FAMOS

The CMS Fast Monte Carlo Simulation

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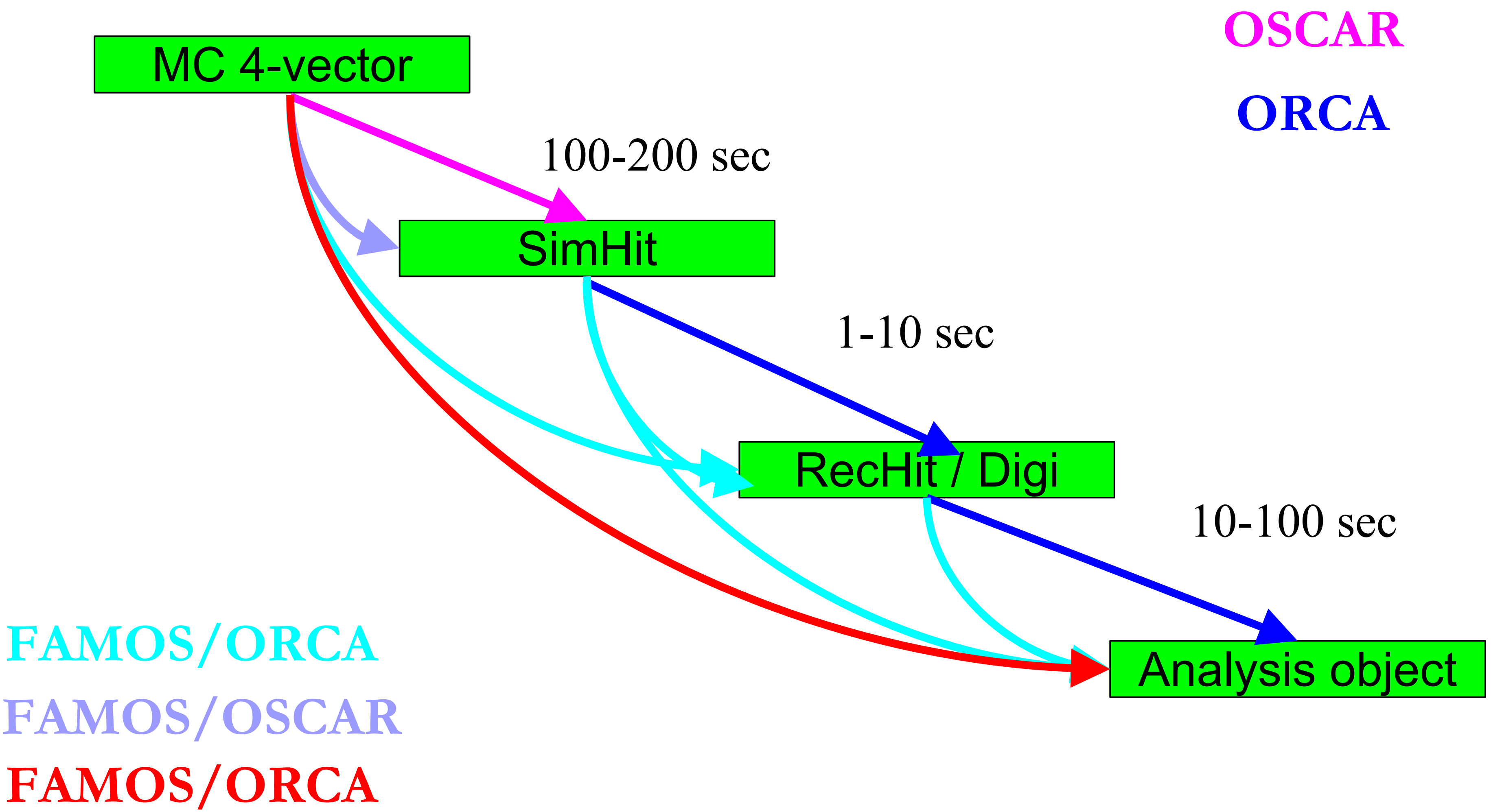
Introduction

