Exp. events per bin

NP constraints

$$\mathcal{L}(\text{data} \mid \vec{\alpha},\vec{\theta},\vec{\rho}) = \prod_{c=1}^{N_C}\prod_{b=1}^{N_B^c} \text{Poisson}(n_{cb} \mid \lambda_{cb}(\vec{\alpha},\vec{\theta},\vec{\rho})) \prod_{i=1}^{N_E} p_e(\tilde{\theta}_e \mid \theta_e).$$

$$\lambda_{cb} = \max\left(0, \sum_p M_{cp}(\vec{\alpha}) N_{cp}(\vec{\theta}_{\mathrm{L}},\vec{\theta}_{\mathrm{S}},\vec{\theta}_{\mathrm{G}},\rho) y_{cbp}(\vec{\theta}_{\mathrm{S}}) + E_{cb}(\vec{\theta}_{\mathrm{B}})\right)$$

Physics model scaling

Process norm.

Process templates

MC stats

Barlow-Beeston

"lite"

$$E_{cb}(\theta) = \theta\left(\sum_p (e_{cpb}N_{cp}M_{cp}(\vec{\alpha}))^2\right)^{\frac{1}{2}}.$$

full

$$E_{cb}(\vec{\theta}) = \overset{\text{Poisson}}{\sum_i}\left(\frac{\theta_i}{\tilde{\theta}_i} - 1\right) y_{cib}N_{cp}M_{ci}(\vec{\alpha}) + \overset{\text{Gaussian}}{\sum_j} \theta_j e_{cjb}N_{cj}M_{cj}(\vec{\alpha}),$$

Gamma

Log-normal

Asymmetric log-normal

$$N = N_0(\theta_G)\prod_n \kappa_n^{\theta_{L,n}} \prod_a \kappa_a^{\mathrm{A}}(\theta^a_{L(S)},\kappa_a^+,\kappa_a^-)^{\theta^a_{L(S)}} \prod_r F_r(\vec{\rho}),$$

rateParams

$\theta_G/\tilde{\theta}_G$ i

$$\kappa^{\mathrm{A}}(\theta,\kappa^+,\kappa^-) = \begin{cases} \kappa^+, & \text{for } \theta \geq 0.5; \\ \kappa^-, & \text{for } \theta \leq -0.5; \\ \exp\left(\frac{1}{2}\left((\ln\kappa^+ + \ln\kappa^+) + \frac{1}{4}(\ln\kappa^+ - \ln\kappa^-)I(\theta)\right)\right), & \text{otherwise,} \end{cases}$$

Interpolation between up and down variations (norm)

$$\kappa_s^{\pm} = \frac{\sum_b y_b^{s,\pm}}{\sum_b y_b^0}.$$

Shape uncert. norm.
change factored out

$$y_b(\vec{\theta}_{\mathrm{S}}) = \begin{cases} \max\left(0, y^0\left(f_b^0 + \sum_s F(\theta_s,\delta_b^{s,+},\delta_b^{s,-}),\epsilon_s\right)\right) & \text{(direct),} \\ \max\left(0, y^0 \exp\left(\ln(f_b^0) + \sum_s F(\theta_s,\Delta_b^{s,+},\Delta_b^{s,-},\epsilon_s)\right)\right) & \text{(logarithmic),} \end{cases}$$

Vertical morphing

$$f_b = y_b / \sum y_b$$

$y^0 = \sum y_b^0$, $\delta^{\pm} = f_i^{\pm} - f_i^0$, and $\Delta^{\pm} = \ln(f_i^{\pm}) - \ln(f_i^0)$.

$$F(\theta,\delta^+,\delta^-) = \begin{cases} \frac{1}{2}\theta'\left((\delta^+ - \delta^-) + \frac{1}{8}(\delta^+ + \delta^-)(3\bar{\theta}^5 - 10\bar{\theta}^3 + 15\bar{\theta})\right), & \text{for } \theta < q; \\ \theta'\delta^+, & \text{for } \theta > q; \\ -\theta'\delta^-, & \text{for } \theta < -q; \end{cases}$$

Interpolation between up and down variations (shape)