Ideales Fermi Gas

$s = \frac{1}{2}$

kinetische Energie $\varepsilon = \frac{p^2}{2m}$ $\quad x^2 = \beta\varepsilon$ $\quad z = e^{\beta\mu}$

$$N = -\frac{\partial \Omega}{\partial \mu}\Big|_{T,V} = (2s+1)\frac{V}{\lambda_T^3} k_B T \frac{\partial f_{\frac{5}{2}}(z)}{\partial z}\frac{\partial z}{\partial \mu}$$

$$= (2s+1)\frac{V}{\lambda_T^3}\underbrace{\left(z\frac{\partial f_{5/2}(z)}{\partial z}\right)}_{= f_{\frac{3}{2}}(z)}$$

$$S(T,V,\mu) = -\frac{\partial \Omega}{\partial T}\Big|_{V,\mu} \overset{\text{Übung}}{\Longrightarrow} U = -\frac{3}{2}\Omega = \frac{3}{2}pV$$

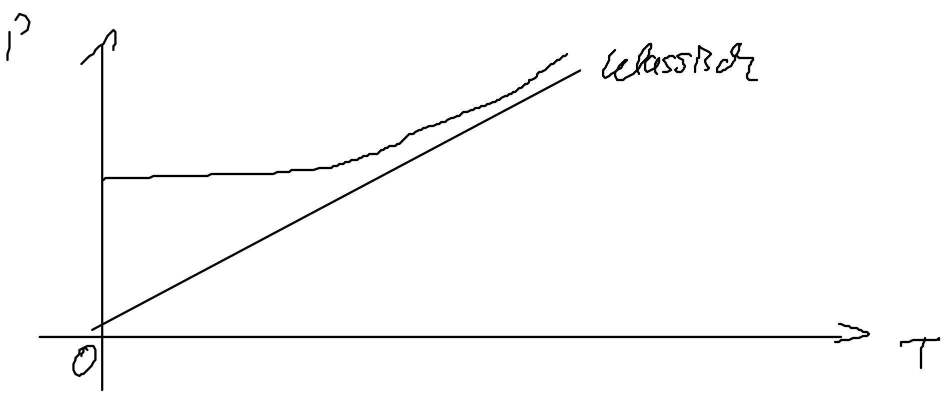
- hohe Temperaturen $k_B T \gg \varepsilon_F$

$\Rightarrow$ ideales klassisches Gas

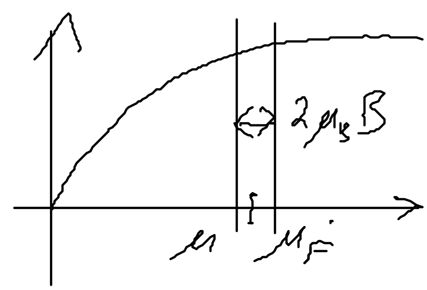
Dichte

$$e^{\beta\mu} = \frac{N}{V}\lambda_T^3 \frac{1}{(2s+1)} = \frac{n\,\lambda_T^3}{2s+1} \Rightarrow \mu = k_B T \ln\left(\frac{n\lambda_T^3}{2s+1}\right)$$