- FAMOS
  - What it is
  - What's in there now
  - Where it's going in the near future

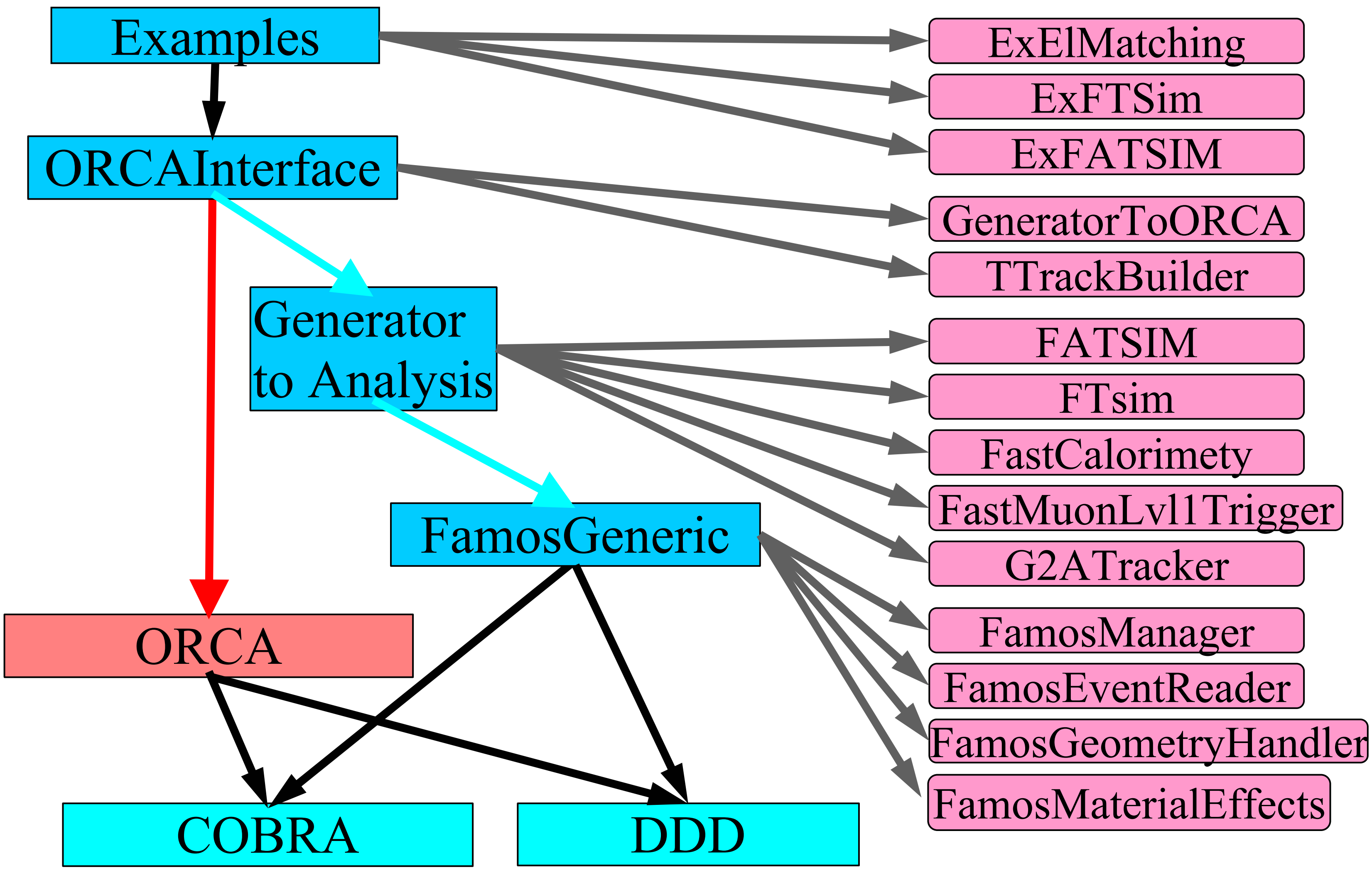
Simulation Chain



How Does Famos Fit Together?

