https://lpnheweb3.in2p3.fr/spip.php?article1498

Search for charged lepton flavor violating decays with the LHCb experiment

- Thèses, Stages, Formation et Enseignement - Propositions de thèses 2020 -

Date de mise en ligne : Tuesday 5 November 2019

Title: Search for charged lepton flavor violating decays with the LHCb experiment

Supervisor: Eli Ben-Haim

Co-supervisor: Francesco Polci

Team: Asymétrie Matière-Antimatière ; group LHCb

Description:

Description: The observation of neutrino oscillations implies that the lepton flavor number is not a conserved quantity. Charged lepton flavor violating processes, instead, have never been observed so far. In fact, in the Standard Model they are expected to be extremely suppressed, and beyond the sensitivity of the current detectors. At the same time, New Physics could enhance their rate to a level that would make them observable: these processes, rare in the Standard Model, are among the most powerful probes for New Physics! The search for charged lepton flavor violating decays has risen in priority since the publication of LHCb measurements of lepton flavor universality: RK = Br(B+' K+e+e-)/Br(B+ ' K+¼+¼-) and RK* = Br(B0' K*0e+e-)/Br(B0 ' K*0¼+¼-). These ratios are precisely predicted in the Standard Model to be equal to unity, while LHCb has observed 2.6 and 2.4 standard deviations from unity for RK and RK*, respectively. If confirmed, these results would imply the violation of the lepton universality, necessarily associated to a new lepton flavor violating interaction that could largely increase the B ' K(*) + '- decay rates, where the two leptons and ' belongs to different flavor families. Observing decays like B ' K(*) + '- would be an outstanding sign of new physics, with many possible implications: on the seesaw mechanism and heavy neutrinos, natural candidates for dark matter; on the grand unified theories involving lepto-quarks; on the physics behind the matter-antimatter asymmetry of the universe. The LHCb experiment has been collecting an unprecedented large quantity of B mesons produced in proton-proton collisions at the Large Hadron Collider LHC at CERN, and is resuming data taking in 2021. The LHCb group in LPNHE has contributed strongly to the test of lepton flavor universality and to the first lepton flavor violating searches. The PhD student will have the opportunity to analyze the full dataset of LHCb and the new data that will be collected, which will further enhance the discovery potential of the experiment for lepton flavor violating decays. He/she will learn about particle physics detectors and sophisticated analysis techniques, and contribute to solve one of the most exciting puzzles in particle physics today.

Internship: An internship before the starting of the PhD is foreseen.

Work location: LPNHE, Paris

Possible trips: CERN

Contacts:

- Francesco Polci, 33 (0)1 44 27 53 07
- Eli Ben-Haim