Chapter 2

Some combinatorics

Coin flips → 5 coins

H H T T H ← microstate
T H H H H ← microstate
→ 3 heads ← macrostate
→ 4 heads ← macrostate

How many microstates are in a macrostate?
↳ Depends on the macrostate

→ Multiplicity $\Omega(n) = \frac{5!}{n!(5-n)!}$ ← combinations for 5 coins

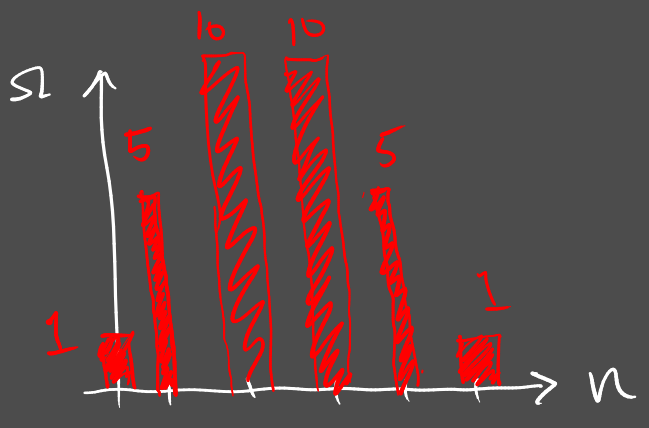
n ↑ macrostate # of heads

$0! = 1$

$1! = 1$

$2! = 2$

$n! = n(n-1)\cdots 1$



↳ generalize to N coins

$$\Omega(N,n) = \frac{N!}{n!(N-n)!} \qquad \binom{N}{n}$$

N: # of coins; n: # of heads

10 atoms → each atom can have 0 or 1 energy unit (quanta)

So how many possible arrangements of 4 quanta (10 quanta)

← microstate

4 energies vs. 10 energies ← macrostate

What if atoms can have more than 1 energy unit at a time

← microstate

$$\Omega(N,q) = \frac{(q+N-1)!}{q!\,(N-1)!} \qquad \binom{q+N-1}{q}$$

Ω: # of atoms; q: packets of energy

↳ This model → Einstein Solid

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