

$$Z_G^{(F-D)} = \prod_i \left[1 + e^{\beta(\mu - \epsilon_i)} \right]$$

$$Z_G^{(B-E)} = \prod_i \left[1 + e^{\beta(\mu + \epsilon_i)} \right]$$

1 Relation between the rand Canonical ensemble and canonical ensemble

$$Z_g = \sum_N \sum_i z^N e^{\beta E_i(n)}$$

$$\langle N \rangle = \frac{z}{Z_G} \frac{\partial Z_G}{\partial z}$$

$$\langle N \rangle = \frac{z}{Z_G} \frac{\partial Z_G}{\partial z} = z \frac{\partial \ln(Z_G)}{\partial z}$$

$$\langle N \rangle = \sum_i \frac{e^{\beta \mu} e^{-\beta E_i}}{1 + e^{\beta \mu} e^{-\beta E_i}}$$