An upgrade study of chargino detection with finer mass splittings.

Janis Erdmanis
graphitewriter@gmail.com
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I. INTRODUCTION

In the standart model Higgs mass is highly sensitive to the details of the physics at high-energy [...]. Unless we accept big number cancelactions in SM, it does not work well with naturalness principle and so we may find solution in BSM physics. One of theories which resolves this issue is supersimetry which introduces new particles, new processes at higher energies. Present knowledge of exlcluded susy parameters requires small higsino mass splittings with energies larger than $100GeV$[1], but smaller than $1TeV$ for naturalness principle to hold. This study considers possibility to catch susy signal in high luminosity LHC data from ATLAS experiment with higsino mass splittings $\Delta m = 5GeV$ and $\mu = 100GeV$ (see figure).

In our study we are trying to find signal which comes from pp colision produced chargaino particle $\tilde{\chi}_1^+, \tilde{\chi}_1^-$ decay to W and Z bosons and further to two or three measurable soft leptons and neitrinos and neitralinos (see figure). If in the pp collision also single jet is produced then for conserving transverse momentum a big missing energy would be produced for neitrinos and neitralinos which will distinguish singnal from standart model background. As a

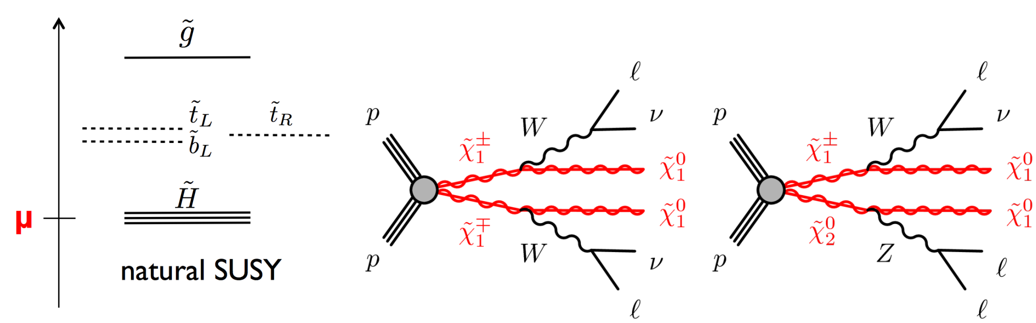

FIG. 1: Considered susy signals in our analysis.

background we consider processes $pp \to \tau\tau + j$, $pp \to t\bar{t} + j$, $pp \to WW + j$. Also because of the large crossection (see table) of process $pp \to W + j$, we consider also background leptons which are incorectly detected and comes from jets (fake leptons).

Process	σ_{eff}
$pp \to \tau\tau + j$	$47.6pb$
$pp \to t\bar{t} + j$	$8.9pb$
$pp \to W + j$	$162pb$
$pp \to WW + j$	$1.34pb$
$pp \to \tilde{\chi}_1^+\tilde{\chi}_1^- + j \to WW + j$	$2.8pb$
$pp \to \tilde{\chi}_1^+\tilde{\chi}_2^0 + j \to WZ + j$	$5pb$

TABLE I: Cross sections for considered processes for collisions at $14TeV$

To study and compare the signal and backgrounds, we turn to Monte Carlo. We simulate the hard processes for the signal in Eq. (8) and the major backgrounds with Madgraph 6. The parton-level events are then showered and hadronized with Pythia 8.

[1] From data of Large electron positron accelerator.

II. SMEARING OF EVENTS

Because detector simulation is costly we use a simplified detector algorithm. Firstly we smear energies, masses, momenta, η, ϕ of all objects (particles and jets) with corresponding performance functions. As jets also produce leptons we add fake electrons which takes into account performance of jet reconstruction algorithms. At the next step we filter out particles which can be detected in ATLAS - $|\eta_l| < 2.5$, $Pt_j > 50GeV$. (What does OverlapRemovel do?). To remove electrons which could come from jets we require that energy and momentum of leptons should be at least 15% with respect to energy of 20^0 and momentum of 30^0 cone. Also we remove low mass lepton pairs $m_{ll} < 12GeV$ because .... And lastly we apply 0.9 probability to actually detect the particle.

To test if the smearing of events works we plotted leading jet transverse momentum at different stages of algorithm (see figure ...). In the figure we see that smearing indeed makes distribution broader, considerable amount of fake particles also are added, and overlap removal helps to recover the shape of generator Pt shape.

