Statistical Mechanics
Physics 406 at University of Michigan
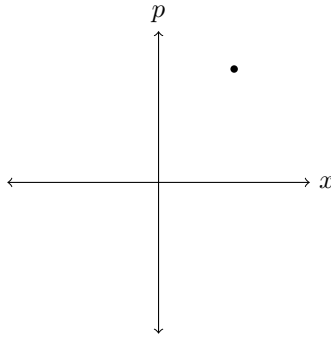
Evan Carpenter

Winter Semester 2022

Lecture 1. (Jan 05) *States, Probability and Binomial Distribution*

Figure 1: Phase space of 1-D particle

Lecture 2. (Jan 10) *Ensembles*

Lagrange multipliers

$$S = -k \sum_r p_r \ln(p_r) \tag{0.1}$$

Microcanonical ensemble: All accessible microstate are equally probable

Lecture 3. (Jan 12) *Finding total microstate*

N particles in volume V with energy between $E, E + \delta E$. Counting number of microstate by using phase space

simplifying example : a 1-D particle has only x and p. Plot in phase space Example in harmonic oscillator with ellipse and shading in phi(E) and Omega(E) Include text in caption explaining equations below it.

Moving to 3-D talk about degrees of freedom and volume of h_0.

Integrating to get Phi(E) with multiintegrals and then taylor approx to get Omega

Quantum Description–¿ specify microstate with quantum numbers

example with simp harmon oscill

Lecture 4. (Jan 19) *More on Microcanonical Ensemble*

$\Omega(E) = \#$ of states with energy between $E + \delta E$

Describing energy levels of each particle, think N-cube

Now particle can interact!! Mechanical interactions and thermal interactions(both macro descriptions).

1 isolated system at equilibrium$\rightarrow$ same system but with partition, now 2 systems. A^0 is comprised of A, A'.

Macro parameters of A^0 are for both states (N,V,E,T,...).

Thermal Interaction External parameters of A, A' are fixed but mean energy transferred from one system to the other as a result of purely thermal interactions called heat. Probabilities of energy states can change when systems interact $P(r)$

Mechanical Interaction External Parameters of A, A' change, one does *work* on the other! This causes the mean energies of A, A' to change.

$$\overline{E} = \sum_r p_r E_r$$

Pure thermal and purely mech example in inf sqwell

Lecture 5. (Jan 24)

Pure thermal interaction changes p_r
Pure mechanical interaction changes E_r