Search for SUSY in CMS multi-jet events with missing energy

Jared Sturdy on behalf of the CMS Collaboration

UNIVERSITY OF CALIFORNIA UC RIVERSIDE

Introduction/Motivation

R-parity conserving SUSY models provide possible candidates for dark matter. In these models, SUSY particles are pair produced, and decays terminate with an LSP, a stable, neutral non-interacting particle. This particle will escape the detector undetected

We present an inclusive search for hadronic events with jets and missing transverse momentum on 1.1/fb of pp data collected with the CMS detector with center-of-mass energy of 7 TeV

All our backgrounds are estimated using various data-driven techniques

Event Selection

Events are selected from a suite of H_T/MH_T cross triggers

H_T is the scalar sum of the p_T of all jets (p_T > 50 GeV, $|\eta|$ < 2.5)

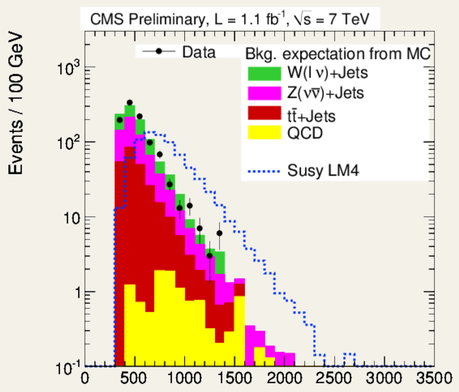
MH_T is the vectorial sum of the p_T of all jets (p_T > 30 GeV, $|\eta|$ < 5.0)

For our baseline selection, we require

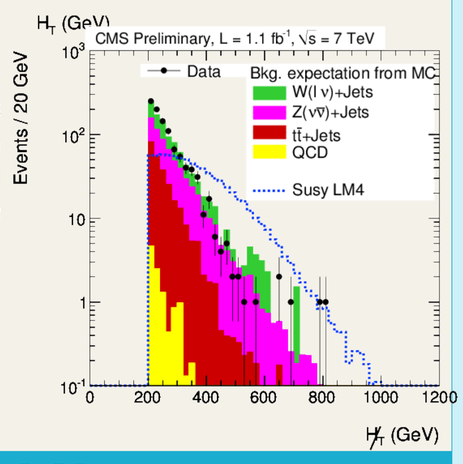
- at least 3 central H_T jets
  - We utilize ParticleFlow jets, reconstructed with the anti-k_T clustering algorithm
- no isolated leptons
- $\Delta\phi$(Jet,MH_T) > (0.5,0.5,0.3) for the 3 leading (MH_T) jets

To complete the baseline selection, we require

- H_T > 350 GeV
- MH_T > 200 GeV



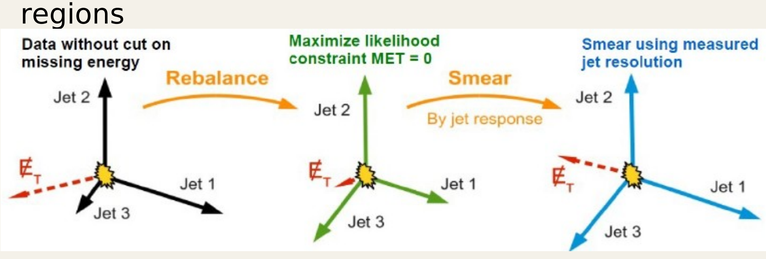
Data/MC comparisons for our search variables compared with a representative cMSSM sample point



QCD

The primary ways QCD events pass our selection is through semi-leptonic decays of heavy flavor jets and through detector effects

We utilize a "re-balance and smear" method to estimate the number of QCD events in our signal regions



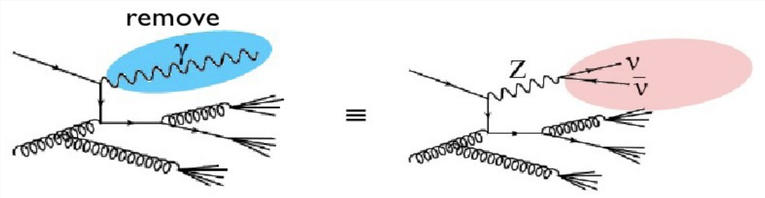
Events are selected from various H_T triggers, and the jet response is sampled p*100 times to obtain the prediction, where p is the prescale value for the given trigger

This is done to sample a complete range of H_T values in an unbiased way

Z→νν

One of the primary (irreducible) backgrounds to our search is the invisible decay of Z bosons, which mimics our exact signal

To estimate this background, we exploit the similarities in kinematics between this signal and that coming from γ+jets events



By removing the photon and recomputing the event variables H_T and MH_T, this event is the same as our background and we can count these events in data and apply a translation factor to obtain an estimate of the invisible Z background

This correction factor has several parts

- Z/γ ratio taken at generator level
- Reconstruction efficiency
- Acceptance
- Purity of γ sample
- Data/MC efficiency ratio

As a cross-check of this method, we also estimate the invisible Z from Z→ll events

