# An upgrade study of chargino detection with finer mass splittings.


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## I. INTRODUCTION

In the standart model Higgs mass is highly dependant on UV physics which leads to so called hierachy problem [...]. 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 the sensitivity to the details of the physics at high-energy is supersimetry which introduces new particles, new processes at higher energies. Naturallness principle and present knowledge of exlcluded susy parameters requires smallest mass splittings (chargaino and neitralino) for higgsino field which we are trying to catch here with assumption that we would have high luminosity LHC data from ATLAS experiment.

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

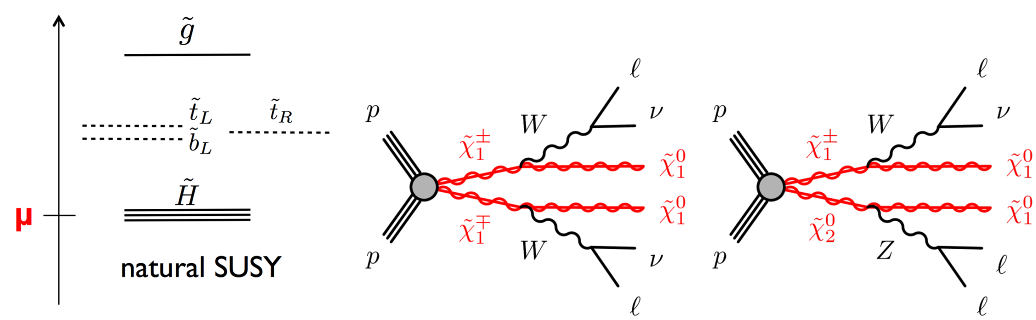


FIG. 1: Considered susy signals in our analysis.

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

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, $\eta$, $\phi$ 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.

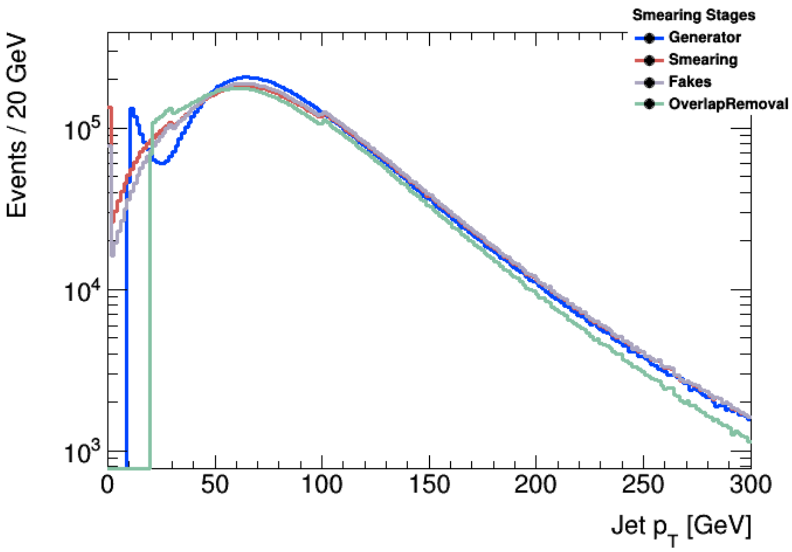


FIG. 2: Leading jet Pt at different stages of algorithm for process $pp \to WW + j$.

## III. HISTOGRAMS BEFORE SELECTION

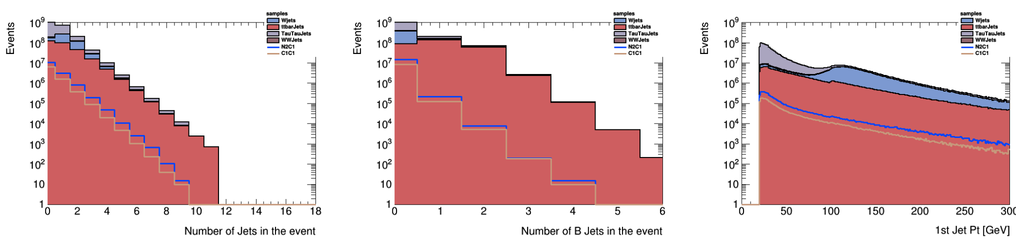


FIG. 3: Number of Jets, Bjets and leading jet transverse momentum.

