Genr8
A General Monte Carlo Event Generator
Version 1.0

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Abstract

Genr8 is a Monte Carlo four-vector generator used for generating phase space distributed events. Given here is a brief description of program and instructions on how to use it.

Introduction

Genr8 is a *C* program [1] that generates peripheral phase space Monte Carlo events. The development of this program was motivated for the use in studying different Hall D detector configurations and subdetector designs. Yet in addition to generating events for design considerations, these events could be used in partial wave analysis for the evaluation of the normalization integrals.

Events can be produced which describe a complex decay chain of intermediary states. Both meson and baryon decay chains are allowed, but with the limiting assumption of a t-channel production process. The four-momentum transfer squared distribution follows that of

$$\frac{d\sigma}{dt} \propto e^{-b|t|}.$$

where the user defines the t-channel slope b.

Initialization

The input to *genr8* is a ASCII file which describes the reaction to be simulated. The format of the ASCII file follows these basic rules:

- All units are related in *GeV*.
- Comment lines start with a "%" and can exist throughout the input file.
- All white space must be blank spaces –no tabs.
- Maintain the order.
  - beam information
  - target information
  - t channel slope
  - # of particles in event list
  - events list
  - "!EOI" end-of-input marker

Below is an example of an input file used to simulate the pseudo-reaction of Figure **??**. "Pseudo" because the angular distributions are not simulated. All events are generated with isotropic angular distributions. The mass and width, on the other hand, follow a simple Breit-Wigner distribution. For true angular distributions which can take into account interference affects, one can weight these generated events with their partial wave intensities.

[1] the source for *genr8* is obtainable from the Hall D cvs repository

```
%%%%%%%%%%%%%%%%% Start Input Values %%%%%%%%%%
% beamp.x    beamp.y    beamp.z    beamMass
          0          0          8          0
% targetp.x    targetp.y    targetp.z    targetMass
          0          0          0          0.938
% t-channelSlope
        5.0
% number of particles needed to describe the isobar decay of X
8
% Create the particle list
%    particle# 0 & 1 are always the Y (baryon system) & X (meson system) respectively
%
% part# chld1# chld2# parent#  Id      nchild     mass      width     charge     flag
% baryon (Y) decay
    0       *       *       *       14       0       0.938       0.0       +1       11
% meson (X) decay
    1       2       3       *       0       2       1.7       0.15       0       00
    2       4       5       1       0       2       1.270       0.10       -1       00
    3       *       *       1       11       0       0.494       0       +1       11
    4       *       *       2       12       0       0.494       0       -1       11
    5       6       7       2       57       2       0.770       0.15       0       00
    6       *       *       5       9       0       0.140       0       -1       11
    7       *       *       5       8       0       0.140       0       +1       11
!EOI
%%%%%%%%%%%%%%%%% End Input Values %%%%%%%%%%
```

For the most part, the input file is straight forward. The gist of the reaction is described in the particle list. Each line in the list consists of values for (in order):

- particle list index
- child1 list index
- child2 list index
- parent list index
- Id (Geant convention see particleType.h)

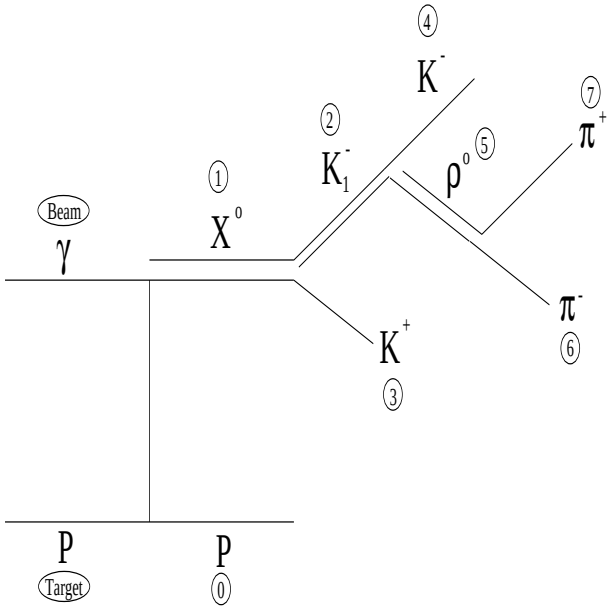

Figure 1: The simulated pseudo-reaction described by the example input file. The particles from the event list are indicated.

- number of children (currently this value is 0 or 2)
- Breit-Wigner mass
- Breit-Wigner width (use "0" for a stable particle)
- charge
- output flag
  - basic (use 11 for stable and 00 for unstable particles)
  - advanced (command line switch chooses level of decay)
    - use 11 for stable charged particles and neutrons.
    - use 10 for gammas.
    - use 01 for pseudo-stable neutral particles (pizeros,etas)
    - use 00 for unstable particles (X, isobars,..)

For multi-particle decays, one can use an infinitely large width for the intermediate isobars. For example, a particle list for a direct 3 π decay could look like:

```
% meson (X) decay
% part# chld1# chld2# parent#   Id      nchild     mass      width      charge      flag
    1       2       3       *       0       2        1.7       0.15       0         00
```

2	4	5	1	0	2	1.270	10	0	00
3	*	*	1	8	0	0.140	0	+1	11
4	*	*	2	8	0	0.140	0	+1	11
5	*	*	2	9	0	0.140	0	-1	11

Event Generation

As described below, Monte Carlo events are obtained by running *genr8* with the appropriate command line switches and redirecting the input file to the standard input. Even though the basic usage will not change, one should be aware that *genr8* is still in development and that its usage could vary. It is always best to check the usage online by executing "*genr8* **-h**".

genr8 usage: [switches] < inputFile
-d debug flag
-n Use a particle name and not its ID number (ASCII only)
-M<max> Process first max events
-l<lfevents> Determine the Lorenz factor with this many
number of events (default is 10000)
-r<runNo> default runNo is 9000.
-P save 11 & 01 flagged events(default saves 11 & 10 flagged events)
-I<filename> Save in itape format.
-A<filename> Save in ASCII format.
-h Print this help message

Output Format

Currently, the Hall D development does not subscribe to any standard input/output formats. *Genr8* supports two output formats: a simple ASCII format, and a BNL-E852 itape format.

The ASCII format consists of an ASCII file that contains a list of events in the form:

RunNumber EventNumber
ParticleIndex ID mass
Charge P.x P.y P.z P.t

...
ParticleIndexLast ID mass
Charge P.x P.y P.z P.t

The itape format was created for use by BNL-E852. The itape library[2] provides routines to read and write itape files. An advantage in using itape format is that many analysis tools exist including a fully developed PWA package. Since itape was developed exclusively for BNL-E852 there exist limitations in its usefulness. A Hall D data format standard is expected to be itape-like.

[2]A slim down version of the itape library is obtainable from the Hall D cvs repository.