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Penguin anomalies, physics beyond the Standard Model

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THE IMPLICATION: *The discrepancy found could mean that there exist particles or symmetries, which have hitherto not been observed.* – PHOTO: REUTERS

Physicists at LHCb, an experiment at the Large Hadron Collider (LHC) in Geneva dedicated to observing the decay of B mesons, have found an exciting and persistent discrepancy between the experimental observations and calculations based on the standard theory. This is exciting because this discrepancy could imply new physics, requiring going beyond what is called the Standard Model of particle physics. In other words, this could mean that there exist particles or symmetries, which have hitherto not been observed.

The anomaly, as this discrepancy is called, is not statistically significant enough to warrant a round of celebrations. However, it is persistent enough for experimentalists to roll up their sleeves and get to work during the next run of the Large Hadron Collider, which is to begin soon.

Among the first to suggest looking for such an anomaly based on calculations is an Indian group. The anomaly is seen in a certain class of decays of B mesons through rare, "penguin" processes. Such an anomaly was first observed in 2013. This persisted and grew stronger on further analysis of the data, as revealed by the LHCb earlier this month. The anomaly shows a statistical significance of only 3.7 sigma deviation. To establish that it is not mere chance scientists need a significance of at least 5 sigma deviation (or a random chance of less than one in a million).

The LHCb specifically looks at the angular distribution of particles coming from the decay of the B meson through a process in which one of the components of the meson, the beauty quark, changes into a quark of a different flavour. Physicist Rahul Sinha of the Institute of Mathematical Sciences, Chennai, and his collaborators were the first to point out, in papers published in 1996 and 1999, that this was the sector where such an anomaly could be observed.

About the lack of conclusive evidence, Prof. Sinha says, "The experimentally observed angular distributions have been compared to the ones computed approximately in the Standard Model. It is possible that hadronic effects are not accurately taken into account, resulting in an improper conclusion about the significance. One needs a more reliable approach."

Apart from indicating the importance of the decay mode and angular observables to search for new physics, Prof. Sinha, Rusa Mandal and Diganta Das had proposed a truly model-independent technique to search for new physics in a recent publication of the American Physical Society. Now, they are examining what the relation derived by them implies for new physics using the full LHC Run-I data set.