$n \ll \frac{1}{\lambda_T^3}$ $\qquad k_B T_F = \varepsilon_F$



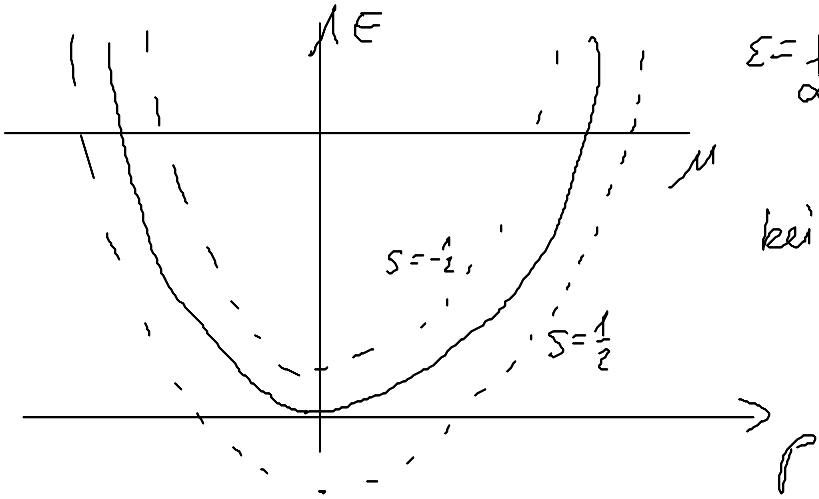
$N_+ = \int_0^{\mu_+} \nu(\varepsilon)\,d\varepsilon \qquad N_- = \int_0^{\mu_-} \nu(\varepsilon)\,d\varepsilon$



$$N_+ - N_- = 2V\int_{-\mu_-}^{\mu_+} \nu(\varepsilon)\,d\varepsilon \qquad \mu_B B \ll \varepsilon_F$$

$$= \underbrace{2\,\nu(\varepsilon_F)\mu_B^2}\,B\,V$$

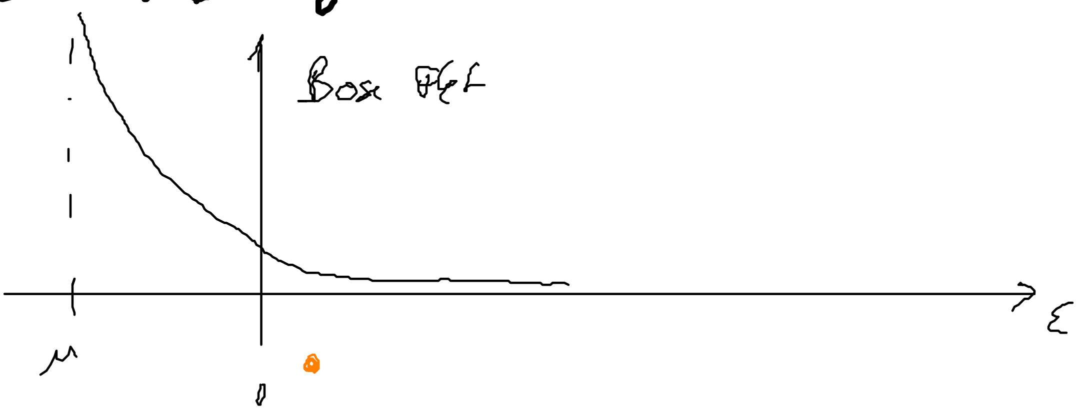
- magnetische Suszeptibilität χ



$\varepsilon = \frac{p^2}{2m}$

bei $T=0$

Idealer Bose Gas

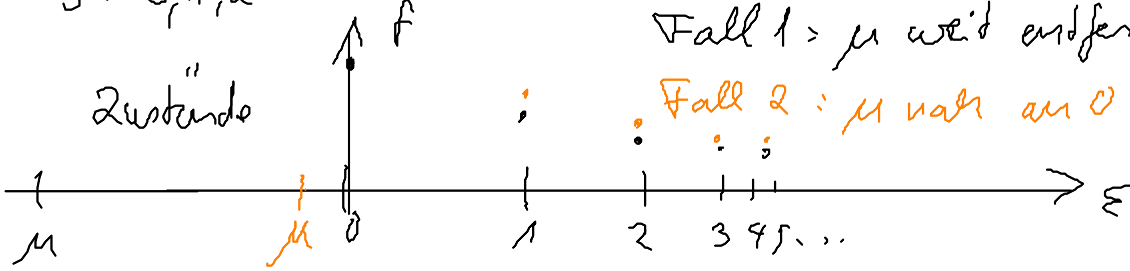


$s = 0, 1, 2$

Zustände

Fall 1: μ weit entfernt von 0

Fall 2: μ nah an 0



$$f = \ln\left(1 - e^{-\beta(\varepsilon - \mu)}\right)$$

betrachte den 0. Zustand getrennt von restlichen Zuständen