Thesis abstract Vsevolod Yeroshenko

″PLUME detector development and charmonia decays to Lambda* anti-Lambda* baryons with LHCb experiment″

Charmonium is an important tool for studying Quantum chromodynamics (QCD) due to both the hard and soft scales involved in its production and decay. Since the discovery of the J/psi state five decades ago, the charmonium production and decay mechanism has yet to be understood. Baryonic decays of charmonia allow probing of the full charmonia spectrum below the D anti-D threshold, yielding a comparison between the properties of different states in a single study. Hadronic collisions at LHC produce all the charmonia states in direct production, decays of higher charmonia states, and decays of b-hadrons. The LHCb experiment, with its high integrated-luminosity data sample, provides a unique opportunity to study the charmonia properties due to its precise vertex reconstruction, robust particle identification, and flexible trigger system. Luminosity is an essential characteristic of colliders and is necessary for absolute determination of the physics event rates. Measurement of luminosity at hadron colliders is challenging and requires specific tools to provide a luminosity counter that is necessarily linear with the luminosity. The new detector for luminosity measurement PLUME was developed and is in operation for the LHCb experiment in Run 3, which started in summer 2022. This thesis presents the development of the PLUME detector, the absolute luminosity calibration, a study of its linearity, the PMT gain adjustment, and the implementation of the new collision time determination technique for the LHCb time alignment using PLUME. In addition, this thesis presents a study of charmonia decays to the pairs of Lambda(1520) anti-Lambda(1520) short-lived strange baryonic resonances reconstructed via their decays to pK. It includes the first measurement of the branching fraction of J/psi to Lambda(1520) anti-Lambda(1520) decay and its angular distribution. The upper limits for the branching fraction of other charmonia resonances below the D anti-D threshold decays to Lambda(1520) anti-Lambda(1520) pairs are set.