

# FPGA Development for the LHCb Vertex Locator Upgrade

Nicholas Mead

8064141

School of Physics and Astronomy  
University of Manchester

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## Abstract

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# 1 Introduction

## 1.1 The Standard Model of Particle Physics

$$E^2 = M^2c^4 + P^2c^2 \quad (1)$$

## 1.2 The LHCb Experiment

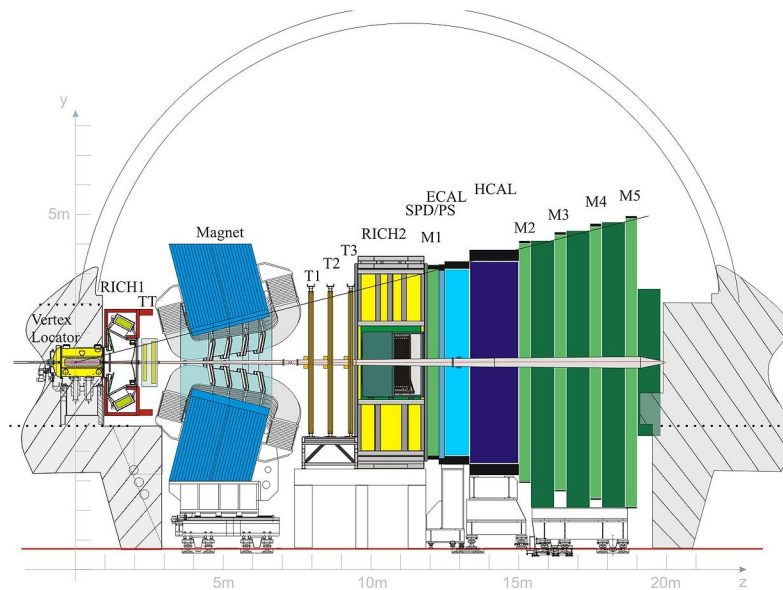


Figure 1: The LCHb Detector along the bending plane.

### 1.2.1 The Detector

### 1.2.2 Physics Studied at LHCb

### 1.2.3 VELO Upgrade

## 1.3 FPGAs in Particle Detectors

### 1.3.1 Field Programable Gate Arrays

### 1.3.2 The Role of FPGA's in the VELO Upgrade

## **2 Scrambling Algorithms**

### **2.1 The Role of Scrambling Data in the VELO**

### **2.2 Additive and Multiplicative Scramblers**

### **2.3 The Different Options for Scrambling Algorithms**

### **2.4 Algorithm Analysis**

#### **2.4.1 Measurements of the Algorithms**

#### **2.4.2 Results of Analysis**

### **2.5 Conclusion**

## **3 Event Isolation Flagging**

Event Isolation

### **3.1 Motivation**

Motivation

### **3.2 Time Sorting Data**

Time Sorting

### **3.3 Bubble Sorting**

Bubble Bubble Bubble

### **3.4 Isolation Checking**

Isolation Checking

### **3.5 Conclusion**

In Conclusion, Nick is Awesome

## **4 Future Development**

This is future dev

### **4.1 LHCb 2020 Upgrade**

2020 upgrade

### **4.2 Further Development of FPGA's in the VELO**

fpga in velo

## **5 Conclusion**

This is the Conclusion

## **6 Acknowledgments**

I would like the Acknowledge Pablo Rodriguez and Marco Gersabeck for there continued support and supervision.



## References

- [1] Cern. *LCHb Collaboration*. 2015. URL: <http://lhcb.web.cern.ch/lhcb/> (visited on 11/21/2015).