Key points of 02/16 lecture

- Non-relativistic (non-interacting) ideal gas:

$$Q_N(T, V) = \frac{1}{N!}\left(\frac{V}{\lambda^3}\right)^N \qquad \text{where } \lambda = \frac{h}{\sqrt{2\pi m k T}}$$

three spatial dimensions

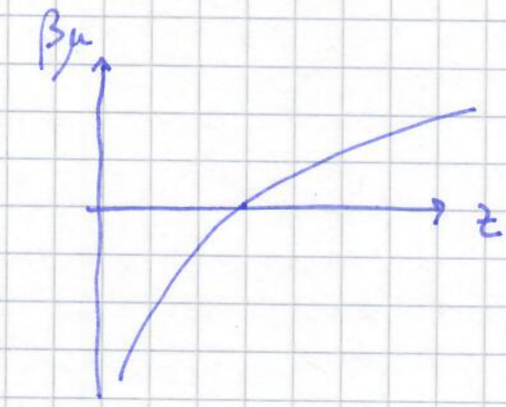
- $$\mathcal{Q}(\mu, T, V) = \exp\left(\frac{zV}{\lambda^3}\right)$$

- $$PV = kT \log \mathcal{Q} = kT \langle N \rangle$$

ideal gas law in grand-canonical ensemble

(or: thermal equation of state of non-relativistic ideal gas)

- $$\mu = \left(\frac{\partial U}{\partial N}\right)_{S,V}$$



← classical regime

→ quantum regime

* negative μ: energy goes down as one adds a particle (system is "happy" to accept new particle)

$$dU = -P\,dV + T\,dS + \mu\,dN$$

↓

goes down as N goes up