LISHEP09

Study of the Pile-up Impact on Hard Single Diffractive Events

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Outline

- Introduction
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- The CMS Experiment
- Samples & Pile-up Scenarios
- Pile-up Impact
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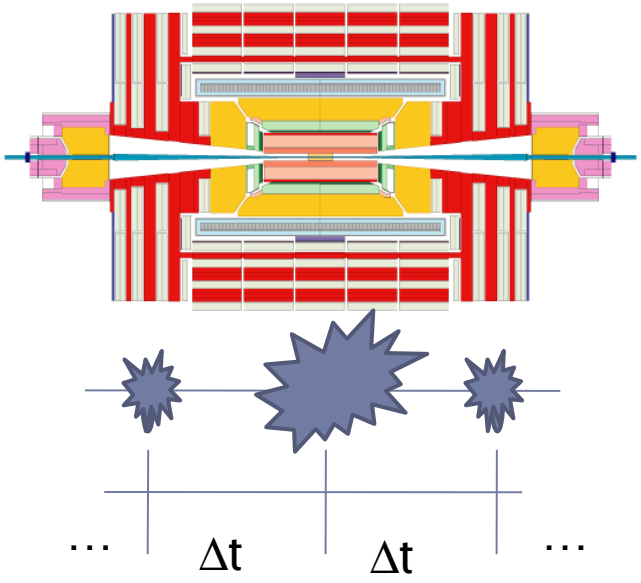


Introduction

LHC will collide protons with an instantaneous luminosity of up to 10^{34} cm^{-2} s^{-1} and a bunch spacing of 25 ns.

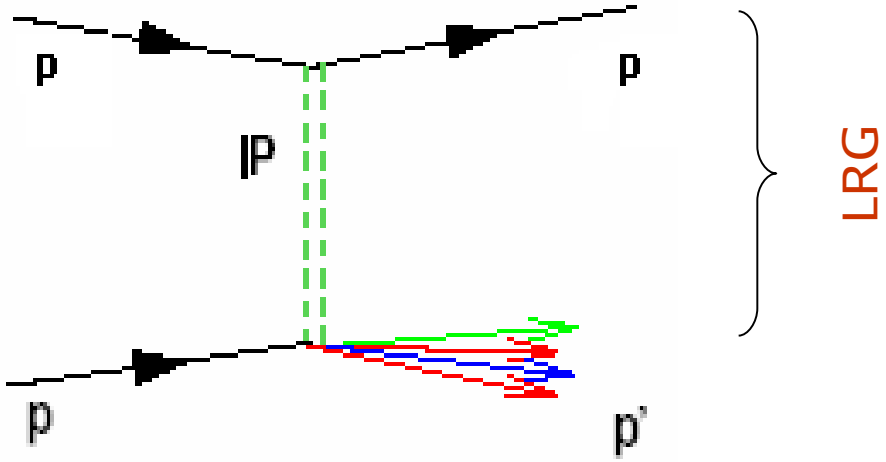
The high luminosity complicates analyses, because at each bunch crossing there will be about 35 minimum bias pp interactions, which pollute any event(pile-up)

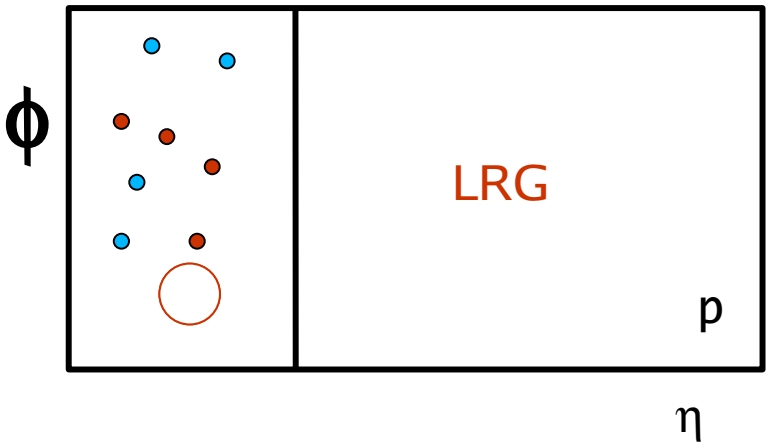
We study the impact of the pile-up on variables commonly used to identify diffractive events and look for those which are less sensitive to pile-up. We aim at developing procedures minimize its influence.

