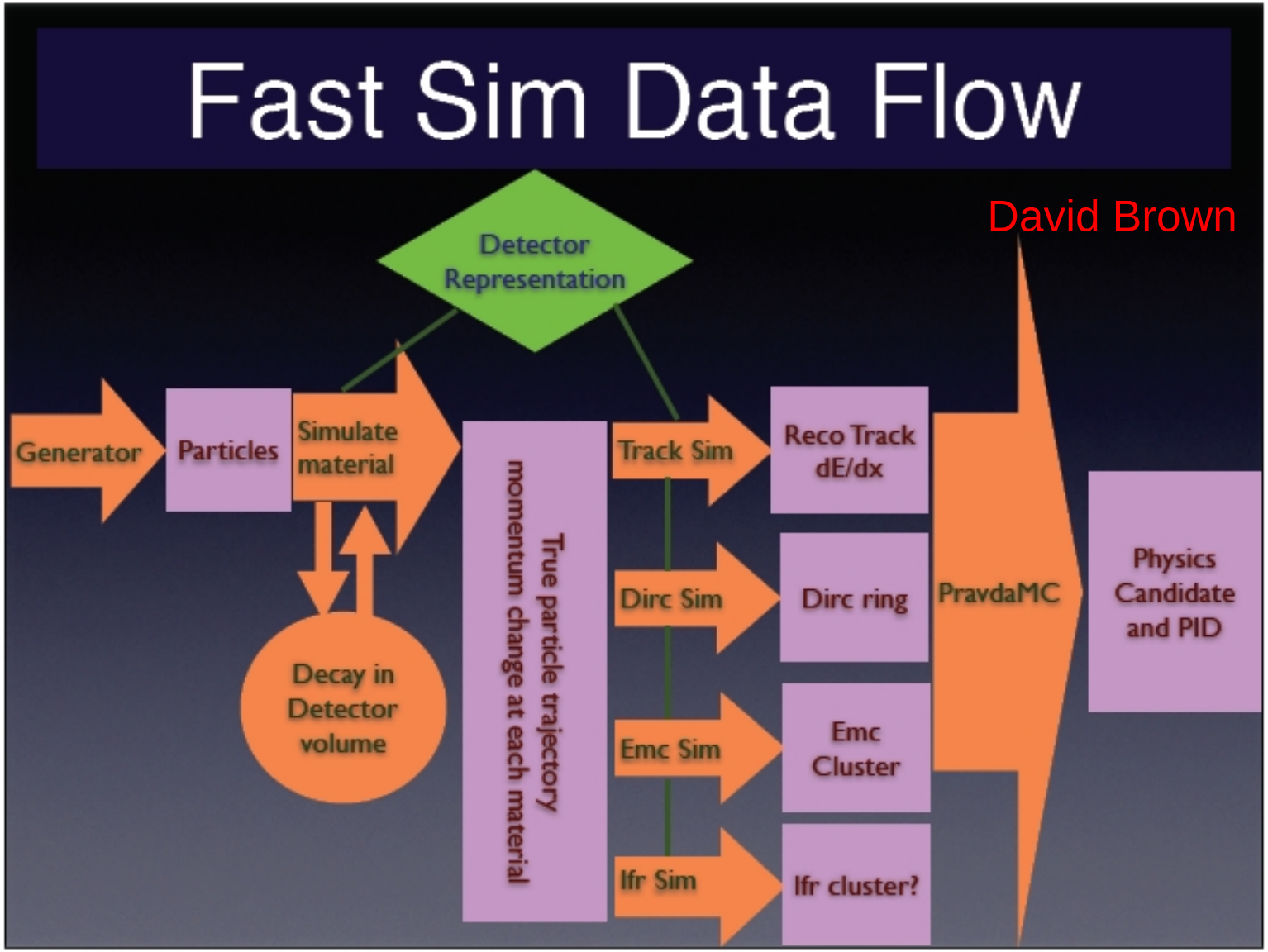
- Overview of the SuperB fast simulation
- The 1st milestone
- Beyond the 1st milestone
- Interplay with physics groups
- Interplay with Geant4 simulation
- Summary

Introduction

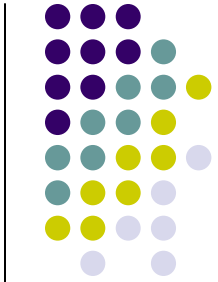


- Goals
  - Detector optimization
    - tracking configuration, resolution requirements,…
  - Physics reach studies
- Performance adequate to the SuperB TDR needs

