



Institut de Physique Nucléaire de Lyon  
Internship carried out from 2018/03/12 to 2018/07/13

Master 2 internship report

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# Signal vs background discrimination $\gamma$ +jet events, recorded by the CMS experiment at LHC.

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# Acknowledgments

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# Acronyms and abbreviations

<b>IPNL</b>	Institut de Physique Nucléaire de Lyon
<b>CERN</b>	Centre Européen pour la Recherche Nucléaire
<b>LHC</b>	Large Hadron Collider
<b>CMS</b>	Compact Muon Solenoid
<b>MVA</b>	MultiVariate Analysis

# Introduction

INTRODUCTION blablabla...

# $\gamma$ +jet event classification in LHC collisions

## 1.1 CMS experiment at LHC

blabla CMS blablabla....

## 1.2 Hadronic jets in proton-proton collisions

Les jets....ca en jette !!

# Collision data

Y en a beaucoup...

## 2.1 Monte-Carlo simulation

Tres jolie ville !

## 2.2 CMS data

blabla cms !

## 2.3 MVA variables

**CHiso  $\gamma$ :** Charged Hadron isolation

**NHiso  $\gamma$ :** Neutral Hadron isolation

**Photoniso  $\gamma$ :** Photon isolation

**$\sigma_{i\eta i\eta}$**  : Energy weighted spread within the 5x5 crystal matrix centred on the crystal with the largest energy deposit in the supercluster. Obtained by measuring position by counting crystals.

**$\sigma_{i\eta i\varphi}$**  : Energy weighted spread within the 5x5 crystal matrix centred on the crystal with the largest energy deposit in the supercluster. Obtained by measuring position by counting crystals.

**$\eta_{\text{width}}$   $\gamma$ :** Shower width in  $\eta$

**$\varphi_{\text{width}}$   $\gamma$ :** Shower width in  $\varphi$



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**$R_9 \quad \gamma$ :** Energy sum of the 3x3 crystals centred on the most energetic crystal in the supercluster divided by the supercluster's energy. Lower values of  $R_9$  for converted photons than those of unconverted photons.

**$Had/Em$  :** Hadronic calorimeter energy deposit over Electromagnetic calorimeter energy deposit

**$E_{n \times m}/E_{5 \times 5}$  :** Energy of most energetic  $n \times m$  crystal set over energy of  $5 \times 5$  crystal set

**$\rho$ :** Pile-up energy, median of the transverse energy density per unit area.

# Input variable analysis

reference [Collaboration 2015].

## 3.1 Background vs Signal discrimination

La discrimination c est mal...!

## 3.2 Variable correlations

co-relation parfois intime entre variables...

# MultiVariate Analysis

## 4.1 Boosted Decision Tree

Yep !

## 4.2 Artificial Neural Network

Le train de tes injures roule sur le rail de mon indifférence....

## 4.3 Results

## Conclusion and future outlook

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