Single Diffractive Jets Events

Events characterized by jets from a hard scattering and a diffracted proton which escapes intact, losing a small momentum fraction

In this work we are studying the inclusive single diffraction (SD) reaction pp->Xp .



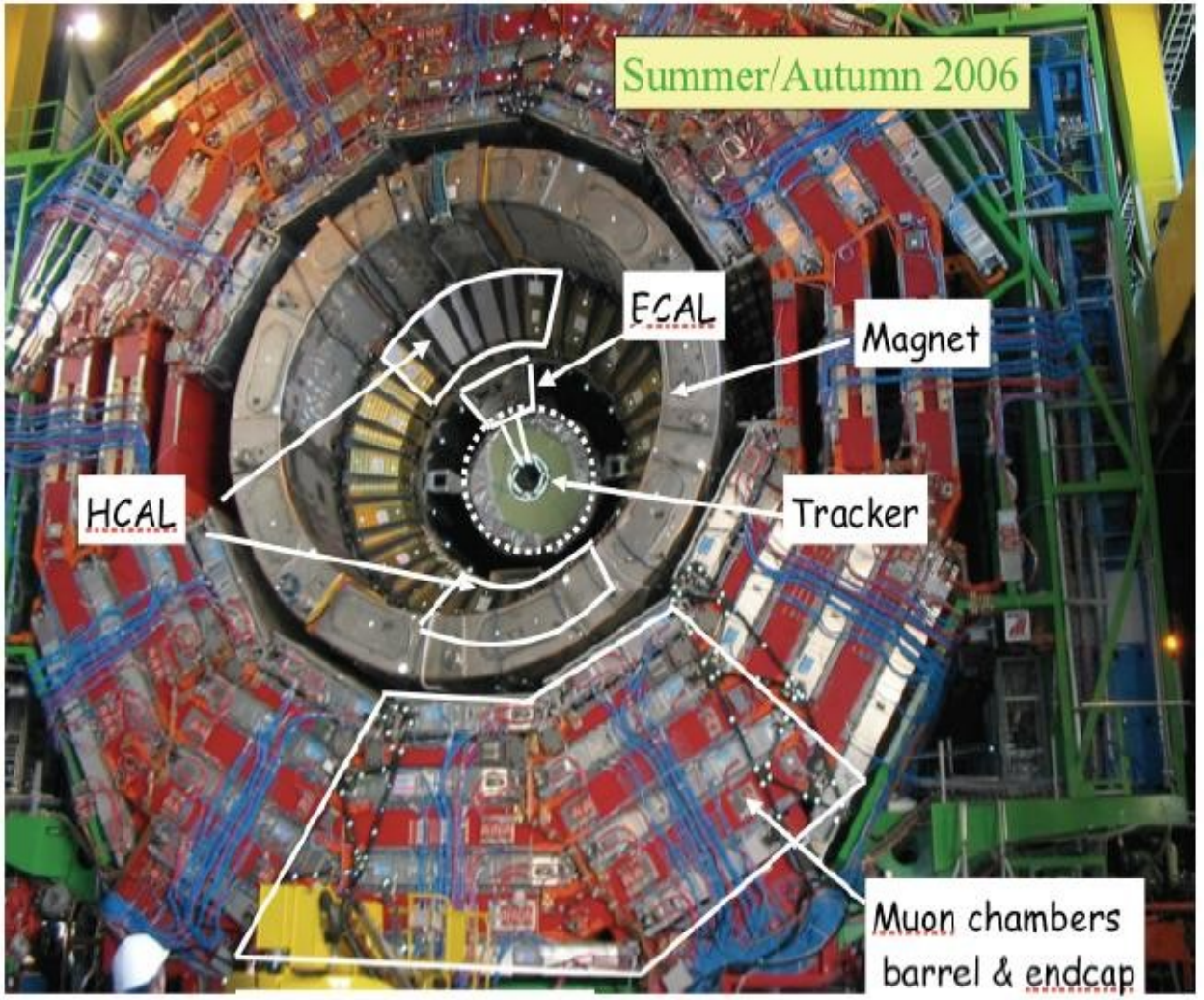


The simbol **IP**: indicates the exchange of a Pomeron(vacuum quantum numbers).

