1 Fluxes

All data is for the 8.5 - 9.0 GeV photon energy bin. Scale the datasets by matching the flux (T is the target factor (density, length, etc.)):

$$\Phi_{\text{bggen}} = T\frac{N_{\text{Thrown}-\text{bggen}}}{d\sigma_{\text{bggen}}},$$

$$\Phi_{\Phi_3(1850)} = T\frac{N_{\text{Thrown}-\Phi_3(1850)}}{d\sigma_{\Phi_3(1850)}}\frac{\Gamma_{\Phi_3(1850)}}{\Gamma_{\Phi_3(1850)\to K^+K^-}},$$

$$\Phi_{Y(2175)} = T\frac{N_{\text{Thrown}-Y(2175)}}{d\sigma_{Y(2175)}}\frac{\Gamma_{Y(2175)}}{\Gamma_{Y(2175)\to f_0(980)\phi}}\frac{\Gamma_{f_0(980)}}{\Gamma_{f_0(980)\to\pi^+\pi^-}}\frac{\Gamma_{\phi}}{\Gamma_{\Phi\to K^+K^-}},$$

$$\Phi_{\eta_1'(2300)} = T\frac{N_{\text{Thrown}-\eta_1'(2300)}}{d\sigma_{\eta_1'(2300)}}\frac{\Gamma_{\eta_1'(2300)}}{\Gamma_{\eta_1'(2300)\to K^*(892)^0\bar{K^0}}}\frac{\Gamma_{K^*(892)^0}}{\Gamma_{K^*(892)^0\to K^+\pi^-}},$$

$$\Phi_{h_2'(2600)} = T\frac{N_{\text{Thrown}-h_2'(2600)}}{d\sigma_{h_2'(2600)}}\frac{\Gamma_{h_2'(2600)}}{\Gamma_{h_2'(2600)\to K_1(1400)^+K^-}}\frac{\Gamma_{K_1(1400)^+}}{\Gamma_{K_1(1400)^+\to K^*(892)^0\pi^+}}\frac{\Gamma_{K^*(892)^0}}{\Gamma_{K^*(892)^0\to K^+\pi^-}},$$

where the K_0 decay branching ratio was excluded from $\Phi_{\eta_1'(2300)}$ because the K^0 was decayed by *hdgeant* rather than *bggen*.

2 Branching Ratios

2.1 $\Phi_3(1850)$

$$\Gamma_{\text{Total}} = \frac{\Gamma_{\Phi_3(1850)\to K^+K^-}}{\Gamma_{\Phi_3(1850)}} = \frac{\Gamma_{\Phi_3(1850)\to KK}}{\Gamma_{\Phi_3(1850)}}\frac{\Gamma_{\Phi_3(1850)\to K^+K^-}}{\Gamma_{\Phi_3(1850)\to KK}} = 0.645 * 0.5 = 0.3225$$

2.2 $Y(2175)$

$$\frac{\Gamma_{Y(2175)\to f_0(980)\phi}}{\Gamma_{Y(2175)}} = 3/120 = 0.025$$

$$\frac{\Gamma_{f_0(980)\to\pi^+\pi^-}}{\Gamma_{f_0(980)}} = \frac{\Gamma_{f_0(980)\to\pi\pi}}{\Gamma_{f_0(980)}}\frac{\Gamma_{f_0(980)\to\pi^+\pi^-}}{\Gamma_{f_0(980)\to\pi\pi}} = 1 * 2/3 = 0.6667$$

$$\frac{\Gamma_{\Phi\to K^+K^-}}{\Gamma_{\phi}} = 0.489$$

$$\Gamma_{\text{Total}} = \frac{\Gamma_{Y(2175)\to f_0(980)\phi}}{\Gamma_{Y(2175)}}\frac{\Gamma_{f_0(980)\to\pi^+\pi^-}}{\Gamma_{f_0(980)}}\frac{\Gamma_{\Phi\to K^+K^-}}{\Gamma_{\phi}} = 0.025 * 0.6667 * 0.489 = 0.00815$$