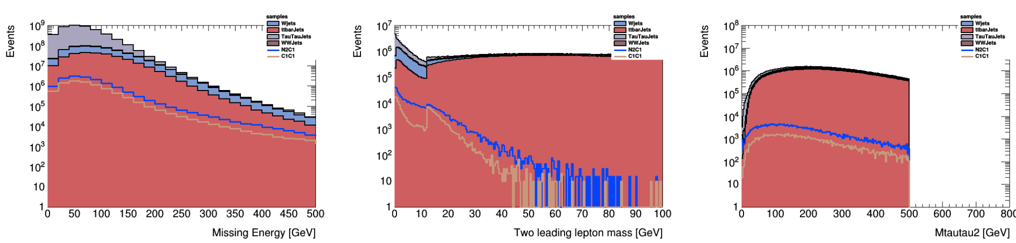


FIG. 4: Missing energy, two leading lepton mass $m_{ll}$ and reconstructed tautau mass $m_{\tau\tau}$ with formula (...)

## 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.

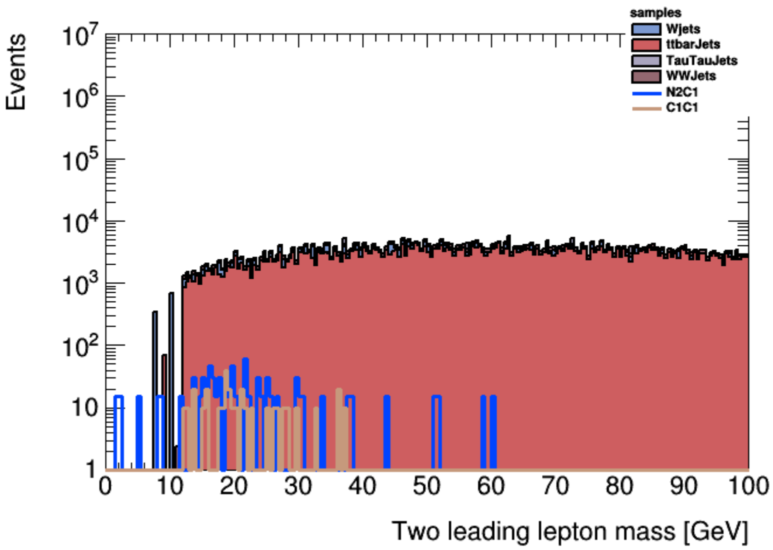


FIG. 5: Two leading lepton masses $m_{ll}$.

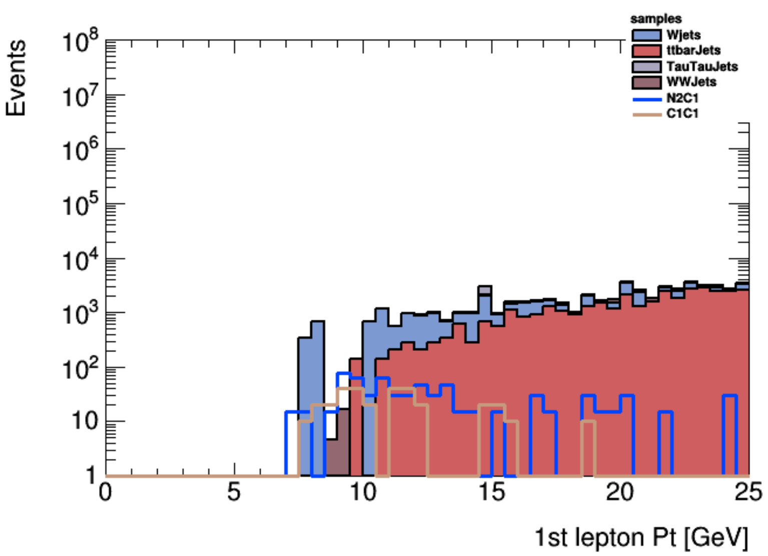


FIG. 6: Leading lepton Pt.