- Idea is to use a chain of individual "simulators"
- These simulators are activated in turn by the FamosEventMgr
  - A normal COBRA singleton
  - accepts registrations of FamosSimulators
  - reads RawHepEvent from DB or Pythia6, etc.
    - use FakeRecReader to run without DB
  - gives RawHepEvent to each FamosSimulator

Structure of FAMOS Now



Details of Some Simulators

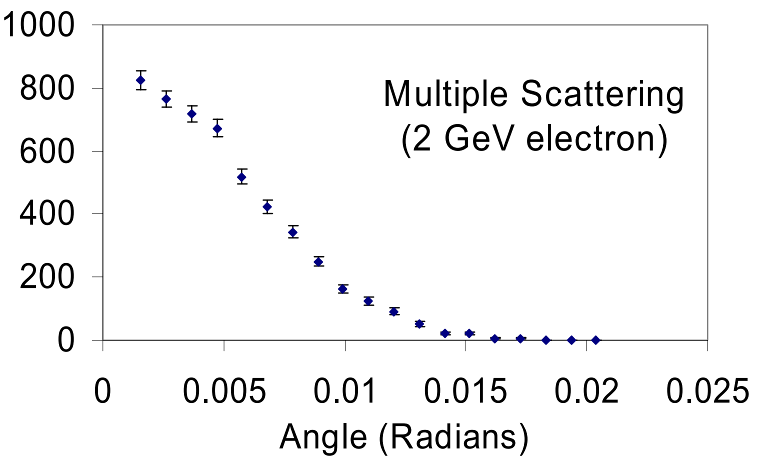
- Working
  - Particle and Material Effects
  - Tracking
  - Fast Calorimetry
- Coming soon…
  - DDD geometry
  - Gflash style simulation of ECAL/HCAL showers

Particle and Material Effects

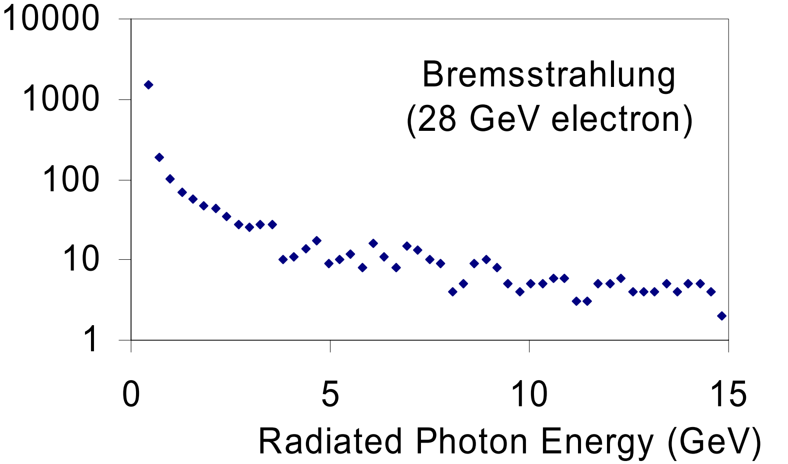
- Interactions available:
  - Multiple Scattering
  - Pair Production
  - Bremsstrahlung
  - dE/dx
  - Long-lived particle decays
- Simulation code is re-write of Geant 3 routines
  - No step lengths
  - Just use material depth from MaterialProperties of surfaces encountered during swim through magnetic field up to calorimeter surface.
  - Constant magnetic field

