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Searches for supersymmetry using the MT2 variable in hadronic events produced in pp collisions at 8 TeV

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Searches for supersymmetry using the $M_{T2}$ variable in hadronic events produced in pp collisions at 8 TeV

Abstract

Searches for supersymmetry (SUSY) are performed using a sample of hadronic events produced in 8 TeV pp collisions at the CERN LHC. The searches are based on the $M_{T2}$ variable, which is a measure of the transverse momentum imbalance in an event. The data were collected with the CMS detector and correspond to an integrated luminosity of 19.5 fb$^{-1}$. Two related searches are performed. The first is an inclusive search based on signal regions defined by the value of the $M_{T2}$ variable, the hadronic energy in the event, the jet multiplicity, and the number of jets identified as originating from bottom quarks. The second is a search for a mass peak corresponding to a Higgs boson decaying to a bottom quark-antiquark pair, where the Higgs boson is produced as a decay product of a SUSY particle. For both searches, the principal backgrounds are evaluated with data control samples.

Link to arXiv

This analysis has been documented in the arXiv:1502.04358. It has been submitted to JHEP.

Plots from SUS-13-019

Figures from the paper

| Figure | Formats | Caption |
|--------|---------|---------|
| ![Figure 1](left): Definition of the topological signal regions in terms of the number of jets $N_j$ and the number of b-tagged jets $N_b$. The pie charts illustrate the expected contributions from different SM processes in the different signal regions; they are similar in all three $H_T$ regions. | pdf, png | Figure 1 (left): Definition of the topological signal regions in terms of the number of jets $N_j$ and the number of b-tagged jets $N_b$. The pie charts illustrate the expected contributions from different SM processes in the different signal regions; they are similar in all three $H_T$ regions. |
| ![Figure 1](right): Definition of the subsequent division in terms of the $H_T$ and $E_T^{miss}$. | pdf, png | Figure 1 (right): Definition of the subsequent division in terms of the $H_T$ and $E_T^{miss}$. |
Table 1: Definition of the signal regions used in the inclusive-$M_{T2}$ search.

| $N_j$ | $N_b$ | Low-$H_T$ region $M_{T2}$ bins (GeV) | Medium-$H_T$ region $M_{T2}$ bins (GeV) | High-$H_T$ region $M_{T2}$ bins (GeV) |
|-------|-------|-------------------------------------|--------------------------------------|-------------------------------------|
| 2     | 0     | 200-250 300-400 500-600             | 150-180 220-270 325-425              | 180-200 250-300 350-450            |
| 1     | 0     | 250-300 350-500 450-550             | 200-250 325-400 550-700              | 250-300 400-600 700-900            |
| $\geq 1$ |          | 250-300 350-400 >550                | 200-250 325-400 >550                 | 250-300 400-600 >550               |
| 3-5   | 0     | 250-300 350-400 450-500             | 200-250 325-400 550-700              | 250-300 400-600 700-900            |
| 6     | 0     | 250-300 350-400 >550                | 200-250 325-400 >550                 | 250-300 400-600 >550               |

Figure 2 (top): Distribution of the $M_{T2}$ variable after the low-$H_T$ event selection. The event yields are integrated in the $(N_j, N_b)$ plane over all the topological signal regions, for both simulated and data samples. The plots serves as an illustration of the background composition of the $M_{T2}$ distribution.

Figure 2 (bottom left): Distribution of the $M_{T2}$ variable after the medium-$H_T$ event selection. The event yields are integrated in the $(N_j, N_b)$ plane over all the topological signal regions, for both simulated and data samples. The plots serves as an illustration of the background composition of the $M_{T2}$ distribution.
**Figure 2 (bottom right):** Distribution of the $M_{T2}$ variable after the high-$H_T$ event selection. The event yields are integrated in the $(N_j, N_b)$ plane over all the topological signal regions, for both simulated and data samples. The plots serves as an illustration of the background composition of the $M_{T2}$ distribution.

**Figures of background estimation**

| Figure | Formats | Caption |
|--------|---------|---------|
| ![Figure 3](pdf, png) | pdf, png | **Figure 3:** The ratio $r(M_{T2})$, described in the text, as a function of $M_{T2}$ for events satisfying the medium-$H_T$ and the $(N_j = 3 \ldots 5, N_b = 0)$ requirements of the inclusive-$M_{T2}$ search. The solid circle points correspond to simple data yields, while the points with open circles correspond to data after the subtraction of the non-multijet backgrounds, as estimated from simulation. Two different functions, whose exponential components are |
fitted to the data in the region $50 < M_{T2} < 80$ GeV, are shown. The green dashed line presents an exponential function, while the blue solid line is the parameterization used in the estimation method.

