Thesis abstract Chiara Mancuso

″Measurement of the CKM angle gamma with the Lambda_b -> D0 p K decay and commissioning of the Upstream Tracker at the LHCb experiment″

Charge Parity (CP) violation is a well-documented phenomenon described by the Standard Model (SM) of particle physics. Understanding CP violation can explain why matter prevailed over antimatter after the Big Bang, essentially explaining our existence. Many theoretical predictions have been experimentally observed, starting with the 1964 discovery of CP violation in the neutral kaon system by James Cronin and Val Fitch. Since then, numerous flavour physics experiments have enriched our knowledge, observation after observation. Today, while CP violation in meson systems has been extensively studied, CP violation in baryon systems remains largely unexplored. This thesis contributes to this field, leveraging the LHCb experiment's unique capability to produce baryons in sufficient quantities for detailed flavour studies. The focus is on the Lambda_b particle, which decays into a three-body final state, D^0 p K-, with the D^0 meson further decaying into two hadrons. The dataset comprises 9 fb^-1 of pp collisions collected between 2011 and 2018 at center-of-mass energies of 7, 8, and 13 TeV. The D^0 final state has been selected choosing the technique later adopted in the research: the GLW (Gronau, London, Wyler) method, which is focusing on CP-even eigenstates, specifically two kaons or two pions. An asymmetry between the final state and its mirror-opposite could be used to measure through the GLW method the CKM (Cabibbo-Kobayashi-Maskawa) angle gamma, a fundamental parameter describing CP violation within the SM. The study employs new Machine Learning (ML) algorithms to optimise signal candidates, enhancing signal yield even in channels previously explored by the collaboration. Complementary to this analysis is a work on the Upstream Tracker (UT) detector, installed after Long Shutdown 1 (LS1) and operational in Run 3 of the LHC. Positioned upstream of the LHCb dipole magnet, the UT improves the momentum resolution of charged particles and reduces the rate of ghost tracks. It provides high-precision spatial measurements, contributing to accurate track reconstruction alongside the Vertex Locator (VELO) and the Scintillating Fibre Tracker (SciFi). This thesis details various phases of the UT commissioning, from installing and testing the Detector Control Boards (DCBs) to monitoring data acquisition and characterising silicon sensors. Tests involved ensuring the correct powering of boards and the functioning of optical links. Characterisation was crucial to identify and mask anomalous noise peaks in sensors and ensure proper operation of the amplification chain. Finally, real-time data monitoring during runs is essential to verify the detector's correct functioning and intervene in case of malfunctionings.