

Department of Physics and Astronomy

University of Heidelberg

Master thesis

in Physics

submitted by

Patrick Fahner

born in Mannheim

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A study of the decay

$$\Lambda_b^0 \rightarrow D^0 p \mu^- \bar{\nu}_\mu X$$

with the LHCb experiment

This Master thesis has been carried out by (Name Surname)

at the

(institute)

under the supervision of

(Frau/Herrn Prof./Priv.-Doz. Name Surname)

(Titel der Masterarbeit - deutsch):

(Abstract in Deutsch, max. 200 Worte. Beispiel: [?])

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(Title of Master thesis - english):

(abstract in english, at most 200 words. Example: [?])

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1 Introduction

2 The LHCb detector

Most parts of this chapter are taken from [1]

The LHCb experiment is one of the four big experiments, currently running at the Large Hadron Collider (LHC) of the European Organization for Nuclear Research CERN in Geneva, Switzerland. In contrast to the other three experiments – ATLAS and CMS are searching for direct hints of new physics, ALICE investigates the Quark-Gluon-Plasma – LHCb is dedicated to look indirectly for physics beyond the Standard Model (see section ??) by the study of hadrons containing either a heavy b - or c -quark.

...

The layout of the LHCb detector can be seen in figure 2.1. It is built as a single-arm forward spectrometer. The reason for this choice is, that at LHC energies of $\sqrt{s} = 14 \text{ TeV}$ at the maximum, b - and \bar{b} - hadrons are predominantly produced in the forward (or backward) region.

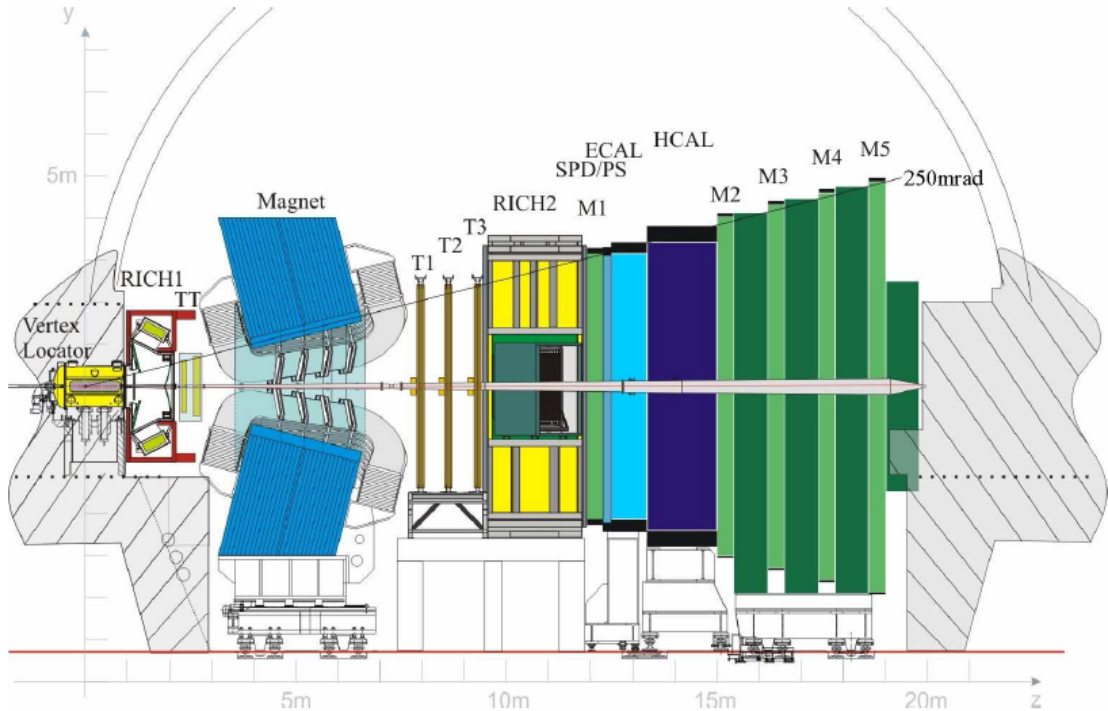


Figure 2.1: The LHCb detector.

2.1 Tracking detectors

Tracking describes the whole procedure to reconstruct the trajectories of the (charged) particles produced in the proton-proton collision. If there's a magnet in use, the particles' charges and momenta can be determined as well. For that purpose, a system of several subdetectors is aligned up- and downstream the dipole magnet, namely the Vertex locator (VELO), the Trigger Tracker (TT) and the Trigger stations (T1-T3) built-up by the Inner Tracker (IT) and the Outer Tracker (OT).

2.1.1 Vertex Locator (VELO)

The VERtEX LOcator (VELO) is placed directly around the primary interaction point. Its task is to precisely measure the track coordinates of charged particles and separate the proton-proton interaction point from other vertices, namely either other primary vertices (so called pile-up events) or secondary vertices. The latter ones are typically for b - or c -hadron decays [2] and a good separation and resolution of these vertices is crucial for the LHCb physics programme. As an example serves the measurement of particles' decay length and time for the determination of the rapid $B_s^0 - \bar{B}_s^0$ oscillation frequency [3].

2.1.2 Trigger Tracker / Tracker Turicensis (TT)

2.1.3 Inner Tracker (IT)

2.1.4 Outer Tracker (OT)

2.1.5 Track classification

2.2 Particle identification

2.2.1 Ring Imaging Cherenkov Detector (RICH)

2.2.2 Calorimeter system

2.2.3 Muon chambers

2.3 Trigger

2.3.1 L0-Trigger

2.3.2 High Level Trigger (HLT)

Part I

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- [1] LHCb collaboration, A. A. Alves Jr. *et al.*, *The LHCb detector at the LHC*, [JINST **3** \(2008\) S08005](#).
- [2] LHCb Collaboration, *LHCb VELO (VErteX LOcator): Technical Design Report*, Technical Design Report LHCb, CERN, Geneva, 2001.
- [3] LHCb, R. Aaij *et al.*, *Precision measurement of the B_s^0 - \bar{B}_s^0 oscillation frequency with the decay $B_s^0 \rightarrow D_s^- \pi^+$* , [New J. Phys. **15** \(2013\) 053021](#), [arXiv:1304.4741](#).

Erklärung:

Ich versichere, dass ich diese Arbeit selbstständig verfasst habe und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe.

Heidelberg, den (Datum)