**Figure 4 (left):** Distribution of the $M_{T2}$ variable for events with one electron in data and simulation. The events satisfy either the low-$H_T$ selection (left) or either of the medium- and high-$H_T$ selections (right). They also satisfy the remaining inclusive-$M_{T2}$ selection requirements, with the exception of the lepton veto. Finally, the condition $M_{T2} < 100$ GeV is imposed on the charged lepton-$E_T^{miss}$ system.

**Figure 4 (middle):** Distribution of the $M_{T2}$ variable for events with one muon in data and simulation. The events satisfy either the low-$H_T$ selection (left) or either of the medium- and high-$H_T$ selections (right). They also satisfy the remaining inclusive-$M_{T2}$ selection requirements, with the exception of the lepton veto. Finally, the condition $M_{T2} < 100$ GeV is imposed on the charged lepton-$E_T^{miss}$ system.

**Figure 4 (right):** Distribution of the $M_{T2}$ variable for events with one tau lepton in data and simulation. The events satisfy either the low-$H_T$ selection (left) or either of the medium- and high-$H_T$ selections (right). They also satisfy the remaining inclusive-$M_{T2}$ selection requirements, with the exception of the lepton veto.
veto. Finally, the condition $M_{T2} < 100$ GeV is imposed on the charged lepton-E$_T^{miss}$ system.

**Figure 5:** Distribution of the $M_{T2}$ variable for data and simulation after requiring the presence of one photon, $N_b = 0$, and the remainder of the inclusive-$M_{T2}$ selection criteria. Events satisfying the low-$H_T$ selection (left), and the medium- and high-$H_T$ selections (right) are shown. For these results, $M_{T2}$ is calculated after adding the photon $p_T$ to the E$_T^{miss}$ vector.

**Figure 6:** $Z(\nu\nu)/\gamma$ ratio from simulation as a function of the boson-\(p_T\).

**Result plots**

Results for the inclusive-$M_{T2}$ analysis

| Figure | Formats | Caption |
|--------|---------|---------|
| ![Figure 1](low H_T.png) | low $H_T$: pdf, png | low $H_T$: pdf, png |
| ![Figure 2](medium + high H_T.png) | medium + high $H_T$: pdf, png | medium + high $H_T$: pdf, png |
| ![Figure 3](high H_T.png) | high $H_T$: pdf, png | high $H_T$: pdf, png |

**Figure 7 (top row):** Distributions of the $M_{T2}$ variable for the estimated background processes and for data. Plots are shown for events satisfying the low-$H_T$ (left), the medium-$H_T$ (middle), and the high-$H_T$ (right) selection criteria.
Results for the inclusive-MT2 analysis
selection. This line is for \((N_j = 2, N_b \geq 1)\). The uncertainties in each plot are drawn as the shaded band and do not include the uncertainty in the shape of the lost-lepton background.

Figure 7 (bottom row): Distributions of the \(M_{T2}\) variable for the estimated background processes and for data. Plots are shown for events satisfying the low-\(H_T\) (left), the medium-\(H_T\) (middle), and the high-\(H_T\) (right) selections, and for different topological signal regions \((N_j, N_b)\) of the inclusive-\(M_{T2}\) event selection. This line is for \((3 \leq N_j \leq 5, N_b = 0)\). The uncertainties in each plot are drawn as the shaded band and do...
not include the uncertainty in the shape of the lost-lepton background.

Figure 8 (top row): Distributions of the $M_{T2}$ variable for the estimated background processes and for data. Plots are shown for events satisfying the low-$H_T$ (left), the medium-$H_T$ (middle), and the high-$H_T$ (right) selections, and for different topological signal regions $(N_j, N_b)$ of the inclusive-$M_{T2}$ event selection. This line is for $(3 \geq N_j \geq 5, N_b = 1)$. The uncertainties in each plot are drawn as the shaded band and do not include the uncertainty in the shape of the lost-lepton background.