Material Effects Simulation

- Top
  - Distribution of scattering angle for 2 GeV electron



- Bottom
  - Energy spectrum of Bremsstrahlung photons from 28 GeV electron



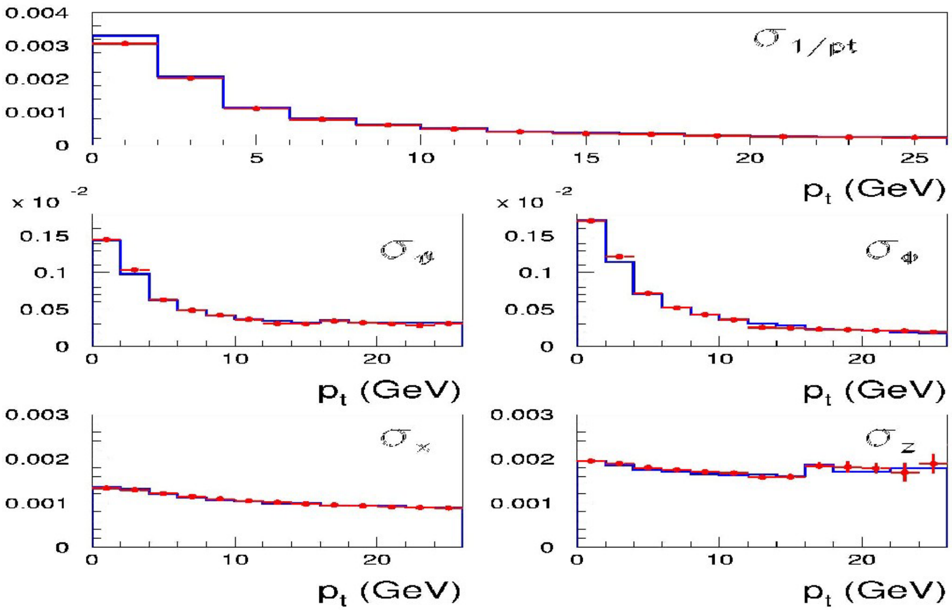
Tracker

- Tracker response/geometry
  - Single Tracks
  - Vertices
  - Jets
- Account for resolutions and correlations
- FTSim module
  - extrapolate generator particle(s) to innermost detector layer
  - build parameterized covariance matrix
  - get resolutions and smear track parameters
  - extrapolate back to (0,0,0), compute impact parameters (and errors)
  - build RecTracks

