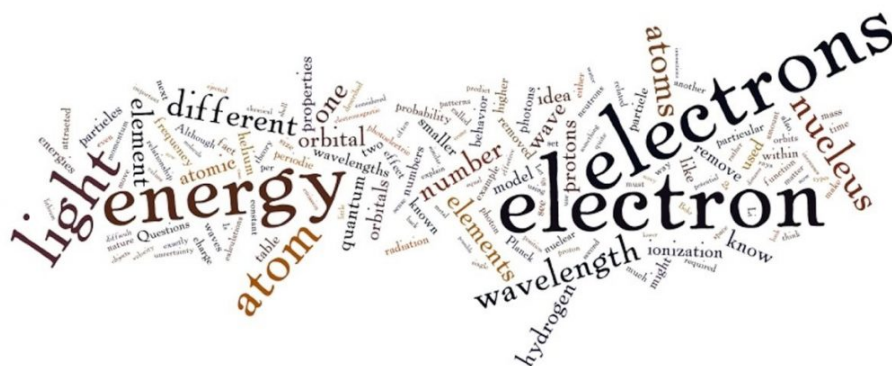


## CHAPTER OVERVIEW

### Chapter 2: Electrons and Orbitals



Even as he articulated his planetary model of the atom, Rutherford was aware that there were serious problems with it. For example because like charges repel and unlike charges attract, it was not at all clear why the multiple protons in the nuclei of elements heavier than hydrogen did not repel each other and cause the nuclei to fragment. What enables them to stay so close to each other? On the other hand, if electrons are orbiting the nucleus like planets around the Sun, why don't they repel each other, leading to quite complex and presumably unstable orbits? Why aren't they ejected spontaneously and why doesn't the electrostatic attraction between the positively-charged nucleus and the negatively-charged electrons result in the negatively-charged electrons falling into the positively charged nucleus? Assuming that the electrons are moving around the nucleus, they are constantly accelerating (changing direction). If you know your physics, you will recognize that (as established by J.C. Maxwell – see below) a charged object emits radiation when accelerating.<sup>[1]</sup> As the electron orbits the nucleus this loss of energy will lead it to spiral into the nucleus – such an atom would not be stable. But, as we know, most atoms are generally quite stable.

So many questions and so few answers! Clearly Rutherford's model was missing something important and assumed something that cannot be true with regard to forces within the nucleus, the orbital properties of electrons, and the attractions between electrons and protons. To complete this picture leads us into the weird world of quantum mechanics.

- 2.1: Light and Getting Quantum Mechanical
- 2.2 Taking Quanta Seriously
- 2.3: Exploring Atomic Organization Using Spectroscopy
- 2.4: Beyond Bohr
- 2.5: Organizing Elements: Introduction to the Periodic Table
- 2.6: Orbitals, Electron Clouds, Probabilities, and Energies
- 2.7: Quantum Numbers
- 2.8: In-Text References

Thumbnail: Covalently bonded hydrogen and carbon in a molecule of methane. (CC BY-SA 2.5; DynaBlast via Wikipedia)

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