Reference Values for $T$, $V/N$, and $p$ \[\text{[Stu71]}\]

The reference values introduced here are based on

(i) thermal wavelength: $\lambda_T = \sqrt{\frac{\hbar^2}{2\pi m k_B T}} = \sqrt{\frac{\Lambda}{k_B T}}$, $\Lambda = \frac{\hbar^2}{2\pi m}$.

(ii) MB equation of state: $p v = k_B T$, $v = V/N$.

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

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

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

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

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).