

Target Thickness and Cross Sections

Maxime Levillain

March 17, 2017



Variables:

- ▶ $N(\theta)$, $N_{bg}(\theta)$: yields for production and empty runs
- ▶ $N_0(\theta)$, $N_{0bg}(\theta)$: live charge for production and empty runs
($|1nC| = 6.242 \cdot 10^9 e^-$)
- ▶ τ : thickness ($b^{-1} = 10^{28} m^{-2}$)

Cross Section:

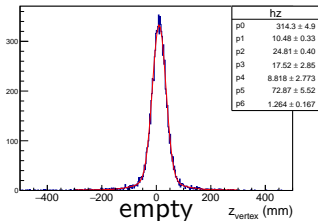
$$\frac{d\sigma}{d\Omega}(\theta) = \frac{1}{2\pi \sin(\theta) \cdot \tau} \left(\frac{N}{N_0} - \frac{N_{bg}}{N_{0bg}} \right)$$

$$\frac{d\sigma}{d\Omega}(Q^2) = \frac{d\sigma}{dQ^2} \frac{dQ^2}{d\Omega}$$

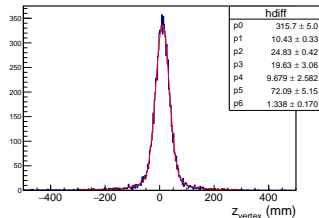
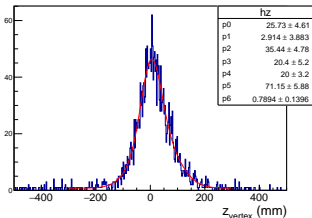
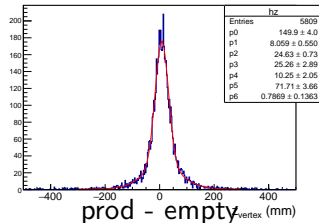
$$\frac{dQ^2}{d\Omega} = \frac{E_{beam} m_{e^-}}{\pi} \cdot \frac{1 - 4\alpha \cos\theta + 6\alpha \cos^2\theta - 2\alpha \cos^3\theta - \alpha \cos^4\theta}{(1 - \alpha \cos^2\theta)^2}$$

with $\alpha = (E_{beam} - m_{e^-}) / (E_{beam} + m_{e^-})$

production



carbon



- ▶ Double gaussian fit

$$g2(z) \approx 300e^{-z^2/(2*0.025^2)} + 20e^{-z^2/(2*0.07^2)}$$

- ▶ Assuming uniform density distribution (P and T averaged for each run):

$$\tau_0 = \rho_0 \cdot \Delta z$$

$$\rho_0 = 2 * P(\text{Torr}) / 0.76(\text{Torr}) * 273.15(\text{K}) / T(\text{K}) \\ * 8.988 \cdot 10^{-5}(\text{g}/\text{m}^3) * N_A / 2.0159(\text{g}/\text{mol})$$

$$\rho_0 \approx 4.65 \cdot 10^{23} \text{H}/\text{m}^3 (\text{for } P=0.47 \text{ Torr and } T=19.5 \text{ K})$$

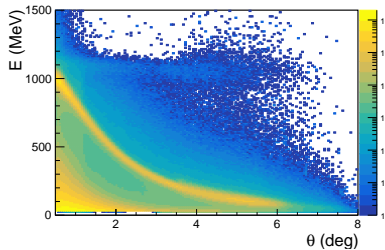
- ▶ Assuming double gaussian profiles :

$$g_2(z) = 300e^{-z^2/(2*0.025^2)} + 20e^{-z^2/(2*0.07^2)}$$

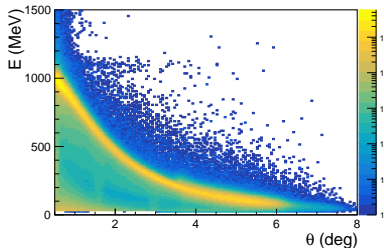
$$\rho = \frac{\rho_0}{g_2(0)} \int_{-0.05}^{0.05} g_2(z) dz$$

