Monojet search for new phenomena with the ATLAS detector

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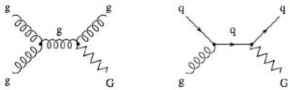
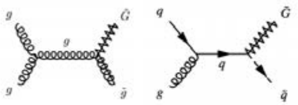
Topologies and Interpretations

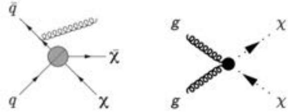
Large Extra Dimensions



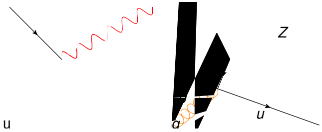
Squark/Gluino + Gravitino



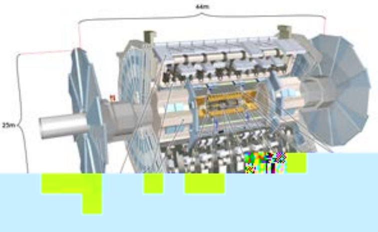
WIMP

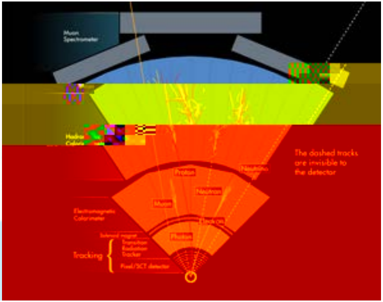


Main Background



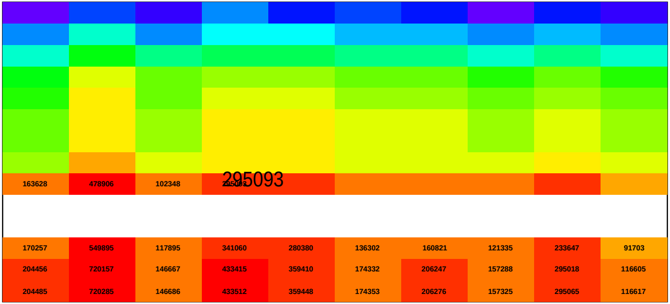
The ATLAS detector





- Partons hadronize to produce steams of columnated particles called \jets"
- Jets deposit their energy in the EM and hadronic calorimeters
- Noninteracting particles escape the detector leaving a momentum imbalance in the plane transverses to the beam line (E_T^{miss}).

Baseline selection



1. Trigger: E_T^{miss} (online) threshold > 80 GeV (4-9% events pass cut)
2. Vertex cut: at least one vertex with at least two tracks (99.9%)
3. Jet cleaning: reject events with poorly reconstructed/mismeasured jets (83%)
4. Lepton Veto: reject events with electrons or muons (96%)

Baseline selection

5. MET cut: E_T^{miss} (o ine)> 120 GeV (4.5%)
6. Lead jet cut: jet p_T > 120 GeV and central (64%)
7. Lead jet cleaning: additional quality cuts to reject non-collision bkg (95%)
8. Third jet veto: reject events with more than 2 jets (53%)
9. Delta phi cut: reject event where E_T^{miss} is aligned with second jet to reduce fake E_T^{miss} (64%)
10. SR2: E_T^{miss} > 220 AND jet p_T > 220 GeV (8%)
11. SR3: E_T^{miss} > 350 AND jet p_T > 350 GeV (10%)
12. SR4: E_T^{miss} > 500 AND jet p_T > 500 GeV (10%)

Backgrounds

- Z ! $+ jet(s)$
    - Irreducible
    - Data-driven estimate
    - Dominant background: 70% (SR3)
- $W(l\ )/Z(ll) + jet(s)$
    - Lepton(s) not reconstructed/misidenti ed
    - Data-driven estimate
    - For W: 29%, Z: 0.16% (SR3)
- Multijet
    - mis-measured jet
    - Matrix method
    - fSR1, SR2, SR3, SR4 g = f1.9%, 0.78%, 0.00%, 0.00%g
- Diboson, tt single top
    - Monte Carlo estimate
    - Combined 1% (SR3)
- Non-Collision
    - Beam halo, cosmic muons
    - Data-driven estimate
    - fSR1, SR2, SR3, SR4 g = f0.19%, 0.086%, 0.00%, 0.00%g

EW Background estimate

Main backgrounds come from $W{=}Z + jet(s)$. A Data-driven method is used to estimate the backgrounds in the SR from a CR.

Data-driven estimate procedure

1. Select data events in CR: N_{CR}^{Data}
2. Remove background in CR: $(N_{CR}^{Data} \quad N_{CR}^{multijet})(1 \quad f_{EW})$
   - where $f_{EW} = \frac{N^{CR;MC}\,(All\ EW\ channels\ except\ CR\ process)}{N^{CR;MC}\,(All\ EW\ channels)}$
3. Use transfer function (TF) to correct from lepton phase space to SR: $TF = \frac{N_{SR\ process}^{MC}}{N_{CR\ process}^{MC}\,SF}$
   - where SF is the product of \scale factors" that correct for trigger and lepton ID e ciencies

Master equation: $N_{SR}^{estimated} = (N_{CR}^{Data} \quad N_{CR}^{multijet})(1 \quad f_{EW}) \quad TF$

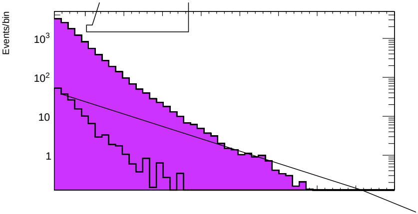
EW CRs

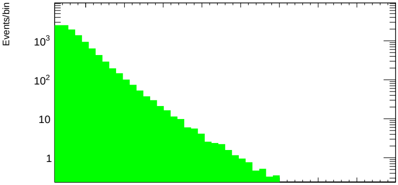
There are four CRs that can be used to estimate SR backgrounds:

