An upgrade study of chargino detection with finer mass splittings.

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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 leptons and neitrinos (see figure). The SM background which is similar to our signal

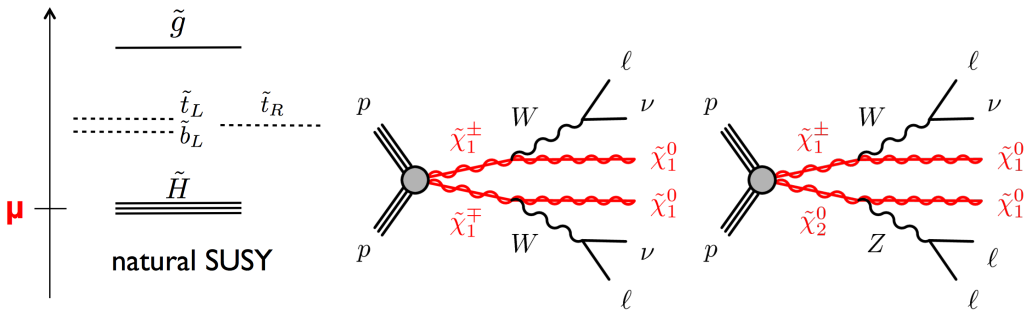

FIG. 1: Considered susy signals in our analysis.

which also produces 2 or 3 soft leptons comes from $pp \to \tau\tau + j$, $pp \to t\bar{t} + j$, $pp \to W + j$. Also because of the large crossectionof process $pp \to WW + j$, we consider also background leptons which are incorectly detected and comes from jets (fake leptons). Cross sections for theese processes are available in table. MadGraph event generator for all

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 $14TeV$

theese processes is used from which we try to extract signal with appropriate selection.

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

[1] From data of Large electron positron accelerator.

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.

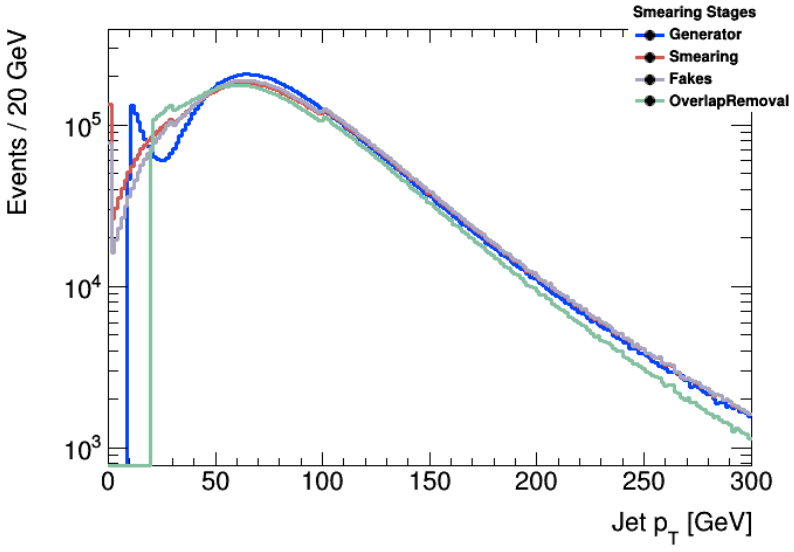

FIG. 2: Leading jet Pt at different stages of algorithm for process $pp \to WW + j$.

III. HISTOGRAMS BEFORE SELECTION

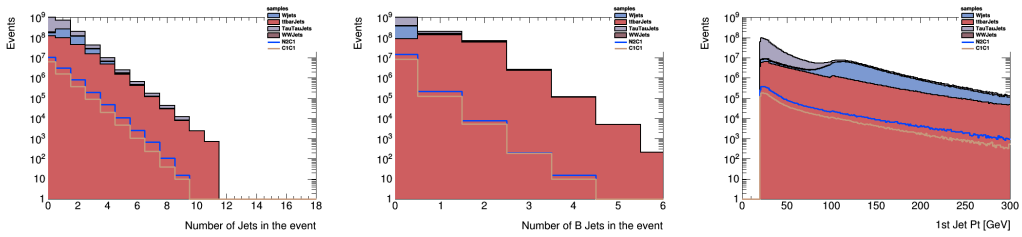

FIG. 3: Number of Jets, Bjets and leading jet transverse momentum.