$$|\tau/\tau_0 - 1| \approx 10\%$$

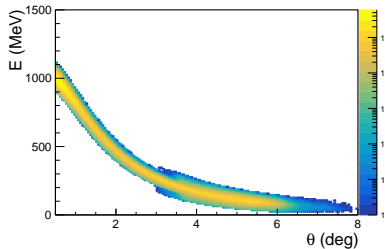
raw



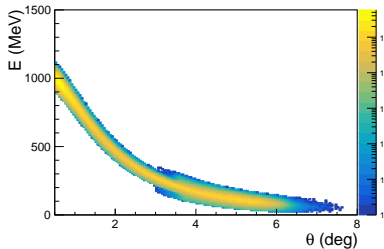
$\Delta\phi$ cut



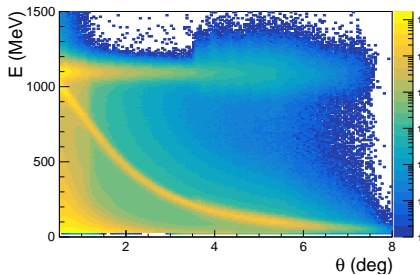
elasticity cut



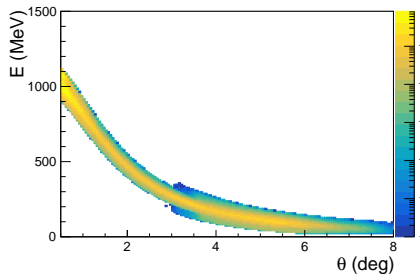
all cuts

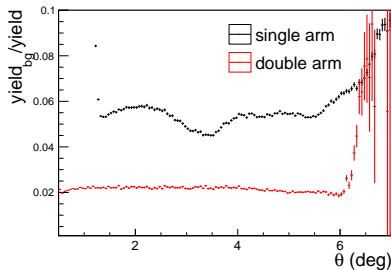
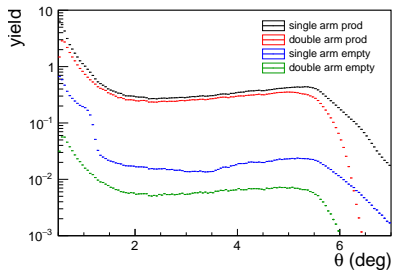


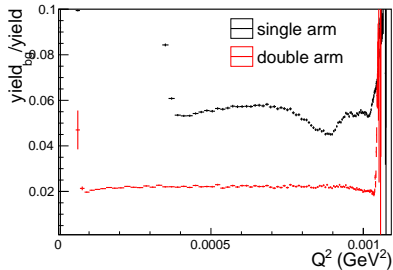
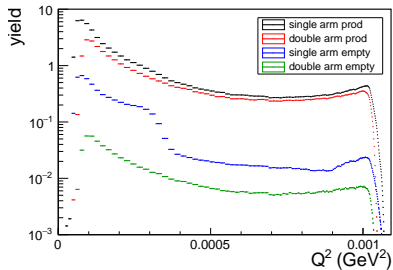
raw



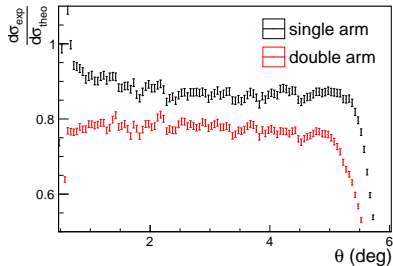
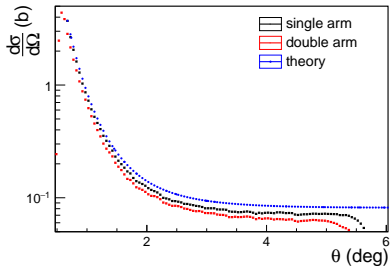
elasticity cut



