Pythia simulation production S-quarks and gluinos via neutralinos, Stau and tau to energies in the range of 7-14 TeV. In cms experiment

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Introduction

SUSY is a proposal symmetry between fermions and bosons. Operators that generate their transformations have spin 1/2.
The minimal supersymmetric model (MSSM), is a scheme to introduce supersymmetry to the standard model (SM), which adds a few new particles. Each particle of M.E. receives a supersymmetric partner or s-particle, one for each degree of freedom.
is presented an study of supersymmetric signals for one particular channel decay with final states of taus, jets and ET_miss, coming from the production of s-quark and gluinos in proton-proton collisions with cms experimental conditions. This channel was simulated using the MC PYTHIA6, for four different center of mass energy 7, 9, 11 and 14 TeV.

Decay Channel

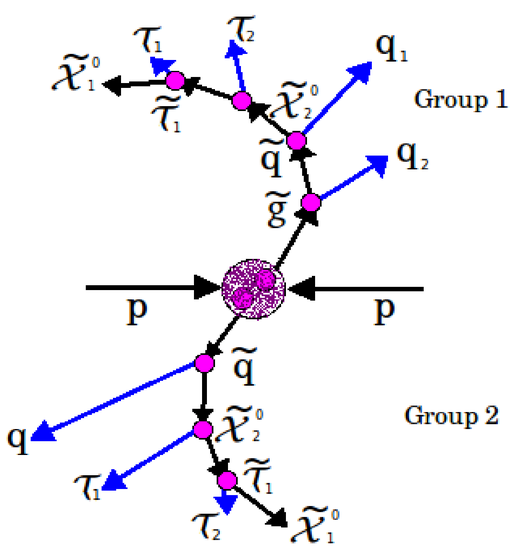


FIGURE 1.

Procedure

During the construction of the code for simulate the decay channel is important to set up the M-SUGRA parameters, also activate the different channels that corresponds to the different particles present in the analysis Fig 1.

The center of mass energy is also specified, type of collision and framework, for this case are proton-proton collisions in cms experiment.

Software requirements and implementations

The software used and installed in the computing systems of the University of Nariño was Pythia 6 and ROOT version 5.32.

The code for the decay channel simulation was developed in a user friendly way , then the user only need to insert the number of events that wants to be generated .

Finally all the histograms related to the decay channel are saved in a rootfile.

Analysis and preliminary results: Energy and angular separation

In all simulations were used 500.000 events.

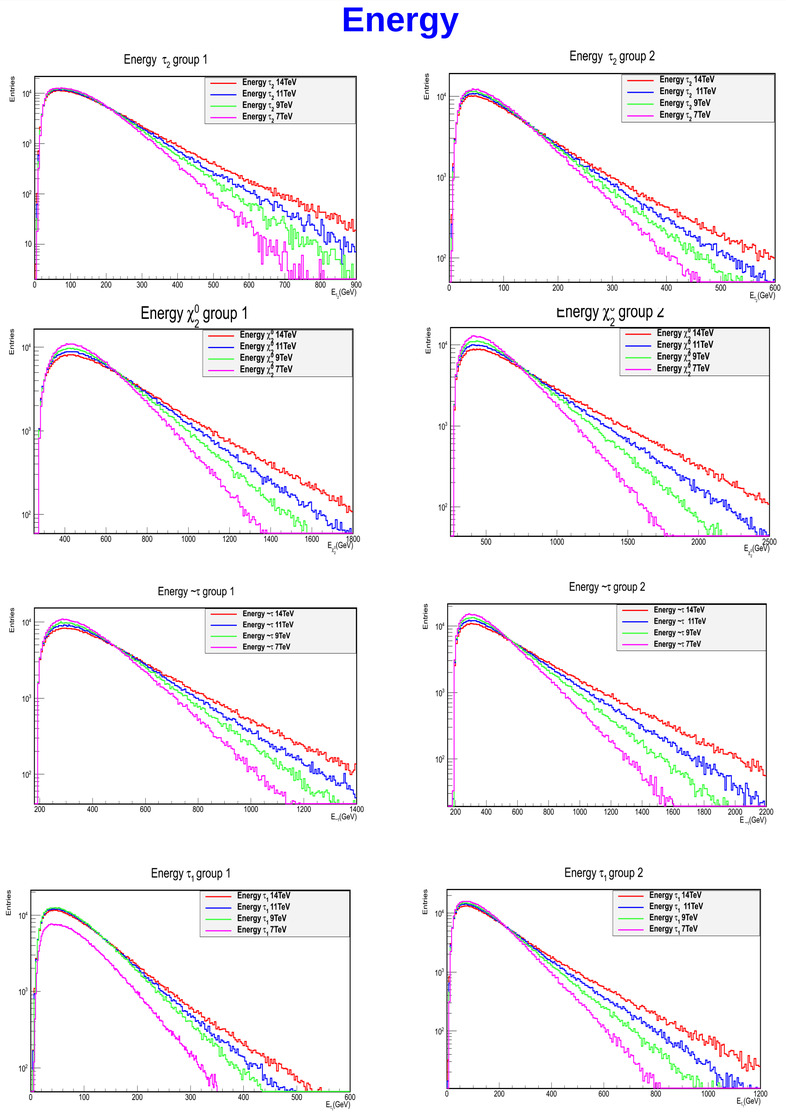
The values obtained for energy and momentum for each particle presented in the decay channel were obtained and the energy and angular distribution were plotted.