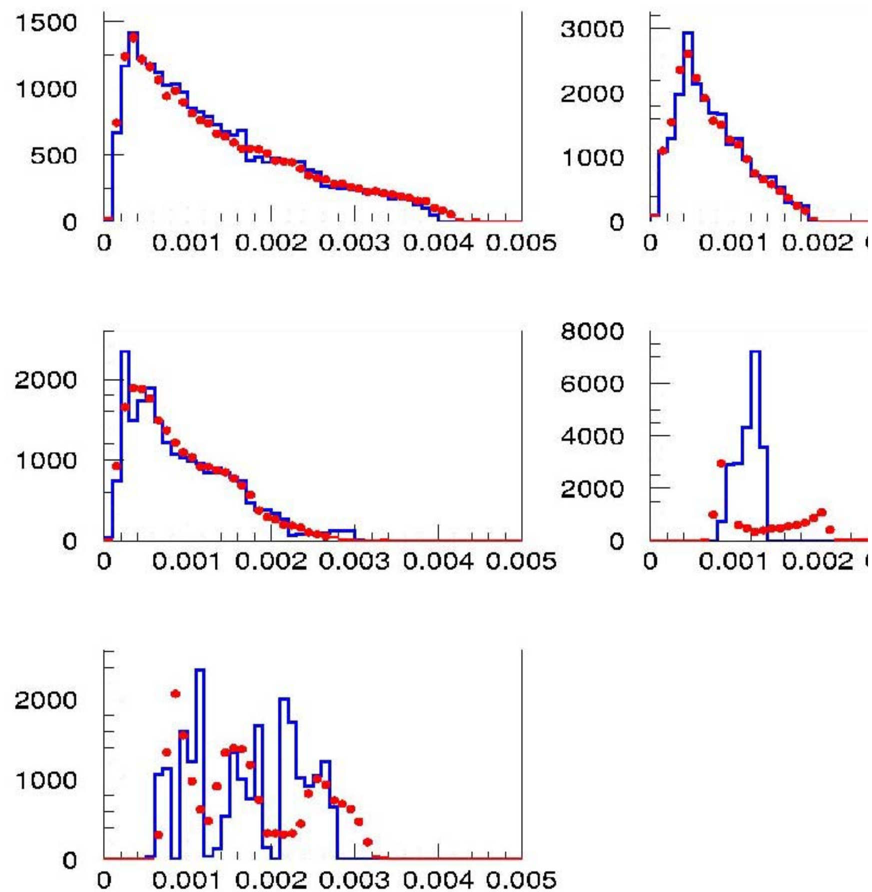
FTSim

- Parameterize covariance matrix diagonal elements as function of ***p*** and $|\cos\theta|$

