

$$E_{\text{beam}}=7.40\text{GeV}, E'=3.20\text{GeV}$$

$$\theta_{\text{HRS}}=33.4^\circ$$

$$Q^2 = 4EE'\sin^2(\theta_{\text{HRS}}/2) = 7.82 \text{ GeV}^2$$

$$\text{Integrated beam charge: BC} = 0.312 \text{ C}$$

$$\text{Used target Length: } L_T = \frac{\Delta e \cdot y}{\sin(\theta_{\text{HRS}})} = 9.08 \text{ cm}$$

$$\text{Target density: } \rho_T = 0.0709 \text{ g/cm}^3$$

$$\text{Angular acceptance: } \Delta\theta=0.090 \text{ rad}, \quad \Delta\phi=0.023 \text{ rad}$$

(θ is the out-of-plane angle, ϕ is the in-plane angle)

$$\text{Solid angle acceptance: } \Delta\Omega = \Delta\theta\Delta\phi = 2.07\text{e-}03 \text{ sr}$$

$$N_{\text{good}}=1802 \text{ (} N_{\text{good}} \text{ is the number of detected one-track electrons)}$$

$$\text{Livetime: LT}=0.996$$

$$\text{Total efficiency for detection: } \epsilon_{\text{det}}=\epsilon_T\epsilon_{\text{PID}}\epsilon_R\epsilon_{\text{track}} = 0.999$$

ϵ_T is the trigger efficiency, ϵ_{PID} is the particle identification efficiency, ϵ_R is the trajectory reconstruction efficiency

and ϵ_{track} is the ratio of one-track trajectories of all trajectories, assume $\epsilon_T=1$, $\epsilon_{\text{PID}}=1$ and $\epsilon_R=1$

$$\text{Integrated luminosity: } L\Delta t = \frac{\text{BC}}{e} \rho_t l_t \frac{N_A}{A_Z} = 7.56\text{e}+41 \text{ cm}^{-2}$$

$$\left(\frac{d\sigma}{d\Omega}\right)_{\text{measured}} = \frac{N_{\text{good}}}{\Delta\Omega L\Delta t LT \epsilon_{\text{det}}} = 1.16\text{e-}36 \text{ cm}^2/\text{sr} = 0.00116 \text{ nb/sr}$$

considering the effect of internal and external bremsstrahlung

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

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

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

$$\Delta E'=0.019 \text{ GeV}$$

($\Delta E'$ is the maximum energy loss of the electron from the elastic peak)

Al cylinder: upstream window 4 mil = 0.0102cm thick, downstream window 4 mil = 0.0102cm, wall 7 mil = 0.0178cm.

LH₂ 15cm thick, cell diameter 2.5 inches

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

$$T' = 1/2 \times 2.5 / \sin(\{33.4\}^\circ) \times 2.54 \text{ cm} = 5.77 \text{ cm}$$

$$t_{\text{tw}} + 1/2T = \frac{4 \times 0.00254 \text{ cm}}{8.9 \text{ cm}} + 1/2 \times \frac{15 \text{ cm}}{866 \text{ cm}} = 9.80 \text{e-}03$$

$$t_{\text{tw}} + T' = \frac{7 \times 0.00254 \text{ cm} / \sin(\theta_{\text{HRS}})}{8.9 \text{ cm}} + \frac{62.6}{30420} + \frac{5.77 \text{ cm}}{866 \text{ cm}} = 1.23 \text{e-}02$$

$$\delta_t = (-4/3) \left\{ 9.80 \text{e-}03 \ln\left(\frac{7.40}{(7.40/3.20)^2 \times 0.019}\right) + 1.23 \text{e-}02 \ln\left(\frac{3.20}{0.019}\right) \right\} = -0.140$$

$$\delta_{\text{inf}} = \frac{-2}{137 \times 3.14} \times \left(\ln\left(\frac{7.82}{(0.511 \times 10^{-3})^2}\right) - 1 \right) \ln\left(\frac{3.20}{0.019}\right) = -0.386$$

$$\left(\frac{d\sigma}{d\Omega}\right)_{\text{Born}} = \left(\frac{d\sigma}{d\Omega}\right)_{\text{measured}} \exp\{-\delta_{\text{inf}} - \delta_t\} = 0.00116 \text{ nb/sr} \times \exp\{0.386 + 0.140\} = 0.00196 \text{ nb/sr}$$

Expected cross section calculation

$$\tau = \frac{Q^2}{4m_p^2} = 2.22$$

$$\epsilon = \frac{1}{1 + 2(1 + \tau)\tan^2(\theta_{\text{HRS}}/2)} = 0.63$$

$$\sigma_{\text{mott}} = \left(\frac{\alpha \cos(\theta/2)}{2E \sin^2(\theta/2)}\right)^2 \frac{E'}{E} = 1.42 \text{e-}05 \text{ GeV}^{-2} = 5.55 \text{e+}00 \text{ nb}$$

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

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

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

$$G_M^p = 1.82 \text{e-}02$$

$$G_E^p = 8.33 \text{e-}03$$

$$\left(\frac{d\sigma}{d\Omega}\right)_{\text{Born}} = \left(\frac{d\sigma}{d\Omega}\right)_{\text{mott}} \frac{\epsilon(G_E^p)^2 + \tau(G_M^p)^2}{\epsilon(1 + \tau)} = 0.00211 \text{ nb/sr}$$

$$\left(\frac{d\sigma}{d\Omega}\right)_{\text{expected}} = 0.00211 \text{ nb/sr} \text{ (from Bosted fitting: P.E.Bosted, Phys. Rev. C 51, 409 (1995))}$$

$$\left(\frac{d\sigma}{d\Omega}\right)_{\text{Born}} / \left(\frac{d\sigma}{d\Omega}\right)_{\text{expected}} = 0.93$$