Präsenzaufgabe von Blatt 9 in Exphy 6 vom 6.6.2012

Präsenz (Formfaktor)

$$F(\vec{q}) = a \int_V f(\vec{x}) e^{\frac{-i\vec{q}\vec{x}}{\hbar}} dV \quad , \quad k = \frac{2\pi}{\lambda}$$

$$F^*(\vec{k}) = b \int f(\vec{x}) e^{-i\vec{k}\vec{x}} dV$$

$$\int_V e^{i\vec{k}\vec{r}} = \int_0^R \int_0^\pi \int_0^{2\pi} e^{-ikr\underbrace{\cos(\vartheta)}_{-u}} r^2 dr \underbrace{\sin(\vartheta) d\vartheta}_{du} d\varphi$$

$$= 2\pi \int_{-1}^{1} e^{ikru} r^2 dr du - 2\pi \int [\tfrac{1}{kr} e^{ikru}]_1^1 r^2 dr$$

$$= -2\pi \int_0^R \tfrac{\sin(kr)}{kr} r^2 dr = -R\cos(kR) - \sin(kR)$$

$$\int_0^R r\sin(r) = [-r\cos(r)]_0^R + \int \cos(r) dr = [-r\cos(r)]_0^R - [\sin(r)]_0^R$$

$$qR = 4 \quad \Rightarrow \quad R = \tfrac{4}{q} = \tfrac{4}{1.8 fm^{-1}} = 2.2 fm$$