Adam Parker
NUGN 510
3/15/18

Homework 3

To accompany code:

2. $D = \frac{1}{3\Sigma_t} \approx \frac{1}{3\Sigma_s} \Rightarrow \Sigma_s \approx \frac{1}{3D}$

$$\Sigma_a = 0.5\Sigma_s \Rightarrow \Sigma_a = \frac{1}{3D} \cdot 0.5$$

Code: @ 50 cm $\phi = 553.88$

Analytical Infinite Plane Source:

$$\phi = \frac{SL}{2D} e^{-x/L} \qquad x \geq 0$$

$\phi @ x=0 = 1000 \Rightarrow S = 544$ $\quad L^2 = \frac{D}{\Sigma_a}$

$$D = \frac{\Sigma_s}{3(\Sigma_s + \Sigma_a)^2} \qquad \Sigma_s = (0.1 \cdot 5\times10^{22} + 0.134\times10^{20} + 240\times10^{16}) \cdot 10^{-24}$$

$$D = 20.02 \qquad \Sigma_s = 0.0074$$

$$\Sigma_a = 0.5\Sigma_s$$
$$\Sigma_a = 0.0037$$

$$L = \sqrt{\frac{20.02}{0.0037}} = 73.56$$

$$\phi = \frac{1000 \cdot 73.56}{2 \cdot 20.02} \cdot e^{-|50|/73.56}$$

$$\phi = 506.75$$

The code gives a slightly higher answer than the analytical solution.

d. $N_d = \frac{2.26\,g}{cm^3} \cdot \frac{1\,mol}{12\,g} \cdot \frac{6.022\times10^{23}\ atoms}{mol}$

$N_d = 1.13\times10^{23}$ atoms/cm^3

$\sigma_s = 4.98\,b$

code: $\phi = 390.94$

Analytical:

$$\phi = \frac{SL}{2D} e^{-|x|/L}$$

$\phi(@\,x=0) = 1000 \Rightarrow S = 30.6$

$L^2 = \frac{D}{\Sigma_a}$ $\quad D = \frac{\Sigma_s}{3(\Sigma_s+\Sigma_a)^2} =$ $\quad \Sigma_s = 4.98 \times 1.13\times10^{23} \times 10^{-24}$

$\Sigma_s = 0.565$

$D = 1/3 \cdot 0.565$

$D = 0.59$ $\quad \Sigma_a = 0.0035 \times 0.113$

$\Sigma_a = 3.96\times10^{-4}$

$$L = \sqrt{\frac{0.59}{3.96\times10^{-4}}} = 38.67$$

$$\phi = \frac{1000 \cdot 38.62}{2 \cdot 0.59} \cdot e^{-(50)/38.62}$$

$\phi = 279.48$

This, again, is below what the code predicted. Could be a disagreement in extrapolation distance.