Number of Interactions (N_i) $\propto$ Number of Target Particles (N_t)

Number of Interactions (N_i) $\propto$ Number of Beam Photons (N_b)

$\therefore \quad N_i \;=\; \sigma \;*\; N_t \;*\; N_b$

where σ is the Cross-Section/Area or interaction probability

Number of Beam Photons calculated using gflux for Beam Energy Range (A-B) GeV

Number of Target Particles (N_t) = Proton Density of LH2 * Volume of Target

Proton Density = 2 * N_A * Density / Molar Mass
" = $2 * 6.022 * 10^{23} * 0.0708/2.016\ cm^{-3}$
" = $0.423 * 10^{23}\ cm^{-3}$

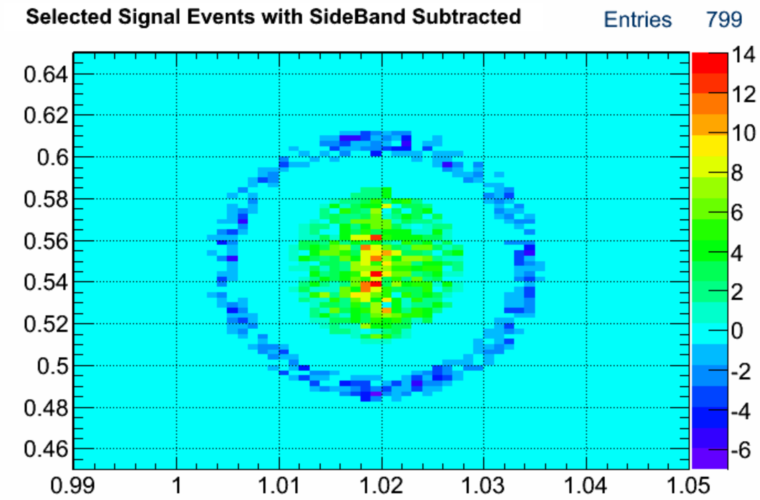
Target Volume = Area * Length = 0.1257 * 40 = 5.0265 cm^3

$$\sigma = \frac{N_E\ w}{2\ N_B\ N_A\ \rho\ L_T} \tag{1}$$

where,

$\rho = 0.0708 gm.cm^{-3}$, $L_T = 40 cm$, $N_B = 5.782 * 10^{11}$,
$N_A = 6.022 * 10^{23}$, $w = 2.016$, $N_E = N_{Events}\ /\ Acceptance.$

Figure: Yield calculation using Elliptically Side-Band Subtracted $\phi - \eta$ Invariant Mass



$Number\ of\ Accepted\ Events$ :: 27235

$Number\ of\ Simulated\ Events$ :: 9305000

Therefore,

$Acceptance = 0.0029269$

&

$N_E = 800/(27235/9305000) = 273324.7659 \approx 273325$

$Number\ of\ photons\ counted\ by\ gflux\ for\ data\ analysed\ for\ this\ analysis$ :: 21780608861890

$N_B \approx 2.1781 \times 10^{13}$

Therefore,

$Cross\ Section\ for\ p\,\gamma \rightarrow p\,\phi\,\eta\ in\ g12,$

$$'' \quad = \frac{273325 \times 2.016}{2 \times 2.1781 \times 10^{13} \times 6.022 \times 10^{23} \times 0.0708 \times 40} \approx 7.417 \times 10^{-33} \quad cm^2$$

$$g12\ Cross\ Section\ for\ \phi\,\eta = 7.417 \quad nano - barns$$

Given that the expected inefficiency is of the order of 40% from ρ cross-section, the number is very preliminary and far from finalised.