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two-body Kepler problem: A classical treatment; 2 Quantum mechanics of two-body Coulomb systems; 2.1 Historical background; 2.2 Group theoretical approach to the two-body problem; 2.2.1 The bound spectrum; 2.2.2 Eigenstates of two charged-particle systems; 2.3 The two-body Coulomb wave functions; 2.3.1 Spherical coordinates; 2.3.2 Parabolic coordinates; 2.3.3 Analytical continuation of the two-body Coulomb wave functions; 3 One particle in an arbitrary potential; 3.1 The variable-phase method
3.2 Phase-amplitude equations for non-local potentials3.2.1 The local potential case; 3.2.2 Numerical considerations; 3.3 The scattering amplitude representation; 3.4 Illustrative examples; 4 Ground states of many-electron systems; 4.1 Time-scale separation; 4.2 Hartree-Fock approximation; 4.2.1 Basis set expansion; 4.3 Configuration interaction; 4.4 The coupled cluster method; 4.5 Variational and diffusion Monte Carlo techniques; 4.6 Density functional theory; 4.6.1 The Hohenberg-Kohn theorem; 4.6.2 The Kohn-Sham equations; 4.6.3 The local density approximation; 4.6.4 Gradient corrections
4.6.5 Implicit orbital functionals4.6.6 Self-interaction corrections; 4.6.7 Extensions of DFT; 5 Electronic excitations; 5.1 Electric dipole transitions; 5.2 Single-photoelectron emission; 5.2.1 One-electron photoemission from unpolarized targets; 5.2.2 Single photoemission from polarized targets; 5.3 General properties of emitted dipole radiation; 5.4 Symmetry properties of many-body photoexcitations; 5.4.1 Propensity rules for the dichroism in multiple photoionization; 5.5 Resonant photoexcitaions processes; 5.5.1 Single channel; 5.5.2 Multi-channel resonant photoexcitations
5.6 Few-body resonances5.6.1 Regularities and classifications of doubly excited states; 5.6.2 Complex rotation method; 6 Two-electrons systems at the complete fragmentation threshold: Wannier theory; 6.1 Classical mechanics of two excited electrons at the double escape threshold; 6.1.1 Wannier threshold law: a classical approach; 6.1.2 Remarks on the classical treatment of two electrons at threshold; 7 Quantum mechanics of many-electron systems at the double escape threshold; 7.1 Generalities of many-electron threshold escape; 7.1.1 Cross section dependence on the number of escaping particles
7.1.2 Structure of the total potential surface for N electron systems7.1.3 Quantum mechanics of N electrons at low kinetic energies; 7.1.4 Quantal calculations of the universal threshold behaviour; 7.1.5 Incorporation of symmetry and spin in many-particle wave functions; 8 Highly excited states of many-body systems; 8.1 General remarks on the structure of the N particle Schrodinger equation; 8.1.1 The Fock expansion; 8.1.2 The Kato cusp conditions; 8.1.3 Boundary conditions for the N-body problem; 9 The three-body Coulomb system; 9.1 Appropriate coordinate systems
9.1.1 Separation of internal and external coordinates

Sommario/riassunto

Knowledge of the excitation characteristics of matter is decisive for the descriptions of a variety of dynamical processes, which are of significant technological interest. E.g. transport properties and the optical response are controlled by the excitation spectrum. This self-contained work is a coherent presentation of the quantum theory of correlated few-particle excitations in electronic systems. It begins with a compact resume of the quantum mechanics of single particle excitations. Particular emphasis is put on Green function methods, which offer a natural tool to unravel the relations