Ion-Matter itneractions

2022-09-15

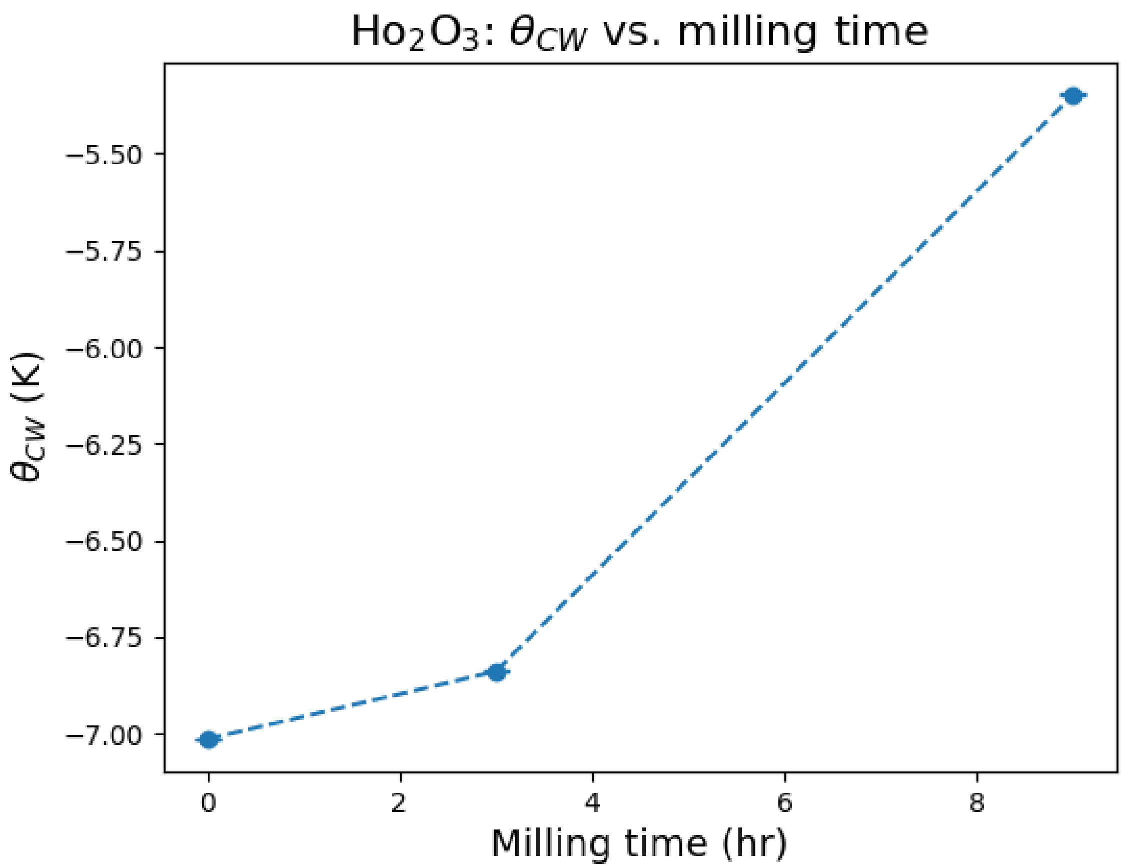

Figure 1: asd

$$S_c = 4\pi r_0^2 m_e c^2 (\frac{z^2}{\beta^2})(\frac{N_A \rho Z}{M_m})\{ln(\frac{2m_e c^2 \gamma^2 \beta^2}{I}) - \beta^2\}$$

$$\alpha \rightarrow T/A = 200 \text{ MeV}, \ T = 800 \text{ MeV}$$
$$r_0 = 2.818 \times 10^{-13} \text{ cm}$$
$$m_e c^2 = 0.511 \text{ MeV}$$
$$z^2 = 4$$

$$E_\alpha = T_\alpha + m_\alpha c^2 = \gamma(m_\alpha c^2)$$
$$T_\alpha = (\gamma - 1) m_\alpha c^2$$

Calculate mass of alpha:

$$m_\alpha = (4 * 931.494 \text{ MeV}) + \delta - 2m_e = 3727.379$$

$$\gamma = 1.215$$
$$\gamma^2 = \frac{1}{1 - \beta^2}$$
$$\beta^2 = 1 - \frac{1}{\gamma^2} = 0.323$$
$$\beta^2\gamma^2 = \gamma^2 - 1$$

$$n_e = \frac{N_A \rho Z}{M_m}$$
$$I_{Al} = 166 \text{ eV}$$

Plug into massive equation. Check units

$S_c = 37.908$ (MeV/cm from star database)

$S_c = 37.879$ MeV/cm from Python calc

Calculating densities

- Use NIST values
  - Air:
    - Z = 6, 7, 8, 18
    - $\rho = 1.20479 \times 10^-2 \ g/cm^3$
    - Mean excitation energy = 86.7 eV

$$\rho_A = \frac{N_A}{M_m}\rho$$
$$\rho_A = \frac{N_A}{mw}\rho n_i$$
$$mw = \sum_{i=1}^{N} = n_i A_i$$
$$f_i = \frac{n_i A_i}{\sum_{i=1}^{N} n_i A_i} = \frac{n_i A_i}{mw}$$
$$\rho_{A_i} = N_A/(mw)\rho\frac{f_i mw_i}{A_i}$$
$$\rho_{A_i} = N_A\rho\frac{f_i}{A_i}$$

or

$$\rho_{A_i} = \frac{N_a \rho f_i}{A_i}$$

Electron density

$$n_e = \sum_{i=1}^{N} \frac{N_a \rho f_i}{A_i} Z_i$$

- Don't need molar weight of molecule

- Electron density of water

$$A_O = 16$$
$$A_H = 1$$
$$Z_O = 8$$
$$Z_H = 1$$
$$f_H = 2/18$$
$$f_O = 16/18$$
$$n_e = N_A\rho[\frac{f_H}{A_H}Z_H + \frac{f_O}{A_O}Z_O]$$
$$n_e = 3.35 \times 10^{23}\ [e^-/cm^3]$$