Remarkable Asymmetry in Behaviour Between Matter and Antimatter

August 2 2004

If we can look at stars, planets and all living beings in the Universe, as well as ourselves, is because, as theoretical physicists suggest, after the primordial cosmic explosion, the "Big Bang", matter has prevailed over antimatter originating Universe as we know it. Today, the amazing idea that there is in nature an asymmetry between matter and antimatter, technically known as CP violation, has been confirmed by new, enthusiastic results reached by BaBar Collaboration, in which Infn is involved.

The present results, just published in the eminent journal "Physical Review Letters", concern in particular a new measurement that shows in an incontrovertible way a remarkable difference in behaviour between particle named B mesons and their antimatter counterpart, anti-B mesons.
These particles are produced by the PEP-II Collider of SLAC Laboratory, California, thanks to collisions between electron beams and their antimatter counterpart, positrons. As generated mesons are short-lived, they decay, that is to say they turn almost immediately in other subatomic particles.
And it is exactly in this turn that BaBar researchers have pointed out a difference in behaviour of particles and antiparticles.
"If there were no difference between matter and antimatter, both the B mesons and the anti-B mesons would exhibit exactly the same pattern of decays. On the contrary, our new measurement shows an example of a large difference in decay rates", says Marcello Giorgi, spokesman of BaBar and researcher of Pisa Infn.

By studying the decay of more than 200 million pairs of B and anti-B mesons, researchers have discovered indeed a new way in which matter-antimatter asymmetry occurs: it is the phenomenon known as CP direct violation, that takes place simply as a difference between the number of matter decays against the ones of antimatter.
"We found 840 examples of the B meson decaying to a kaon and a pion, but only 646 examples for the anti-B. The new measurement is first of all a result of the outstanding performance of SLAC's PEP-II accelerator and the efficiency of BaBar detector", concludes Giorgi.

Physicists coming from several countries are involved in BaBar Collaboration and the role of Italian component is remarkable. Just think that the massive quantity of rough data produced by BaBar, at a rate of one TeraByte per day, that is to say one thousand billions bytes, have passed to Italy, where a primary process has occurred by the calculus centre of Padova Infn.

"For the Italian component of Infn, the second community in the Collaboration after the American, this is a very satisfactory result. Our contribute to the experiment is on a wide range. It goes indeed from the maintenance of the refined detectors that snap the short-lived meson B, to the enthusiastic commitment in the data analysis", adds Mauro Morandin, Padova Infn, who, with Francesco Forti, Pisa Infn, co-ordinates the about one hundred Italian physicists and engineers involved in BaBar.
"Gianluca Covato, a young researcher of La Sapienza University (Rome) and of Princeton University and Jim Olsen, of Princeton University, have coordinated the work that has leaded in record time to this result, one of the most important among the one hundred already published by the Collaboration", concludes Mauro Morandin.

As Johnatan Dorfan, Director of SLAC, declares "This observation is a significant step forward in assembling the pieces of the puzzle of matter

versus antimatter in the Universe".

Source: Istituto Nazionale di Fisica Nucleare