✦ CMSIM+ORCA6 — Parametrized

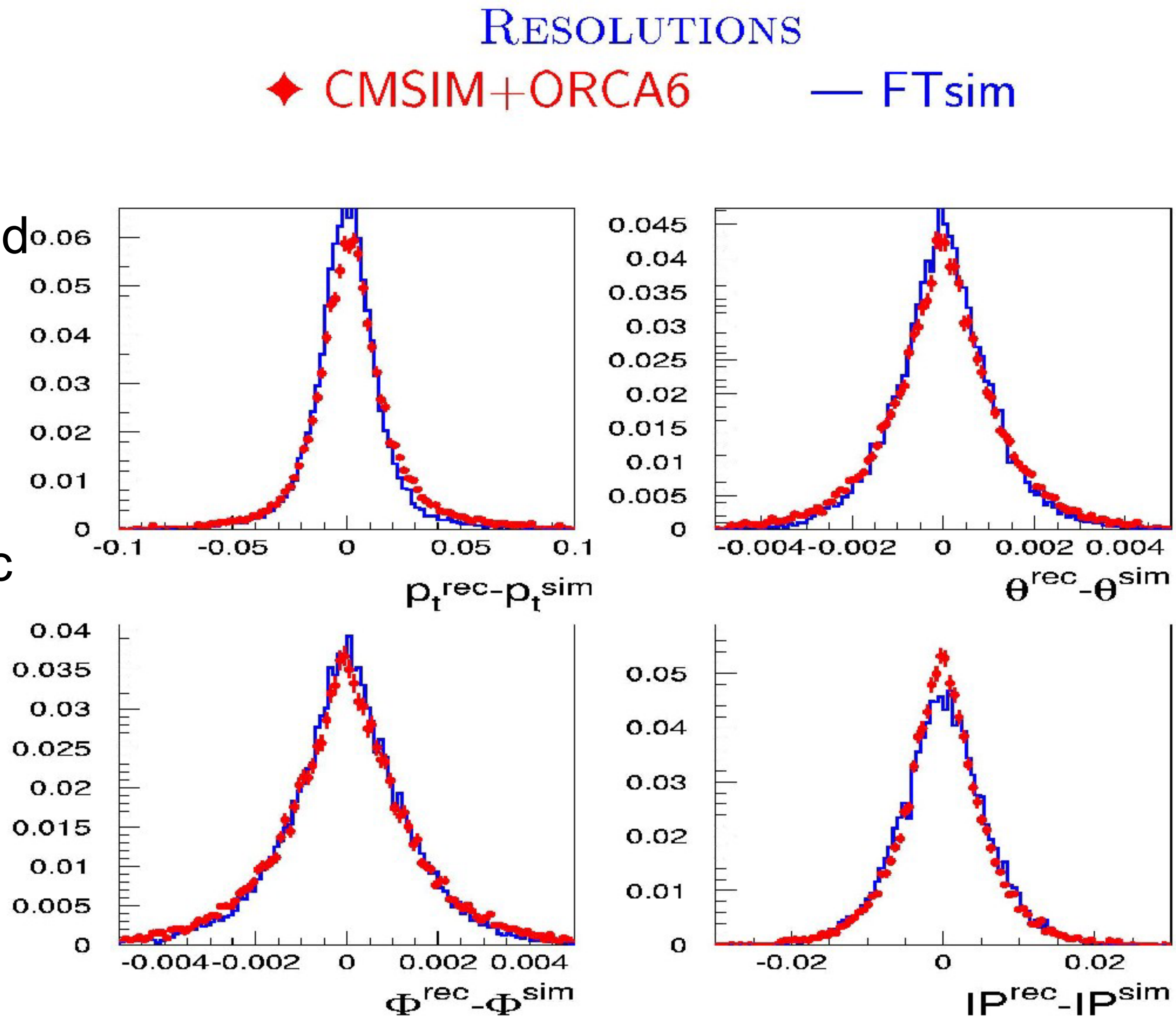


Covariance matrix elements: $\langle\sqrt{C_{jj}}\rangle$



FTSim

- Parameterized with
  - bb events
  - DY events
- 33 events/sec
  or
  0.03 s/ev



Fast Calorimetry

- Simple calorimetric clusters
  - ECAL – use only electrons & photons

$$\left(\frac{\sigma}{E}\right)^2 = \left(\frac{a}{\sqrt{E}}\right)^2 + \left(\frac{\sigma_n}{E}\right)^2 + c^2$$

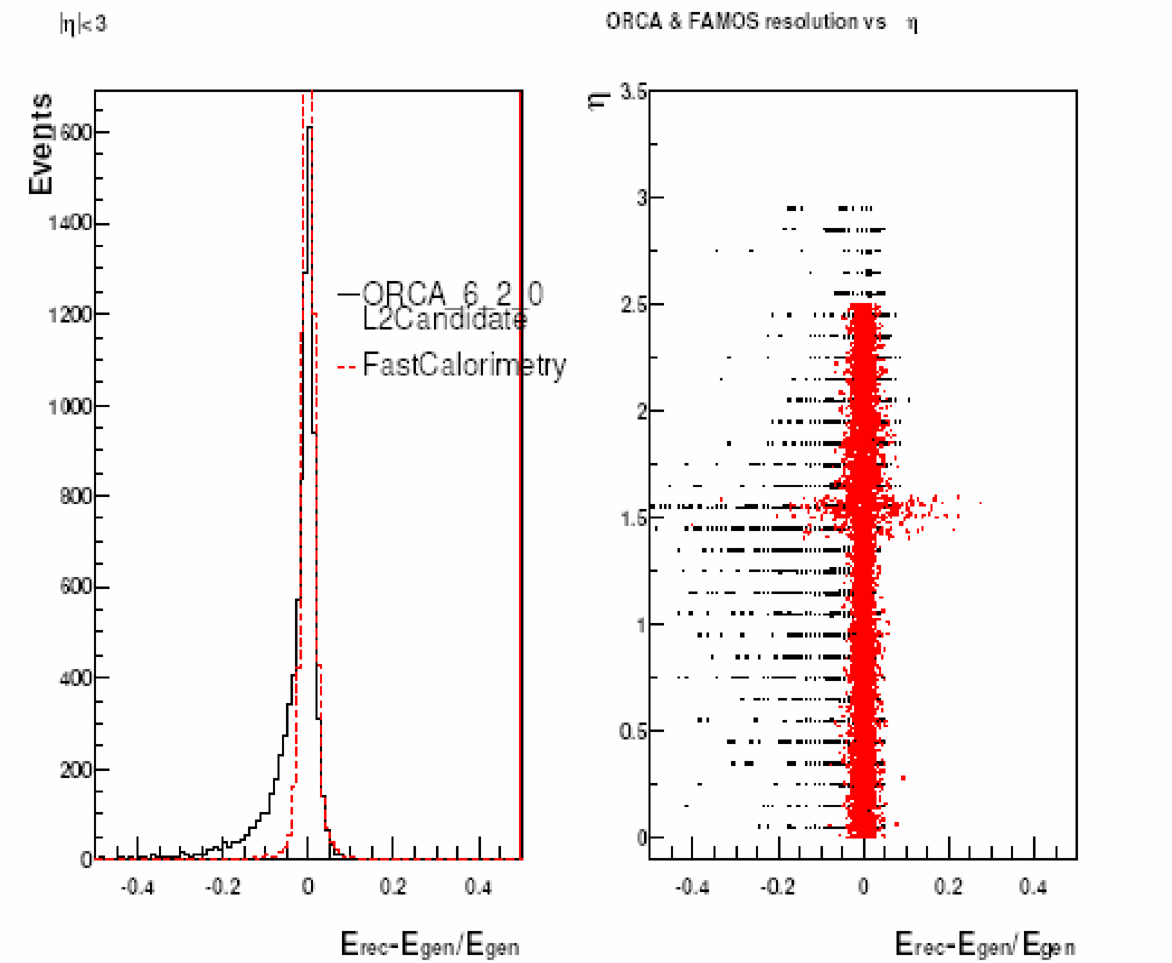
  - HCAL, VCAL – use all but muons & neutrinos