Large Rapidity Gap:

region devoid of particles

Compact Muon Solenoid



- 4 Tesla magnetic field
- Central Tracker ($|\eta|<2.5$)
- ECAL ($|\eta|<3.0$)
- HCAL ($|\eta|<5.0$)
- Muons ($|\eta|<2.4$)

Samples & Pile-up Scenarios

CMS FASTSIM samples :

Signal: Pomwig single diffractive jets (σ: 168 nb, $< S^2 > = 5\%$) - ~100k events

- Reconstructed with SiSCone (cone radius = 0.5)

Background: Pythia QCD samples generated in $p_{T(hat)>}$Bins(30-50, 50-80, 80-120, 120-170)GeV

Possible pile-up scenarios:

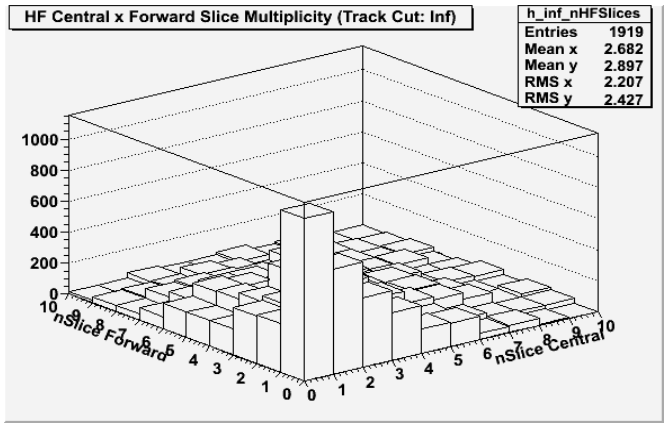
- "**First scenario**": 43 x 43 bunches, L = 6.1 x 10^{30} $cm^{-2}s^{-1}$, bunch space = 1632 ns
- "**Second scenario**": L = 5 x 10^{32} $cm^{-2}s^{-1}$, bunch space = 75 ns
- "**Third scenario**": L = 2.8 x 10^{33} $cm^{-2}s^{-1}$, bunch space = 25 ns

