Summary of the Workshop on Shower Parameterizations at Evolene

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Workshop Goals

- Bring developers of shower parameterization code together.

- Develope set of detailed benchmarks, on both generated and reconstruction level.

- Validate Frozen Showers for electrons and for photons.

- Improve description of the shower shapes

- Improve infrastructure for the frozen shower libraries.

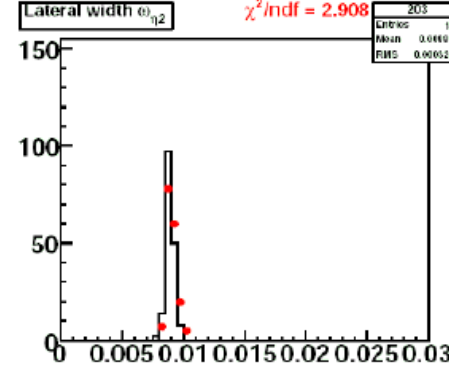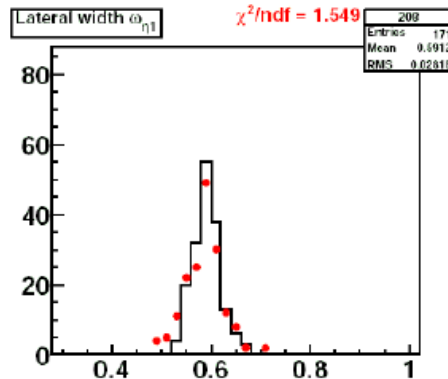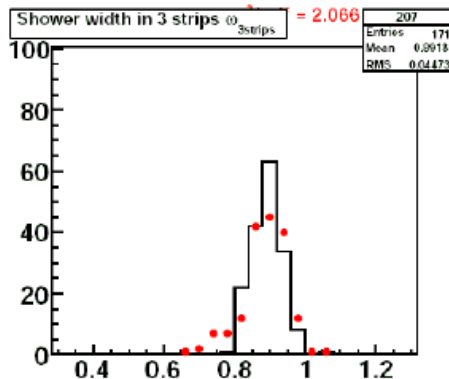- Discuss new ideas: hardware acceleration of shower simulation.
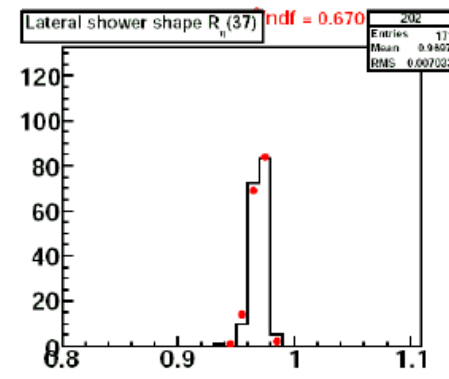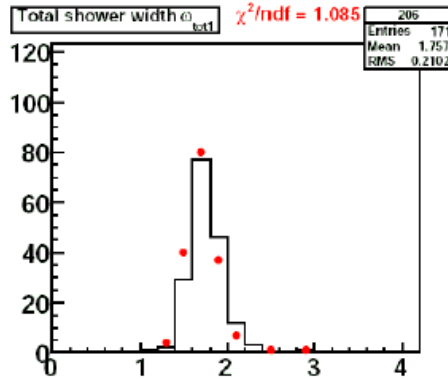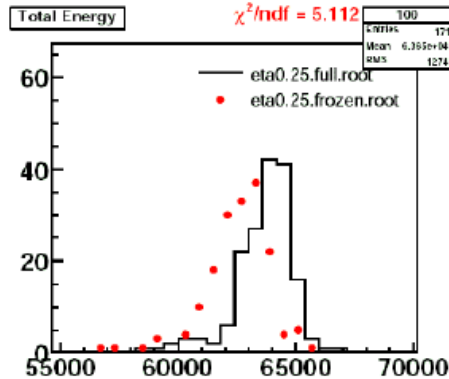
Participants: W. Ehrenfeld, S. Glazov, R. Placakyte (DESY), J. Bodreau, V. Tsulaia (Pitsburg), Z. Marshall (SLAC), A. Waugh (Sydney)

Validation at Reconstruction Level

- full simulation
- FS (no kill) + param

e of 64 GeV from IP, eta=0.25

r13.0.20

- Adapt existing code to version 13.0.20.

