

Electron Positron Annihilation

Here we explain the content of the example `expl2`, corresponding to the input file `examples/expl2.optns`.

Simulation configuration

Let us consider electron-positron annihilation at 91.2 GeV, which can be defined in the input file as:

```
!-----  
!           Electron-positron annihilation  
!-----  
!-----  
!           Define run  
!-----  
application ee  
set engy 91.2  
set nevent 10000  
set modsho 100  
set ndecay 1000000 ! do not decay pi0  
set irescl 0      ! to avoid calling a procedure not needed for ee  
!-----  
!           Printout particle list  
!-----  
print * 2
```

We first define an application of type `ee`, which corresponds to an electron-positron annihilation. We set the energy of the collision to 91.2 GeV (`set engy 91.2`) and the number of simulated events to 10000 (`set nevent 10000`). A message will be displayed in the standart output every 100 events (`set modsho 100`).

We choose to block the decay of the particle π^0 whose EPOS identifier is 110. The EPOS particle identifiers are described in the file `src/KWt/idt.dt`. This syntax `set ndecay 1000000` is still working, but better use `nodecays 110 end` (more clear).

The command `set irescl 0` is used to avoid calling a procedure not needed for an application of type `ee`.

The print command `print * 2` writes the particle list in a file. The output file name is created from the optns file name: `#{CHK}/z-expl2.check`

Results

In `#{CHK}z-expl2.check`, one finds several lists of partices (including their parent-children relations), at different stages of the simulation. The structure of the file is as follows

```
##### start event number 1 #####  
.....  
##### list before fragmentation #####  
...  
##### list after fragmentation #####  
...  
##### final decay #####  
...  
##### list after bjinta #####  
...  
##### start event number 2 #####  
.....
```

where “...” refers to the particle list at that stage. A particle list contains the particles with one line per particle, with several columns, representing particle properties and parent children relations, a detailed discusson can be found in “Check File Structure”.

For simplicity we only show the first 9 columns, corresponding to: `ior`, `jor`, `i`, `ifr1`, `ifr2`, `id`, `ist`, `ity`, and `pt` (see Check File Structure).

The first table (before fragmentation) shows the initial particles (electron, id=12 and positron, id=-12), the photon (id=10) produced from $e^+ + e^- \rightarrow \gamma$, and then the produced chain of partons from $\gamma \rightarrow s + \bar{s} \rightarrow s + g + g + \bar{s}$ with a strange quark (id=3) and a strange antiquark (id=-3) as well as two gluons (id=9).

```
#####
##### list before fragmentation #####
#####
ior jor i ifr1 ifr2 id ist ity pt
-----
0 0 1 0 0 12 1 0 0.000E+00
0 0 2 0 0 -12 1 0 0.000E+00
1 2 3 4 7 10 1 0 0.000E+00
3 3 4 0 0 3 20 30 0.109E+01
3 3 5 0 0 9 20 30 0.778E+00
3 3 6 0 0 9 20 30 0.446E+00
3 -3 7 0 0 -3 20 30 0.000E+00
```

Next we look at the list after fragmentation. In our example, the chain of 4 partons $s - g - g - \bar{s}$ represents a kinky string, which decays into hadrons. In the list, one first maps the chain of partons to a string, with i=8, and with status ist=29 (=string). The string entry is only for bookkeeping, the properties of the string are known via the parent indices ior and jor, which allow to trace back to the partons which constitute the string.

```
#####
##### list after fragmentation #####
#####
ior jor i ifr1 ifr2 id ist ity pt
-----
4 7 8 9 22 800100010 29 30 0.225E-03
8 0 9 0 0 -130 0 30 0.213E+00
8 0 10 0 0 110 0 30 0.116E+00
8 0 11 0 0 110 0 30 0.874E+00
8 0 12 0 0 111 0 30 0.730E+00
8 0 13 0 0 121 0 30 0.687E+00
8 0 14 0 0 111 0 30 0.519E+00
8 0 15 0 0 231 0 30 0.370E+00
8 0 16 0 0 -231 0 30 0.210E-01
8 0 17 0 0 2130 0 30 0.780E+00
8 0 18 0 0 -1231 0 30 0.635E+00
8 0 19 0 0 -120 0 30 0.162E+00
8 0 20 0 0 120 0 30 0.215E+00
8 0 21 0 0 230 0 30 0.672E+00
8 0 22 0 0 330 0 30 0.389E+00
```

Directly following the string stry i=8, we see the string decay products, with i from 9 to 22. All these particles have mother index 8 (the string) and status 0, because they are (at this moment) last generation. The resonances did not decay yet.