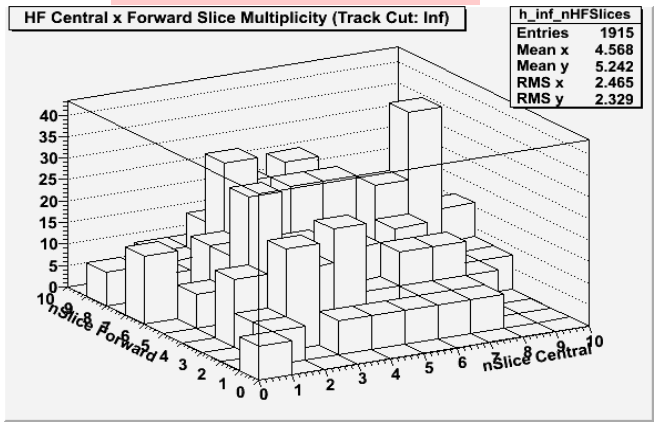
Hadronic Forward Multiplicities

without pile-up

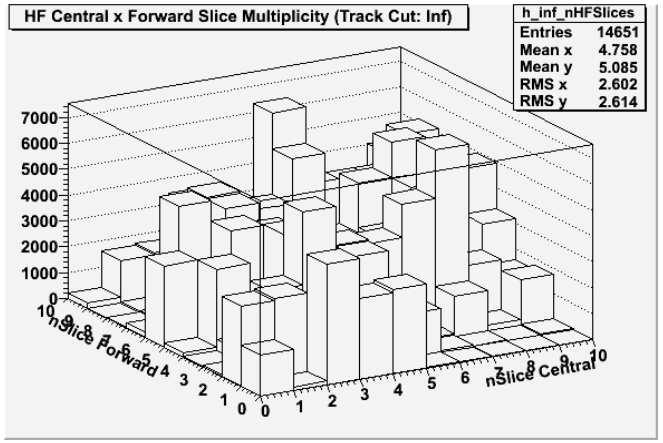
with pile-up

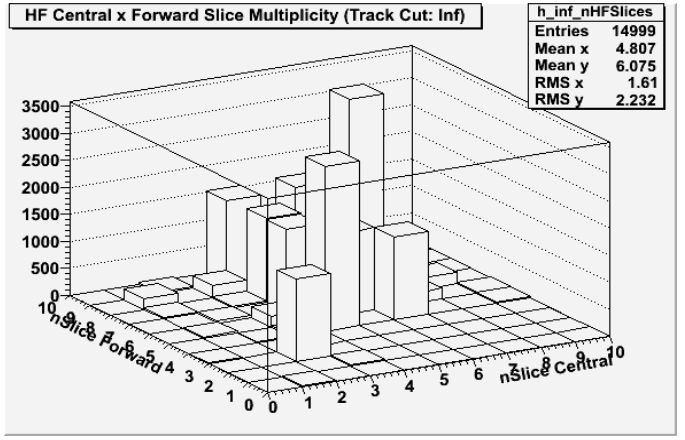
$<N_{PU}>/Bx \sim 5$





Pomwig SD di-jets





Pythia QCD

Similar procedure of A. Vilela and F. Silva

HF($3 \leq |\eta| \leq 4$) vs HF ($4 \leq |\eta| \leq 5$)

FastSim - CMSSW_1_8_4 - 14 TeV

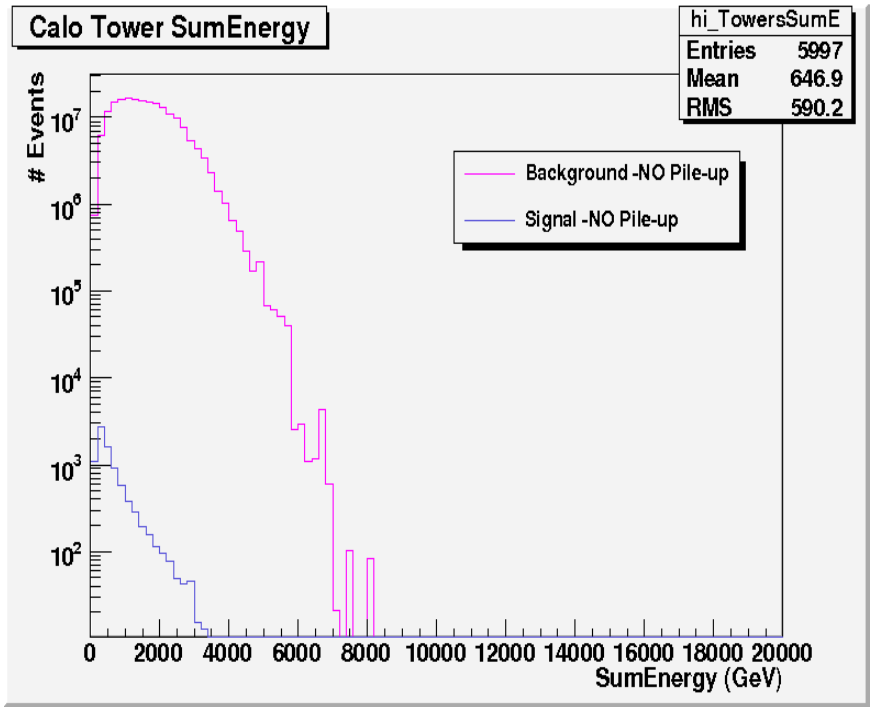
LowLumiPU ($L = 2.8 \times 10^{33}$ cm^{-2}s^{-1}, bunch space = 25 ns)

