Nuclear reaction rate

Reaction rate (thin target):

$$R\left[s^{-1}\right] = \phi_p\left[s^{-1}\right] \cdot N_t\left[cm^{-2}\right] \cdot \sigma\left[cm^2\right]$$

$$R\left[s^{-1}\right] = \phi_p\left[s^{-1}\right] \cdot \frac{x\left[g/cm^2\right] \cdot 6.02 \cdot 10^{23}}{A[g]} \cdot \sigma\left[cm^2\right]$$

Beam attenuation (thick target):

$$\phi\left[s^{-1}\right] = \phi_0\left[s^{-1}\right] \cdot e^{-N_t\left[cm^{-2}\right]\sigma\left[cm^2\right]}$$

$$\phi\left[s^{-1}\right] = \phi_0\left[s^{-1}\right] \cdot e^{-\frac{x\left[g/cm^2\right] \cdot 6.02 \cdot 10^{23} \sigma\left[cm^2\right]}{A[g]}}$$

Example: ^{130}Sn on ^{27}Al $x = 1, 2, 3\left[g/cm^2\right]$ $\sigma = 3.6[b]$ $\frac{\phi}{\phi_0} = 0.923, 0.852, 0.786$

^{130}Sn on CH_4 $x = 1, 2, 3\left[g/cm^2\right]$ $\frac{\phi}{\phi_0} = 0.837, 0.701, 0.587$

Nuclear reaction rate

Beam attenuation (thick target):

$$\phi\left[s^{-1}\right] = \phi_0\left[s^{-1}\right] \cdot e^{-N_t\left[cm^{-2}\right]\sigma\left[cm^2\right]}$$

$$\phi\left[s^{-1}\right] = \phi_0\left[s^{-1}\right] \cdot e^{-\frac{x\left[g/cm^2\right]\cdot 6.02\cdot 10^{23}\,\sigma\left[cm^2\right]}{A[g]}}$$

Example: $^{130}Sn \;\; on \;\; CH_4 \;\; x = 1, 2, 3\left[g/cm^2\right]$

$$N_t = \frac{x\left[g/cm^2\right]\cdot 6.02\cdot 10^{23}}{16[g]}\cdot 5 = x\left[g/cm^2\right]\cdot 1.88\cdot 10^{23}\left[g^{-1}\right]$$

$$\frac{4}{5}\, are\ H\ nuclei: \; N_H = x\left[g/cm^2\right]\cdot 1.51\cdot 10^{23}\left[g^{-1}\right]$$

$$\frac{1}{5}\, are\ C\ nuclei: \; N_C = x\left[g/cm^2\right]\cdot 3.76\cdot 10^{22}\left[g^{-1}\right]$$

$^{130}Sn \;\; on \;\; ^{1}H \;\; x = 0.25, 0.50, 0.75\left[g/cm^2\right] \;\; \sigma = 0.53[b]$ $\quad \frac{\phi}{\phi_0} = 0.923, 0.853, 0.787$

$^{130}Sn \;\; on \;\; ^{12}C \;\; x = 0.75, 1.50, 2.25\left[g/cm^2\right] \;\; \sigma = 2.6[b]$ $\quad \frac{\phi}{\phi_0} = 0.907, 0.822, 0.746$

$^{130}Sn \;\; on \;\; CH_4 \;\; x = 1, 2, 3\left[g/cm^2\right]$ $\quad \frac{\phi}{\phi_0} = 0.837, 0.701, 0.587$