QCD, Electroweak Physics, and Searches for Exotic Signatures in the Forward Region at LHCb

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The LHCb experiment is a forward spectrometer that offers a unique phase-space coverage at the Large Hadron Collider (LHC). Such a unique coverage offers the possibility to produce complementary and unique physics results in electroweak (EW), quantum chromodynamics (QCD), and searches for exotic signatures from beyond the Standard Model (BSM) physics. These proceedings provide an exhibition of select results from the LHCb experiment in the fields of EW, QCD, and exotics.

1 Introduction

The experimental discovery of the Higgs Boson in 2012 by the ATLAS [1] and CMS [2] experiment provided a complete picture of the Standard Model (SM) particles. Despite this astounding discovery, numerous measurements of the SM continue to be the highlight of the High Energy Physics (HEP) world. The driving force for such precision measurements is to provide a probe for physics beyond the SM (BSM) [3], where deviations from the expectation could provide an illumination on not yet understood physical phenomena.

The LHCb collaboration continues to produce significant precision measurements in the electroweak (EW) and hard Quantum Chromodynamics (QCD) fields to contribute to the larger global understanding of such topics. Furthermore, a thriving exotics group compliments such measurements with direct searches for a variety of BSM models and archetypes. This document shares a selection of recent results in the aforementioned fields and then briefly describes some exotic prospects for the Run 3 datataking period. For a full list of publications from LHCb related to these fields, the reader is encouraged to visit Ref. [4].

2 The LHCb Detector

The LHCb detector [5,6] is a single-arm forward spectrometer at CERN's Large Hadron Collider, designed for precision tracking and particle identification. It features multiple tracking detectors, a dipole magnet, and several particle identification systems including Cherenkov detectors, calorimeters, and muon chambers. Following the first major upgrade during Long Shutdown 2[7], the detector now supports higher luminosities and fully software-based event reconstruction, enabling enhanced exploration of exotic physics.

3 Precision Electroweak Measurements

Precision EW measurements serve as a probe of the SM and by definition [8] have sensitivity to new physics beyond the SM. Equation 1 exemplifies the connection to the experimentally measurable