Introduction

Condensed matter physics – physics of many particles interacting with each other

In particular, condensed matter studies many systems of large numbers of atoms which adhere to each other. Often it is used synonimously to * Solid State * owing to the fact that all systems become solid at low temperatures, with the only exception of liquid helium

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

... ~ 1 cm solid:

problem, etc.)

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 atoms

Employ methods which would allow us to treat these large numbers of electrons collectively or develop analytical tools for treating that many particles