Comparison of GMSB Supersymmetry and Standard Model in ATLAS

using $Z(\ell^+\ell^-)+ \not{E}_T$ final state; $\ell = \mu, e$

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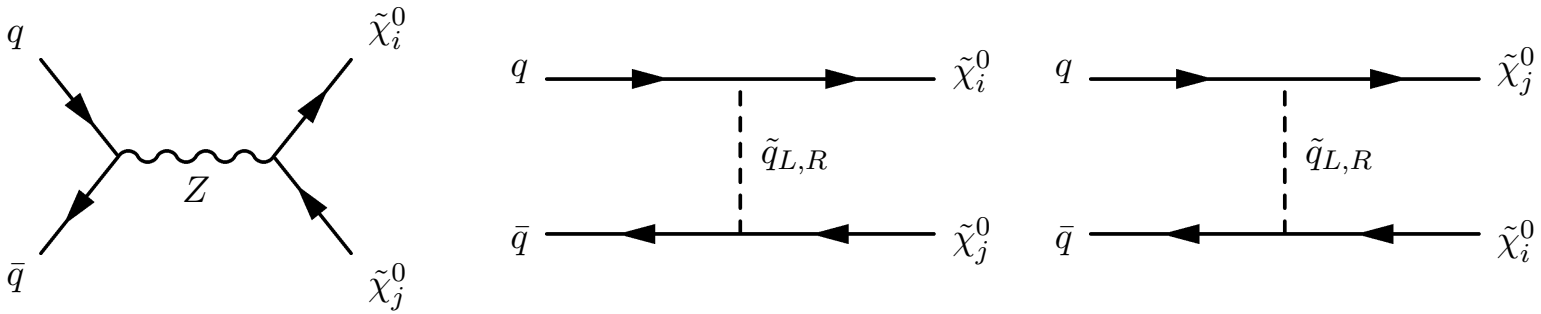
GMSB Comparison with SM

- Inclusive search using the $Z(\ell\ell)+\not{E}_T$ final state
- No requirement on source of Z - all included
- Different production mechanisms lead to different types of events
- Compare GMSB signal in two different channels to Standard Model "inclusive Z" background



Example of Neutralino-Neutralino production in GMSB

Mass Spectrum Generation

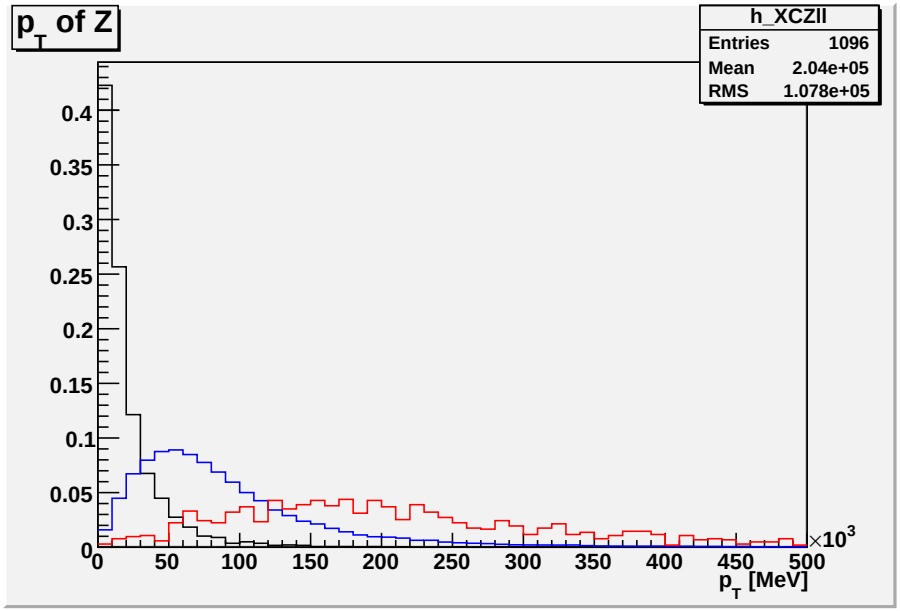
- Phenomenology of a SUSY model depends on the identity of the lightest supersymmetric particle (LSP) and the next-to-lightest supersymmetric particle (NLSP).
- All sparticles cascade decay to the NLSP which then decays to its superpartner and the (stable) LSP.

