


SPH4U
UNIVERSITY PHYSICS

REVOLUTIONS IN MODERN PHYSICS: ...

- ☛ The Standard Model of Elementary Particles (P.644-653)




The Standard Model of Elementary Particles

In science, some advances happen when old ideas generate new thinking. Other innovations occur because new ideas force the old ones to be discarded. For example,

Understanding the Atom

- Rutherford discovered the nucleus and proposed that electrons in an atom orbit the nucleus like a planetary system. However, classical physics predicts that this system is not stable and so it was replaced by the Bohr model.
- The Bohr model of the atom proposes that electrons can only orbit the nucleus at certain allowed energy levels. These electrons transition between levels by emitting or absorbing photons whose energies are equal to the difference between the energy levels.

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Twenty-First-Century Physics and Antimatter

- After Rutherford's discovery of the atomic nucleus, the next level in the progression of understanding the atomic and subatomic world is the inner workings of the atomic nucleus and how protons, neutrons, and other subatomic particles are put together.
- Antimatter is a particle of matter that has the same mass and opposite charge as its corresponding particle of ordinary matter. The positron, for example, is the antimatter counterpart of the electron.

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 **The Standard Model of Elementary Particles** 

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The Standard Model

- *The standard model is the current theory of particle physics, which predicts that nature consists of quarks, leptons, and bosons, that interact through the fundamental forces of nature (i.e. the strong nuclear force, the weak nuclear force, and electromagnetism).*
- *Quarks combine to form hadrons, which include protons and neutrons. Leptons include electrons and neutrinos.*
- *Bosons mediate fundamental forces. The Higgs boson helps explain the origin of particle masses.*

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A Theory of Everything

- *At a fundamental level, almost every concept that we understand about our universe comes from quantum mechanics or the theory of relativity, which includes special relativity, and general relativity.*
- *A theory of everything attempts to explain and predict interactions in both the macroscopic and the quantum worlds by combining quantum mechanics and the theory of general relativity into one theory.*

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 **✓ Check Your Learning**

TEXTBOOK
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