Bottom quarks reveal something of their identity

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Dutch researcher Bram Wijngaarden investigated how bottom quarks are created during collisions between protons and antiprotons. Wijngaarden's measurements have contributed to a better understanding of the theory, and can be used to explain why the production of these quarks during such collisions is higher than had originally been expected.

Bram Wijngaarden investigated the creation of bottom quarks using the D zero experiment of the particle accelerator at the Fermi lab in Chicago, United States. In this Tevatron particle accelerator, protons and antiprotons collide with each other. Bottom quarks are created as a result of the strong nuclear force that arises during these collisions.

In the 1990s measurements with the Tevatron particle accelerator and with the Hera particle accelerator in Hamburg revealed that the production of bottom quarks was higher than had been theoretically predicted. Since then theoretical physicists have done a lot of work to explain the difference. Wijngaarden's measurements must reveal whether the theory provides a good description of the reality.

Bottom quarks

Bottom quarks are created during high-energy collisions between particles. The bottom quark is one of six quarks. Together with the top quark it is one of the heaviest quarks. These quarks are only found under extreme circumstances, such as during collisions between particles. After the collision the bottom quarks decay into other particles. Measuring devices detect the electrical signals left behind by the particles. Signals from the decay products of the bottom quarks can be distinguished from the other particles released because bottom quarks are heavier and on average breakdown slightly less quickly.

By measuring the angle between two bottom quarks from the same collision, Wijngaarden could study the strong nuclear force directly. This angle was measured as the angle between the avalanches from the decay products of the bottom quarks. In the first-order approach, the theory predicts that the two bottom quarks always move apart from each other at an angle of 180 degrees. Wijngaarden showed that in a number of cases the angle is much smaller. The second-order approach predicts that the angle is much smaller in a number of cases but the average size of the angle measured by the researcher differed from the result obtained using this approach. The strong nuclear force can be tested more accurately with new measurements made with the help of methods developed by Wijngaarden.

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