Back-to-Back b Baryons in Batavia

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Scientists at the Department of Energy's Fermi National Accelerator Laboratory have announced the observation of the cascade b baryon-again.

In a paper submitted for publication to *Physical Review Letters* on June 12, scientists of Fermilab's DZero experiment announced their discovery of the "triple scoop" baryon, which contains one quark from each generation of matter.

Then, on June 15, scientists from Fermilab's CDF experiment announced their own independent cascade b observation.

At a packed Fermilab seminar on June 15, no sooner had DZero's Eduard De La Cruz Burelo sat down after presenting DZero's discovery of the cascade b baryon than Dmitry Litvintsev of Fermilab's CDF collaboration rose to present CDF's observation of the cascade b baryon to the same standing-room-only audience. The CDF scientists will submit their results for publication this week.

The newly discovered cascade is made of a down, a strange and a bottom quark. It is the first observed baryon formed of quarks from all three families of matter. After independently gathering and analyzing data from Fermilab's Tevatron collider for more than six years, the two Fermilab collider experiments reported the results of the their search for the cascade b baryon within days of each other.

"It is remarkable that our two collaborations would uncover the same particle at practically the same time," said Jacobo Konigsberg, University of Florida physicist and cospokesperson of the CDF experiment.

The CDF and DZero experiments are located about a mile apart on the Tevatron accelerator ring. Each collaboration numbers about 700 physicists from universities and laboratories worldwide. Currently, CDF and DZero are the highest-energy collider experiments in the world. As the start of operations at the Large Hadron Collider in Europe approaches, interest heightens in particle physics discoveries at Fermilab.

"These are very exciting times for the Tevatron program," said Director Pier Oddone. "There is a friendly yet intense competition between the two experiments, and this is a healthy thing. Not only are they able to cross-check each other, they are also pushing harder, knowing that their sister experiment may be doing exactly the same thing at the same moment."

The two collaborations found a remarkably similar number of proton-antiproton collisions that resulted in the production and detection of such rare, previously unseen, particles. From the trillions of collisions that have occurred in each experiment since 2001, the DZero experiment reported 19 candidate cascade b baryons, while the CDF experiment had 17. Both experiments measured the mass of this new particle. DZero measured 5.774 ± 0.019 GeV/c^2; and CDF measured the mass with even greater precision at 5.7929 ± 0.0030 GeV/c^2. The two results are consistent.

"This is a demonstration of the beauty and power of the laws of physics. By studying these collisions, two different teams, using different apparatus, at different points of the Tevatron accelerator, are able to find an incredibly rare particle, formed by three different quarks, and get a consistent picture of nature," said CDF cospokesperson Rob Roser, Fermilab.

To keep their research unbiased, experimental collaborations normally share their results only when they are final, through publications in scientific journals. Once each collaboration publishes its individual results on a particular topic, the experiments sometimes combine those published results in order to obtain an even better result with higher precision. The cooperation and teamwork needed to combine final results will be increasingly important as both collaborations push to find rare subatomic processes, including those that involve the elusive Higgs boson.

The discovery of the cascade b is the latest in a chain of discoveries made by CDF and DZero in the last few years. Last October, the CDF collaboration discovered another particle related to the cascade b, the sigma b. As the Tevatron delivers more and more data, the possibilities increase for the observation of even rarer processes.

Source: Fermilab