

CHAPTER OVERVIEW

6: The Hydrogen Atom

The solution of the Schrödinger equation (wave equation) for the hydrogen atom uses the fact that the Coulomb potential produced by the nucleus is isotropic (it is radially symmetric in space and only depends on the distance to the nucleus). Although the resulting energy eigenfunctions (the orbitals) are not necessarily isotropic themselves, their dependence on the angular coordinates follows completely generally from this isotropy of the underlying potential: the eigenstates of the Hamiltonian (that is, the energy eigenstates) can be chosen as simultaneous eigenstates of the angular momentum operator. This corresponds to the fact that angular momentum is conserved in the orbital motion of the electron around the nucleus. Therefore, the energy eigenstates may be classified by two angular momentum quantum numbers, ℓ and m (both are integers). The angular momentum quantum number $\ell = 0, 1, 2, \dots$ determines the magnitude of the angular momentum. The magnetic quantum number $m = -\ell, \dots, +\ell$ determines the projection of the angular momentum on the (arbitrarily chosen) z -axis.

[6.1: The Schrodinger Equation for the Hydrogen Atom Can Be Solved Exactly](#)

[6.2: The Wavefunctions of a Rigid Rotator are Called Spherical Harmonics](#)

[6.3: The Three Components of Angular Momentum Cannot be Measured Simultaneously with Arbitrary Precision](#)

[6.4: Hydrogen Atomic Orbitals Depend upon Three Quantum Numbers](#)

[6.5: s-orbitals are Spherically Symmetric](#)

[6.6: Orbital Angular Momentum and the p-Orbitals](#)

[6.7: The Helium Atom Cannot Be Solved Exactly](#)

[6.E: The Hydrogen Atom \(Exercises\)](#)

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