$$\left(\frac{\sigma}{E}\right)^2 = \left(\frac{a}{\sqrt{E}}\right)^2 + c^2$$

  - Generate **`SimpleCaloCluster`** objects
    - provides energy, ϕ, θ, radius, link to generator particle
  - Simplified geometry (hard coded frontface numbers)

Fast Calorimetry

- Single Electron
  - Clear differences between ORCA and FAMOS in this case
  - Due to simple propagation of particle to calorimeter – no material
  - MaterialEffects classes will fix this problem

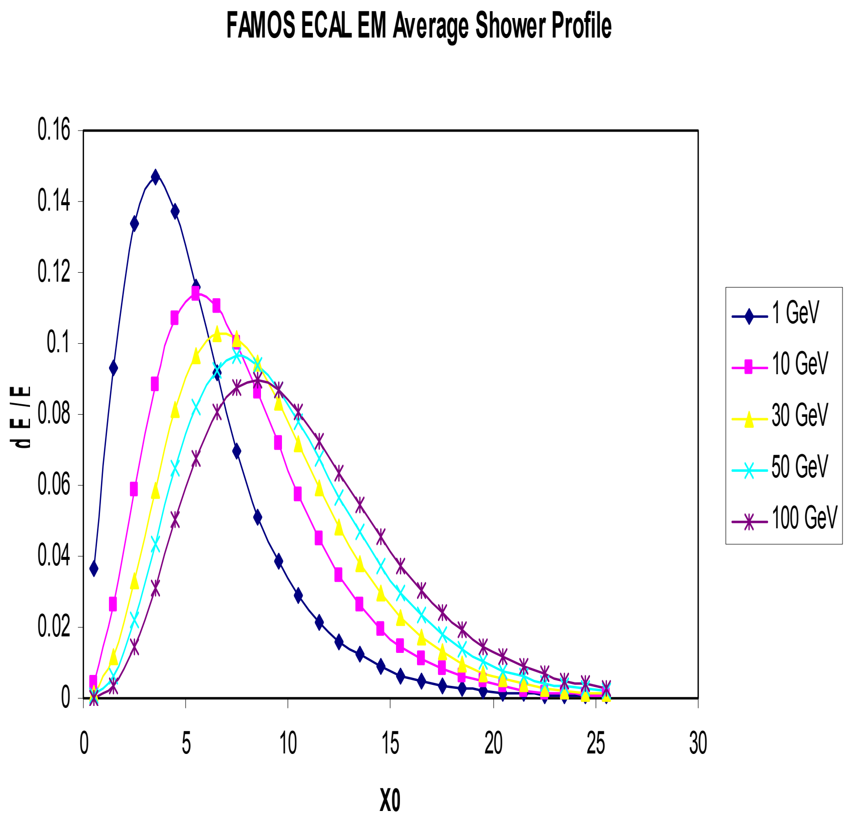


Coming Soon…

- DDD Geometry
  - Need to build a simplified tracker using active Geant-4 volumes from OSCAR
  - Will reduce these to cylinders and planes with appropriate material budgets
    - MaterialEffects classes will use this geometry to produce conversions, Brems, scattering etc. before particles reach fast calorimeter simulation
  - Expect first iteration of this geometry in next 2-3 weeks