Results for the inclusive-MT2 analysis
Figure 8 (middle row): Distributions of the $M_{T2}$ variable for the estimated background processes and for data. Plots are shown for events satisfying the low-$H_T$ (left), the medium-$H_T$ (middle), and the high-$H_T$ (right) selections, and for different topological signal regions $(N_j, N_b)$ of the inclusive-$M_{T2}$ event selection. This line is for $(3 \geq N_j \geq 6, N_b = 2)$. The uncertainties in each plot are drawn as the shaded band and do not include the uncertainty in the shape of the lost-lepton background.

Figure 8 (bottom row): Distributions of the $M_{T2}$ variable for the estimated background processes and...
for data. Plots are shown for events satisfying the low-\(H_T\) (left), the medium-\(H_T\) (middle), and the high-\(H_T\) (right) selections, and for different topological signal regions (\(N_j \geq 6, N_b = 0\)) of the inclusive-M_{T2} event selection. This line is for \((N_j, N_b)\). The uncertainties in each plot are drawn as the shaded band and do not include the uncertainty in the shape of the lost-lepton background.

Figure 9 (top row): Distributions of the M_{T2} variable for the estimated background processes and for data. Plots are shown for events satisfying the low-\(H_T\) (left), the medium-\(H_T\) (middle), and the high-\(H_T\) (right) selections,
and for different topological signal regions ($N_j \geq 6, N_b = 1$) of the inclusive-$M_{T2}$ event selection. This line is for $(N_j, N_b)$. The uncertainties in each plot are drawn as the shaded band and do not include the uncertainty in the shape of the lost-lepton background.

Figure 9 (middle row): Distributions of the $M_{T2}$ variable for the estimated background processes and for data.Plots are shown for events satisfying the low-$H_T$ (left), the medium-$H_T$ (middle), and the high-$H_T$ (right) selections, and for different topological signal regions ($N_j \geq 6, N_b = 2$) of the inclusive-$M_{T2}$ event selection. This line is
The uncertainties in each plot are drawn as the shaded band and do not include the uncertainty in the shape of the lost-lepton background.
the shape of the lost-lepton background.

Table 2: Event yields, for estimated background and data, in the signal regions of the inclusive-M_{T2} search. The uncertainties are the quadratic sum of statistical and systematic uncertainties.

