$$\hbar \Delta l = (\vec{p}_i - \vec{p}_f) R$$

$$\Delta l = (k_i - k_f) R$$

$$\Delta l^2 = (k_i^2 + k_f^2 - 2 k_i k_f \cos\theta) R^2$$

$$k_i \sim k_f \sim 2\pi/\lambda, \quad 1 - \cos\theta = 2\sin^2 \theta/2 \sim \frac{\theta^2}{2}$$

$$\theta = \lambda \cdot \Delta l / 2\pi R$$

For alpha particles of 172 MeV, $\theta = 4^o$ corresponds to quadrupole