Elastic Run # 1371+1372 (LH_2)

E_{beam}=4.89GeV, E'=3.04GeV

$\theta_{HRS}=28.0^{o}$

$$\text{BCharge} = 3.055\mu A \times 13.041\text{mins} \times \frac{75}{78} + 3.040\mu A \times 60.866\text{mins} \times \frac{342}{362} = 12.8\ \text{mC}$$

$$\text{Target Thickness} = \frac{\Delta e.y}{\sin(\theta_{HRS})} = 4.00\text{cm}/\sin(28.0^{o}) = 8.52\ \text{cm}$$

$\rho_T=0.0709\ g/cm^3$

$\Delta\theta$=0.090 rad, $\Delta\phi$=0.015 rad

$\Delta\Omega = \Delta\theta\Delta\phi$ = 1.35e-03 sr

N_{good}=4014

LT=0.971, $\in_{track}$=0.998

$Q^2 = 4EE'\sin^2(\theta_{HRS}/2) = 3.48\ GeV^2$

$$L\Delta t = \frac{\text{BCharge}}{e^-}\ \rho_t l_t\ \frac{N_A}{A_Z} = 2.91e{+}40\ cm^{-2}$$

$$\left(\frac{d\sigma}{d\Omega}\right)_{measured} = \frac{N_{good}}{\Delta\Omega\ L\Delta t\ LT\ \in_{track}} = 1.05e{-}34\ cm^2/sr = 0.105\ nb/sr$$

considering the effect of internal and external bremsstrahlung

$$\left(\frac{d\sigma}{d\Omega}\right)_{measured} = \left(\frac{d\sigma}{d\Omega}\right)_{corr} \exp(\delta_{inf}+\delta_t)$$

$\delta_{inf}=(-2\alpha/\pi)[\ln(Q^2/m^2-1)\ln(E'/\Delta E')]$

$$\delta_t = -4/3\{ [t_{iw}+1/2T]\ln\left(\frac{E}{(E/E')^2\Delta E'}\right) + [t_{fw}+T']\ln\left(\frac{E'}{\Delta E'}\right) \}$$

Al cylinder: upstream window 4 mil thick, downstream window 4 mil, wall 7 mil.

LH_2 15cm thick, cell diameter 2.5 inches

Air after the target: T_{air} = 62.6 cm (estimate)

T' = 1/2 X 2.5 / $\sin(28^{o})$ x 2.54 cm = 6.76 cm

$\Delta E'$=0.112 GeV

$$t_{iw}+1/2T = \frac{4 \times 0.00254cm}{8.9cm} + 1/2 \times \frac{15cm}{866cm} = 1.14 \times 10^{-3} + 8.66 \times 10^{-3} = 9.80 \times 10^{-3}$$

$$t_{fw}+T' = \frac{7 \times 0.00254cm / \sin(28^{o})}{8.9cm} + \frac{62.6}{30420} + \frac{6.76cm}{866cm} = 4.26 \times 10^{-3} + 2.06 \times 10^{-3} + 7.81 \times 10^{-3} = 1.41 \times 10^{-2}$$

$$\delta_t = (-4/3) \{ 9.80 \times 10^{-3} \ln(\frac{4.89}{(4.89/3.04)^2 \times 0.112}) + 1.41 \times 10^{-2} \ln(\frac{3.04}{0.112})\} = (-4/3)(3.82 \times 10^{-2} + 6.16 \times 10^{-2}) = -0.099$$

$$\delta_{inf} = \frac{-2}{137 \times 3.14} \times (\ln\frac{3.48}{(0.511 \times 10^{-3})^2} - 1) \ln(\frac{3.04}{0.112}) = -0.236$$

$$(\frac{d\sigma}{d\Omega})_{corr} = (\frac{d\sigma}{d\Omega})_{measured} \exp\{-\delta_{inf} - \delta_t\} = 0.105 \text{ nb/sr} \times \exp\{0.236 + 0.099\} = 0.147 \text{ nb/sr}$$

$$(\frac{d\sigma}{d\Omega})_{expected} = 0.177 \text{ nb/sr}$$ (from Bosted fitting: P.E.Bosted, Phys. Rev. C 51, 409 (1995))

$$(\frac{d\sigma}{d\Omega})_{corr} / (\frac{d\sigma}{d\Omega})_{expected} = 0.83$$

Expected cross section calculation

$$\tau = \frac{Q^2}{4m_p^2} = 0.99$$

$$\epsilon = \frac{1}{1+2(1+\tau)\tan^2(\theta_{HRS}/2)} = 0.80$$

$$\sigma_{mott} = (\frac{\alpha \cos(\theta/2)}{2E \sin^2(\theta/2)})^2 \frac{E'}{E} = 9.52e\text{-}05 GeV^{-2} = 3.73e+01 \text{ nb}$$

Bosted fitting: P.E.Bosted, Phys. Rev. C 51, 409 (1995)

$$G_E^p(Q^2) = \frac{1}{1+0.62Q+0.68Q^2+2.80Q^3+0.83Q^4}$$

$$G_M^p(Q^2 = \frac{\mu_p}{1+0.35Q+2.44Q^2+0.50Q^3+1.04Q^4+0.34Q^5}$$

$$G_M^p = 8.30e\text{-}02$$

$$G_E^p = 3.05e\text{-}02$$

$$\frac{d\sigma_{ep}}{d\Omega} = \frac{d\sigma}{d\Omega_{mott}} \frac{\epsilon(G_E^P)^2 + \tau(G_M^P)^2}{\epsilon(1+\tau)} = 0.177 \text{nb/sr}$$