

New Vector Particles Observed at BESIII

The Beijing Spectrometer Experiment (BESIII) has announced the observation of more new charmonium-like states.

The experiment measured the $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ and $e^+e^- \rightarrow \pi^+\pi^-h_c$ cross sections with high precision, using 9fb-1 data collected with the BESIII detector at the BEPCII accelerator, and two resonant structures were observed in each decay mode. The first structure, Y(4220), with a mass of about 4.22 GeV, was seen in both modes. The Y(4320) was seen in the $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ process at about 4.32 GeV, and the Y(4390) was seen in the $e^+e^- \rightarrow \pi^+\pi^-h_c$ mode at about 4.39 GeV. They are all vector particles, and they are different from any of the known vector charmonium and charmonium-like states.

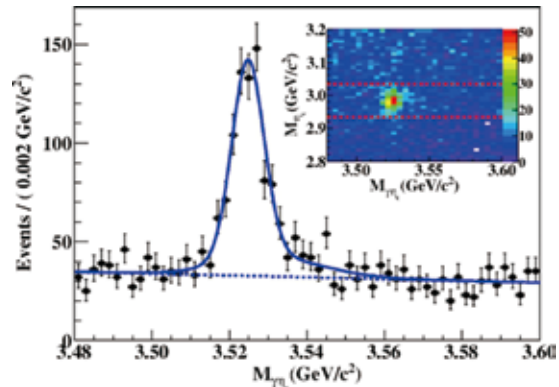
The results were published in the latest issue of *Physical Review Letters* (March 3, 2017, Volume 118, issue 9).

As more and more vector particles have been observed between 4 and 4.6 GeV, and this is the mass region for many kinds of exotic hadrons containing a pair of charm-anticharm quarks, investigation of these states is high on the priority list for theorists.

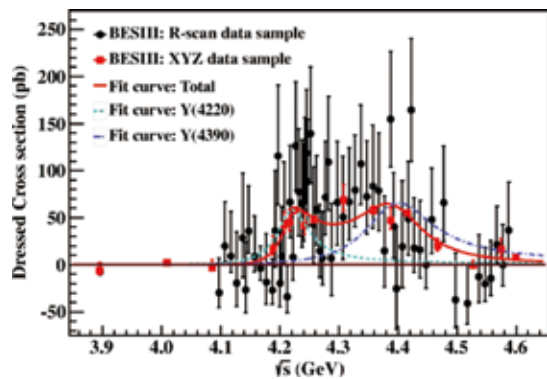
The possibility of these new states being quark-gluon hybrids, tetraquark states, hadron molecules, hadro-charmonia, or something more exotic, needs to be further studied with the new measurements from the BESIII experiment.

The data analyzed in these papers were taken in two years during 2013 and 2015. With the same data sample, BESIII has previously discovered the charged charmonium-like states $Z_c(3900)$ and $Z_c(4020)$, as well as the X(3823).

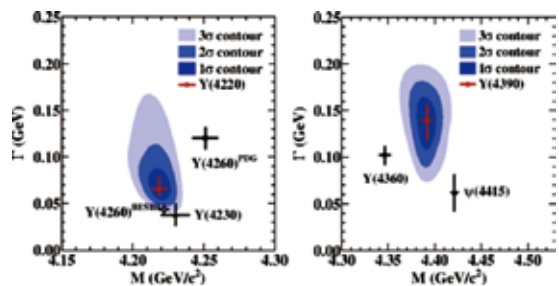
BESIII is taking more data this year, looking for further discoveries in this region. With these data, the collaboration hopes to strengthen the study of exotic hadrons and better understand the quark confinement of the strong interaction.



The M_{η_c} distribution in the η_c signal region of 4.416 GeV data.



Fit to the dressed cross section of $e^+e^- \rightarrow \pi^+\pi^-h_c$ with the coherent sum of two Breit-Wigner functions.



The likelihood contours in the mass and width planes for Y(4220) (left panel) and Y(4390) (right panel).