Calorimeter Tower's Energy Sum

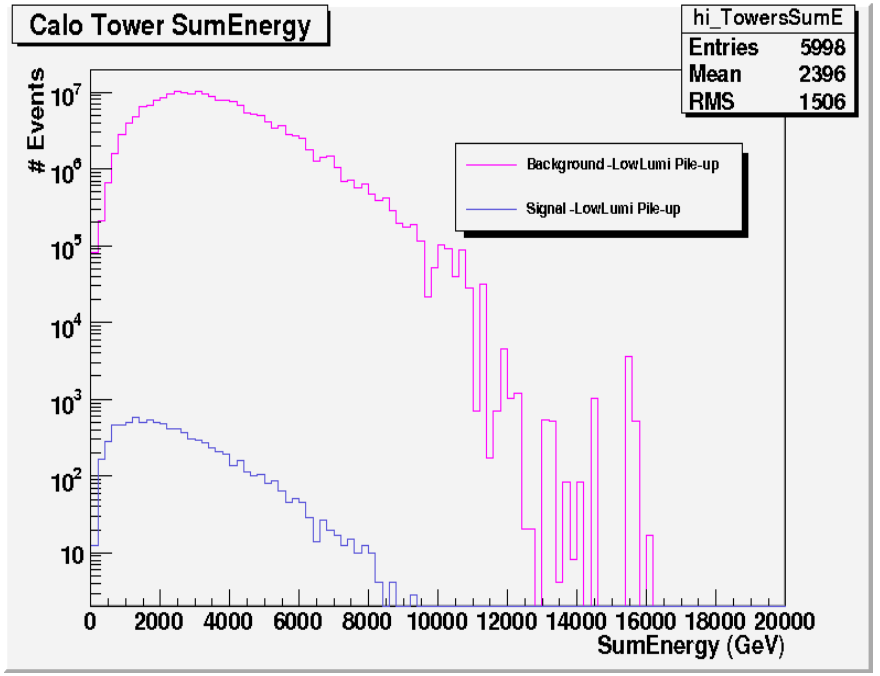
- **Pomwig SD di-jets**
- **Pythia QCD**

$<N_{PU}>/Bx \sim 5$

without pile-up



with pile-up



FastSim - CMSSW_1_8_4 - 14 TeV

LowLumiPU ($L = 2.8 \times 10^{33}$ $cm^{-2}s^{-1}$, bunch space = 25 ns)

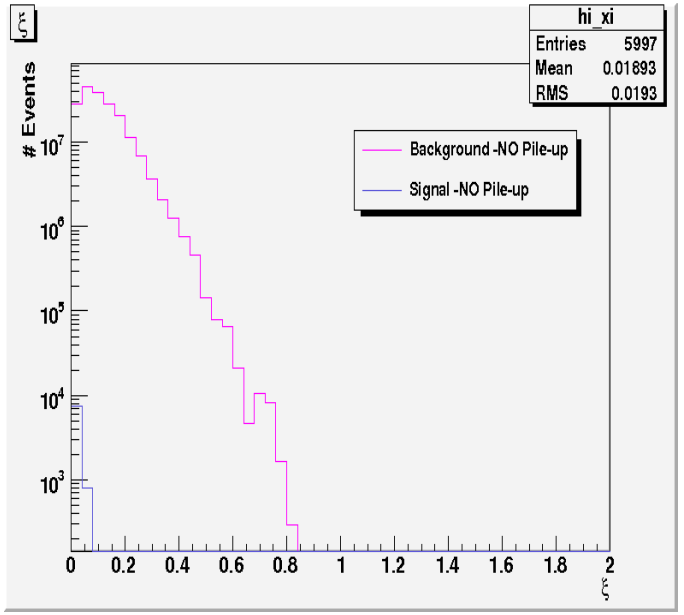
Diffracted Proton Fractional Momentum Loss