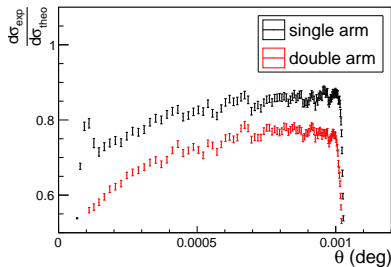
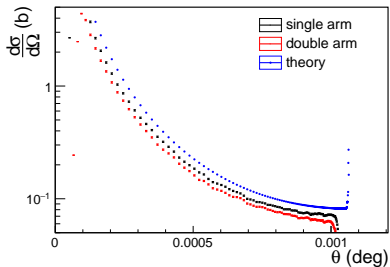


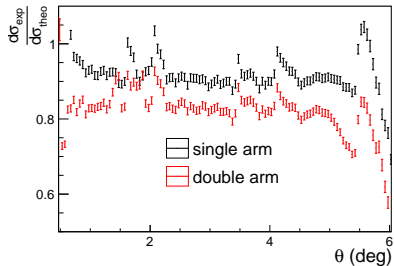
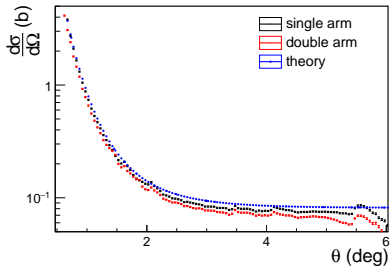


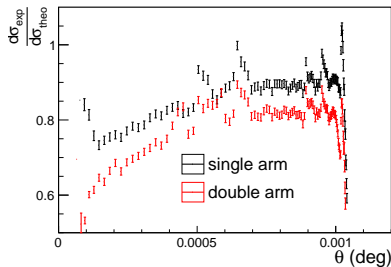
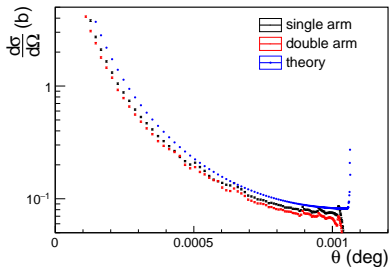
Raw Cross Sections (without acceptance) (θ) **PRad** ^oton _{radius}



Raw Cross Sections (without acceptance) (Q^2 PRad)







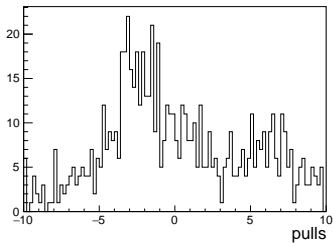
► Definition

$$p(\theta)_{run} = \frac{x_{run}(\theta) - \langle x \rangle(\theta)}{\sqrt{\sigma_{x_{run}}^2(\theta) - \sigma_{\langle x \rangle}^2(\theta)}}$$

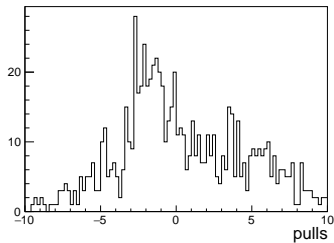
$$x_{run}(\theta) = N_{run}(\theta) / N_{0\ run}$$

$$\langle x \rangle(\theta) = \sum_{run} N_{run}(\theta) / \sum_{run} N_{0\ run}$$

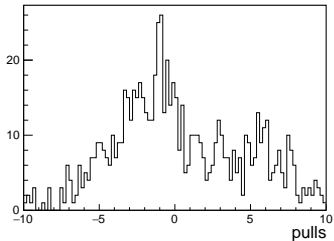
1 - 2 degree



2 - 3 degree



3 - 4 degree



4 - 5 degree