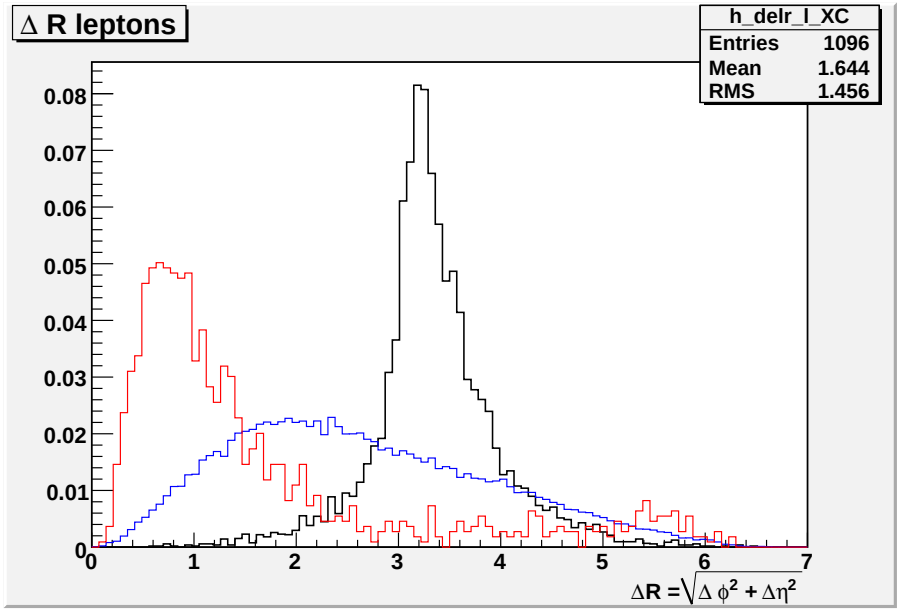
Λ	M	N_5	$\tan(\beta)$	μ	C_{grav}
80 TeV	3Λ	2	3	169 GeV	1

Paricle	**Mass**
$\tilde{G}$ (LSP)	4.62 eV
$\tilde{\chi}_1^0$ (NLSP)	134.7 GeV
$\tilde{\chi}_4^0$	443.3 GeV
$\tilde{C}_2^{\pm}$	442.9 GeV

- Three particles in Red are grouped together (similar masses) in following plots

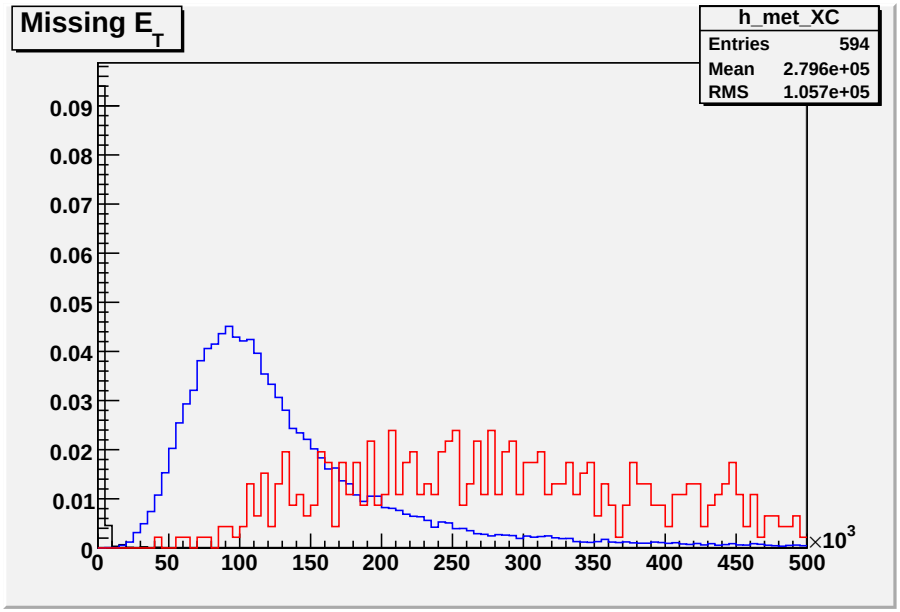
All plots normalized to 1 in order to compare shapes

