

Introduction to Particle Physics

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1. What is Particle Physics?

- Particle physics is a branch of physics that studies the nature and behavior of subatomic particles, which are the fundamental building blocks of matter.
- It aims to understand the fundamental forces that govern the universe by studying how particles interact with each other.

2. Subatomic Particles

- Atoms are made up of subatomic particles such as protons, neutrons, and electrons.
- Subatomic particles are further divided into elementary particles, which are the most basic building blocks of matter.

3. Standard Model of Particle Physics

- The Standard Model is a theory that describes the fundamental particles and their interactions via three of the four fundamental forces: electromagnetic, weak, and strong nuclear forces.
- It categorizes particles into two groups: fermions (quarks, leptons) and bosons (force carriers like photons, W and Z bosons).

4. Particle Accelerators

- Particle accelerators are machines that accelerate subatomic particles to high speeds and collide them to study their properties.
- Examples include the Large Hadron Collider (LHC) at CERN, which discovered the Higgs boson in 2012.

5. Applications of Particle Physics

- Particle physics has practical applications in various fields, such as medical imaging (PET scans), semiconductor technology, and nuclear energy.

6. Unsolved Mysteries

- Despite significant progress, particle physics faces unresolved questions like the nature of dark matter, the unification of forces, and the existence of supersymmetry.

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7. Future Prospects

- Future experiments, such as upgrades to the LHC and construction of new colliders like the International Linear Collider (ILC), aim to push the boundaries of our understanding of the universe.

8. Conclusion

- Particle physics plays a crucial role in advancing our understanding of the universe at its most fundamental level, paving the way for groundbreaking discoveries and technological innovations.