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THEPEG

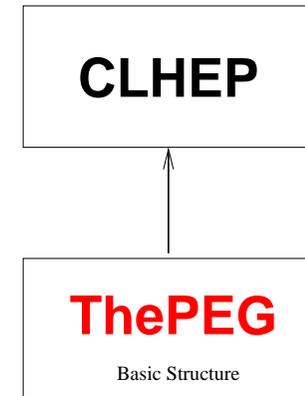
Toolkit for High Energy Physics Event Generation

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CERN
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Leif Lönnblad

What is THEPEG

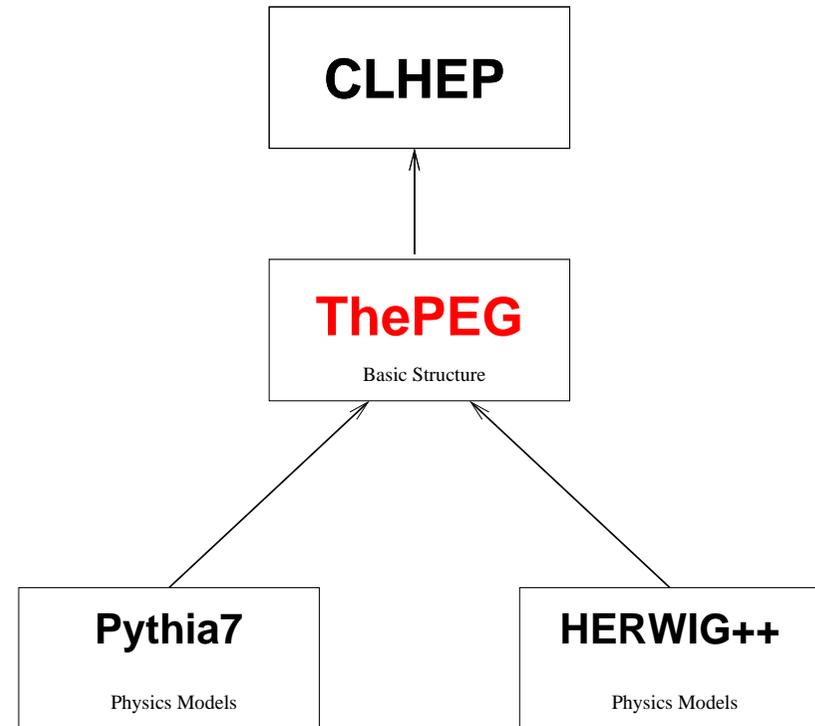
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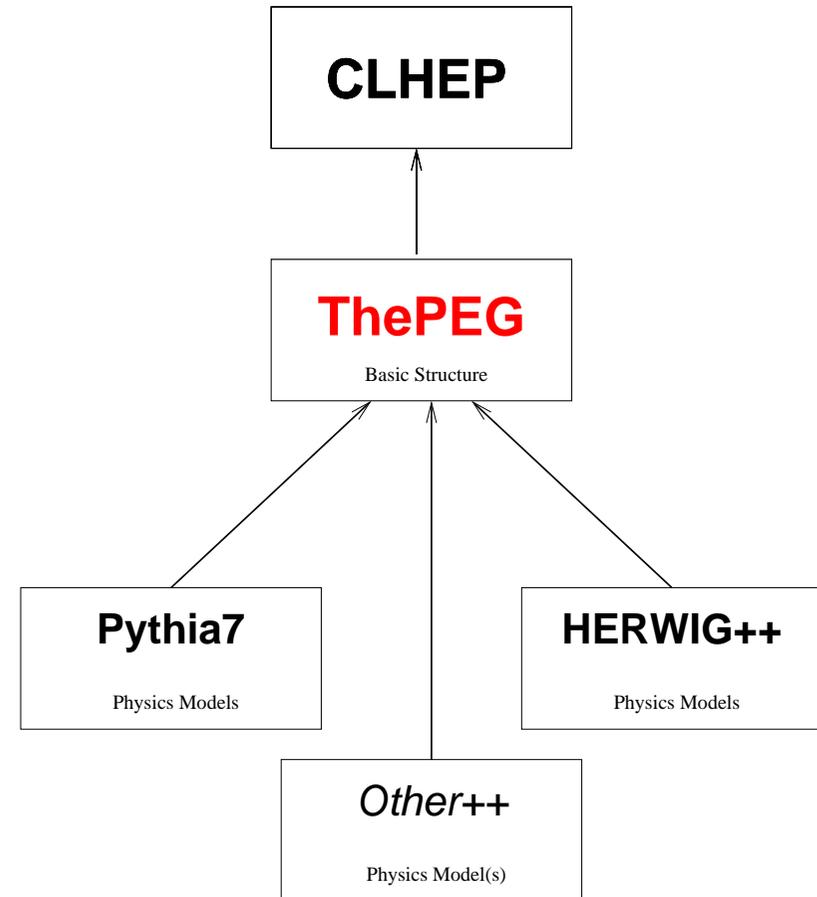


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But it is open for anyone. . .