- ESD based ElectronContainer, details container for EM shower properties.

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EMEC sampling fraction variation

At the Parametrisation workshop in Februrary 2007 at CERN Guillaume Unal suggested a few plots to see what effects the fast shower parametrisation reproduces. The following is one from the talk:
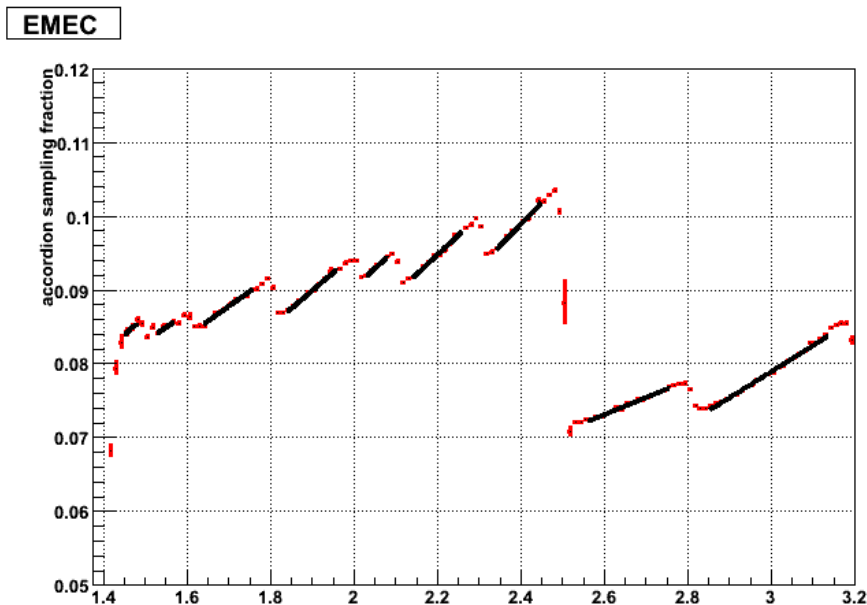
EMEC

The effect is of the order of 10%.

New Binning for EMEC

Old binning:

5 bins: 1.6, 2.0, 2.4, 2.6, 3.0
1000 events/bin
standard energy binning
size: 29 Mb

New binning:

