Reference Values for T, $V/\mathcal{N}$, and p [tln71]

The reference values introduced here are based on

(i) thermal wavelength: $\lambda_T \doteq \sqrt{\dfrac{h^2}{2\pi m k_B T}} = \sqrt{\dfrac{\Lambda}{k_B T}}, \quad \Lambda = \dfrac{h^2}{2\pi m}.$

(ii) MB equation of state: $pv = k_B T, \quad v \doteq V/\mathcal{N}.$

- $p_v v = k_B T_v, \quad v = \left(\dfrac{\Lambda}{k_B T_v}\right)^{\mathcal{D}/2} \qquad (v = \text{const.})$
- $p_T v_T = k_B T, \quad v_T = \left(\dfrac{\Lambda}{k_B T}\right)^{\mathcal{D}/2} \qquad (T = \text{const.})$
- $p v_p = k_B T_p, \quad v_p = \left(\dfrac{\Lambda}{k_B T_p}\right)^{\mathcal{D}/2} \qquad (p = \text{const.})$

The reference values for $k_B T$, v, and p in isochoric, isothermal, and isobaric processes are

$$k_B T_v = \frac{\Lambda}{v^{2/\mathcal{D}}} \qquad p_v = \frac{\Lambda}{v^{2/\mathcal{D}+1}} \qquad (v = \text{const.})$$

$$v_T = \left(\frac{\Lambda}{k_B T}\right)^{\mathcal{D}/2} \qquad p_T = \Lambda\left(\frac{k_B T}{\Lambda}\right)^{\mathcal{D}/2+1} \qquad (T = \text{const.})$$

$$k_B T_p = \Lambda\left(\frac{p}{\Lambda}\right)^{2/(\mathcal{D}+2)} \qquad v_p = \left(\frac{\Lambda}{p}\right)^{\mathcal{D}/(\mathcal{D}+2)} \qquad (p = \text{const.})$$

These reference values are useful for bosons and fermions.

Universal curves for isochores, isotherms, and isobars:

- p/p_v versus T/T_v at $v = \text{const.}$
- p/p_T versus v/v_T at $T = \text{const.}$
- v/v_p versus T/T_p at $p = \text{const.}$

For fermions we will introduce alternative reference values based on the chemical potential (Fermi energy).