Ideal Fermi-Dirac gas: isochores I [tsl46]

Reference values for temperature and pressure:

$$k_BT_v = \frac{\Lambda}{v^{2/\mathcal{D}}}, \quad p_v = \frac{k_BT_v}{v}; \qquad \Lambda \doteq \frac{h^2}{2\pi m}, \quad v \doteq \frac{gV}{\mathcal{N}}.$$

$$\frac{T_F}{T_v} = \frac{p_F}{p_v} = \left[\Gamma\left(\frac{\mathcal{D}}{2}+1\right)\right]^{2/\mathcal{D}} \overset{\mathcal{D}\gg 1}{\rightsquigarrow} \frac{\mathcal{D}}{2e}.$$

Isochore:

$$\frac{p}{p_F} = \frac{T}{T_F}\frac{f_{\mathcal{D}/2+1}(z)}{f_{\mathcal{D}/2}(z)}, \qquad \frac{T}{T_F} = \left[\Gamma\left(\frac{\mathcal{D}}{2}+1\right)f_{\mathcal{D}/2}(z)\right]^{-2/\mathcal{D}}.$$

Low-temperature limit [tex119]:

$$\lim_{T\to 0}\frac{p}{p_F} = \left(\frac{\mathcal{D}}{2}+1\right)^{-1}.$$

High-temperature asymptotic regime [tex119]:

$$\frac{pV}{\mathcal{N}k_BT_F} \sim \frac{T}{T_F}\left[1+\left[2^{\mathcal{D}/2+1}\Gamma\left(\frac{\mathcal{D}}{2}+1\right)\right]^{-1}\left(\frac{T_F}{T}\right)^{\mathcal{D}/2}\right].$$

The excess pressure relative to the Maxwell-Boltzmann line may be called a manifestation of *statistical interaction pressure*.