Master Research Projects

In Experimental Particle Physics with the LHCb Experiment

LHCb Experiment

The Large Hadron Collider beauty, or LHCb, experiment at CERN is a high energy physics experiment dedicated to the study of subatomic particles containing beauty quarks. It tests the Standard Model (SM) of particle physics through high precision measurements of decay rates and asymmetries.
In the LHCb group at the Van Swinderen Institute, we search for physics beyond the SM by analysing the collected data and studying the performance of LHCb's vertex locator, and we prepare for the future by contributing towards its next upgrade.

Join one of our Ongoing Research Projects:

- **First measurement of the decay $B_c \to \tau\nu$**
  - The decay rate of $B_c \to \tau\nu$ provides a powerful test of the SM, but is experimentally extremely challenging due to the neutrinos which cannot be detected.
  - You will understand how a particle physics analysis is performed, process and plot data, study kinematic distributions, optimize selections, and evaluate your results.
- **First search for the lepton flavour violating decay $\Lambda_b \to \Lambda\tau\mu$**
  - Lepton flavour violation is a forbidden process in the SM, however, it has been observed in neutrino oscillations. Do we also see it in decays of Λ_b baryons?
  - You will understand how a particle physics analysis is performed, process and plot data, study kinematic distributions, optimize selections, and evaluate your results.
- **Performance study of LHCb's Vertex Locator**
  - The VELO plays a crucial role in the identification of b-hadrons and measuring the properties of their decay. Understanding its performance is needed to control systematic uncertainties.
  - You will understand how a high energy physics detector is used to measure particles, how we go from electrical signals to hits to particle tracks, and what information we can extract.
- **Development of a new data acquisition strategy using the FELIX read-out card**
  - After the future upgrade, LHCb will operate at an order of magnitude higher luminosities, and thus create higher data rates. We are developing the corresponding data acquisition system.
  - You will learn hardware programming, design and implement new components for the data acquisition, and test them in simulation and on the FELIX card.
- **Development of new silicon pixel detectors with picosecond timing capabilities**
  - After the future upgrade, LHCb will operate at an order of magnitude higher luminosities, and thus create higher data rates. We are developing the next generation particle detectors.
  - You will understand how a high energy physics detector is used to measure particles, how we go from electrical signals to hits to particle tracks, and what information we can extract.
- **Phenomenology of CP violation in B meson decays**
  - To compare high precision experimental measurements with the theory predictions, we need to include subleading effects in our interpretation of the results.
  - You will understand the subtleties and challenges involved in interpreting experimental measurements in terms of the theory parameters when going beyond leading approximation.

Interested? Get in touch to know more about these opportunities

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