14 bins: 1.62, 1.78, 1.82, 1.98,2.02, 2.08, 2.12, 2.28, 2.32, 2.48,
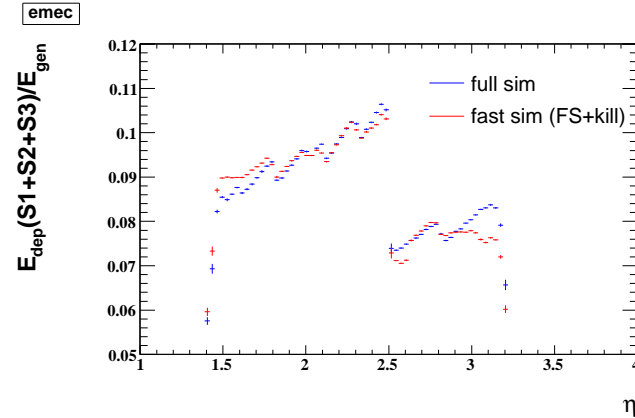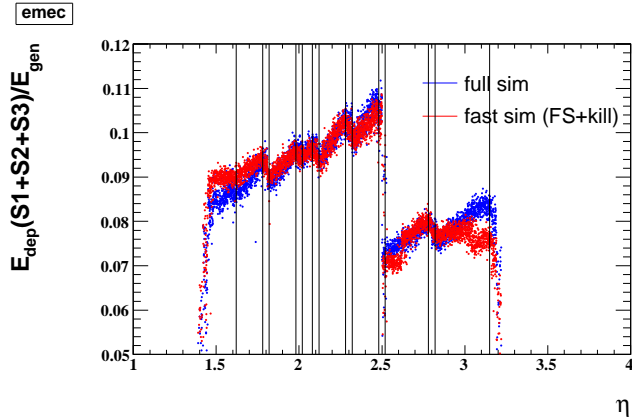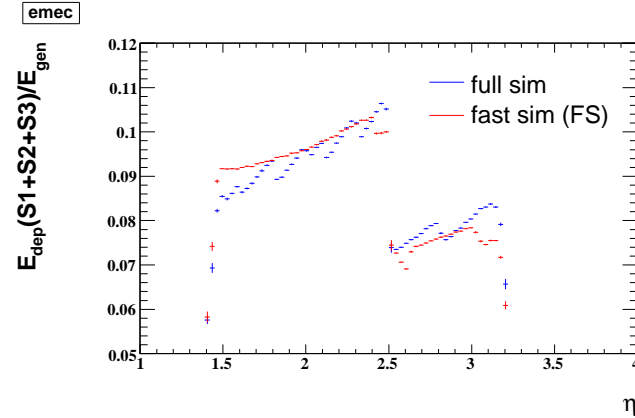2.52, 2.78, 2.82, 3.15
eta bin changes: $2.4 \rightarrow 2.48$, $2.6 \rightarrow 2.52$
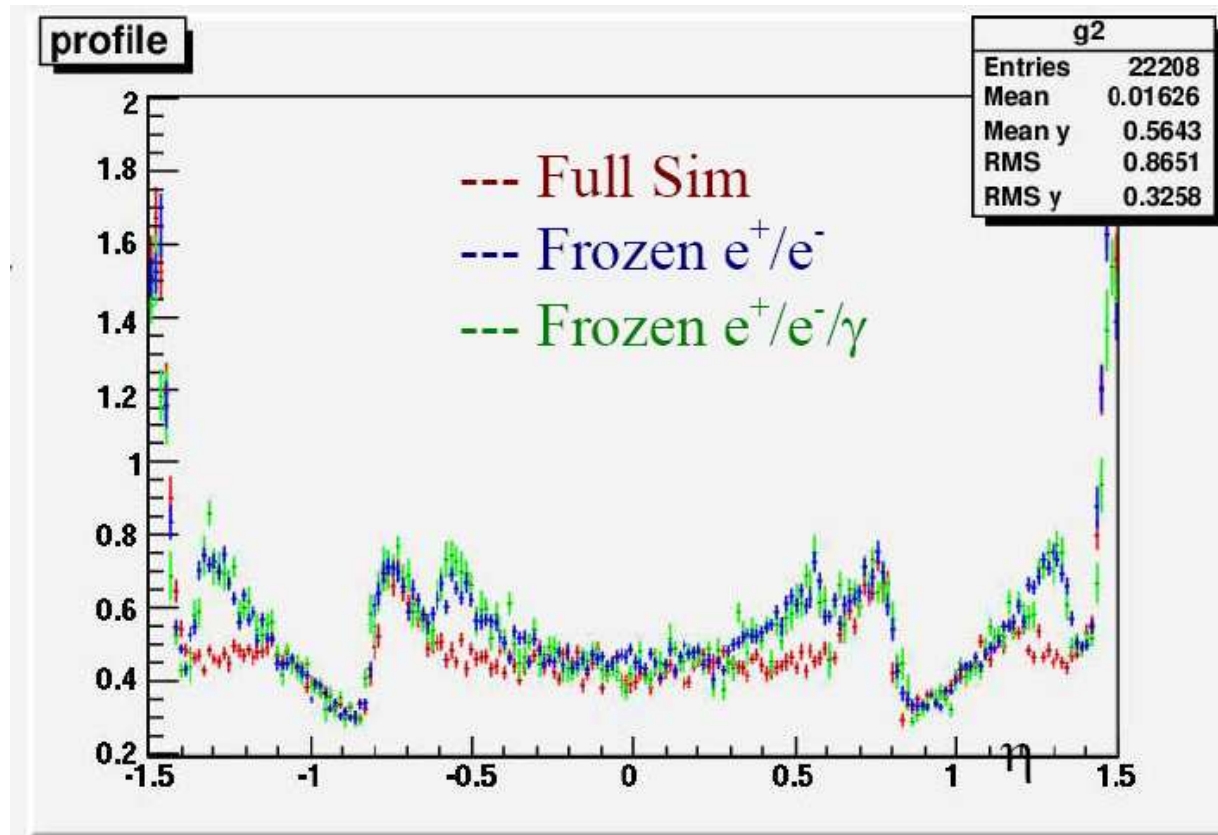500 events/bin
standard energy binning
size: 40 Mb

