

Ideal Fermi-Dirac gas: isochores II [tln73]

Reference values for temperature and pressure:

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

Noncommuting limits $z \rightarrow \infty$, $\mathcal{D} \rightarrow \infty$:

- $z < \infty$, $\mathcal{D} \rightarrow \infty$:

$$\frac{p}{p_v} = \frac{T}{T_v} \frac{f_{\mathcal{D}/2+1}(z)}{f_{\mathcal{D}/2}(z)} \xrightarrow{\mathcal{D} \rightarrow \infty} \frac{T}{T_v} \quad (\text{ideal MB gas}).$$

- $\mathcal{D} \rightarrow \infty$, $z \rightarrow \infty$ with $\mathcal{D}/2 = r \ln z$, $r \geq 0$:

$$\frac{p}{p_v} = \frac{f_{\mathcal{D}/2+1}(z)}{[f_{\mathcal{D}/2}(z)]^{1+2/\mathcal{D}}} \xrightarrow{\mathcal{D} \gg 1} \frac{e^{-1}}{1+2/\mathcal{D}},$$

$$\frac{T}{T_v} = [f_{\mathcal{D}/2}(z)]^{-2/\mathcal{D}} \xrightarrow{\mathcal{D} \gg 1} \frac{\mathcal{D} e^{-1}}{2 \ln z} \quad (\text{pure Fermi sea}).$$

