Introduction

Statistical physics studies systems of large numbers using probability theory and statistics. These particles may be atoms, molecules, electrons & ions (like in plasma) etc.

In general, the state of N particles is described by the many-body wavefunction

$\Psi(\vec{r}_1, \vec{r}_2, \ldots, \vec{r}_N, t)$

They obey Schroedinger equation

$$\left(-\frac{\hbar^2}{2m}\sum_{i=1}^{N}\nabla_i^2 + \sum_{i<j} V(\vec{r}_i - \vec{r}_j) + \sum_i U(\vec{r}_i)\right)\Psi = i\hbar\frac{\partial\Psi}{\partial t}$$

($= E\Psi$, if looking for eigenstates)

It looks like a relatively easy problem; one just has to solve the equation

The number of atoms in a ~1 cm solid:

$N \sim 10^{24}$

The amount of storage required to solve it grows exponentially with the number of grows exponentially with the

atoms

Statistical physics attempts to use prob-ty theory and statistics to describe such systems of many particles. Often it's not important even whether these particles are classical or quantum.

Hamilton's equations for a system with f degrees of freedom

$$\begin{cases} \dot{p}_i = -\dfrac{\partial H}{\partial q_i} \\ \dot{q}_i = \dfrac{\partial H}{\partial p_i} \end{cases} \qquad i = 1, 2, \dots, f$$

If these are N particles, then $f = 3N$

We'll start with a brief reminder of basic concepts of quantum mechanics.