1.1 α粒子速度 v_0，能量 $E_0 = \frac{1}{2}m_\alpha v_0^2$，考虑对心碰撞

碰撞后 α粒子速度 $v = \frac{(m_\alpha - m_e)v_0}{m_\alpha + m_e} = \frac{7299}{7301}v_0$

动能 $E = \frac{1}{2}m_\alpha v^2 \approx 0.9995 E$ 动能仅改变 0.05%。

故电子的影响可忽略

1.3 $a = \frac{e^2}{4\pi\varepsilon_0}\frac{z_1 z}{E} = \frac{e^2}{4\pi\varepsilon_0}\frac{2\times79}{7.68 MeV} = 2.96\times10^{-14}$ m

$b = \frac{a}{2}\cot\frac{\theta}{2} = \frac{a}{2}\cot75° = 3.97 fm$

1.4 极立体角 $d\Omega = \frac{dS}{R^2} = 0.015$ rad

$\frac{dn}{n} = \frac{1}{4\pi}\frac{N t \pi}{4}a^2\frac{d\Omega}{\sin^4\frac{\theta}{2}} = 8.9\times10^{-6}$

1.6 $N_t = \frac{\sigma}{M_y} = 5.86\times10^{22}$ m^{-2} 投影到 α粒子方向上 $(N_t)' = \frac{N_t}{\cos30°} = 6.77\times10^{22}$ m^{-2}

至用此公式 $a^2 = \frac{16\sin^4\frac{\theta}{2}}{(N_t)'d\Omega}\frac{dn}{n}$ ⟹ $a = \frac{4\sin^2\frac{\theta}{2}}{\sqrt{(N_t)'d\Omega}}\sqrt{\frac{dn}{n}} = 3.87\times10^{-14}$

⟹ $\overline{Z} = 47$

1.8 $\int_{20°}^{180°}\frac{dn}{n} = \int_{20°}^{180°}\frac{N_t\pi}{2}a^2\frac{d\sin\frac{\theta}{2}}{\sin^3\frac{\theta}{2}} = 4\times10^{-3}$

$\begin{cases} \int_{20°}^{180°}\frac{d\sin\frac{\theta}{2}}{\sin^3\frac{\theta}{2}} = 16.08 \\ N_t = 6.309\times10^{18} cm^{-2} \end{cases}$ ⟹ $a = 5.01\times10^{-14}$ m

$$\frac{d\sigma}{d\Omega} = \frac{a^2}{(2\sin\frac{\theta}{2})^4} = 2.51 \times 10^{-27} \, m^2 = 2.51 \times 10^{-23} \, cm^2$$

1.9 对 Au $a_{Au} = 1.14 \times 10^{-13} \, m$

对 Ag $a_{Ag} = 6.77 \times 10^{-14} \, m$

分别 计算 Au, Ag 对 原子 的 散射

总 比例 为 一 着相地, 为

$$\int_{60°}^{180°} \frac{dn_1}{n_1} + \int_{60°}^{180°} \frac{dn_2}{n_2} =$$

$$\int_{60°}^{180°} \frac{x\pi}{2} a_{Au}^2 \frac{d\sin\frac{\theta}{2}}{\sin^3\frac{\theta}{2}} + \int_{60°}^{180°} \frac{y\pi}{2} a_{Ag}^2 \frac{d\sin\frac{\theta}{2}}{\sin^3\frac{\theta}{2}} = 1.3 \times 10^{-3}$$

1.13 Au $Z = 79$ $r_{min} = a = 50.56 \, fm$

Li $Z = 3$ $r_{min} = a = 1.92 \, fm$

1.15 Hg $Z = 80$ $a = \frac{e^2}{4\pi\varepsilon_0} \frac{1 \times 80}{0.87 \, MeV} = 1.32 \times 10^{-13} \, m$

$b = \frac{a}{2} \cot 45° = 66.21 \, fm$, $r_{min} = \frac{a}{2}(1 + \frac{1}{\sin 45°}) = 1.60 \times 10^{-13} \, m$

原子 总 数密度 N

金 x   银 y

$x + y = N$

$y = 0.3 N$

$197u\,x + 108u\,y = 1.5 \, mg \cdot cm^{-2}$

$\Rightarrow x = 3.713 \times 10^{18} \, cm^{-2}$

$y = 1.591 \times 10^{18} \, cm^{-2}$