High-Mass Diffraction in Pythia (6 & 8)

- σ_{diff} obtained from parametrizations (Schuler-Sjöstrand) ~ dM/M^2 with exponential t slope, and fudge parameters
  - **1)** $(1\text{-}M^2/s)$ to kill distribution at edge of phase space. **2)** Smeared-out enhancement in resonance region (no attempt to model individual resonances separately). **3)** DD: Suppression for systems overlapping in rapidity.
  - String fragmentation. Constrained by LEP, but diffraction is different. **Could we constrain multiplicity distributions and momentum (x) spectra, identified-particle ratios (eg K/π, K*/K, p/π, Λ/p) directly in diffractive processes (as function of M)?**
- P8: M>10 GeV (user-definable) modeled as Pomeron-proton collision
  - M and t distribution depends on Pomeron flux: several parametrizations
- MPI allowed inside Pomeron-proton system (amount depends on σ_{Pp})
  - Default σ_{Pp} ~ 10 mb (larger than nominal value of 2 mb, which would give too much activity). Perceive as effective parameter that lumps together many effects. Includes gap survivial.
  - Gap always survives (no MPI involving Pomeron's p remnant)
  - **To constrain, need data on event shapes in diffractive events, such as multiplicity distributions, UE in diffractive jets. (Still useful if only in restricted fiducial regions.)**
- Colour reconnections can mimic large gaps, but now without constraint of no net quantum number transfer → measurable?

The diffractive cross sections are given by

$$\begin{aligned}
\frac{d\sigma_{sd(XB)}(s)}{dt\, dM^2} &= \frac{g_{3\mathbb{P}}}{16\pi}\, \beta_{A\mathbb{P}}\, \beta^2_{B\mathbb{P}}\, \frac{1}{M^2}\, \exp(B_{sd(XB)}t)\, F_{sd} \ , \\
\frac{d\sigma_{sd(AX)}(s)}{dt\, dM^2} &= \frac{g_{3\mathbb{P}}}{16\pi}\, \beta^2_{A\mathbb{P}}\, \beta_{B\mathbb{P}}\, \frac{1}{M^2}\, \exp(B_{sd(AX)}t)\, F_{sd} \ , \\
\frac{d\sigma_{dd}(s)}{dt\, dM_1^2\, dM_2^2} &= \frac{g^2_{3\mathbb{P}}}{16\pi}\, \beta_{A\mathbb{P}}\, \beta_{B\mathbb{P}}\, \frac{1}{M_1^2}\, \frac{1}{M_2^2}\, \exp(B_{dd}t)\, F_{dd} \ .
\end{aligned}$$

The slope parameters are assumed to be

$$\begin{aligned}
B_{sd(XB)}(s) &= 2b_B + 2\alpha' \ln\left(\frac{s}{M^2}\right) \ , \\
B_{sd(AX)}(s) &= 2b_A + 2\alpha' \ln\left(\frac{s}{M^2}\right) \ , \\
B_{dd}(s) &= 2\alpha' \ln\left(e^4 + \frac{s s_0}{M_1^2 M_2^2}\right) \ .
\end{aligned}$$

The fudge factors are:

$$\begin{aligned}
F_{sd} &= \left(1 - \frac{M^2}{s}\right)\left(1 + \frac{c_{res}\, M^2_{res}}{M^2_{res} + M^2}\right) \ , \\
F_{dd} &= \left(1 - \frac{(M_1 + M_2)^2}{s}\right)\left(\frac{s\, m_p^2}{s\, m_p^2 + M_1^2\, M_2^2}\right) \\
&\times \left(1 + \frac{c_{res}\, M^2_{res}}{M^2_{res} + M_1^2}\right)\left(1 + \frac{c_{res}\, M^2_{res}}{M^2_{res} + M_2^2}\right) \ .
\end{aligned}$$