CERN's LHCb experiment takes precision physics to a new level

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(PhysOrg.com) -- Results presented by CERN1's LHCb experiment at the biennial Lepton-Photon conference in Mumbai, India on Saturday 27 August are becoming the most precise yet on particles called B mesons, which provide a way to investigate matter-antimatter asymmetry.

The LHCb experiment studies this phenomenon by observing the way B mesons decay into other particles. The new results reinforce earlier measurements from LHCb presented at last month's European Physical Society conference in Grenoble, France, showing that the B meson decays so far measured by the collaboration are in full agreement with predictions from the Standard Model of particle physics, the theory physicists use to describe the behaviour of fundamental particles.

"This result shows that we're now able to measure the finest details of the B meson system," said LHCb spokesperson Pierluigi Campana, "which puts us right where we need to be to start finding cracks in the Standard Model, and explaining matter-antimatter asymmetry."

Matter and antimatter are thought to have existed in equal amounts at the beginning of the universe, but as the universe expanded and cooled, an asymmetry developed between them, leaving a universe that appears to be composed entirely of matter. Heavy quarks provide a good place to investigate this phenomenon because the heavier the quark, the more ways it can decay, and all of these decays are described by the Standard Model. The Standard Model predicts matter-antimatter asymmetry, but at a level which is too small to explain the observed asymmetry in the

Universe. Deviations from the predictions would bring an indication of new physics. B-quarks are produced copiously at the LHC, which makes them the particle of choice for studying matter-antimatter asymmetry in the laboratory. Quarks are never produced alone, but always travel in company: they are accompanied by another quark giving rise to the family of particles called B mesons. It is these that LHCb studies.

Earlier in the year, experiments at Fermilab presented results that hinted at a divergence from the Standard Model. Since then, however, the LHCb experiment has surpassed the Fermilab experiments' precision, and sees no such divergence.

"These results suggest that the devil is in the detail," said Campana, "and we've reached the point where we're getting right down into the details. It's not the devil we expect to find there, though, but new hints of deviations from the Standard Model."

LHCb has been able to reach this level of precision so early in the operational lifetime of the LHC thanks to the excellent performance of the LHC, and the way that LHCb scientists have worked with LHC engineers to optimize the amount of data collected by the experiment. Unlike the large general-purpose detectors, ATLAS and CMS, the LHCb detector has not been constructed to record data at the maximum rate the LHC can deliver. LHCb contains very sensitive elements close to the beam that can measure the point of decay of B mesons. Reconciling the need to protect these devices from possible beam damage with maximizing beam intensity is the challenge these engineers and scientists have overcome.

"Collaboration with the accelerator people has been fantastic," said Campana, "It's allowing us to collect data much faster than expected, and bringing us closer to being able to understand where the antimatter went."

More information: www.quantumdiaries.org/2011/08 … -the-standard-model/

Provided by CERN