The components of THEPEG

- **Basic infrastructure:** Smart pointers, extended type information, object persistency, Exceptions, Dynamic loading, ...
- **Kinematics:** Extra utilities on top of CLHEP vectors, 5-vectors, flat n-body decay, ...
- **Repository:** Manipulation of **interfaced** objects. Setting of parameters and switches and connecting objects together.
- **Handler classes:** to inherit from to implement a specific physics model.
- **Event record:** Used to communicate between handler classes.
- **Particle data:** particle properties, decay tables, decayers etc...



THEPEG defines a set of abstract **Handler** classes for hard partonic sub-processes, parton densities, QCD cascades, hadronization, etc. . .

These handler classes interacts with the underlying structure using a special **Event Record** and a pre-defined set of **virtual** function definitions.

The procedure to implement e.g. a new hadronization model, is to write a new (C++) class **inheriting** from the abstract **HadronizationHandler** base class, implementing the relevant virtual functions.



How to use THEPEG

Running THEPEG is separated into two phases.

- **Setup:**

A setup program is provided to combine different objects implementing physics models together to build up an EventGenerator object. Here the user can also change parameters and switches etc.

No C++ knowledge is needed for this. In the future we would like a nice GUI so that the user can just click-and-drag.

The [Repository](#) already contains a number of ready-built EventGenerators. It is also possible to specify AnalysisHandler object for an EventGenerator.

In the end the built EventGenerator is saved to a file.



- **Running:**

The saved EventGenerator can be simply read in and run using a special slave program. If AnalysisHandlers have been specified, this is all you have to do.

Alternatively the the file with the EventGenerator can be read into any program which can then use it to generate events ^a which can be sent to analysis or to detector simulation.

^aThePEG::Events which can be translated into HepMC::GenEvents



The `EventGenerator` class is the main class administrating an event generation run.

It maintains global information needed by the different models: The `ParticleData` objects to be used, a `StandardModel` object with couplings etc, a `RandomGenerator`, a list of `AnalysisHandlers` etc.

It also has an `EventHandler` object to administer the actual generation.



Status

THEPEG version 1.0 α exists and is working. Snapshots of the current development code is available from <http://www.thep.lu.se/ThePEG>.

PYTHIA7 is now based on THEPEG. Version 1.0 α exists and is working. Snapshots of the current development code is available from <http://www.thep.lu.se/Pythia7>.

HERWIG++ is also based on THEPEG. Version 1.0 exists and is working. Can be obtained from <http://www.hep.phy.cam.ac.uk/theory/Herwig++/>.



PYTHIA7/THEPEG includes some basic $2 \rightarrow 2$ matrix elements, a couple of PDF parameterizations, remnant handling, initial- and final-state parton showers, Lund string fragmentation and particle decays.

HERWIG++ includes a new parton shower algorithm, improved cluster fragmentation. Mainly e^+e^- .



Current Work

The code documentation has been converted into Doxygen format.
Soon to start with referens and user manual also using Doxygen.

The plan is to have many *Howto* examples where the user community are welcome to contribute



Currently the `EventHandler` structure is a bit too rigid. Although it allows alternatives through inheritance, it was not really optimized for that.

Currently an alternative `EventHandler` based on external matrix element generation through the Les Houshes accord is being developed, and the `EventHandler` class will be modified to allow for a more elegant implementation.

This is also needed for the LDC model way of generating events.



Future Plans

- THEPEG: Documentation
- THEPEG: Java GUI
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- HERWIG++: Initial state PS
- HERWIG++: SUSY/BSM stuff
- HERWIG++: All the rest...
- ARIADNE: Dipole shower.
- ARIADNE: LDC model with multiple interactions.



Manpower

- THEPEG: L.L., Stefan Gieseke, Alberto Ribon, Peter Richardson.
- PYTHIA7: L.L., Torbjörn Sjöstrand
- HERWIG++: Stefan Gieseke, Alberto Ribon, Peter Richardson, Mike Seymour, Phil Stephens, Bryan Webber.
- ARIADNE: L.L. Nils Lavesson