Scheme of fast simulation

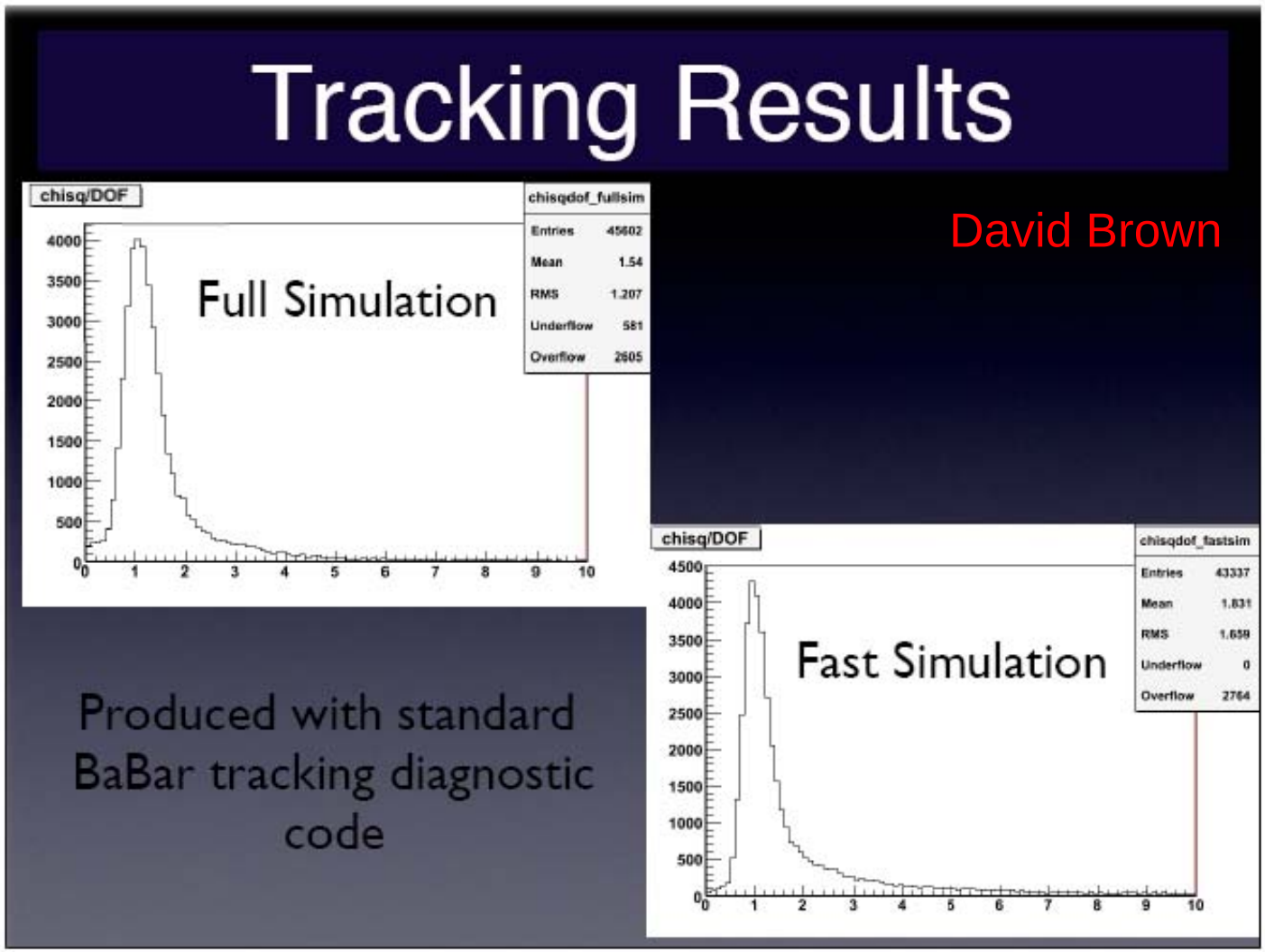


Tracking

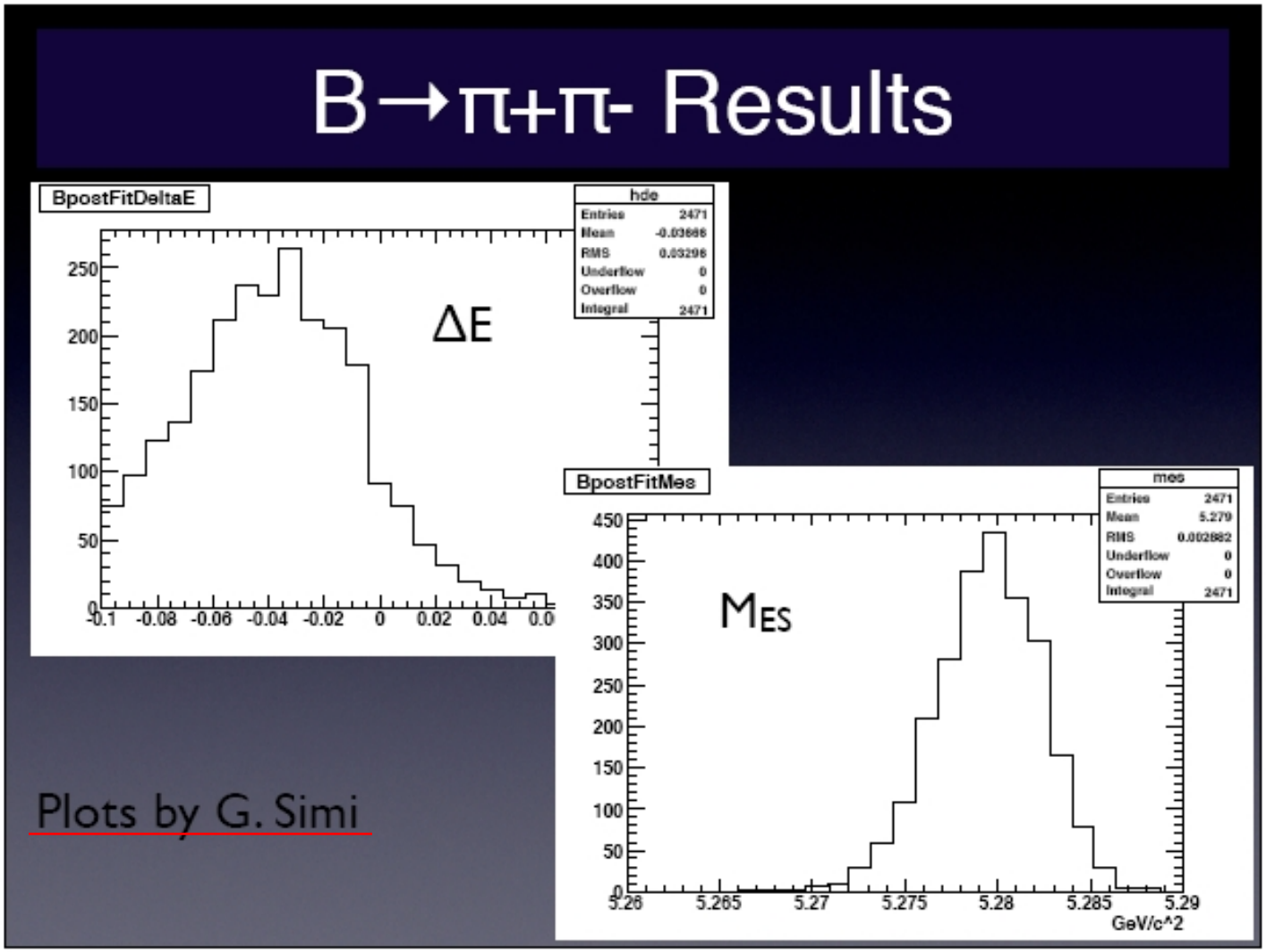


- Propagate generated particle through the detector and evaluate the trajectory.
- Use BaBar DetectorModel to describe geometry and materials
- Multiple scattering and energy loss taken into account
- Hits are generated at each active layer with position smeared by resolution function
- Use BaBar Kalman fit to reconstruct tracks. No pattern recognition.
- The current version is being extended with a number of additional features

