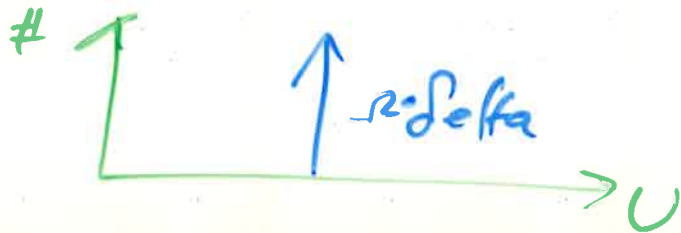


# Ensembles



## 1) Microcanonical Ensemble

Energy is exactly known,  $N, V$   
isolated system



Fundamental Assumption of Stat. Mech.  
All states are equally likely

↓↓↓↓↓↓↓  $\vec{B}$

e.g.



$N=6$  spins  
up or down

$$E_{up} = -\vec{\mu} \cdot \vec{B} = +\mu B$$

$$E_{down} = -\vec{\mu} \cdot \vec{B} = -\mu B$$

↑ distinguishable

Suppose  $U = 2\mu B$  exactly  $\Rightarrow$  4 up + 2 down

Microstates: ddurru, duduru, duudru,  
...

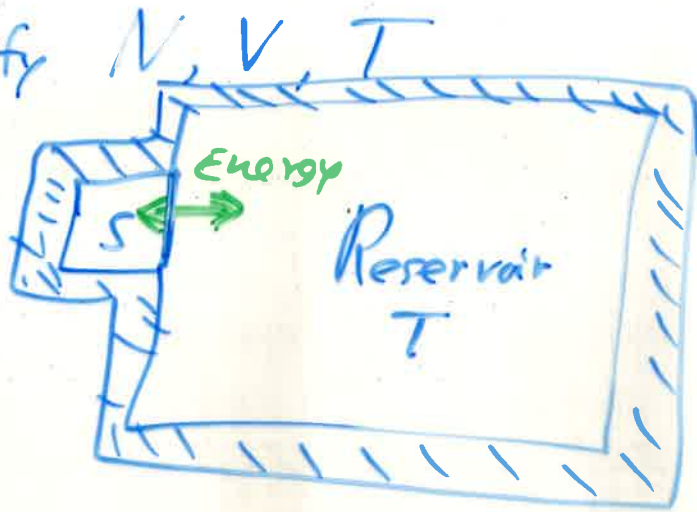
$$\Omega = \# \text{ of microstates: } \binom{6}{2} = \frac{6!}{2!(6-2)!} = 15$$

$$\text{Probability: } P(\text{urrudd}) = \frac{1}{15} \quad \left| \quad S = k_B \ln(\Omega) \right.$$
$$P(\text{rududu}) = \frac{1}{15} \quad \left| \quad T = \frac{\partial U}{\partial S}$$

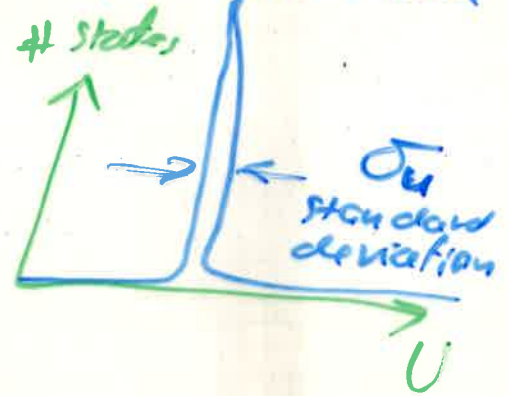
## 2) Canonical Ensemble

specify  $N, V, T$

Boltzmann  
weighted



$S+R$  is  
microcanonical



## 3) Grand Canonical Ensemble

specify  $\mu, V, T$

Gibbs weighted



$S+R$  is microcanonical