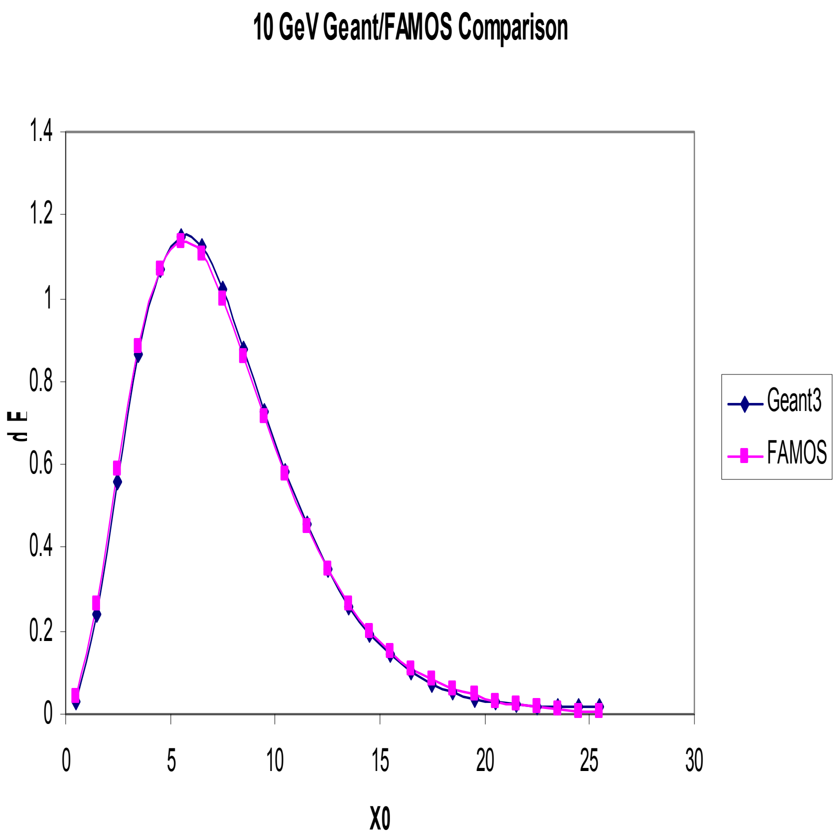
Gflash ECAL/HCAL Showers

- More detailed simulation than simple parameterisations based on resolutions
  - Simulates shower development in ECAL/HCAL material using gamma distribution
  - Parameters extracted from Geant 3 simulation
    - Eventually will be tuned to Geant 4/Testbeam



FAMOS/Geant Shower Comparison

- Example here is a comparison of average shower profiles for 10 GeV EM showers between Geant 3 and Gflash
  - Fairly good agreement between shower shapes
- HCAL shower parameterisations underway



Next Steps

- Integrate more realistic tracker geometry/materials into fast calorimeter simulation
  - More realistic treatment of conversions/Brems
  - Interface it properly into ORCA RecObjs
- Finalise Gflash shower simulation
  - Need to create/extract ECAL/HCAL geometry in a simple, “fast” way
  - Interface at the SimHit level
    - Quite a lot of work!

Going Forward

- FAMOS is central to the Physics TDR
  - But currently only few people are developing it part-time
  - Need more volunteers to work on
    - Geometry implementation
    - Interface to ORCA RecObjs
    - ORCA/Famos validation and testing
    - Fast trigger simulation…
- Let me know if you want to help out!
  - It's a way to get involved with the physics TDR NOW