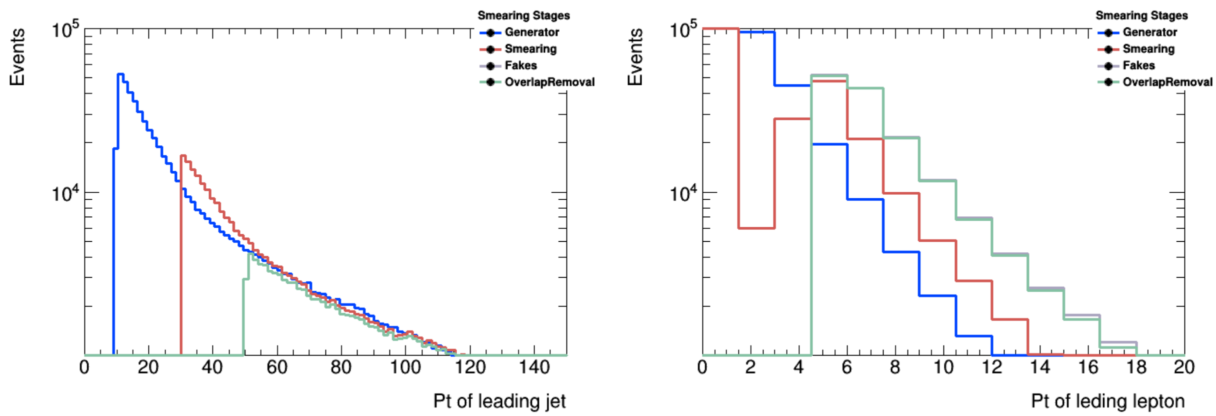

FIG. 2: Tests of smering functions for signal sample

III. EVENT SELECTION

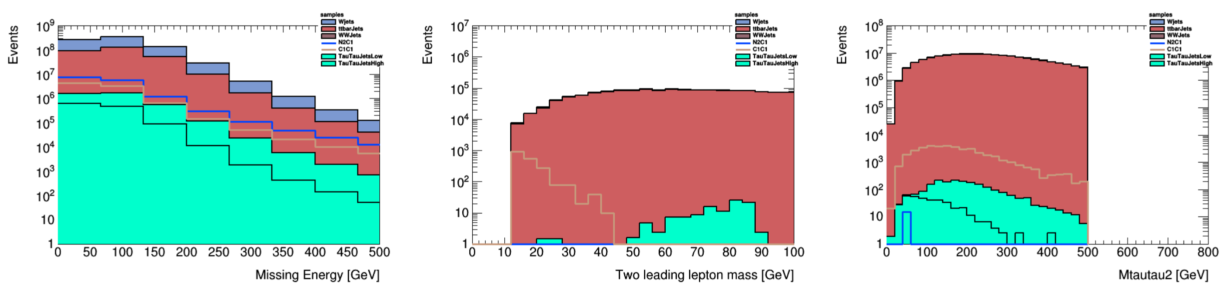

FIG. 3: Missing energy, two leading lepton mass m_{ll} and reconstructed tautau mass $m_{\tau\tau}$ with formula (...)

To compare and check our simulation and smearing algorithm we use selection from [...] for the same kind of process.

- $MET > 100GeV$. Because we expect large missing energy in form of neitralinos and neitronos in our signal.
- Single Jet with $Pt > 100GeV$ and no $Bjets$ in event. We want missing energy to come from particles not in jets and bjets are produced mainly by background $pp- > t\bar{t} + j$.
- $2\ leading\ lepton\ Pt > 7GeV$. We are eliminating here not considered background
- $m_{\tau\tau} > 150GeV$. Should eliminate $pp \rightarrow \tau\tau$ background as it has resonance at $100GeV$.
- $M(1stl + 2ndl) < 12GeV$.

where we also afterwards make seperation for two and three lepton processes.

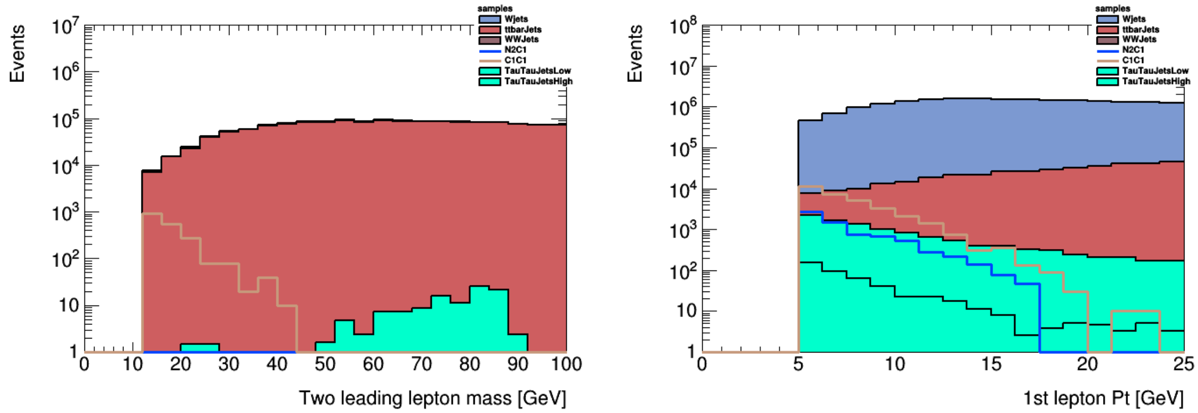

FIG. 4: The signal after sellection

IV. CONCLUSSIONS