A search for for highly ionizing short tracks and a measurement of the jet transverse-momentum resolution at the CMS detector

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Contents

1 Introduction

This is the introduction. GeV

2 The standard model of particle physics and supersymmetric extensions

This will contain the theory part

3 Experimental setup

This is the detector chapter

4 Measurement of the jet transverse-momentum resolution

bla bla bla

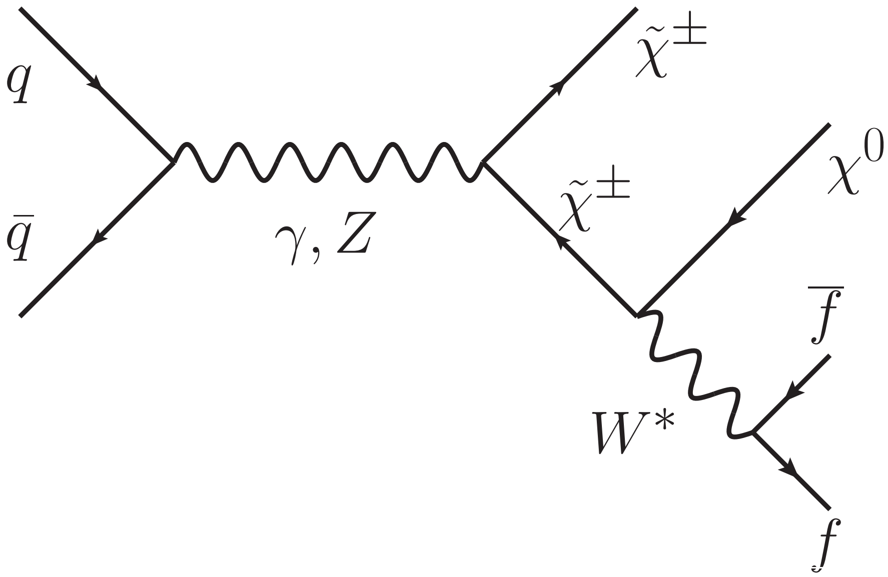

Figure 5.1: Feynman diagram showing production and decay of a chargino pair.

5 A search for highly ionizing short tracks at the CMS detector

This search aims to look for charged particles decaying inside the tracker to one fermion and a neutralino. In case the chargino and the lightest neutralino are almost mass-degenerate the fermion is very low in momentum and can therefore be hardly detected in the tracker. The momentum of the fermion is of course highly dependent on the actual mass gap between the neutralino and the chargino. The typical p_{T} distribution of a pion when the mass gap is about the pion mass is shown in figure **??** Being in principle sensitive to any physics beyond the standard model, this search is motivated by the possible existence of a supersymmetric chargino. As showed in chaper **??** Supersymmetry is one of the most promising theories beyond the Standard Model and is very well motivated from either theoretical and experimental point of view. It is able to give possible answers to the main short-comings of th SM and is therefore an attractive theory, which deserves to be looked at.

There are many analyses done at CMS which are in principle sensitive to such a supersymmetric chargino. This analyis wants to focus on long lifetimes such that the chargino does not directly decay, but reaches at least to first layers of the detector, being the silicon pixel and strip trackers. On the other hand, it has been designed in a way, that the chargino is not that-lonmg lived, that it travels through the whole detector, but decays at least before the muon chambers, thus is not reconstructed as a muon. There have been analysis at CMS and Atlas looking for such middel-live charginos. The new aspect of the

