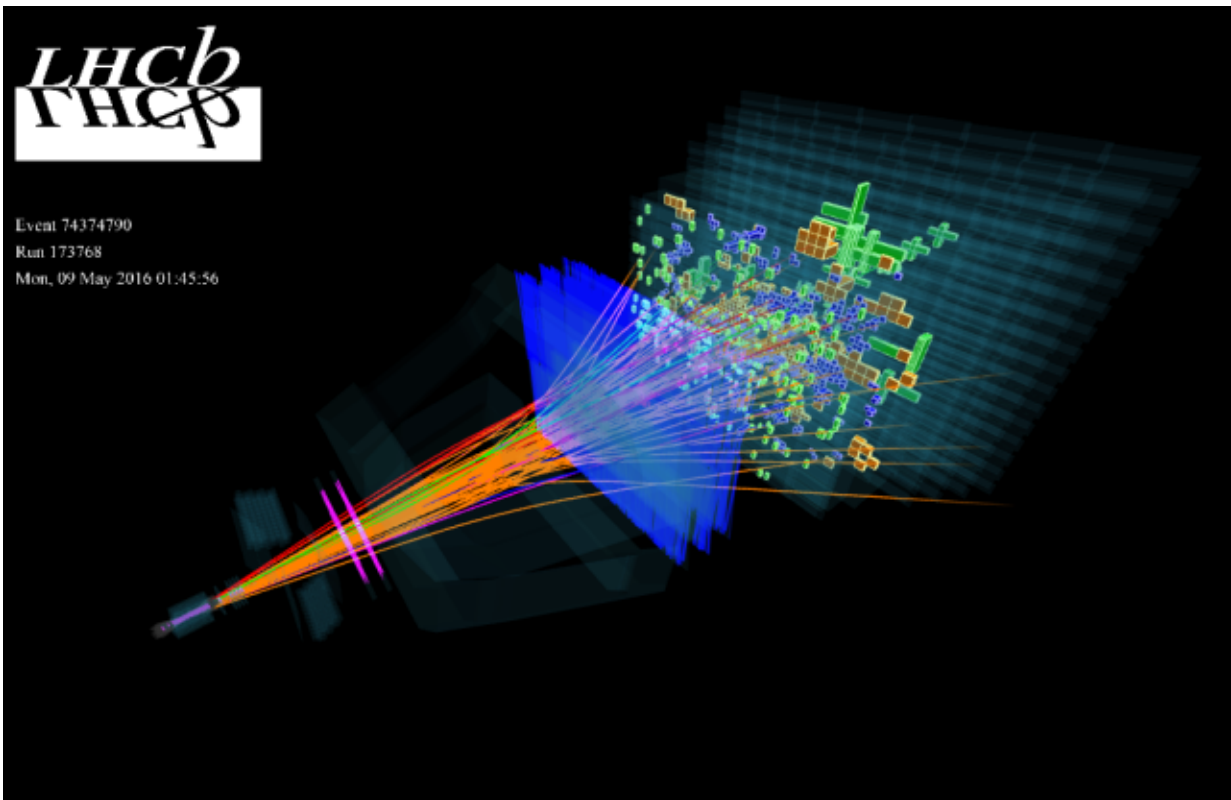


LHCb observes an exceptionally large group of particles

March 17 2017, by Stefania Pandolfi



A typical LHCb event fully reconstructed. Particles identified as pions, kaon, etc. are shown in different colours. Credit: LHCb collaboration

The LHCb experiment at CERN is a hotbed of new and outstanding physics results. In just the last few months, the collaboration has announced the measurement of a very rare particle decay and evidence

of a new manifestation of matter-antimatter asymmetry, to name just two examples.

In a paper released today, the LHCb collaboration announced the [discovery](#) of a new system of five [particles](#) all in a single analysis. The exceptionality of this discovery is that observing five new states all at once is a rather unique event.

The particles were found to be [excited states](#) – a particle state that has a higher energy than the absolute minimum configuration (or ground state) – of a particle called "Omega-c-zero", Ω_c^0 . This Ω_c^0 is a baryon, a particle with three quarks, containing two "strange" and one "charm" quark. Ω_c^0 decays via the strong force into another baryon, called "Xi-c-plus", Ξ_c^+ (containing a "charm", a "strange" and an "up" quark) and a kaon K^- . Then the Ξ_c^+ particle decays in turn into a proton p , a kaon K^- and a pion π^+ .

From the analysis of the trajectories and the energy left in the detector by all the particles in this final configuration, the LHCb collaboration could trace back the initial event – the decay of the Ω_c^0 – and its excited states. These particle states are named, according to the standard convention, $\Omega_c(3000)^0$, $\Omega_c(3050)^0$, $\Omega_c(3066)^0$, $\Omega_c(3090)^0$ and $\Omega_c(3119)^0$. The numbers indicate their masses in megaelectronvolts (MeV), as measured by LHCb.

This discovery was made possible thanks to the specialised capabilities of the LHCb detector in the precise recognition of different types of particles and also thanks to the large dataset accumulated during the first and second runs of the Large Hadron Collider. These two ingredients allowed the five excited states to be identified with an overwhelming level of statistical significance – meaning that the discovery cannot be just a statistical fluke of data.

The next step will be the determination of the quantum numbers of these new particles – characteristic numbers used to identify the properties of a specific particle – and the determination of their theoretical significance. This discovery will contribute to understanding how the three constituent quarks are bound inside a baryon and also to probing the correlation between quarks, which plays a key role in describing multi-quark states, such as tetraquarks and pentaquarks.

More information: Observation of five new narrow $\Omega^{0/c}$ states decaying to $\Xi_c^+ K^-$. arxiv.org/abs/1703.04639

Provided by CERN

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