$$\text{Reconstructed } \xi = \sum_{towers}(E_T e^{\pm\eta})/\sqrt{s}$$

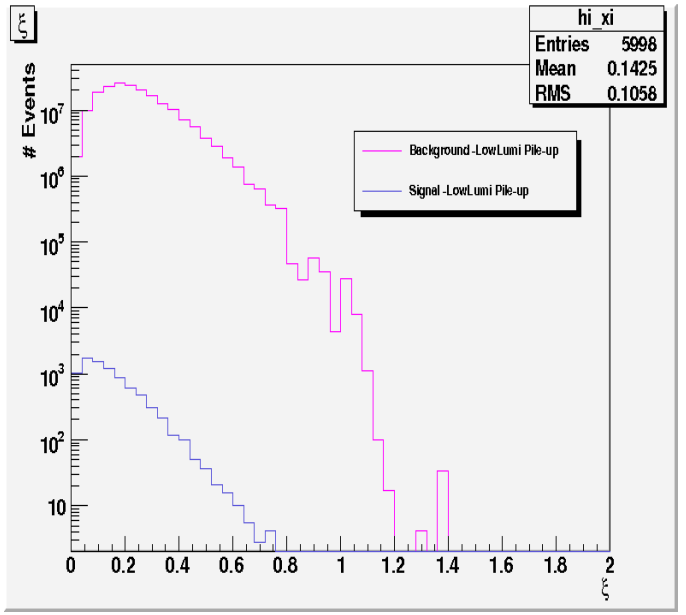
- **Pomwig SD di-jets**
- **Pythia QCD**

$\langle N_{PU} \rangle / Bx \sim 5$

without pile-up



with pile-up



FastSim - CMSSW_1_8_4 - 14 TeV
LowLumiPU ($L = 2.8 \times 10^{33}$ cm^{-2}s^{-1}, bunch space = 25 ns)