| Signal region | Low-\(H_T\) region | Medium-\(H_T\) region | High-\(H_T\) region |
|---------------|---------------------|----------------------|---------------------|
| \(N_b = 2, N_L = 0\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 553±270 | 588 | 125–150 | 167±20 | 171 | 150–160 | 128±17 | 104 | 150–200 | 19±4.3 | 18 |
| 240–290 | 395±53 | 451 | 180–220 | 85±11.3 | 91 | 220–270 | 70±10.3 | 78 | 200–260 | 14±5.4 | 10 |
| 200–350 | 288±40 | 318 | 350–420 | 296±52 | 232 | 270–325 | 38±1.8 | 48 | 350–350 | 6.3±1.8 | 9 |
| 420–490 | 165±36 | 162 | 325–425 | 43±4.1 | 0.1 | 425–580 | 21±4.7 | 29 | >550 | 3.0±1.4 | 6 |
| 400–450 | 56±12.8 | 56 | 570–650 | 17±4.3 | 19 | 580–780 | 20±8.5 | 10 | >780 | 3.5±1.4 | 2 |
| \(N_b = 2, N_L \geq 1\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 56±12.8 | 56 | 160–180 | 27±4.9 | 30 | 180–190 | 21±7.5 | 19 | >180 | 4.4±2.6 | 2 |
| 250–310 | 34±2.8 | 44 | 310–380 | 25±9.7 | 29 | 310–380 | 13±4.5 | 15 | >380 | 3.4±1.7 | 9 |
| 380–450 | 19±5.8 | 13 | 450–550 | 12±6.3 | 8 | >550 | 2.6±0.8 | 3 | >550 | 3.4±1.5 | 4 |
| \(N_b = 3–5, N_L = 0\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 305±34 | 300 | 200–240 | 79±108 | 104 | 215–250 | 134±16 | 152 | 220–270 | 25.5±4.3 | 25 |
| 250–310 | 711±86 | 827 | 310–350 | 492±65 | 522 | 250–300 | 112±14 | 119 | 270–350 | 19.3±3.5 | 19 |
| 310–350 | 420±37 | 333 | 350–420 | 139±29 | 145 | 300–370 | 89±12.2 | 91 | 350–450 | 9.1±2.5 | 6 |
| 420–490 | 60±0.13 | 66 | 490–570 | 13±8.3 | 21 | 480–640 | 35±8.0 | 40 | >650 | 4.4±1.6 | 5 |
| 570–650 | 3±1.5 | 2 | >650 | 3.4±1.5 | 4 | >800 | 10.0±2.7 | 16 | >800 | 3.4±1.5 | 4 |
| \(N_b = 3–5, N_L = 1\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 305±34 | 300 | 200–250 | 91±22.0 | 97 | 210–270 | 52±8.6 | 63 | 230–350 | 6.2±1.6 | 9 |
| 250–310 | 107±21 | 172 | 310–380 | 103±16 | 98 | 270–380 | 38±5.1 | 47 | >380 | 3.5±1.0 | 3 |
| 380–450 | 40±6.8 | 47 | 450–550 | 17±9.6 | 19 | >550 | 3.6±0.9 | 4 | >550 | 4.0±1.2 | 7 |
| \(N_b = 3–5, N_L = 2\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 91±22.0 | 97 | 200–250 | 52±7.13 | 39 | 210–270 | 52±8.6 | 63 | 230–350 | 6.2±1.6 | 9 |
| 250–325 | 18.6±8.5 | 16 | 325–425 | 18.6±8.5 | 16 | 270–380 | 38±5.1 | 47 | >380 | 3.5±1.0 | 3 |
| \(N_b \geq 6, N_L = 0\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 50±8.9 | 56 | 200–200 | 42±4.7 | 55 | 160–200 | 26.5±5.5 | 29 | >290 | 6.8±2.3 | 9 |
| 250–325 | 52±7.13 | 39 | 250–325 | 14±3.7 | 16 | 270–370 | 5±1.7 | 11 | >370 | 2.9±1.1 | 5 |
| \(N_b \geq 6, N_L = 1\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 50±8.9 | 56 | 200–250 | 19±3.6 | 34 | 200–250 | 19±3.6 | 34 | >300 | 4.5±1.7 | 2 |
| 250–325 | 14.7±3.1 | 23 | >325 | 4.5±1.9 | 11 | >370 | 5±1.7 | 11 | >370 | 2.9±1.1 | 5 |
| \(N_b \geq 6, N_L = 2\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 32.0±6.7 | 31 | 200–250 | 12.0±4.3 | 15 | 130–170 | 40±7.0 | 54 | >120 | 12.1±2.9 | 12 |
| 250–325 | 14.7±3.1 | 23 | >325 | 4.5±1.9 | 11 | >370 | 5±1.7 | 11 | >370 | 2.9±1.1 | 5 |
| \(N_b \geq 3, N_L \geq 3\) | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data | \(M_{T2} [\text{GeV}]\) | Prediction | Data |
| 200–250 | 16.1±6.2 | 16 | 200–250 | 16.1±6.2 | 16 | 125–175 | 31.9±11.4 | 17 | >125 | 4.5±2.1 | 3 |

Figure 10: Event yields, for both estimated backgrounds and data, for the three \(H_T\) selections and all the topological signal regions of the inclusive-M_{T2} search. The
Results for the $M_{T2}$-Higgs analysis

| Channel     | Lost lepton | $Z(\nu\bar{\nu})$+jets | Total background | Data |
|-------------|-------------|--------------------------|------------------|------|
| Low-$H_T$   | 37.1 ± 9.0  | 6.9 ± 6.9                | 44.0 ± 11.3      | 55   |
| High-$H_T$  | 64.8 ± 16.4 | 4.4 ± 4.4                | 69.2 ± 17.0      | 81   |

Table 3: Event yields for the $W(\ell)\nu\bar{\nu}$+jets and $Z(\nu\bar{\nu})$+jets processes (i.e. the lost-lepton background), the $Z(\nu\bar{\nu})$+jets background, and data. Yields are shown for both the low- and the high-$H_T$ selections of the $M_{T2}$-Higgs search. The lost-lepton background is estimated from data control samples, while the $Z(\nu\bar{\nu})$+jets is evaluated using simulation.

