LIP INTERNSHIP PROGRAM
COIMBRA LISBOA MINHO

LIP Internship Program 2021

Final Workshop

Braga - Coimbra - Lisbon, September 13-14, 2021

Gernot Eichmann
(on behalf of the organizers)

LIP INTERNSHIP PROGRAM

COIMBRA LISBOA MINHO

54 projects, 88 students ...

Thank you for taking part!

Foremost to you, **the students**, for spending the summer engaging in research work with us;

The **supervisors** for designing the research projects and for mentoring them;

Everyone at **LIP** involved in the organization (including ECO, IT, directorate, secretariat, ...)

It has been a busy summer ...

- **Pre-Tutorials** (June 30)
- **Lectures & tutorials week** (July 5-9)
- **Mid-term activities** (July 23 - August 13)
- **Final Workshop** (September 13-14)
- **Final papers** (by October 10)

... but we hope you enjoyed it!

INTERNSHIP PROGRAM

COIMBRA LISBOA MINHO

Paper write-up

You are encouraged to write a **research paper** on the results of your project, which will be hosted on the LIP website:

- Suggested length: **5 pages** (not more than 10 pages)
- Use LaTeX template on Overleaf (instructions were sent by email)
- Please submit by **October 10**

LIP-STUDENTS-20-19

Measurement of B meson production in pp collisions at 5 TeV

Maria Faria[1,a]

[1] *Instituto Superior Técnico, Lisboa, Portugal*
[2] *Massachusetts Institute of Technology, Cambridge, USA*

Project supervisors: N. Leonardo[1], Z. Shi[2]

October 2020

Abstract. We perform a measurement of the B production differential cross section in proton-proton collisions at a center of mass energy of 5.02 TeV. Multivariate (machine learning) algorithms are employed in the data selection, and likelihood methods are used to extract the B signal from data. The detector efficiency is determined from simulation which in turn is validated through detailed comparisons with data. A study of the sources of systematic uncertainty for the cross section is performed. This measurement contributes to furthering our understanding of b-quark and hadron production, and coupled with similar measurements in PbPb collisions provides insight on the nature of the QGP medium.

Keywords: LHC, CMS, b quark, differential cross section, quark gluon plasma

1 Introduction

At our energy scale, quarks and gluons are confined inside hadrons, such as protons and neutrons. However, under extreme conditions of temperature and pressure, a new state of matter is formed, the so-called quark-gluon plasma (QGP), in which quarks and gluons are asymptotically free. This QGP is believed to have existed in the very early universe and can also be re-created at the LHC, in high-energy collisions of heavy ions, such as PbPb collisions.

In this work, we present a preliminary measurement of the B meson differential cross section using the decay $B_s^0 \rightarrow J/\Psi\,\phi$ in proton-proton (pp) collisions at $\sqrt{s}$ = 5.02 TeV, using data collected by the CMS experiment. This differential cross-section measurement is by itself of great significance, and it complements studies performed at other LHC energies, allowing one to study the $\sqrt{s}$ dependence of the cross section. It is also an ingredient necessary to calculate the nuclear modification factor (R_{AA}), a quantity with which we can gain more insight about the QGP, and that can be derived from the results here obtained in pp collisions along with similar studies in PbPb collisions [1].

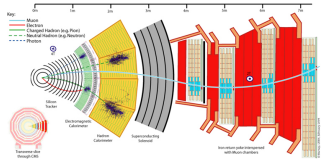

Figure 1: Schematic transverse view of a slice of the CMS detector.

muon detectors installed outside the solenoid and sandwiched between the layers of the steel return yoke. A more complete description of the CMS detector can be found elsewhere [3].

For the purpose of our analysis, the more relevant subdetectors are the innermost and outermost layers of the CMS detector. The latter, the muon chambers, provide identification of the final-state muons, thus further allowing to select the events of interest in real time (trigger). The silicon tracker provides precise measurements of the charged-particles trajectories (muons and kaons), and el-

INTERNSHIP PROGRAM

COIMBRA LISBOA MINHO

Before coming to the end ...

Welcome to our Final Workshop!

INTERNSHIP PROGRAM

COIMBRA LISBOA MINHO

Final Workshop

- 2 days of presentations
- 8 sessions

1 presentation per project:

- **10 + 2 min** (1 student)
- **14 + 2 min** (multiple students)
  Try to stay within time!

You'll share your screen on Zoom, please also upload your slides

Most importantly:
Ask questions!

INTERNSHIP PROGRAM

COIMBRA LISBOA MINHO

Let's start!