Calorimetric Forward-Backward Asymmetry

Pomwig SD di-jets

Pythia QCD

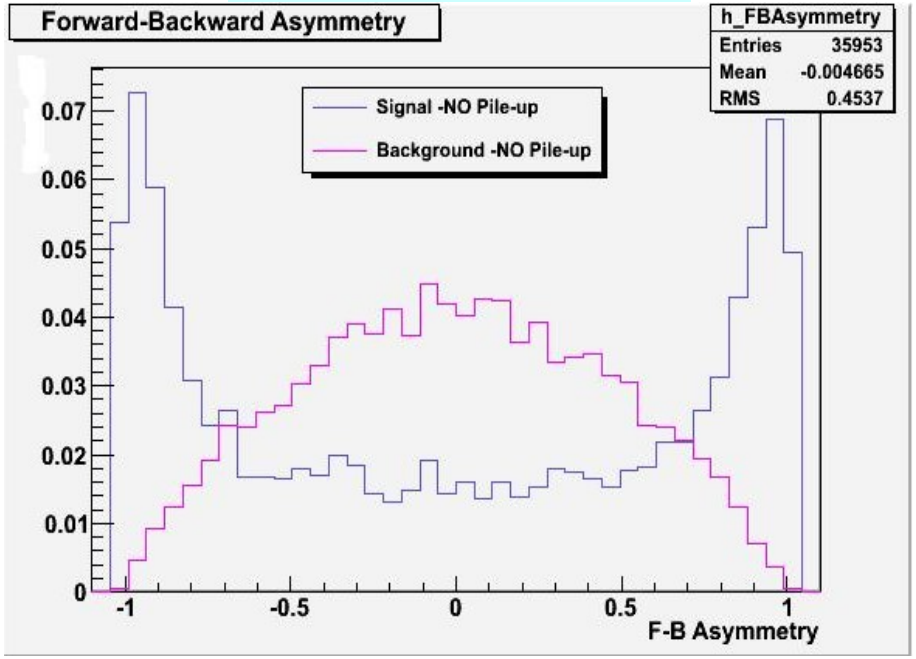
$\langle N_{PU} \rangle / Bx \sim 5$

The events are normalized by the area

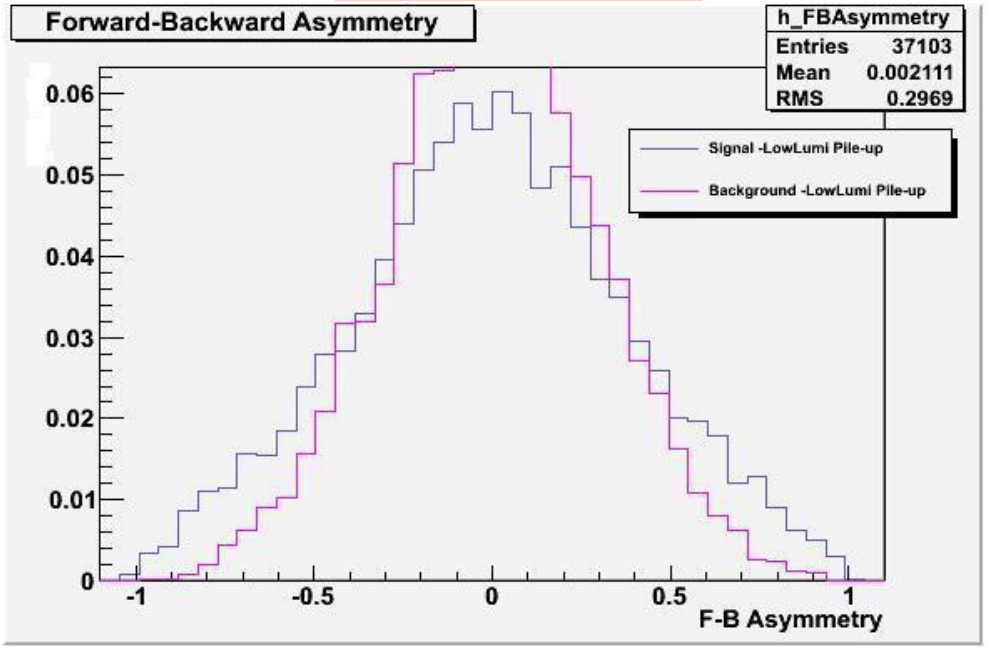
Hadronic Forward

FB_ Assimetry = [E(forward)-E(backward)]/ [E(forward) +E(backward)]

without pile-up



with pile-up



FastSim - CMSSW_1_8_4 - 14 TeV

LowLumiPU ($L = 2.8 \times 10^{33}$ $cm^{-2}s^{-1}$, bunch space = 25 ns)