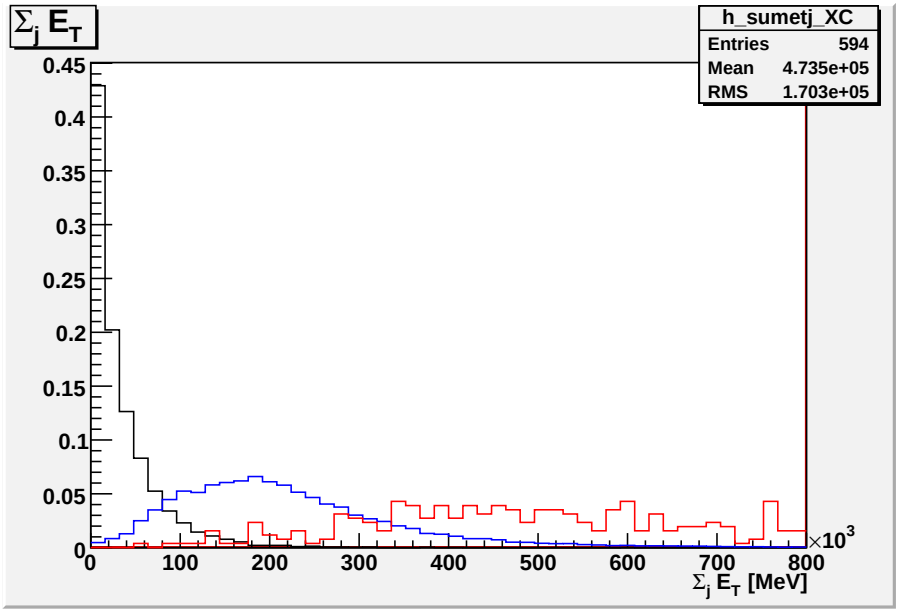




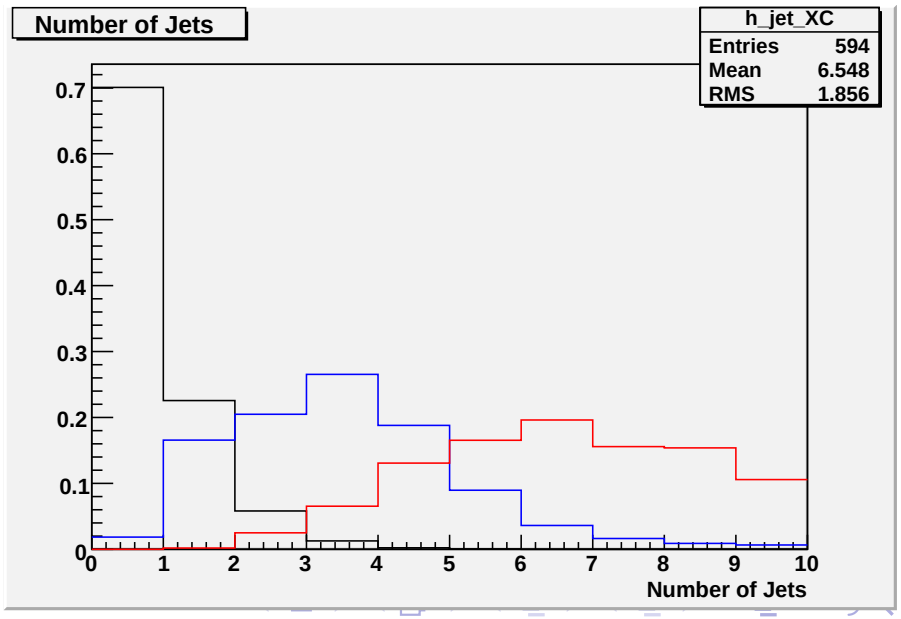
- More massive parent in GMSB results in greater p_T of Z
- Leptons receive a boost due to this higher p_T, more massive parent $\Rightarrow$ smaller ΔR

Process	Mass
SM Inclusive Z	-
$\tilde{\chi}_1^0$	134.7 GeV
$\tilde{\chi}_4^0, \tilde{C}_2^{\pm}$	~443 GeV





