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Search for supersymmetry in events with a single lepton, jets, and missing transverse momentum using a neural network

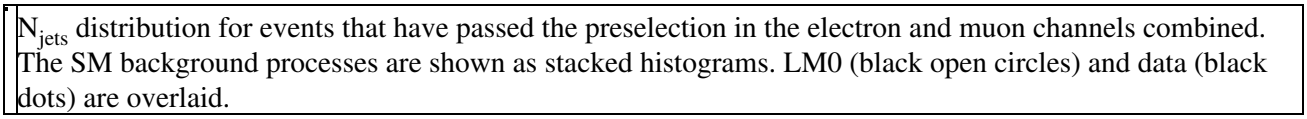
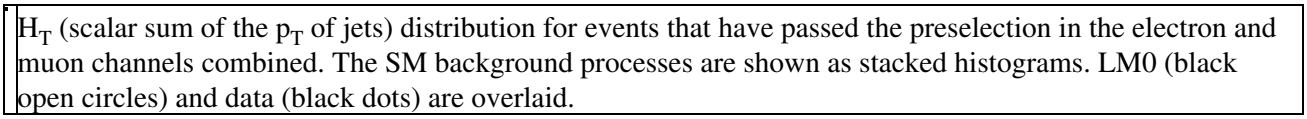
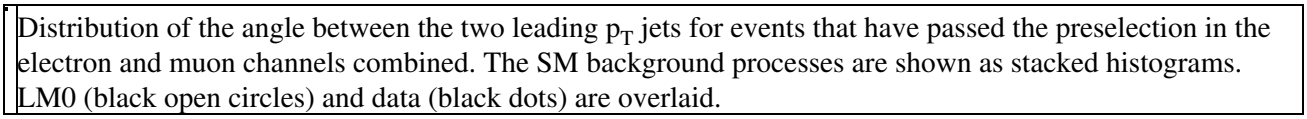
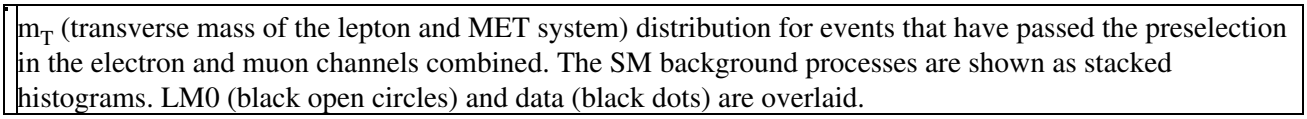
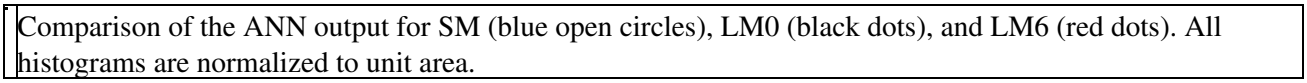
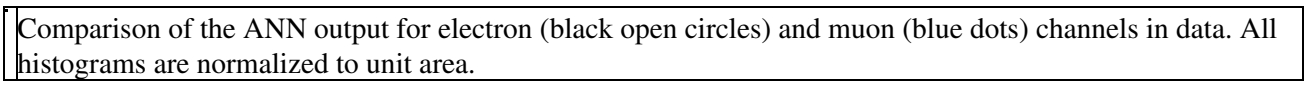
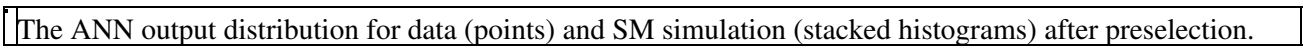
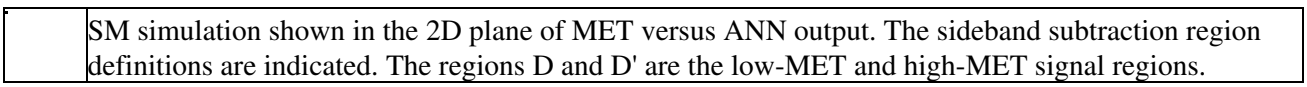
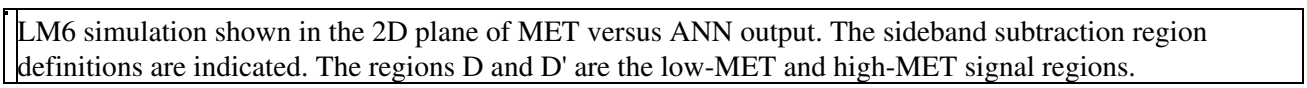
Abstract

A search for supersymmetry in proton-proton collisions at center-of-mass energy of 7 TeV is presented, focusing on events with a single isolated lepton, energetic jets, and large missing transverse momentum. The analyzed data corresponds to a total integrated luminosity of 4.98 fb^{-1} recorded by the CMS experiment. The search uses an artificial neural network to suppress Standard Model backgrounds, and estimates residual backgrounds using a fully data-driven method. The analysis is performed in both the muon and electron channels, and the combined result is interpreted in terms of limits on the CMSSM parameter space.