Tracking performance



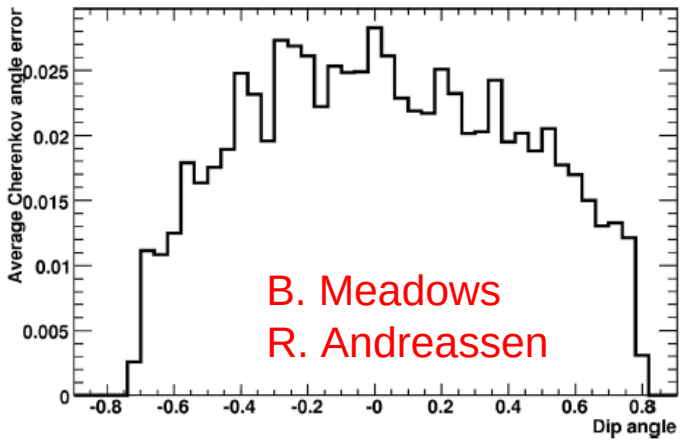
First reconstructed B decays



DIRC

- PacTrk gives true **x**,**p** of tracks at the DIRC entrance.
- DIRC response is parametric. From **x**,**p** it gives:
  - Cherenkov angle+ error, Nphotons
- BaBar ring dictionary is used
  - In general if DIRC design changes, a new ring dictionary is probably needed (from Geant4 simulation)
- Working implementation of Babar DIRC already available. It's fast and gives reasonable results. Still needs extensive validation.

Ex. of simu output: $\sigma\Theta_C$ vs. dip angle



EMC

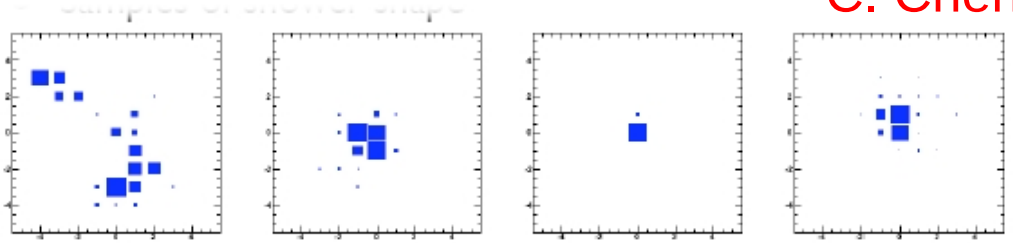
- PacTrk provides true **x**,**p** of tracks and photons at the EMC entrance.
- EMC response is parameterized/sampled from a shower library, which is created from BaBar data or Geant4:
  - store many samples of clusters for each species and **x,p**
  - when running simulation, pick up one cluster

library sources:

- EMC barrel: BaBar Geant4/data
- EMC forward: Geant4 (under develop.)
- EMC backward (possible): Geant4

C. Cheng

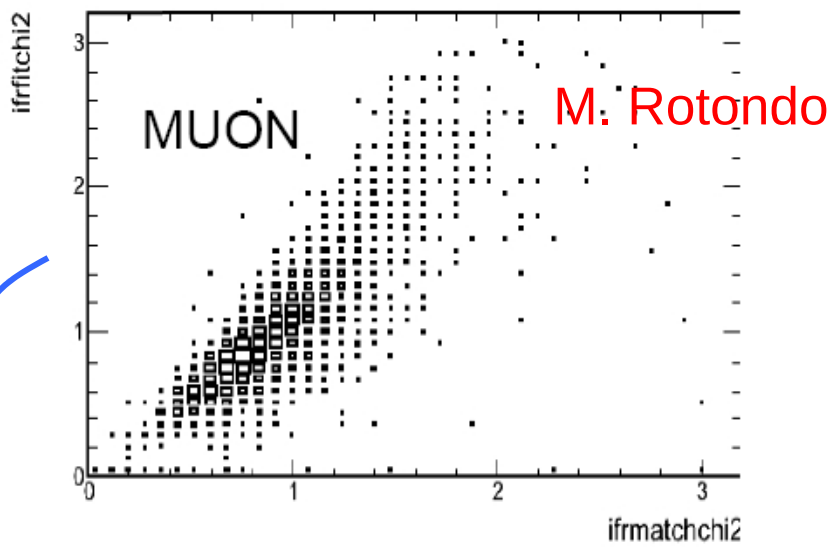
1GeV K_L EMC clusters
(BaBar barrel detailed MC)



