Homework 12

Jiinyuan Wu

December 8, 2022

Problem 1

Solution The data used are $m_{\mathrm{e}} = 0.066m$, $m_{\mathrm{h}} = 0.5m$, and the conservation laws are

$$\frac{p_{\mathrm{e}}}{2m_{\mathrm{e}}} + \frac{p_{\mathrm{h}}}{2m_{\mathrm{h}}} = E_{\mathrm{photon}}, \quad p_{\mathrm{e}} + p_{\mathrm{h}} = \frac{E_{\mathrm{photon}}}{c}, \tag{1}$$

and we get

$$p_{\mathrm{e}} = 1.65 \times 10^{-25}\,\mathrm{kg \cdot m/s}, \quad p_{\mathrm{h}} = -1.64 \times 10^{-25}\,\mathrm{kg \cdot m/s}, \quad \frac{p_{\mathrm{e}}^2}{2m_{\mathrm{e}}} = 1.41\,\mathrm{eV}, \quad \frac{p_{\mathrm{h}}^2}{2m_{\mathrm{h}}} = 0.18\,\mathrm{eV}. \tag{2}$$

Problem 2

Solution

Problem 3

Solution Here we use

$$d_{n,p} = 105 \left\{ \frac{(N_a/N_d)^{\pm 1}}{10^{-18}\,(N_d + N_a)} [\epsilon e \Delta\phi]_{\mathrm{ev}} \right\}^{1/2} \text{ Å} \tag{3}$$

from A&M (29.18). Since $N_a = N_d$, we have $d_n = d_p = 25\,\text{Å}$, and therefore $N_a = N_d = 4.4 \times 10^{18}\,\mathrm{cm}^{-3}$.