LHCb experiment observes new matter-antimatter difference

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A view of the LHCb underground area, looking upwards from the cavern floor
Credit: Anna Pantelia/CERN

(Phys.org) —The LHCb collaboration at CERN today submitted a paper to *Physical Review Letters* on the first observation of matter-antimatter asymmetry in the decays of the particle known as the B^0_s. It is only the fourth sub-atomic particle known to exhibit such behavior.

Matter and antimatter are thought to have existed in equal amounts at the beginning of the universe, but today the universe appears to be composed essentially of matter. By studying subtle differences in the behavior of particle and antiparticles, experiments at the LHC are seeking to cast light on this dominance of matter over antimatter.

Now the LHCb experiment has observed a preference for matter over antimatter known as CP-violation in the decay of neutral B^0_s particles. The results are based on the analysis of data collected by the experiment in 2011. "The discovery of the asymmetric behavior in the B^0_s particle comes with a significance of more than 5 sigma—a result that was only possible thanks to the large amount of data provided by the LHC and to the LHCb detector's particle identification capabilities," said Pierluigi Campana, spokesperson of the LHCb collaboration. "Experiments elsewhere have not been in a position to accumulate a large enough number of B^0_s decays."

Violation of the CP symmetry was first observed at Brookhaven Laboratory in the US in the 1960s in neutral particles called kaons. About 40 years later, experiments in Japan and the US found similar behavior in another particle, the B0 [superscript 0] meson. More recently, experiments at the so-called B factories and the LHCb experiment at CERN have found that the B^+ meson also demonstrates CP violation.

All of these CP violation phenomena can be accounted for in the Standard Model, although some interesting discrepancies demand more detailed studies. "We also know that the total effects induced by Standard Model CP violation are too small to account for the matter-dominated universe," said Pierluigi Campana. "However, by studying these CP violation effects we are looking for the missing pieces of the puzzle, which provide stringent tests of the theory and are a sensitive probe for revealing the presence of physics beyond the Standard Model."

More information: arxiv.org/abs/1304.6173

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