with the aim to get an geometric idea of the channel, was obtained the energy for each particle and the angular separation of the particles that belong to the same vertex that was obtained with the next equation:

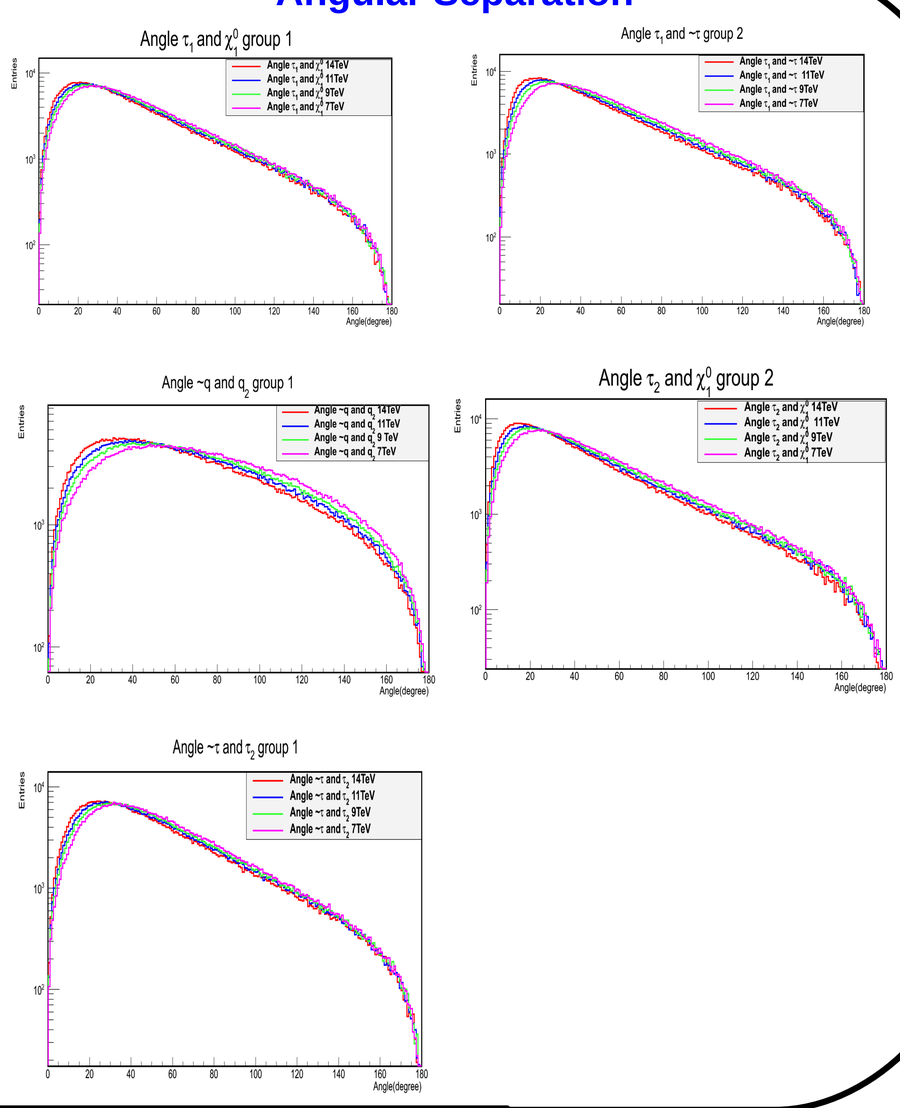
$$\theta = Cos^{-1}\left(\frac{\vec{P}_1 \cdot \vec{P}_2}{P_1 P_2}\right)$$

Where Pi is the momentum of the particle i.