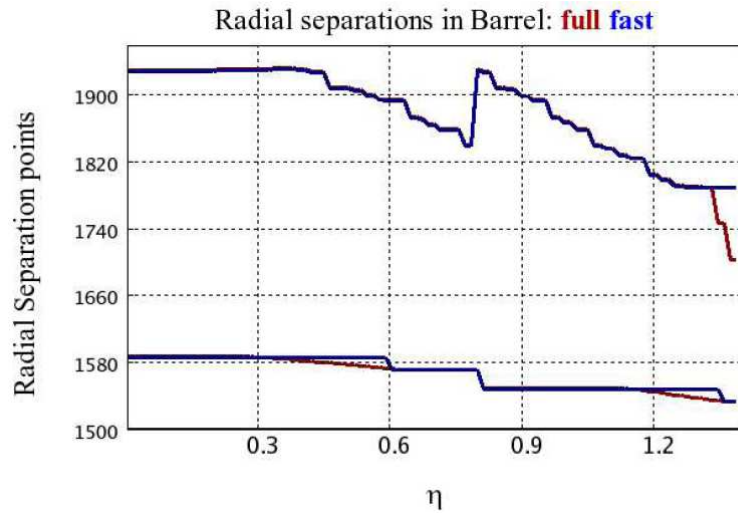# Plots with Standard/New Binning
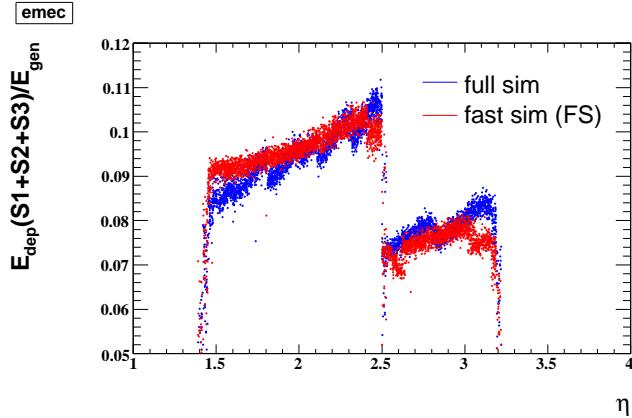
Variation of visible energy inside the outer wheel is reproduced. Differences at the edges of the calorimeter stay — to be understood.

S1/S2 problem

Ratio of the energy deposited in sampling 1 over sampling 2 for 50 GeV electrons vs $|\eta|$. Visible departures for $|\eta| \sim 0.5$ and ~ 1.3

Solution to S1/S2 problem

Radial separations in Barrel: **full** **fast**

Frozen shower simulation calculators use different readout geometry (read from DB) vs full simulation (hardcoded). Differences for S1/S2 boundary at $|\eta| \sim 0.5$ and ~ 1.3.