In the list, we see several resonances, which will finally decay:

- i=12, id=111, name=rho0
- i=13, id=121, name=rho+
- i=14, id=111, name=rho0
- i=15, id=231, name=K*0
- i=16, id=-231, name=K*0b
- i=17, id=2130, name=Lambda
- i=18, id=-1231, name=Sigma*0
- i=21, id=230, name=K0
- i=22, id=330, name=eta'

The decay products will be seen in the following list, where the father index ior (the leftmost number) allows to identify the decaying particle.

```
#####
##### final decay #####
#####
12 0 23 0 0 -120 0 30 0.880E+00
12 0 24 0 0 120 0 30 0.337E+00
13 0 25 0 0 120 0 30 0.328E+00
13 0 26 0 0 110 0 30 0.447E+00
14 0 27 0 0 -120 0 30 0.359E+00
14 0 28 0 0 120 0 30 0.334E+00
15 0 29 0 0 -120 0 30 0.193E+00
15 0 30 0 0 130 0 30 0.508E+00
16 0 31 0 0 120 0 30 0.268E+00
16 0 32 0 0 -130 0 30 0.284E+00
17 0 33 0 0 -120 0 30 0.231E+00
17 0 34 0 0 1120 0 30 0.552E+00
18 0 35 0 0 -2130 0 30 0.391E+00
18 0 36 0 0 110 0 30 0.264E+00
21 0 37 0 0 -20 0 30 0.672E+00
22 0 38 0 0 -120 0 30 0.108E+00
22 0 39 0 0 120 0 30 0.118E+00
22 0 40 0 0 220 0 30 0.205E+00
35 0 41 0 0 120 0 30 0.562E-01
35 0 42 0 0 -1120 0 30 0.399E+00
```

We also see a decay of a decay product: particles 41 and 42 are decay products of 35, which is already decay product of 18. In principle we are done, particle production is finished, but it is nevertheless useful to consider one more list, namely the full list at the end with the complete parent-children relations for all particles. This is provided in the following list.

```
#####
##### list after bjinta #####
#####
ior jor i ifr1 ifr2 id ist ity pt
-----
0 0 1 0 0 12 1 0 0.000E+00
0 0 2 0 0 -12 1 0 0.000E+00
1 2 3 4 7 10 1 0 0.000E+00
3 3 4 8 0 3 21 30 0.109E+01
3 3 5 8 0 9 21 30 0.779E+00
3 3 6 8 0 9 21 30 0.446E+00
3 -3 7 8 0 -3 21 30 0.247E-04
4 7 8 9 22 800100010 29 30 0.225E-03
8 0 9 0 0 -130 0 30 0.213E+00
8 0 10 0 0 110 0 30 0.116E+00
8 0 11 0 0 110 0 30 0.874E+00
8 0 12 23 24 111 1 30 0.730E+00
8 0 13 25 26 121 1 30 0.687E+00
8 0 14 27 28 111 1 30 0.519E+00
8 0 15 29 30 231 1 30 0.370E+00
8 0 16 31 32 -231 1 30 0.210E-01
8 0 17 33 34 2130 1 30 0.780E+00
8 0 18 35 36 -1231 1 30 0.635E+00
8 0 19 0 0 -120 0 30 0.162E+00
8 0 20 0 0 120 0 30 0.215E+00
8 0 21 37 37 230 1 30 0.672E+00
8 0 22 38 40 330 1 30 0.389E+00
12 0 23 0 0 -120 0 30 0.880E+00
12 0 24 0 0 120 0 30 0.337E+00
13 0 25 0 0 120 0 30 0.328E+00
13 0 26 0 0 110 0 30 0.447E+00
14 0 27 0 0 -120 0 30 0.359E+00
14 0 28 0 0 120 0 30 0.334E+00
15 0 29 0 0 -120 0 30 0.193E+00
15 0 30 0 0 130 0 30 0.508E+00
16 0 31 0 0 120 0 30 0.268E+00
16 0 32 0 0 -130 0 30 0.284E+00
17 0 33 0 0 -120 0 30 0.231E+00
17 0 34 0 0 1120 0 30 0.552E+00
```

| | | | | | | | | |
|----|---|----|----|----|-------|---|----|-----------|
| 18 | 0 | 35 | 41 | 42 | -2130 | 1 | 30 | 0.391E+00 |
| 18 | 0 | 36 | 0 | 0 | 110 | 0 | 30 | 0.264E+00 |
| 21 | 0 | 37 | 0 | 0 | -20 | 0 | 30 | 0.672E+00 |
| 22 | 0 | 38 | 0 | 0 | -120 | 0 | 30 | 0.108E+00 |
| 22 | 0 | 39 | 0 | 0 | 120 | 0 | 30 | 0.118E+00 |
| 22 | 0 | 40 | 0 | 0 | 220 | 0 | 30 | 0.205E+00 |
| 35 | 0 | 41 | 0 | 0 | 120 | 0 | 30 | 0.562E-01 |
| 35 | 0 | 42 | 0 | 0 | -1120 | 0 | 30 | 0.399E+00 |