Improving Energy Conservation in LEP models

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11 May 2006

History

- Gunter ran energy-momentum tests on the processes in the QGSP physics list
- Many LEP processes were found not to conserve energy (by large amounts ~GeV)
- I started looking at LEP models to find the problems
- The biggest problems were fixed, some smaller ones remain, but will require significant re-factoring

Classes Fixed

- G4ReactionDynamics
- G4Nucleus
- G4InelasticInteraction

Problems Fixed (1)

- The wrong nuclear inelasticity was being applied to the non-annihilation channels
- In LEP the final state is calculated by first trying one model, then another, then another. If one fails, it often passed on the failed kinematics to the next model.
- Protons and neutrons removed from the target nucleus were being counted on average (as nucleons), making baryon and charge conservation impossible
- The method which suppressed changed pions in the final state did not take into account incident strange particles

Problems Fixed (2)

- The energy balance routines preferentially added the target or current nucleon to the forward or backward clusters instead of trying pions first.
- Black track energies were not used consistently in all methods

Results

- Excess energy events now reduced to about 1/1000
- Energy deficit events are much fewer as well
- Events with energy deficit are more numerous due to modeling aspects, but the width of the deposited energy peak is now much narrower.

Energy deposited by 1 GeV n-bars in steel calorimeter
Blue: before fix Red: after fix