

High-energy physicists predict new family of four-quark objects

November 8 2013



Beijing Spectrometer Detector Credit: The BESIII Collaboration

An international team of high-energy physicists says the discovery of an electrically charged subatomic particle called $Z_c(4020)$ is a sign that they have begun to unveil a whole new family of four-quark objects.

The Beijing Spectrometer (BESIII) collaboration, which includes scientists from UH Mānoa, previously announced the discovery of a mysterious four-quark particle called $Z_c(3900)$ in April 2013.

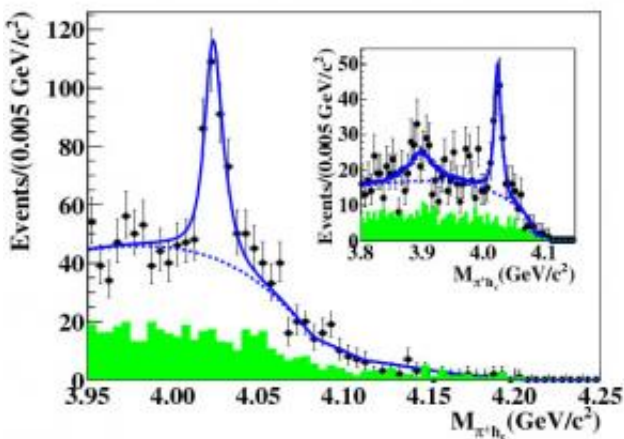
"While quarks have long been known to bind together in groups of twos or threes, these new results seem to be quickly opening the door to a previously elusive type of four-quark matter," said Frederick Harris, a professor of physics and astronomy at UH Mānoa, and a spokesman for

the BESIII experiment. "The unique data sample collected by the BESIII collaboration has continued to yield a stream of clues about the nature of multi-quark objects."

The recent breakthroughs by the BESIII collaboration have come about through a dedicated study of the byproducts of the anomalous $Y(4260)$ particle.

Using the Beijing Electron Positron Collider (BEPCII) in China, scientists tuned the energy at which electrons and positrons annihilate matter to 4260 MeV, which corresponds to the mass of the $Y(4260)$ particle. The BESIII Collaboration used this method to directly produce and collect large samples of the particle's byproducts, or decays.

This experimental method allowed the BESIII collaboration to first observe the $Z_c(3900)$ and then the $Z_c(4020)$. Also recently spotted in the decays is the electrically neutral $X(3872)$, a particle that has been experimentally established for more than 10 years, and has long been suspected to be a four-quark object.



Using decays of the $Y(4260)$, a family of four-quark objects has begun to appear.

"The year 2013 has so far been an exciting one for the BESIII experiment," Harris said. "Using decays of the $Y(4260)$, a family of four-quark objects has begun to appear. While the theoretical picture remains to be finalized, more and more clues are suggesting that we are witnessing new forms of matter. And while a new 'zoo' of mysterious [particles](#) is emerging, it seems a new classification system may soon be at hand to understand it."

More information: The scientists have reported their findings to the scientific journal *Physical Review Letters*, including:

Observation of $Z_c(4040)$ in $e+e- \rightarrow D^*D^*- \pi^+$ process at 4.26 GeV. arXiv:1308.2760

Observation of a charged charmoniumlike structure $Z_c(4020)$ and search for the $Z_c(3900)$ in $e+e-$ to $\pi^+\pi^-h_c$. arXiv:1309.1896

Observation of a charged $(DD^*\bar{c})$ - mass peak in $e+e- \rightarrow \pi^+(DD^*\bar{c})$ -at $E_{cm}=4.26$ GeV. arXiv:1310.1163

Observation of the $X(3872)$ in $e+e- \rightarrow \gamma \pi^+\pi^- J/\psi$ at \sqrt{s} around 4.26 GeV. arXiv:1310.4101

For more information, visit: www.phys.hawaii.edu/newsEvents...s/bes-pr-11-2013.pdf

Provided by University of Hawaii at Manoa

Citation: High-energy physicists predict new family of four-quark objects (2013, November 8)

retrieved 25 April 2024 from

<https://phys.org/news/2013-11-high-energy-physicists-family-four-quark.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.