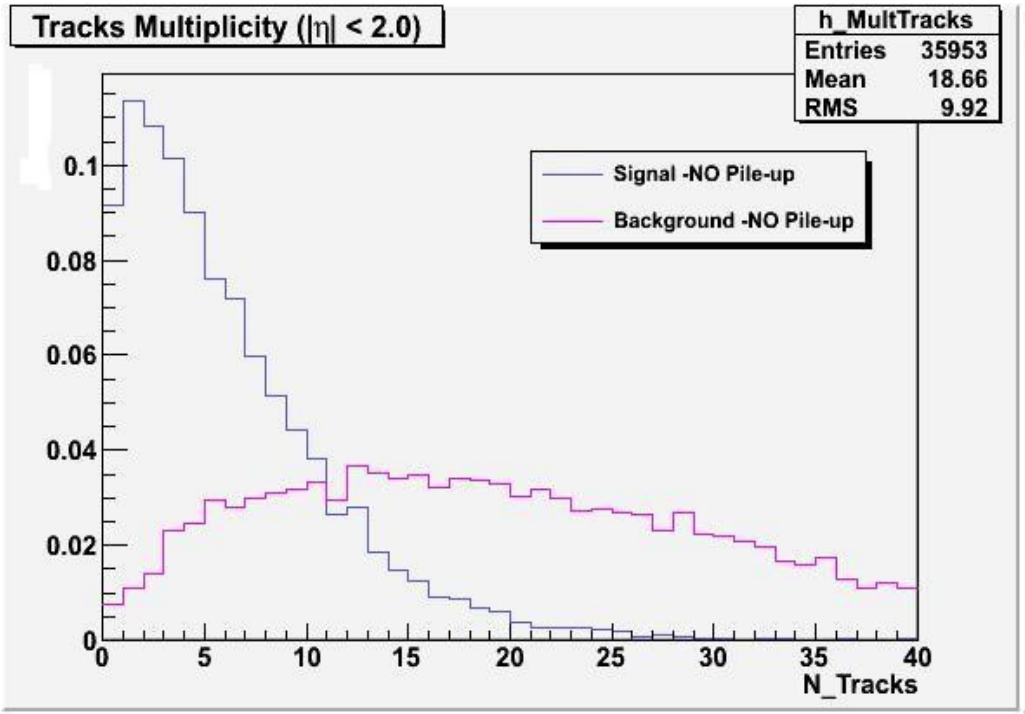
Track Multiplicity

Pomwig SD di-jets

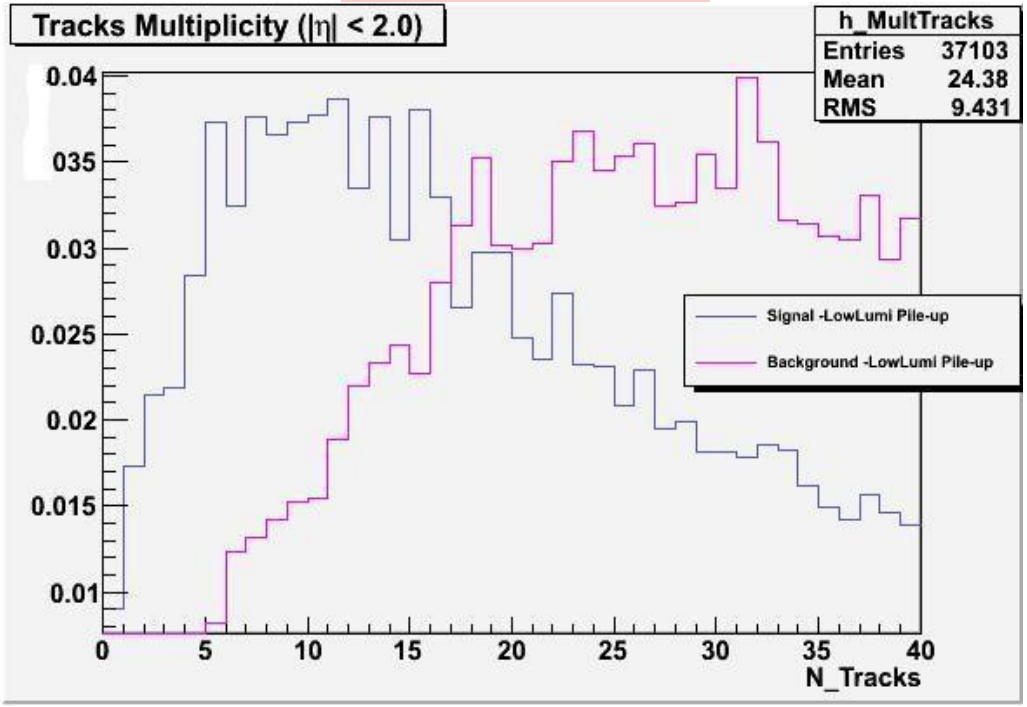
Pythia QCD

$<N_{PU}>/Bx \sim 5$

without pile-up



with pile-up



FastSim - CMSSW_1_8_4 - 14 TeV

LowLumiPU ($L = 2.8 \times 10^{33}$ $cm^{-2}s^{-1}$, bunch space = 25 ns)

The events are normalized by the area

Summary & Next Steps

- Even in low luminosity , pile-up will be present and play an important role.

- We studied the separetion power of several variables commonly used to discriminate between Single Diffraction(signal) and QCD(background), with and without PU.

- Next step is to study the efficiency and purity of the identification of the diffractive events.

- We also plan to use multivariate analysis (TMVA) to study the efficiency and purity of identification with Neural Networks and Fisher's discriminant.

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