IFR

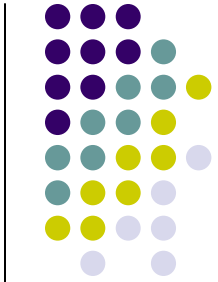
- PacTrk provides true **x**,**p** of tracks and photons at the EMC entrance.
- For each entering particle the number and spread of the hits per layers are simulated:
  - With respect to the previous solution where the final reco. quantities were simulated:
    - output is more realistic
    - correlations are more easily accounted

kind of corr. that we want to avoid to parametrize



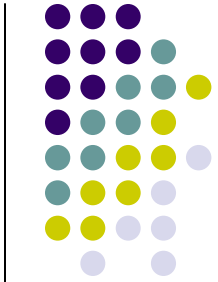
reconstructed quantities used in selectors are derived from the hits

Approaching the 1st milestone



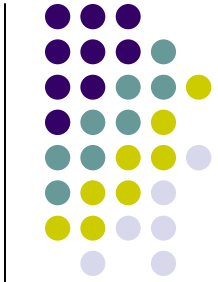
- Release the 1st version of Fast Simulation in ~1 month or a little later.
  - Ambitious but feasible plan. All the 'ingredients' are in good shape. We need to finalize some of them and put all together
  - Code stored in SVN repository
- A User Guide will be made available when the code is released.
- Efforts also devoted to make the code accessible outside BaBar. Need to:
  - Clean dependencies with the BaBar code not needed by the fast simulation and extract a tarball which can be compiled and run by everybody.
  - Receive the approval by the BaBar management after the sensible code has been removed.

Looking beyond the 1st milestone



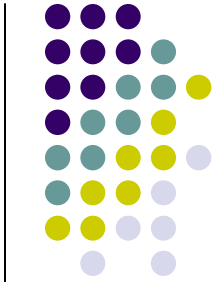
- The detector configuration in the 1st release will describe BaBar to validate the output of the simulation.
- Additional SuperB elements will be included in the next steps :
  - forward (backward) PID. What is the impact on benchmark channels?
  - new forward (backward) EMC
  - Upgraded IFR
  - Note: SVT and DCH are configured in PacTrk, therefore can be modified from the beginning.
- Resolution functions, geometry and materials are provided by the subsystems.
- Inclusion of forward PID (as of other systems) needs shared work with the PID group also in terms of code development

Looking beyond the 1st milestone



- Validation studies of current simulation already started and planned after the public release of the code.
- Future improvements:
  - Tracking code will be progressively extended with additional features
  - Response of DIRC, EMC and IFR output will be refined.
- Time schedule: we'll try to draw a time plan of the priorities shortly after this meeting, to be updated after the first milestone is reached.

Interplay with physics groups

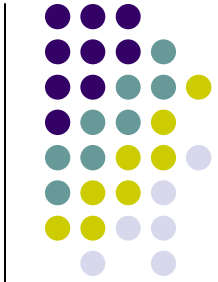


- One of the goals for the Fast Sim. group in this workshop was to establish an active collaboration with the physics groups.
- Physics conveners of Valencia meeting were asked to identify a set of benchmark channels differing for experimental technique, nature of backgrounds, systematics etc..
- For each channel they were asked to indicate specific requirements that the simulation should satisfy.
- First indications to the Fast Sim. group are expected at the end of June.

Common description of detector in full and fast simulation?

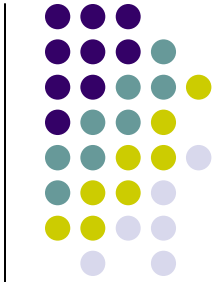
- Detector configuration controlled by an ascii file
- Plan to replace current format with GDML-like xml language
  - Use GDML to describe geometry and materials
  - Add extension to describe sensor segmentation and response functions
- Derive FastSim from FullSim description?
  - It requires code to reduce the complexity of the geometry
- Describe detector with a ‘master config. file’ and convert it to FastSim and FullSim descriptions?
  - Solution adopted at ILC
- Final decision not taken yet, but a few interesting ideas.

Interplay with Geant4 simulation



- FastSim and FullSim developments are NOT independent.
- FastSim uses (will use) input from Geant4 simulation of SuperB in several ways:
  - shower library of forward EMC
  - DIRC ring dictionary (in case DIRC changes require a new one)
  - response function of forward PID
  - hitmaps of machine background

Summary



- A fast simulation tool is being developed and is close to its first public release
  - Tracking code is implemented. It's being tested and extended.
  - Development of outer detectors (parametric response) is in good shape.
- A liaison with the physics groups has been established
- The first public release allows optimization studies of SVT and DCH.
- Inclusion of additional SuperB detectors requires collaboration of detector groups (already started). Plan to discuss the time plan and manpower with the subsystems shortly after this meeting.