Physics II

Thermal Physics and Optics

Suggested Texts

- Heat and Thermodynamics – Dittman & Zemansky
- Statistical and Thermal Physics – Reif
- Thermal Physics – Kittel and Kroemer
- Thermodynamics - Fermi

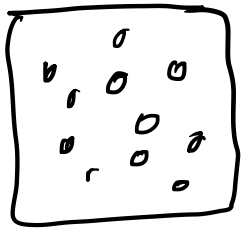
Physics I : Classical Mech

Newtonian dynamics

$$\vec{F} = m\vec{a}$$

Given $\vec{F}(\vec{r}, v, t)$, $\vec{r}(0)$, $\vec{v}(0)$, find $\vec{r}(t)$

Are we going to go beyond Newton?



10^{23} molecules.

- knowing all forces between 10^{23} molecules
- solving 10^{23} coupled 2nd order diff eqns.
- knowing 6×10^{23} initial conditions
- In principle if you could solve

→ clueless about how water → vapour

gas → liquid

Need new Strategy

microscopic ⟶ macroscopic

ignore details, reduce from $6N$ $(3N + 3N)$

variables ⟶ very few variables

directly measurable, directly perceivable by senses.

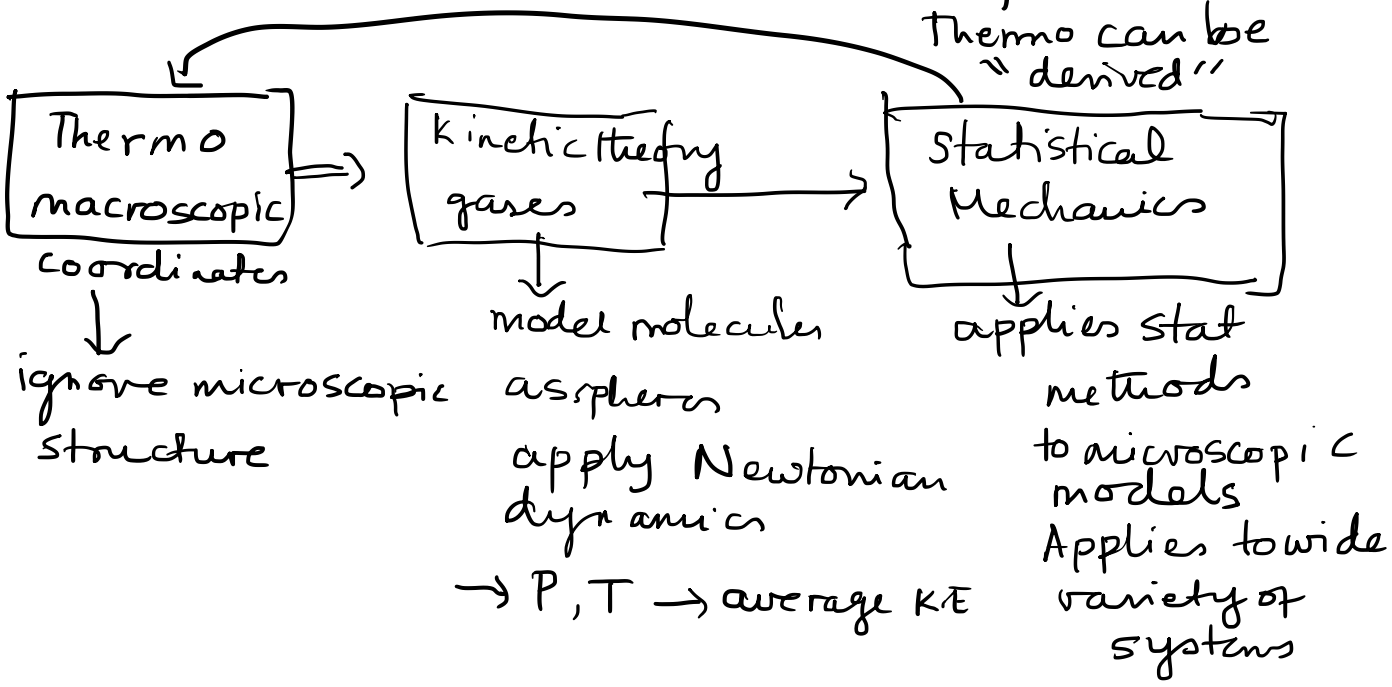
State of a system : $\{\vec{r}_i, \vec{p}_i\}$ $i = 1, \cdots N$

State of a system in Thermodynamics $\{X, Y\} \sim \{P, V\}$

Remarkable predictive power, generality.

We will confine to systems in equilibrium

coordinates will be time independent



Laws of Thermodynamics

2nd Law Carnot (1824), 1st Law (1848) Kelvin & Helmholtz

Zeroth Law (1931)

Equilibrium and Zeroth Law

Systems with const mass → fixed # of particles

described by 2 independent coordinates

(X, Y) : X : generalized force (e.g P)

Y : generalized displacement (e.g V)

Examples of Thermo systems in equilibrium

system	X	Y
homogeneous fluid	P	V
stretched wire	$\mathcal{J}$ tension	l length
soap film	γ surface tension	A area
Magnet	H applied field	M magnetization

Thermo coordinates

extensive

scale with the size

V, l, A, M

intensive

do not scale with size

P, T,