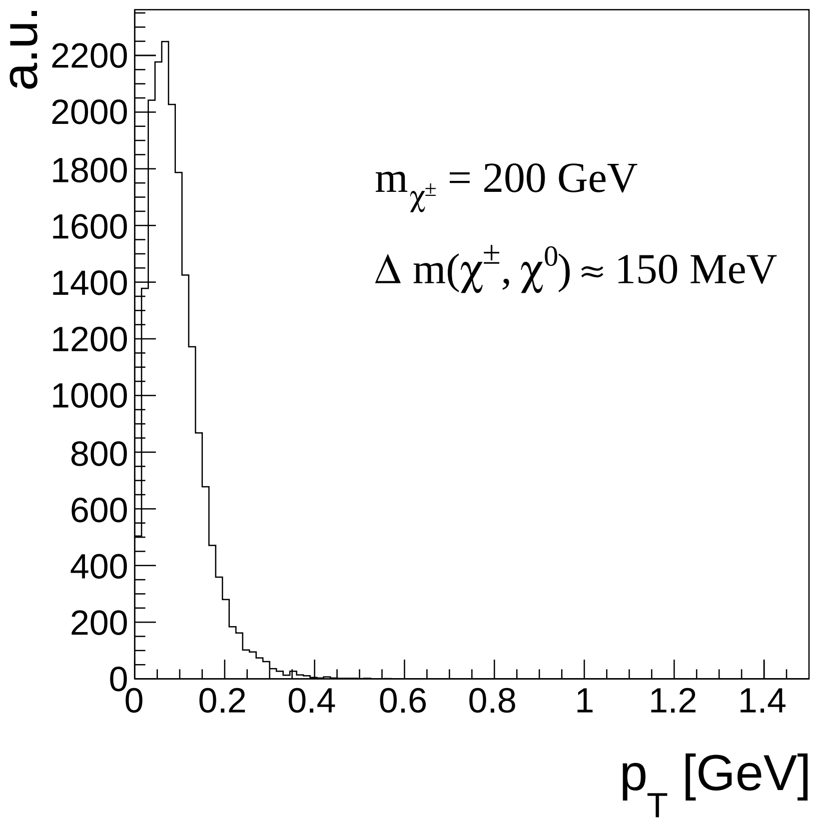

Figure 5.2: Transverse momentum distribution of pions coming from chargino decay into a neutralino with a mass gap of 150 MeV.

analysis is the inclusion of the variable dE/dx. The pixel and the silicon tracker at CMS have been calibrated already offline, when building these moduls. Unfortunately it is not so good. The silicon strip tracker has been calibrated in the context of a search for heavy, stable charged particle (cite something). In this analysis, also very short tracks become very important, showing not more than three of four hits. Therfore also the pixel detector needs to bec calibrated in order to increase senssitivy for those short tracks

- Show Feynman diagram.
- Aim of this analysis: Search for middle lived charginos decaying into neutralino and a low momentum fermion
- They are characterized by high dE/dx (high mass - low velocity) and (dependent on the lifetime) short tracks.
- No identification as leptons
- Interpretated in the context of supersymmetric models
- Exclusion limits from pre LHC data up to 100 GeV for Charginos (from LEP)

5.1 General search strategy

- Importance of De/Dx
- No cut on number of valid hits
- Importance of pixel gain calibration

5.2 Gain calibration of the silicon pixel tracker

See small document I wrote

5.3 Signal samples

- signal samples generated with Madgraph and pythia
- They are decayed in Geant to only pions. Around ten different lifetimes were simulated
- Higgsino/wino chargino
- append slha file
- For other lifetimes: lifetime reweighting is done PLOT
- For five diffenrent masses (100-500 GeV)

5.4 Event selection

5.5 Main discriminating variables

- dE/dx
- pt

5.6 Sources of backgrounds

- Background consist of particles which make high energy deposits and are high pt
- In general: Low background search

5.6.1 Fake tracks

- Definition of fake tracks
- How can they fake the signal

5.6.2 Muons

- How can muons fake the signal

5.6.3 Pions

- How can pions fake the signal

5.6.4 Electrons

- How can electrons fake the signal

5.7 Background estimation methods

5.7.1 Fake background

5.7.2 Leptonic background

5.8 Optimisation of search sensitivity

- Show plots
- show table

5.9 Systematic ucnertainties

Obvious

5.10 Results

- Method of limit setting
- 1-d limits
- 2-d limits

6 Conclusions

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