Energy



Angular Separation



Analysis and preliminary results: Missing transverse energy

Missing transverse energy

One of the most important signals that reveal the existence of supersymmetric matter is the missing transverse energy that leave the lightest neutralino LSP (Lightest, supersymetric particle), when this particle passes through the detector. This energy is reconstructed from the sum vector of the transversal energies deposited in all cells in the calorimeter. Then the missing energy vectors is given by:

$$\vec{E}_T^{miss} = -\sum_n \left(E_n \sin\theta_n \cos\phi_n \,\hat{i} + E_n \sin\theta_n \sin\phi_n \,\hat{j}\right)$$

In the figure(2) is showed the missing energy for some center of mass energies

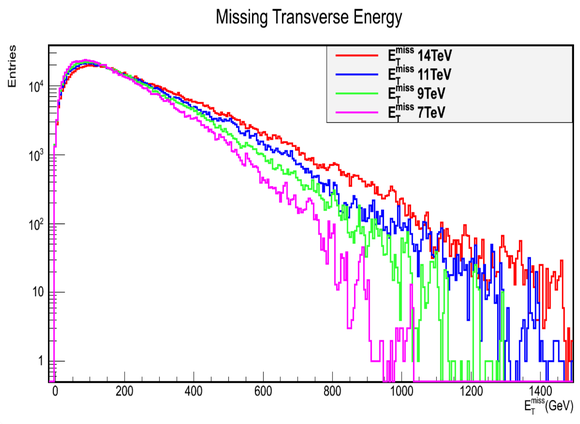


Figure 2.

Summarized results

In the table 1 and 2 are presented the mean values obtained for the histograms related to the two groups of the decay channel and the energies for the different particles (neutralinos, super-tau, tau)

In the figure 3 and 4 all this results are plotted to see the energy dependence with different center of mass energy.

Group 1

Particle	7 TeV	9 TeV	11 TeV	14 TeV
$\widetilde{\chi}_1^0$	301.3 GeV	326.7 GeV	342.3 GeV	361.3 GeV
τ_1	89.81 GeV	96.09 GeV	100.5 GeV	107.5 GeV
$\widetilde{\tau}$	399.2 GeV	422.9 GeV	442.4 GeV	466.2 GeV
τ_2	134.8 GeV	143 GeV	150.5 GeV	159 GeV
$\widetilde{\chi}_2^0$	540.6 GeV	574.1 GeV	600.9 GeV	633.8 GeV
q_1	411 GeV	435.8 GeV	457 GeV	485.9 GeV
$\widetilde{q}$	956.8 GeV	1003 GeV	1038 GeV	1138 GeV
q_2	111.4 GeV	116.7 GeV	120.7 GeV	134.3 GeV

Table 1.

Group 2

Particle	7 TeV	9 TeV	11 TeV	14 TeV
q	411 GeV	482.8 GeV	515.9 GeV	485.9 GeV
$\widetilde{\chi}_2^0$	596.4 GeV	649.2 GeV	703 GeV	765.7 GeV
τ_1	149.4 GeV	162.8 GeV	176.3 GeV	192 GeV
$\widetilde{\tau}$	440.1 GeV	478.1 GeV	519.6 GeV	569.1 GeV
τ_2	100.4 GeV	108.8 GeV	116.2 GeV	126.1 GeV
$\widetilde{\chi}_1^0$	341.4 GeV	370.2 GeV	400.3 GeV	437 GeV

Table 2.

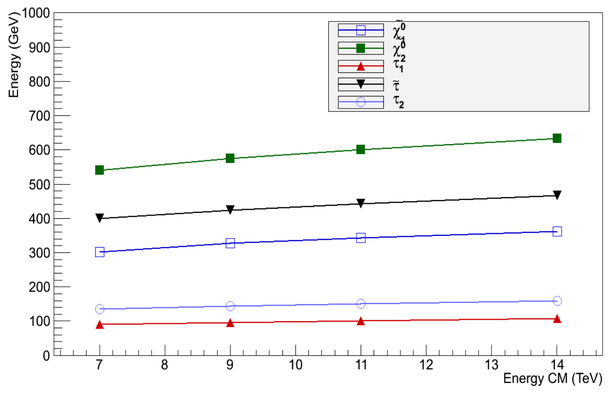


Figure 3. Group 1

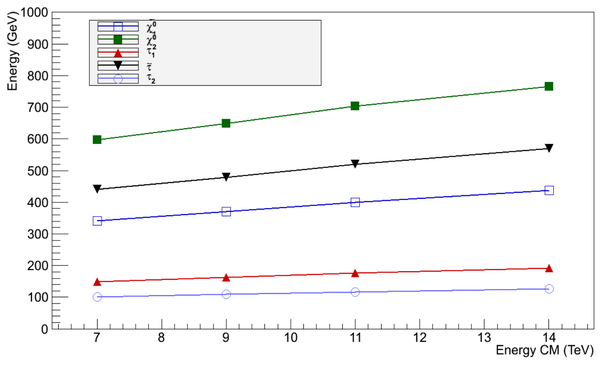


Figure 4. Group 2

References

Huertas Lina, Producción de s-quarks y gluinos en el experimento CMS.

Dominique J. Mangeol Reconstruction of SUSY with tau's in the final state at CMS.

Cavanugh R. Inclusive SUSY Searches at CMS with Emphasis on Detector Systematics.

Pythia 6.4 Physics and Manual

https://pythia6.hepforge.org/

ROOT An object-Oriented Data Analysis Framework

http://root.cern.ch/drupal/