Figure 11: Distributions of the $M_{bb}$ variable for the $W(\ell)\nu\bar{\nu}$+jets and $Z(\nu\bar{\nu})$+jets processes (i.e. the lost-lepton background), the $Z(\nu\bar{\nu})$+jets background, data, and a possible SUSY signal. The distributions are shown for both the low $H_T$: pdf, png and high $H_T$: pdf, png.
low- (left) and the high-\(H_T\) (right) selections of the \(M_{T2}\)-Higgs search. The lost-lepton background is estimated from data control samples, while the \(Z(\nu\nu)\) + jets is evaluated using simulation. The uncertainties in each plot are drawn as the shaded band and do not include the uncertainty in the shape of the lost-lepton background. The signal model consists of gluino pair production events with one of the two gluinos containing an h boson in its decay chain. For this model it is assumed \(m_{\tilde{g}} = 750\) GeV and \(m_{\tilde{g}_1^0} = 350\) GeV.

### Systematics

| Process          | \(M_{T2} < 200\) GeV | \(M_{T2} \geq 200\) GeV | Effect | Shape |
|------------------|----------------------|------------------------|--------|-------|
| Multijet         |                      |                        | 10\%–50\% |       |
| \(W(\nu)\) + jets and Top |                      |                        | 10\%–50\% |       |
| \(Z(\nu\nu)\) + jets | Systematics on \(Z(\nu\nu)\) + jets \((\delta \eta = 0\rightarrow 1)\) | 20\%–30\% |       |
|                  | Systematics on \(Z(\nu\nu)\) + jets \((\delta \eta = 0\rightarrow 1)\) | 5\%–100\% |       |
|                  | Simulation \((\delta \eta = 2)\) | 100\% |       |
|                  | Integrated luminosity | 2\% |       |
|                  | Trigger efficiency   | 1\% |       |
|                  | Jet energy scale     | 5\%–15\% | x     |
| Signal           | b-tagging scale factor | 5\%–40\% | x     |
|                  | Jet energy scale     | 5\%–40\% | x     |
|                  | System recoil modelling | 10\%–20\% | x     |

Table 4: Summary of the different systematic uncertainties of the SM background predictions and of the signal efficiency. A given source of uncertainty can contribute differently depending on the search region, and the typical ranges of effect are shown. Sources of uncertainty that change the shape of the \(M_{T2}\) distributions in the inclusive-\(M_{T2}\) analysis or the shape of the \(M_{bb}\) distributions in the \(M_{T2}\)-Higgs search are marked with a cross in the last column.

### Exclusion limits
Figure 12 (a): Exclusion limits at 95\% CL for direct squark production. The upper set of curves corresponds to the scenario where the first two generations of squarks are degenerate and light, while the lower set corresponds to only one accessible light-flavour squark. For convenience, diagonal lines have been drawn corresponding to $m_{\tilde{q}_i} = m_{u,b,i}$ and $m_{\tilde{q}_i} = m_{t,q,i} - (m_W + m_b)$ where applicable. The limits are electronically available as a ROOT file.

Figure 12 (b): Exclusion limits at 95\% CL for direct bottom-squark production. For convenience, diagonal lines have been drawn corresponding to $m_{\tilde{b}_i} = m_{u,b,i}$ and $m_{\tilde{b}_i} = m_{t,q,i} - (m_W + m_b)$ where applicable. The limits are electronically available as a ROOT file.

Figure 12 (c): Exclusion limits at 95\% CL for direct top-squark production. For convenience, diagonal lines have been drawn corresponding to $m_{\tilde{t}_i} = m_{u,b,i}$ and $m_{\tilde{t}_i} = m_{t,q,i} - (m_W + m_b)$ where applicable. The limits are electronically available as a ROOT file.
**Figure 13 (a):** Exclusion limits at 95\% CL for gluino mediated squark production. For convenience, diagonal lines have been drawn corresponding to $m_{\tilde{g}} = m_{\tilde{q}}$ and $m_{\tilde{g}} = m_{\tilde{q}} - m_{\tilde{q}^0}$ where applicable. The limits are electronically available as a ROOT file.

**Figure 13 (b):** Exclusion limits at 95\% CL for gluino mediated bottom-squark production. For convenience, diagonal lines have been drawn corresponding to $m_{\tilde{g}} = m_{\tilde{b}}$ and $m_{\tilde{g}} = m_{\tilde{b}} - m_{\tilde{b}^0}$ where applicable. The limits are electronically available as a ROOT file.

