Study of rare b- and c-hadron decays at the LHCb experiment

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The results of current experiments in particle physics are described by a theory called the Standard Model (SM). The SM describes data astonishingly well, without significant discrepancies. Despite its success at describing the wealth of particle physics data, there are several known issues with the SM. Attempts to solve the issues with the SM often do so by extending it to include new particles with masses that are heavier than the known SM particles. Many of these extensions have consequences that should be measurable at the LHC experiments.

Amongst the many ways of searching for experimental evidence of these new particles, searches involving decays of hadrons containing a bottom or charm quark play a prominent role. In these searches, the new heavy particles appear as virtual particles inside Feynman diagrams and influence how the bottom and charm hadrons decay. One interesting class of decays involves transitions where the b- or c-hadron decays to a lighter hadron and a pair of leptons. These processes are rare in the SM and include the decays $B^0 \to K^{*0}\mu^+\mu^-$, $B_s^0 \to \phi\mu^+\mu^-$ and $\Lambda_b^0 \to \Lambda\mu^+\mu^-$. The decay distributions of the particles coming from these decays provides a wide sensitivity to different new physics models and importantly can be used to distinguish between different types of model. The LHCb experiment is dedicated to studying b- and c- hadron decays, providing large samples of even these rare processes, which will allow us in the coming years to test the SM to unprecedented precision and hopefully find evidence for something beyond it.

The project will involve two main aspects: you will contribute to the data taking and quality assurance of the LHCb experiment and to the development of software that could enhance the capabilities of the experiment; and you will carry out a study of one (or more) rare b- or c-hadron decays, using the LHCb dataset, with the aim of establishing evidence for physics beyond the SM. Both aspects will be achieved using modern computing techniques and courses in these techniques will be included as a part of the elementary particle physics group graduate training curriculum. The project will require some international travel, including visits to CERN in Switzerland.

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