Week 1 – Early Quantum Theory

Nathan Lachenmyer and Kathleen Alexander

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Timeline of Early Quantum Theory

- (1897) J.J. Thomson – Discovery of Electron
- (1904) J.J. Thomson – Thomson Model
- (1909) Hans Geiger and Ernest Marsden – Geiger-Marsden Experiment
- (1911) Ernest Rutherford – Rutherford Model
- (1913) Niels Bohr – Bohr Model
- (1916) Arnold Sommerfeld – Bohr-Sommerfeld Model
- (1922) Otto Stern and Walther Gerlach – Stern-Gerlach Experiment
- (1924) Louis de Broglie – Wave-Particle Duality

Thomson Model

"...the atoms of the elements consist of a number of negatively electrified corpuscles enclosed in a sphere of uniform positive electrification....."

Rutherford Model

"... the atom consists of a central charge supposed concentrated at a point ... surrounded by a compensating charge of N electrons ..."

Bohr Model

"... it seems necessary to introduce in the laws in question a quantity foreign to the classical electrodynamics, i.e., Plancks constant, or as it often is called the elementary quantum of action."

Bohr-Sommerfeld Model

Added additional quantum numbers to account for elliptical orbits and spectral splitting. Had the right idea – energy a function of n, l, m, and s – but math was fundamentally flawed.

de Broglie Relations

"for both matter and radiations, light in particular, it is necessary to introduce the corpuscle concept and the wave concept at the same time."

Summary

Electrons have a very complex energy structure that involves the four quantum numbers n, l, m, and s. These quantum numbers can only take on a small set of discrete values, giving rise to discrete energy levels. In addition, electrons must be considered as both waves and particles simultaneously, suggesting that particle 'orbits' may be interpretted as 'wave functions'.