Plots from A. Waugh confirm that fix in the geometry description resolves $S1/S2$ problem
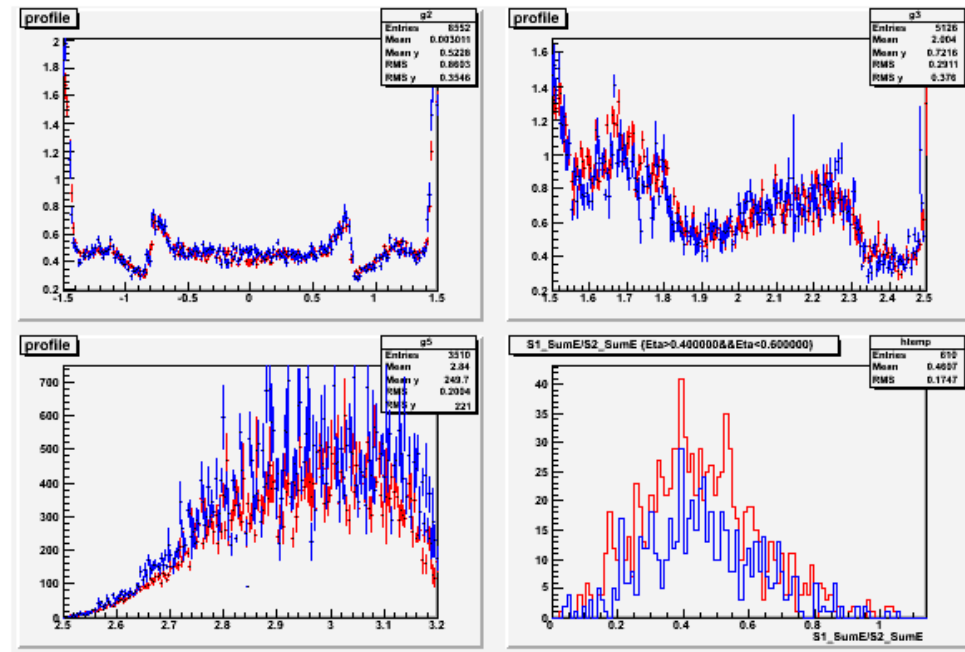
Storage of Frozen Shower Libraries

- Single set of shower libraries for EMB, EMEC, FCAL, photons and electrons take ~ 200 MB of space. Currently stored as text files in CVS.

- Several copies (buffers) of the shower libraries are planed to be stored ~ 1 GB of disk space.

- Shower libraries may need to be re-created for different simulation options, different GEANT version/physics list, etc.

Need better storage format/data base to handle. Database pointing to pool files or directly store shower library buffers to the database. To be decided/implemented for version 14.

Hardware acceleration of shower simulation

- Full GEANT shower simulation is a massive parallel task.

- Significant fraction of time is taken for locating the hits inside detector volumes.

Similar problems started to be adressed recently by hardware "physics" simulation for video games (e.g. collision detection) based on dedicated physics acceleration cards (e.g. AGEIA) or video cards (e.g. CUDA by NVIDIA).

- New generation of video cards support full REAL*4 arithmetics including all trigonometric functions.

- Large memory (640 MB) allows to store detector geometry/frozen shower hits locally.