**Figure 13 (c):** Exclusion limits at 95\% CL for gluino mediated top-squark production. For convenience, diagonal lines have been drawn corresponding to $m_{\tilde{g}} = m_{\tilde{t}}$ and $m_{\tilde{g}} = m_{\tilde{t}} - m_{\tilde{t}^0}$ where applicable. The limits are electronically available as a ROOT file.
Figure 14: Exclusion limits at 95% CL for gluino pair production with one gluino decaying via $\tilde{g} \rightarrow q_1\tilde{\chi}_1^0$, while the other gluino decays via $\tilde{g} \rightarrow q_2\tilde{\chi}_1^-$. For convenience, diagonal lines have been drawn corresponding to $m_{\tilde{g}} = m_{\tilde{q}}$ and $m_{\tilde{q}} = m_{\tilde{g}} - 200 \text{ GeV}$. The limits are electronically available as a ROOT file.

Figure 15: Exclusion limits at 95% CL as a function of $m_0$ and $m_{1/2}$ for the cMSSM/mSUGRA model with $\tan\beta = 30$, $A_0 = -2\max(m_0, m_{1/2})$, and $\mu < 0$. Here, $m_{\tilde{c}}$ is the average mass of the first-generation squarks.

Figure 16: Exclusion limits at 95% CL as a function of $m_0$ and $m_{1/2}$ for the cMSSM/mSUGRA model with $\tan\beta = 30$, $A_0 = -2\max(m_0, m_{1/2})$, and $\mu < 0$. Here, $m_{\tilde{c}}$ is the average mass of the first-generation squarks.

Table 5: Summary of observed mass limits (at 95% CL) for different SUSY simplified models and for the cMSSM/mSUGRA model. The limits quoted are the observed limits using the signal cross section minus one standard deviation ($\sigma_{\text{theory}}$) of its uncertainty. For the simplified models, the limit on the mass of the parent particle is quoted for $m_{\tilde{\chi}_0^0}$, while for the LSP the best limit on its mass is quoted. The best limit on the mass splitting between the parent particle mass and the LSP mass is also given. Finally, the absolute limits on the squark and gluino masses are quoted for the cMSSM/mSUGRA model.
### Additional Material

| Figure | Formats | Caption |
|--------|---------|---------|
| ![Figure](image.png) | SUSY: pdf, png QCD: pdf, png | **Figure:** $M_{T2}$ for pseudojets versus multijet events from the SUSY LM6 signal. The 1σ integration time is a preselection of $E_{T\text{miss}} > 30$ GeV and $H_T > 450$ GeV. The LM6 point is defined, e.g. in JHEP 1210 (2012) 018, doi:10.1007/JHEP10(2012)018, arXiv:1207.1798. |

| ![Figure](image.png) | low $H_T$: pdf, png high $H_T$: pdf, png | **Figure:** Invariant mass $M_{bb}$ of the two selected $b$-tagged jets as reconstructed for the main SM backgrounds from simulation for the low-$H_T$ (left) and high-$H_T$ (right) selections, in the mass range 20 < $M_{bb}$ < 200 GeV. A signal (gluino-induced simplified model T5Wh) is also superimposed. This is the phase space selection of the $M_{T2}$ Higgs analysis. |

| ![Figure](image.png) | low $H_T$: pdf, png high $H_T$: pdf, png | **Figure:** The $M_{T2}$ distributions for $N_{j} \geq 4$, $N_b \geq 2$ for the main SM backgrounds from simulation for low $H_T$ (left) and high $H_T$ (right). A signal (gluino-induced simplified model T5Wh with $m_{\tilde{g}} = 750$ GeV, $m_{\tilde{q}} = 350$ GeV) is also superimposed. This is the phase space selection of the $M_{T2}$ Higgs analysis. |

| ![Figure](image.png) | pdf, png | **Figure:** The $\Delta R(b_1, b_2)$ distributions between the two selected $b$ jets, at high $H_T$ for the main SM backgrounds (left) and for the simplified model T5Wh (right) with $m_{\tilde{g}} = 750$ GeV, $m_{\tilde{q}} = 350$ GeV. The $\Delta R(b_1, b_2)$ is required to be smaller than 1.5 in order to... |

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**Additional Material for $M_{T2}$ Higgs analysis**

| Figure | Formats | Caption |
|--------|---------|---------|
| ![Figure](image.png) | pdf, png | **Figure:** The $M_{T2}$ distributions for $N_{j} \geq 4$, $N_b \geq 2$ for the main SM backgrounds from simulation for low $H_T$ (left) and high $H_T$ (right). A signal (gluino-induced simplified model T5Wh with $m_{\tilde{g}} = 750$ GeV, $m_{\tilde{q}} = 350$ GeV) is also superimposed. This is the phase space selection of the $M_{T2}$ Higgs analysis. |

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**Additional Material**
reconstruct an invariant mass from the two b jets.

