

# 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/>**