



Linearity, Symmetry, and Prediction in the Hydrogen Atom (Undergraduate Texts in Mathematics)

Stephanie Frank Singer

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The predictive power of mathematics in quantum phenomena is one of the great intellectual successes of the 20th century. This textbook, aimed at undergraduate or graduate level students (depending on the college or university), concentrates on how to make predictions about the numbers of each kind of basic state of a quantum system from only two ingredients: the symmetry and the linear model of quantum mechanics. This method, involving the mathematical area of representation theory or group theory, combines three core mathematical subjects, namely, linear algebra, analysis and abstract algebra. Wide applications of this method occur in crystallography, atomic structure, classification of manifolds with symmetry, and other areas. The topics unfold systematically, introducing the reader first to an important example of a quantum system with symmetry, the single electron in a hydrogen atom. Then the reader is given just enough mathematical tools to make predictions about the numbers of each kind of electronic orbital based solely on the physical spherical symmetry of the hydrogen atom. The final chapters address the related ideas of quantum spin, measurement and entanglement. This user-friendly exposition, driven by numerous examples and exercises, requires a solid background in calculus and familiarity with either linear algebra or advanced quantum mechanics. *Linearity, Symmetry, and Prediction in the Hydrogen Atom* will benefit students in mathematics, physics and chemistry, as well as a literate general readership. A separate solutions manual is available to instructors.

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