Link to approved PAS

- CMS-PAS-SUS-11-026

Plots from the PAS

FIGURE (click image for PDF)	Caption
	N_{jets} distribution for events that have passed the preselection in the electron and muon channels combined. The SM background processes are shown as stacked histograms. LM0 (black open circles) and data (black dots) are overlaid.
	H_T (scalar sum of the p_T of jets) distribution for events that have passed the preselection in the electron and muon channels combined. The SM background processes are shown as stacked histograms. LM0 (black open circles) and data (black dots) are overlaid.
	Distribution of the angle between the two leading p_T jets for events that have passed the preselection in the electron and muon channels combined. The SM background processes are shown as stacked histograms. LM0 (black open circles) and data (black dots) are overlaid.
	m_T (transverse mass of the lepton and MET system) distribution for events that have passed the preselection in the electron and muon channels combined. The SM background processes are shown as stacked histograms. LM0 (black open circles) and data (black dots) are overlaid.
	Comparison of the ANN output for SM (blue open circles), LM0 (black dots), and LM6 (red dots). All histograms are normalized to unit area.
	Comparison of the ANN output for electron (black open circles) and muon (blue dots) channels in data. All histograms are normalized to unit area.
	The ANN output distribution for data (points) and SM simulation (stacked histograms) after preselection.
	SM simulation shown in the 2D plane of MET versus ANN output. The sideband subtraction region definitions are indicated. The regions D and D' are the low-MET and high-MET signal regions.
	LM6 simulation shown in the 2D plane of MET versus ANN output. The sideband subtraction region definitions are indicated. The regions D and D' are the low-MET and high-MET signal regions.

	The MET distribution of low ANN output events (0.2 < ANN output < 0.4) (black open circles) overlaid on the MET distribution of high ANN output events (ANN output > 0.4) (blue dots) for SM simulation. The distributions are normalized in the MET sideband, 150 GeV < MET < 350 GeV (regions A and C for the two distributions respectively). The last histogram bin includes overflow.

	The MET distribution of low ANN output events in the presence of LM6 (black open circles), the distribution of high ANN output events in the presence of LM6 (red dots), and the distribution of high ANN output events with SM only (blue dots). The distributions are normalized in the MET sideband, 150 GeV < MET < 350 GeV (regions A and C for the two distributions respectively). The last histogram bin includes overflow.

	Data, SM simulation and LM6 distributions of MET for low ANN output (0.2 < ANN output < 0.4). The SM background processes are shown as stacked histograms; data (black dots) and LM6 (black open circles) are overlaid.

	Data, SM simulation and LM6 distributions of MET for high ANN output (ANN output > 0.4). The SM background processes are shown as stacked histograms; data (black dots) and LM6 (black open circles) are overlaid.

	Data, SM simulation and LM6 distributions of ANN output for the MET normalization region (150 < MET < 350 GeV). The SM background processes are shown as stacked histograms; data (black dots) and LM6 (black open circles) are overlaid.

	Data, SM simulation and LM6 distributions of ANN output for the MET signal regions (MET > 350 GeV). The SM background processes are shown as stacked histograms; data (black dots) and LM6 (black open circles) are overlaid.

	The MET distributions in data for low ANN output (0.2 < ANN output < 0.4) and high ANN output (ANN output > 0.4) events. The normalization region is 150 < MET < 350 GeV.

	CMSSM limit by combining the low-MET and high-MET signal regions.

Tables from the PAS

FIGURE (click image for PDF)	Caption

	Event counts for various regions defined by the background subtraction method.

	Closure test of the background estimation method using SM simulation. Regions D and D' are the low-MET and high-MET signal regions. For D_{pred} (D'_{pred}), the values for the SM components are based on their respective yields in regions A, B and C (A, B' and C). For total SM, the value of D_{pred} (D'_{pred}) is based on the total SM yields in regions A, B and C (A, B' and C). Hence, the values of D_{pred} and D'_{pred} for total SM cannot be obtained by adding the corresponding values for the SM components.

	The background prediction for data. The corrected prediction ignores the statistical uncertainty on the correction factor, since it is treated as a systematic uncertainty.

	Summary of the systematic uncertainties in the background determination.

Additional material

FIGURE (click image for PDF)	Caption

	Expected CMSSM limits using the low-MET and high-MET signal regions by themselves, compared to the expected limit from shape analysis.

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