SR process	$Z \to \nu\bar{\nu}$+jets	$W \to \tau\nu$+jets $W \to \mu\nu$+jets	$W \to e\nu$+jets	$Z \to \tau^+\tau^-$+jets $Z \to \mu^+\mu^-$+jets
CR process	$W \to e\nu$+jets $W \to \mu\nu$+jets $Z \to e^+e^-$+jets $Z \to \mu^+\mu^-$+jets	$W \to \mu\nu$+jets	$W \to e\nu$+jets	$Z \to \mu^+\mu^-$+jets

- $N^{MC}_{CR\ process}$ is found with SR selection on E_T^{miss} after lepton(s) are removed.
- Currently working on $Z\ !\quad ee + jet(s)$ CR for SR $Z\ !\qquad + jet(s)$ background estimate

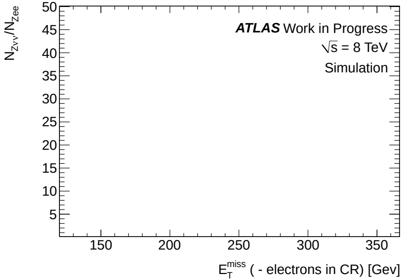
Zee CR

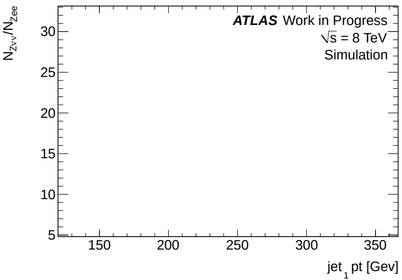




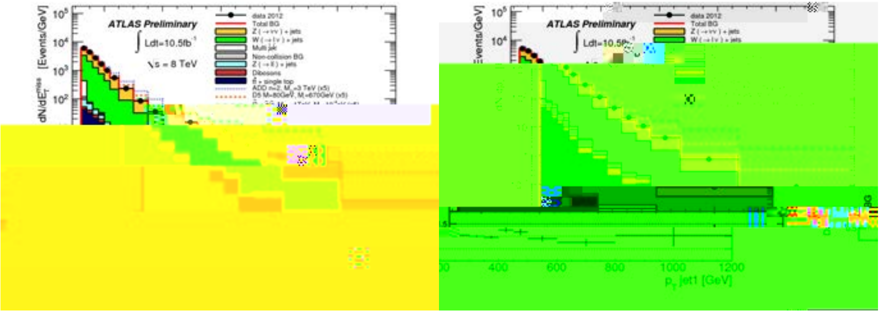
- Trigger : lowest unprescaled two-electron trigger
- Good Electrons: Inverted electron veto, $p_T > 25GeV$
- e-jet overlap removal: remove closest jet within the vicinity of a good electron ($R > 0{:}5$)
- Z mass: invariant mass cut $66GeV < M_{ee} < 116GeV$

Transfer Functions



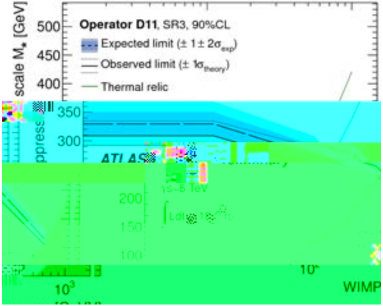


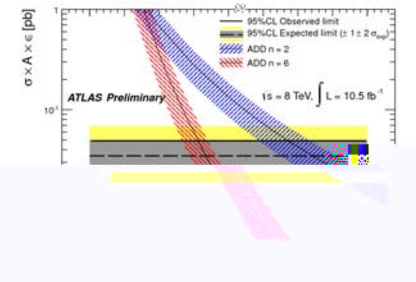
- $E_T^{CR} = E_T^{miss}$ *electrons*
- Transfer functions applied to each bin
- Higher stat. samples needed for full SRs

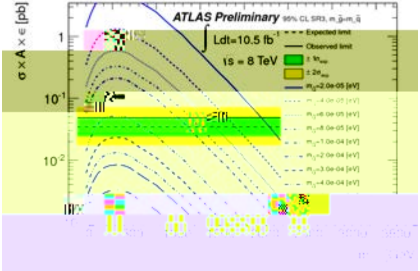


- Dashed lines indicate prediction from respective theory interpretations
- No excess above Standard Model observed
- Limits on interpretations set.

HCP Limits (ATLAS-COM-CONF-2012-190)



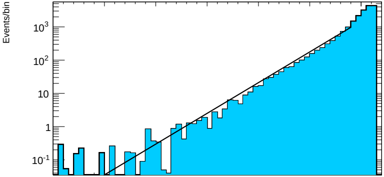




- Sensitivity limited by background MC statistics in SR3
- For full dataset analysis we expect a signi cant increase in sensitivity with new Sherpa samples

Backup slides

Auxiliary Zee distributions



Blinding strategy

Proposed blinding strategy is de ned by 3 phases:

Blinding procedure

1. Blinding: Look in SR1 ($E_T^{miss}; p_T^{jet} > 120$) only, with the subset of events de ned by EventNumber%N==0
2. Partial unblinding: Look in all SRs, but only with the same subset of events (EventNumber%N==0)
3. Full unblinding: Look at all data

Where N is chosen such that we are insensitive to signals beyond the HCP SR3 limits. Using HCP results N=12.

Tigger e ciency curves (ATLAS-COM-CONF-2012-190)