

Teoria dei sistemi a molti corpi

Theoretical aspects of systems with many degrees of freedom

1) BASIC ELEMENTS OF STATISTICAL MECHANICS

The notion of ensemble. The micro-canonical ensemble. The ideal gas. The equipartition theorem. The canonical ensemble. Equivalence among ensembles. The grand-canonical ensemble. Quantum Statistical Mechanical. The Maximal Entropy method.

2) CLASSICAL MOLECULAR DYNAMICS

The discretization of Hamilton-Jacobi equations. Liouville temporal evolution operator. Leap-frog. Molecular dynamics as a canonical transformation. Multiple-Time-Step.

3) THE FUNCTIONAL INTEGRAL

The functional integral in Quantum Mechanics. The evolution kernel of the free particle. The evolution kernel of the harmonic oscillator. Perturbation theory. Wick rotation and the correspondence between Quantum Mechanics and Statistical Mechanics. Green's functions and generating functional. Semi-classic approximation and effective action.

4) STOCHASTIC METHODS FOR THE CALCULATION OF THE PARTITION FUNCTION

Importance sampling and the Monte Carlo method. Markov chains, detailed balance, the Metropolis algorithm. Hybrid Monte Carlo. Brownian motion, The Langevin and Fokker-Planck equations. The asymptotic solution of the Fokker-Planck equation.

5) QUANTUM MONTE CARLO

6) FERMIONIC SYSTEMS IN CONDENSED MATTER

The Born-Oppenheimer approximation. The Thomas-Fermi model. The Hartree Fock approximation. Density functional theory. Car-Parrinello molecular dynamics.