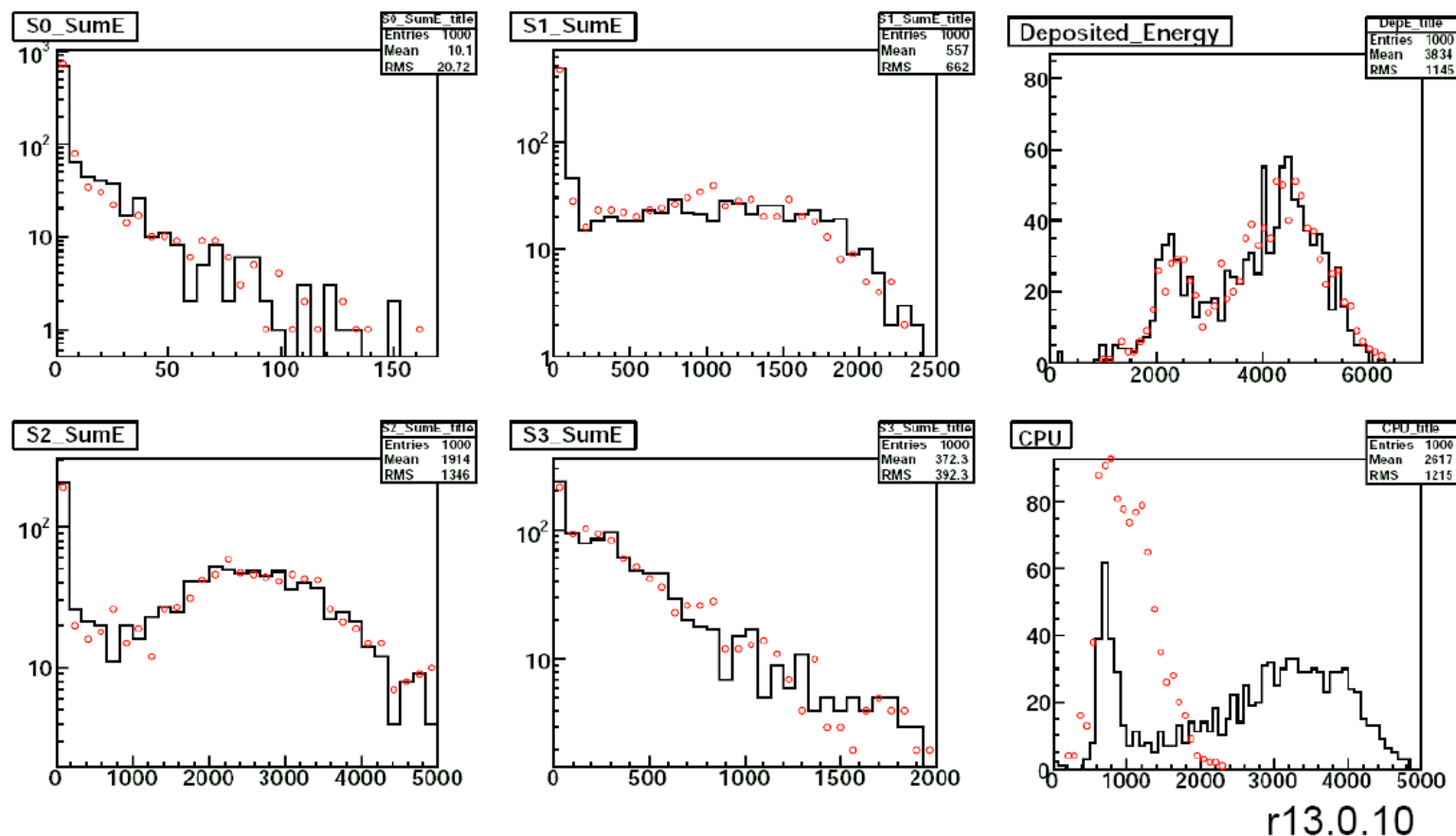- Linux support, C and Fortran(!) developement enviroment.

- Cheap: 0.4 TFLOPS for 400$

Aim for initial feasibility study based on FS/LAr stack.

Post Evolene: π^+ in EMEC

Plots from M. Agostini.

Conclusions

- Shower parameterizations for version 13.0.20 show reasonable agreement with full simulation.

- First official validations samples to be produced.

- Improvements are expected for version 13.0.30.

- More infrastructure developement/tuning/optimization/checks are still needed.

Preliminary agreement:
Next workshop: End of the year at DESY,
final fixes for v14 + new development.