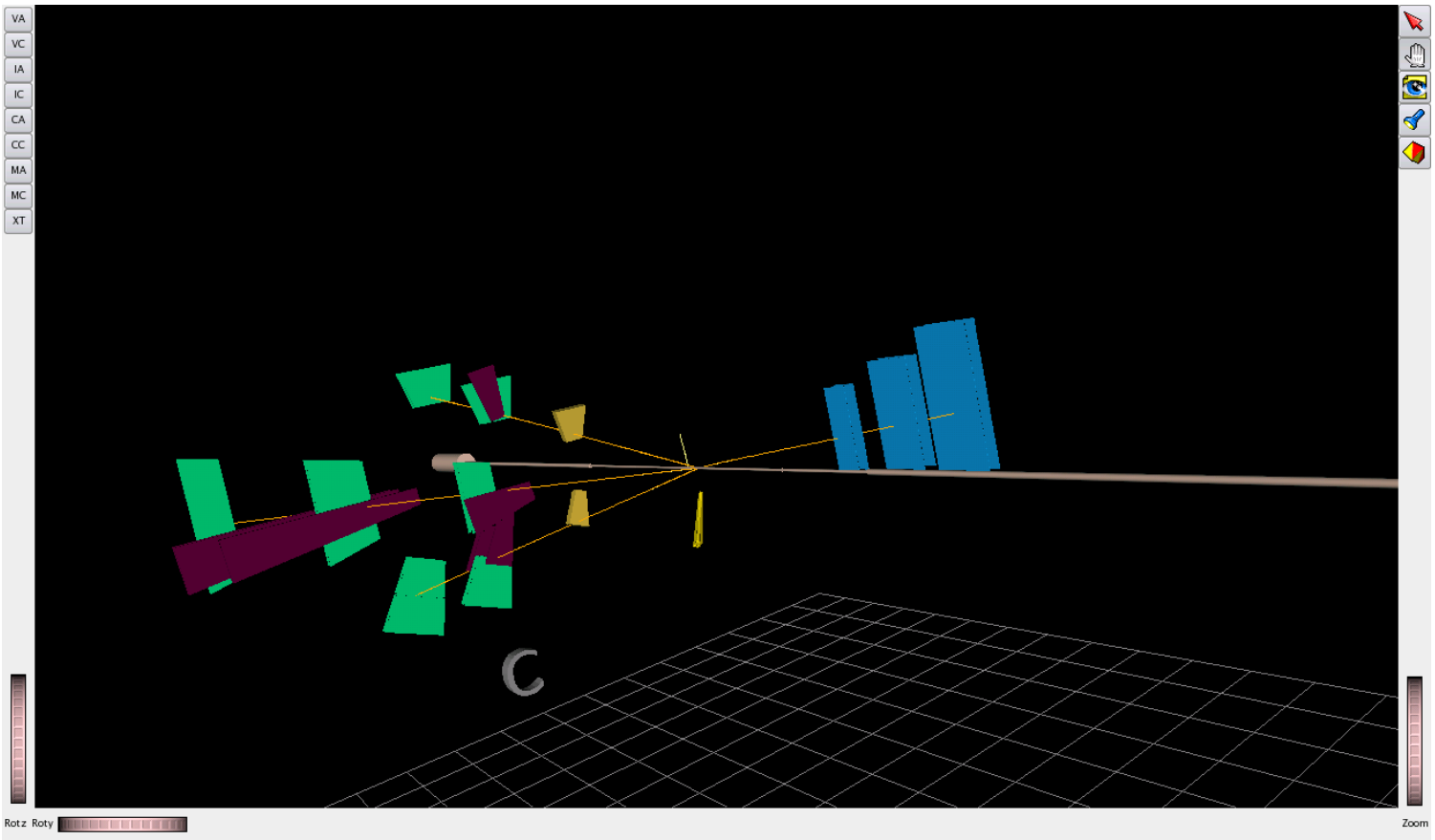
Process	**Mass**
SM Inclusive Z	-
$\tilde{\chi}_1^0$	134.7 GeV
$\tilde{\chi}_4^0, \tilde{C}_2^{\pm}$	$\sim$443 GeV



- Heavier parent implies a cascade decay in the event, i.e. more jets and more missing E_T

$$\tilde{C}_1^+ \to \tilde{\chi}_1^0 + d + \bar{u}$$

$$\tilde{\chi}_3^0 \to \tilde{\mu}(\to \tilde{\chi}_1^0 + \mu) + \mu$$



Plan

- Compare kinematics of $Z(\ell\ell)$ final state within GMSB for different sources: missing E_T, etc.
- Obtain mSUGRA ntuple of events
- Compare distributions between GMSB and mSUGRA

Backup

Event Generation and Preselection

Generation

- Generated 75000 events of the process $pp \to \tilde{\chi}_1^0 \tilde{\chi}_1^0$ based on the SUSY mass spectrum with ATLAS Athena 14.2.25.9
- **Forced** $Z \to \ell\ell$, $\ell = \mu, e$ decay mode (to save time in event generation)
- For 10 TeV, $\sigma(pp \to \tilde{\chi}_1^0 \tilde{\chi}_1^0) = 1.88$ pb.

Preselection

- $Z \to \ell^+\ell^-$, $|\eta(\mu/e)| < 2.5$ and $p_T(\mu/e) > 6$ GeV