Proton-proton scattering

We describe the following configuration files found in **examples/ :**

- **expl3.optns** - proton-proton collision without hydro and hadronic cascade
- **expl4.optns** - proton-proton parameterized fluid expansion (mimic hydro)
- **expl5.optns** - proton-proton with hydro and hadronic cascade with ROOT output

The common part for the three cases

In all cases, we consider a proton-proton scattering at 7 TeV. Here is the common configuration part for each example:

```
application hadron !hadron-hadron, hadron-nucleus, or nucleus-nucleus

set laproj 1  !projectile atomic number
set maproj 1  !projectile mass number
set latarg 1  !target atomic number
set matarg 1  !target mass number
set ecms 7000 !sqrt(s)_pp
set istmax 25 !max status considered for storage
set iranphi 1 !for internal use.
              !if iranphi=1 event will be rotated such
              !that the impact parameter angle
              !and the (n=2) event plane angle
              !(based on string segments) coincide.
              !Particles rotated back at the end.
ftime on      !string formation time non-zero

!suppressed decays:
nodecays 110 20 2130 -2130 2230 -2230 1130 -1130 1330 -1330 2330 -2330 3331 -3331 end
```

The command **application hadron** specifies which kind reaction we simulate (**hadron** stands for all kinds of hadron-hadron scattering, but also hadron-nucleus or nucleus-nucleus),

then we specify projectile and target, providing the atomic and mass number, and the energy given as center of mass energy (in GeV), using the **set** command.

Some more "technical settings" are needed: **set istmax 25** defines the maximal status value considered for storage, **set iranphi 1** is needed for internal use. In case of iranphi=1 the event will be rotated such that the impact parameter angle and the (n=2) event plane angle (based on string segments) coincide. Particles are rotated back at the end. Finally **ftime on** means that a non-zero string formation time is used (it should only be turned off for testing purposes).

The command **nodecays** allows us to block the decay of the particles π^0, K_s, Λ, $\bar{\Lambda}$, Σ^-,$\overline{\Sigma^-}$ Σ^+,$\overline{\Sigma^+}$, Ξ^0, $\overline{\Xi^0}$, Ξ^-, $\overline{\Xi^-}$, Ω^-, $\overline{\Omega^-}$ (see **src/KWt/idt.dt** for the id codes)

The specific part for each case

expl3.optns - proton-proton collision without hydro and hadronic cascade

Following the "common part" discussed above, one needs:

```
set ninicon 1    !number of initial conditions used for hydro
core off         !core/corona not activated
hydro off        !hydro not activated
eos off          !eos not activated
hacas off        !eos not activated
set nfull 200    !number of events
set nfreeze 1    !number of freeze out events per hydro event
set modsho 1     !printout every modsho events
set centrality 0 !0=min bias
!fillTree(C1)
```

Here, we deactivate all the hydro components (**core off**, **hydro off**, **eos off**) and we deactivate the hadronic cascade (**hacas off**).

The variable **ninicon** allows (in case of hydro) to overlay several initial configuarations, in case of "no hydro" we set it to unity. Also **nfreeze** > 1 makes only sense for hydro, here we need unity.

The variable **nfull** corresponds to the number of different initial conditions simulated. A message will be displayed in the standart output every event (**set modsho 1**).

The command **set centrality 0** means that we simulate minimum bias events.

The command **fillTree4(C2)** writes results into a ROOT file, but to do so it must be uncommented.

The following analysis part is discussed in a separate chapter.

expl4.optns - proton-proton parameterized fluid expansion (mimic hydro)

Following the “common part” discussed above, one needs:

```
set ninicon 1    !number of initial conditions used for hydro
core PFE         !parameterized fluid expansion (mimic hydro)
hydro off        !hydro not activated
eos off          !eos not activated
hacas full       !hadronic cascade activated
set nfull 200    !number of events
set nfreeze 1    !number of freeze out events per hydro event
set modsho 1     !certain printout every modsho events
set centrality 0 !0=min bias
```

In this example, in order to get a much faster simulation compared to full hydro, we mimic the hydrodynamic evolution of the core (**core PFE**, **hydro off**, **eos off**). The key word **PFE** means Parametrized Fluid Expansion. The hadronic re-scatterings simulated with UrQMD are enabled (**hacas full**).

expl5.optns - proton-proton with hydro and hadronic cascade with ROOT output

Following the “common part” discussed above, one needs:

```
set ninicon 1    !number of initial conditions used for hydro
core full        !core/corona activated
hydro hlle       !hydro activated (hlle)
eos x3ff         !eos activated (standard epos eos x3ff)
hacas full       !hadronic cascade activated
set nfull 5      !number of events
set nfreeze 1    !number of freeze out events per hydro event
set modsho 1     !certain printout every modsho events
set centrality 0 !0=min bias
fillTree4(C2)    !root output
```

Here, we activate all the hydro components (**core full**, **hydro hlle**, **eos x3ff**) and the hadronic re-scatterings simulated with UrQMD (**hacas full**).

To increase statistics, one might increase nfreeze.

The command **fillTree4(C2)** writes results into a ROOT file, where **C2** means that the number of Pomerons is used as centrality variable. In case of nucleus-nucleus collisions, we usually use **C1** for impact parameter as centrality variable