

[tex166] Paramagnetic FD gas VI: isothermal compressibilities

There are two distinct quantities that go by this name:

$$\kappa_{TM} \doteq -\frac{1}{V} \left(\frac{\partial V}{\partial p} \right)_{TMN}, \quad \kappa_{TH} \doteq -\frac{1}{V} \left(\frac{\partial V}{\partial p} \right)_{THN}. \quad (1)$$

Calculate both quantities and render them as follows:

$$\kappa_{TM} = \frac{\lambda_T^{\mathcal{D}}}{k_B T} \left[\frac{[f_{\mathcal{D}/2}(z_+)]^2}{f_{\mathcal{D}/2-1}(z_+)} + \frac{[f_{\mathcal{D}/2}(z_-)]^2}{f_{\mathcal{D}/2-1}(z_-)} \right]^{-1}, \quad (2)$$

$$\kappa_{TH} = \frac{\lambda_T^{\mathcal{D}}}{k_B T} \frac{f_{\mathcal{D}/2-1}(z_+) + f_{\mathcal{D}/2-1}(z_-)}{[f_{\mathcal{D}/2}(z_+) + f_{\mathcal{D}/2}(z_-)]^2}. \quad (3)$$

Note that the two expressions become identical for $H = M = 0$.

Solution: