StdHepC++ and the Particle Data Table

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Abstract

StdHepC++[1] provides a common framework for the exchange of particles among Monte Carlo event generators and related analysis code. As a result of discussions within the HEP community, StdHepC++ will be expanded to provide a class to hold the particle properties and decay tables. This talk discusses the new class and the current status of StdHepC++ as a whole.

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1 Introduction

HEPEVT StdHepC++ is intended as a C++ replacement (and extension of) the HEPEVT common block.

CLHEP StdHepC++ is available in CLHEP 1.5 and later.

HepMC A parallel effort, HepMC, duplicates much of this work and has a nice DAG-like model of decay vertices and particles. StdHepC++ will migrate to compatibility with HepMC.

SimParticleData CLHEP has requested that we write a class which contains all possible Particle Decay Table information.

2 The Code

2.1 SimParticle

SimParticleMap SimParticleData is retrieved from the SimParticleMap using a SimParticleID as the map key.

SimParticleData SimParticleData is the base class which contains Particle Data Table information for a particle type, as identified by its particle ID. Defined decay modes are contained in a vector of SimParticleDecay objects.

SimParticleID The SimParticleID class contains utility methods to extract information from the particle ID. It also verifies that a particle ID is valid.

SimParticleDecay SimParticleDecay contains all the information for a specific decay mode.

other classes Certain information, such as spin, color, and decay mode helicity, lends itself to inclusion via classes. These classes or their methods can be overridden by routines which require, for instance, the helicity in a different form than provided by the default class.

2.2 StdHepC++

Run StdHep::Run contains run information such as the run number and contains the I/O methods. It also has a PrintVersion method. The basic class is abstract so methods can be defined as needed.

Event Because there may be several interactions in one beam crossing, an event is a collection of collisions. StdHep::Event has a vector of pointers to collisions, an event number, and the number of collisions.

Collision StdHep::Collision contains a vector of pointers to particles, a collision number, the number of particles, and the input I/O stream. A collision is a single interaction.

Particle StdHep::Particle contains the volatile particle information for each particle generated in a Monte Carlo event.

3 Directed Acyclic Graphs

We propose to put the Particles comprising a Collision into a directed acyclic graph (DAG) instead of a vector. A DAG is a templated class which knows the parent/child relations, so the Particles can be envisioned as associated with points on a graph and these points can be connected to one another by arcs representing the relationships. This provides a natural method for determining parent/child relationships in the particle list, yet separates the relationship data from the intrinsic data describing each Particle. Once the DAG is implemented, the mother and daughter information can be removed from the Particle class.

The DAG can contain arbitrary numbers of points, children, parents, and roots. Roots are the points with no parents. Note that children can have multiple parents, and of course, parents can have multiple children. However, there cannot be more than one arc between any two given points. Also, there cannot at any time be a closed circle in the graph. Methods which add Particles or assign relationships will enforce this.

A full description of this proposal is available at http://www-pat.fnal.gov/stdhep/c++/dag.txt.

References

[1] StdHepC++: http://www-pat.fnal.gov/stdhep/c++/.

[2] T. Sjöstrand *et al.*, in "Z physics at LEP1", CERN 89-08, vol. 3, p.327.

[3] T. Sjöstrand, "Interfacing four-fermion generators with QCD generators", Workshop on Physics at LEP2, (Jan. to Oct. 1995).

[4] Particle Data Group: D.E. Groom *et al.*, The European Physical Journal **C3** (2000) 205 http://www-pdg.lbl.gov/mc_particle_id_contents.html.

[5] Pythia7: http://www.thep.lu.se/tf2/staff/leif/Pythia7/Welcome.html

[6] CLHEP: http://wwwinfo.cern.ch/asd/lhc++/clhep/

[7] HepMC: http://mdobbs.home.cern.ch/mdobbs/HepMC/