

## [tex161] Paramagnetic FD gas I: pressure and entropy

Derive from either the the Helmholtz potential  $A(T, V, M, N)$  or the grand potential  $\Omega(T, V, H, \mu)$ , both established in [tsc16], parametric expressions for the two thermodynamic functions  $p(T, z_+, z_-)$  and  $S(T, V, z_+, z_-)$  representing pressure and entropy, respectively. The results are as follows:

$$p = \sum_{\sigma=\pm} k_B T \lambda_T^{-\mathcal{D}} f_{\mathcal{D}/2+1}(z_\sigma), \quad (1)$$

$$S = k_B \sum_{\sigma=\pm} N_\sigma \left[ \left( \frac{\mathcal{D}}{2} + 1 \right) \frac{f_{\mathcal{D}/2+1}(z_\sigma)}{f_{\mathcal{D}/2}(z_\sigma)} - \ln z_\sigma \right]. \quad (2)$$

For the expression for  $p$  we only need to remember that  $\Omega = -pV$ . Only the derivation of  $S$  requires some work.

**Solution:**