2.3 $\eta_1'(2300)$

$$\frac{\Gamma_{\eta_1'(2300)\to K^*(892)^0\bar{K^0}}}{\Gamma_{\eta_1'(2300)}} = \frac{\Gamma_{\eta_1'(2300)\to K^*K}}{\Gamma_{\eta_1'(2300)}}\frac{\Gamma_{\eta_1'(2300)\to K^*(892)^0\bar{K^0}}}{\Gamma_{\eta_1'(2300)\to K^*K}} = 8/172 * 0.5 = 0.02326$$

$$\frac{\Gamma_{K^*(892)^0\to K^+\pi^-}}{\Gamma_{K^*(892)^0}} = \frac{\Gamma_{K^*(892)^0\to K\pi}}{\Gamma_{K^*(892)^0}}\frac{\Gamma_{K^*(892)^0\to K^+\pi^-}}{\Gamma_{K^*(892)^0\to K\pi}} = 0.998 * 2/3 = 0.665$$

$$\Gamma_{\text{Total}} = \frac{\Gamma_{\eta_1'(2300)\to K^*(892)^0\bar{K^0}}}{\Gamma_{\eta_1'(2300)}}\frac{\Gamma_{K^*(892)^0}}{\Gamma_{K^*(892)^0\to K^+\pi^-}} = 0.02326 * 0.665 = 0.0154679$$

2.4 $h_2'(2600)$

$$\frac{\Gamma_{h_2'(2600)\to K_1(1400)^+K^-}}{\Gamma_{h_2'(2600)}} = \frac{\Gamma_{h_2'(2600)\to K_1(1400)K}}{\Gamma_{h_2'(2600)}}\frac{\Gamma_{h_2'(2600)\to K_1(1400)^+K^-}}{\Gamma_{h_2'(2600)\to K_1(1400)K}} = 28/79 * 0.5 = 0.1772$$

$$\frac{\Gamma_{K_1(1400)^+\to K^*(892)^0\pi^+}}{\Gamma_{K_1(1400)^+}} = \frac{\Gamma_{K_1(1400)^+\to K^*(892)\pi}}{\Gamma_{K_1(1400)^+}}\frac{\Gamma_{K_1(1400)^+\to K^*(892)^0\pi^+}}{\Gamma_{K_1(1400)^+\to K^*(892)\pi}} = 0.94 * 2/3 = 0.6266667$$

$$\frac{\Gamma_{K^*(892)^0\to K^+\pi^-}}{\Gamma_{K^*(892)^0}} = \frac{\Gamma_{K^*(892)^0\to K\pi}}{\Gamma_{K^*(892)^0}}\frac{\Gamma_{K^*(892)^0\to K^+\pi^-}}{\Gamma_{K^*(892)^0\to K\pi}} = 0.998 * 2/3 = 0.665$$

$$\Gamma_{\text{Total}} = \frac{\Gamma_{h_2'(2600)\to K_1(1400)^+K^-}}{\Gamma_{h_2'(2600)}}\frac{\Gamma_{K_1(1400)^+\to K^*(892)^0\pi^+}}{\Gamma_{K_1(1400)^+}}\frac{\Gamma_{K^*(892)^0\to K^+\pi^-}}{\Gamma_{K^*(892)^0}} = 0.1772*0.6266667*0.665 = 0.0738452$$

3 Matching

Signal/Background Ratio R:

$$R = \frac{Y_{\text{Signal}}M}{Y_{\text{Total}-\text{Background}}}$$

- $M \equiv \frac{\Phi_{\text{bggen}}}{\Phi_{\text{Signal}}}$: Signal Yield Multiplier
- Y_{Signal} = Number of signal events remaining after cuts
- $Y_{\text{Total}-\text{Background}} = Y_{\text{bggen}} + MY_{\text{Signal}-\text{Combinatoric}-\text{Background}}$, where the Y's are the number of particle combinations, NOT the number of events!!!

$$M_{\text{Signal}} = \frac{\Phi_{\text{bggen}}}{\Phi_{\text{Signal}}} = \frac{T\frac{N_{\text{Thrown}-\text{bggen}}}{d\sigma_{\text{bggen}}}}{T\frac{N_{\text{Thrown}-\text{Signal}}}{d\sigma_{\text{Signal}}}\frac{1}{\Gamma_{\text{Total}-\text{Signal}}}} = \frac{d\sigma_{\text{Signal}}}{d\sigma_{\text{bggen}}}\frac{N_{\text{Thrown}-\text{bggen}}}{N_{\text{Thrown}-\text{Signal}}}\Gamma_{\text{Total}-\text{Signal}}$$