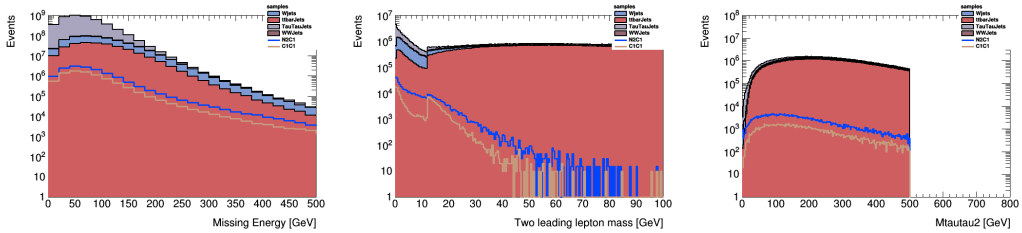

FIG. 4: Missing energy, two leading lepton mass m_{ll} and reconstructed tautau mass $m_{\tau\tau}$ with formula (...)

IV. EVENT SELECTION

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

- $MET > 100GeV$. Because ...
- $1stJetPt > 100GeV$.
- 2 *leading lepton* $Pt > 7GeV$.
- $m_{\tau\tau} > 150GeV$.
- $M(1stl + 2ndl) < 12GeV$.

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

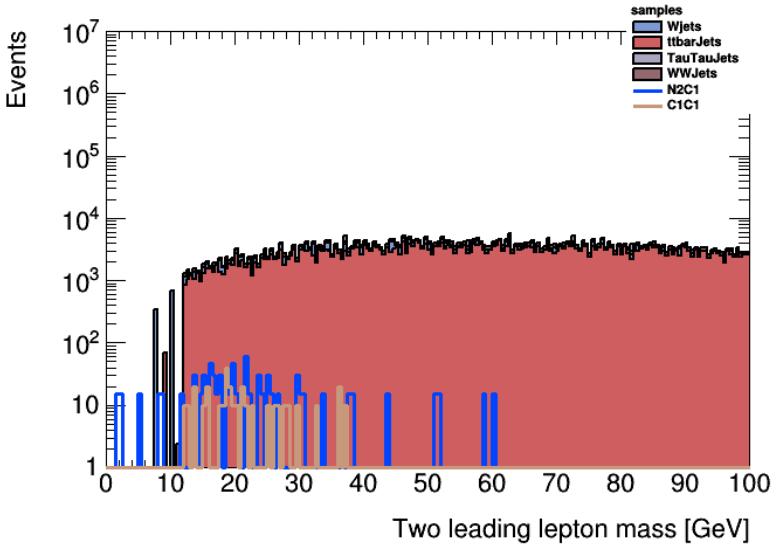

FIG. 5: Two leading lepton masses m_{ll}.

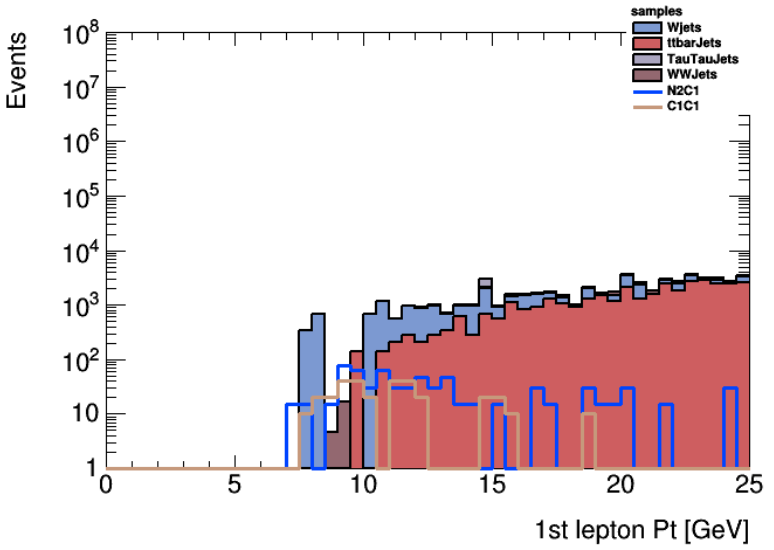

FIG. 6: Leading lepton Pt.