

Three New Exotic Particles Discovered With Large Hadron Collider

July 7, 2022

In news—The Large Hadron Collider(LHC) experiment has observed three never-before-seen particles recently.

About three new particles-

- The **collaboration has observed a new kind of “pentaquark”** and the **first-ever pair of “tetraquarks”**.
- The first kind was observed in an analysis of “decays” of negatively charged B mesons. **It is a pentaquark made up of a charm quark and a charm antiquark**, and an up, a down, and a strange quark.
- **It is the first pentaquark found to contain a strange quark.**
- The finding has a **statistical significance of 15 standard deviations**, far beyond the 5 standard deviations that are required to claim the observation of a particle in particle physics.
- **The second kind is a doubly electrically charged tetraquark. It is an open-charm tetraquark** composed of a charm quark, a strange antiquark, and an up quark and a down antiquark.
- **It was spotted together with its neutral counterpart** in a joint analysis of decays of positively charged and neutral B mesons.
- The three “exotic” additions to the growing list of new hadrons found at the LHC will help physicists better understand how quarks bind together into these composite particles.

What are quarks?

- **Quarks are elementary particles that come in six “flavours”:** up, down, charm, strange, top, and bottom.
- They usually **combine together in groups of twos and threes to form hadrons** such as the protons and neutrons that make up atomic nuclei.
- But **they can also combine into four-quark and five-quark particles, called tetraquarks and pentaquarks.**
- **These exotic hadrons were predicted by theorists about six decades ago** around the same time as conventional hadrons – but they have been observed by LHC and other experiments only in the past 20 years.

What about tetraquarks and pentaquarks?

- **According to the CERN, most exotic hadrons discovered in the past two decades are tetraquarks or pentaquarks** containing a charm quark and a charm antiquark – with the remaining two or three quarks being an up, down or strange quark or their antiquarks.
- **In 2020 the LHC experiment discovered an exotic tetraquark** made up of two charm quarks and two **charm antiquarks**, and two **“open-charm” tetraquarks** consisting of a charm antiquark, an up quark, a down quark and a strange antiquark.
- In 2021 **it found the first-ever instance of a “double open-charm” tetraquark** with two charm quarks and an up and a down antiquark.
- **Open charm means that the particle contains a charm quark without an equivalent antiquark.**

About CERN-

- CERN – Conseil Européen pour la Recherche Nucléaire **is the original name of the European Organisation for Nuclear Research**, which **runs the particle accelerator complex** that houses the LHC, the world’s largest and most complex collider.
- **Established in 1954**, the organization is based in a

northwest suburb of Geneva on the **Franco–Swiss border** and has 23 member states.

- **Israel is the only non-European country granted full membership.**
- CERN is an official United Nations Observer.
- CERN's main function is to provide the particle accelerators and other infrastructure needed for high-energy physics research – as a result, numerous experiments have been constructed at CERN through international collaborations.
- **CERN is the site of the Large Hadron Collider (LHC)**, the world's largest and highest-energy particle collider.
- The main site at Meyrin hosts a large computing facility, which is primarily used to store and analyse data from experiments, as well as simulate events.
- CERN is also the birthplace of the World Wide Web.

Further

reading:

<https://journalsofindia.com/what-is-the-large-hadron-collider/>