A new particle discovered by Babar experiment

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It can help to reveal the secrets of the strong force

Its name is Y(4260) and it is not a new humanoid of Stars Wars, but a particle identified for the first time by BaBar experiment: an international collaboration - formed by the large participation of the Italian physicists of the National Institute for Nuclear Physics (Infn) - that has its seat in Stanford (California). Y(4260) represents an interesting element with respect of particles' field and it will provide very useful signs about character of the strong force, that is the force that holds together the different particles inside atomic nuclei.

The discovery, announced during the international symposium "Lepton Photon" just finished in Uppsala in Sweden, has been presented today during a meeting of the Supervising Committee of Babar experiment that this year has taken place in Rome, by the seat of Infn Headquarter.

"At first sight Y(4260) seems to be what we call a charmonic state, that is to say a particle made up of the combination of a charm quark and of its equivalent antiparticle: an anticharm quark", explains Marcello Giorgi, Infn researcher, professor of Physics at Pisa University and involved in Babar experiment since a long time.

Physicists have known since some time that for each particle, an antiparticle exists, nearly identical in all aspects, except for some properties that are opposite. The antiparticle of the electron is for instance the positron, named also antielectron, provided with positive electric charge, rather than negative. During the 50's it was although discovered that particles can be made up also of the combination of a fundamental particle and its corresponding antiparticle. "The first case was the positronium one, made up of the combination of an electron and a positron. The first charmonium, that is to say a particle made up of a charm quark and anti-charm, was instead discovered at the same time in Brookhaven and at Slac, both in the USA, by Samuel Ting and Burton Richter, awarded with the Nobel in 1976: its existence it was soon afterwards confirmed thanks to the analysis of the data produced in Italy by the National Laboratories of Frascati of Infn. As time passed, it was realized that charmoni are a real family of similar particles, but with a different mass. Nobody had been able to observe Y(4260) up to now, not only because there is a little possibility to produce it in the accelerators used today by physicists, but also because it is extremely unstable", explains Mauro Morandin, Infn researcher and national spokesman of BaBar experiment.

"Compound particles, made up of the combination of a fundamental particle and its corresponding antiparticle, are of great interest for physics. Quarks and corresponding anti-quarks can be held together because of several mechanisms: in order to understand the so-called strong force [the strong force is one of the four fundamental forces of nature, the other are the electromagnetic force, the weak force, responsible for fusion mechanisms occurring inside stars and the gravitational force] it is necessary to grasp these mechanisms deeply. The strong force holds together quarks of different type that form neutrons and protons, and holds also neutrons and protons together inside atomic nuclei. It is therefore a very important force, because without it would be impossible to conceive the existence of matter that forms all we know. All signs let us suppose that Y(4260) will give very interesting indications about it, whether it is really a charmonium, or, all the more so, something more exotic", concludes Marcello Giorgi.

The most surprising aspect of Y(4260) is although the fact that some properties of its nature seem to be unusual for a charmonium. This makes think that the particle could be something much more complex: a kind of molecule made up of particles named D mesons, or a state made up of four quarks. Since 2003 BaBar has discovered states that can have this structure never observed before, such as the DsJ (2317), the DsJ (2458), and the X(3872), but there are no definitive evidences for this interpretation. Verifying these possibilities is the challenge for the next future.

Source: National Institute for Nuclear Physics (INFN)