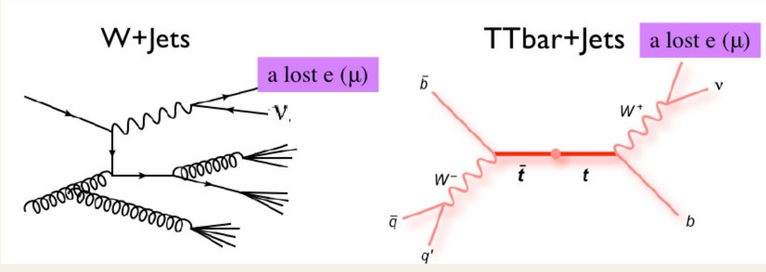
Here we apply a correction factor that takes into account acceptance, reconstruction efficiency and branching ratio difference

For high H_T regions, this method is statistically limited, but for our baseline selection, it agrees well with the γ+jets method

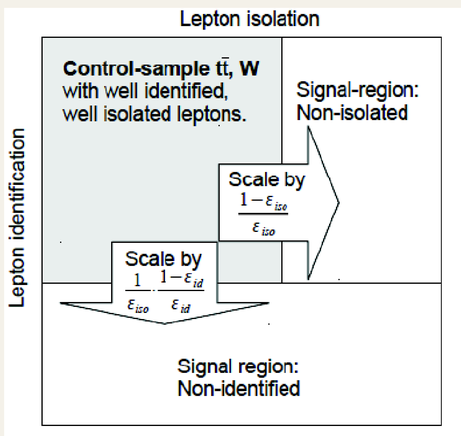
$t\bar{t}$/W

Both $t\bar{t}$ and W events can end up in our search regions in several ways:

- e/μ/τ "lost" - "lost lepton" background
- Hadronic τ decays - "hadronic τ" background



A lepton is "lost" if it fails ID/Isolation and is not rejected by the lepton veto search requirement



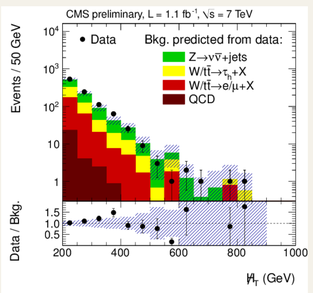
To evaluate the hadronic tau background, a sample of single μ+jets events is used, where the μ is replaced with a jet from a τ-jet response template obtained from MC

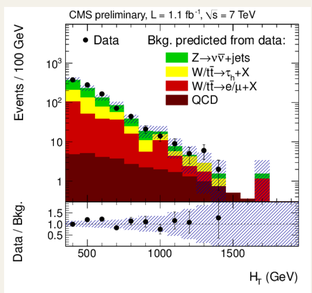
The event variables are then recomputed including this jet and the nominal selections are applied

Additional corrections are due to efficiency, acceptance, and branching fraction are applied to obtain the background estimate

Total Data-Driven Background

Combining all of our data-driven background estimates, we see good agreement with our observed data yield, with no significant excess

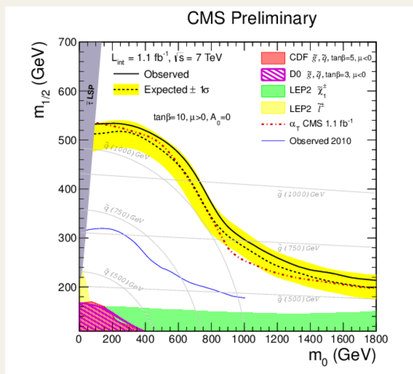




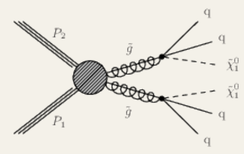
Results/Interpretation

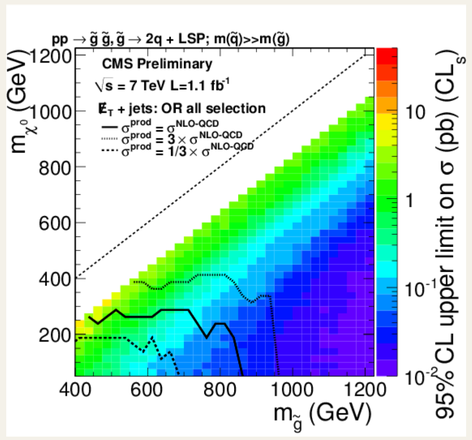
As we see no significant excess in our data yields compared to our SM backgrounds, using our data yields as well as our background estimates in our search regions, we are able to set limits on different SUSY models

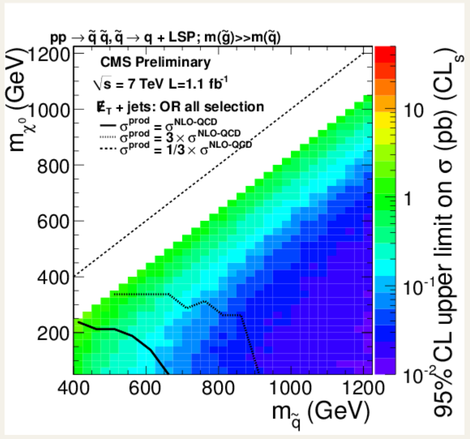
cMSSM – We place limits on the allowed values for m_0 and $m_{1/2}$

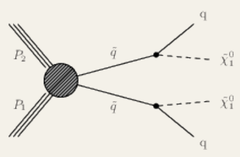


SMS - We also place limits on cross-sections from specific processes from 'simplified model surveys'









Contact Information

Email: sturdy@cern.ch