**Figure:** Invariant mass $M_{bb}$ of the two selected b-tagged jets as reconstructed for the simplified model T5Wh, with $m_{\chi^0} = 750$ GeV, $m_{\chi^0} = 350$ GeV) at low $H_T$ (left), and at high $H_T$ (right). In red, the invariant mass distribution for true combinations (two b jets from Higgs decay selected); in blue, the invariant mass distribution for other combinations (combinatorial background).

### Additional Material for Background Estimations

| Figure | Formats | Caption |
|--------|---------|---------|
| ![Figure](barrel.png) | **barrel:** pdf, png | **Figure:** Extended maximum likelihood fit to the shower shape variable $\eta_{i\eta_i}$ for barrel photons (left) and endcap photons (right). The green and pink histograms correspond to the signal and background templates respectively. The blue histogram shows the total sum. |
| ![Figure](endcap.png) | **endcap:** pdf, png |
| ![Figure](distribution.png) | **distribution:** pdf, png | **Figure:** Left: Comparison between data and simulation for the $Z(\ell\ell)$ and $M_{T^2}$ distributions with $N_b \geq 2$, $N_b = 0$, $H_T > 450$ GeV, and boson-$p_T > 80$ GeV. The boson-$p_T$ is added to the $E_T^{miss}$ vector. The data correspond to 19.5 fb$^{-1}$. Backgrounds have been subtracted using simulation. Right: The corresponding ratios $Z(\ell\ell)/\gamma$ in data and simulation. |
| ![Figure](ratio.png) | **ratio:** pdf, png |

**Additional Material for MT2 Higgs analysis**
selected. The dilepton-$p_T$ vector is added to the $E_T^{miss}$ vector. The contribution of non-Z background is small and subtracted using simulation. Right: The corresponding ratios $Z_{ll}(1b)/Z_{ll}(0b)$ in data and simulation.

**Figure:** $M_{T2}$ distributions for the medium $H_T$ selection for $3 \leq N_j \leq 5$ jet and $N_b = 1$. The left figure shows data compared to the pure simulation predictions, where it can be observed that the multijet event dominated region is not well described by simulation. In the right figure the multijet event simulation is replaced by the prediction from data (by construction of the method there is no prediction at $M_{T2} < 50$ GeV). It can be observed how the data-prediction agreement in the multijet event dominated region is improved.

**Figure:** Normalized $M_{T2}$ distribution for $N_j = 2$, $N_b = 0$, medium $H_T$ with varied distributions by 1 standard deviation (1σ) due to $p_T$ MC NLO uncertainty. These distributions are used, among others, to assess the $M_{T2}$ shape systematics for the Lost Lepton background component.

**Figure:** Invariant mass $M_{bb}$ as reconstructed for the main SM backgrounds at low $H_T$ (left) and high $H_T$ (right) with at least one lepton, at least four jets and two $b$ jets, and with $M_{T2} > 50$ GeV (high $H_T$), or $M_{T2} > 200$ GeV (low $H_T$).
Additional Material for Results and Exclusion limits, Signal Efficiencies

We provide in electronic form (as a ROOT file) the signal efficiency for all used search regions separately. You access a specific bin following scheme:

For inclusive $M_{T2}$ analysis:

The root files contain histograms (TH2F) for each search bin called: $[HT]_{[\text{topological}]}_{[MT2]}$ where

- $[HT]$ is the $H_T$ region under consideration, i.e. lowHT, mediumHT, or highHT,
- $[\text{topological}]$ is the topological region under consideration, i.e. 2j0b, 2j1to2b, 3to5j0b, 3to5j1b, 3to5j2b, ge6j0b, 6j1b, 6j2b, or 3b,
- $[MT2]$ is the $M_{T2}$ signal bin, e.g. $MT2$-$200$to$250$. For the last $M_{T2}$ bin (e.g. $M_{T2}$ > 425 GeV for low $H_T$, 3 ≤ $N_j$ ≤ 5, 2 b jets) the latter number has to be replaced by 9999, e.g. $MT2$-$425$to$9999$.

As an example: For the signal region with 3 ≤ $N_j$ ≤ 5, 2 b jets, medium $H_T$, and $M_{T2}$ = 270-380 GeV the histograms name is mediumHT_3to5j2b_MT2-270to280.

For the $M_{T2}$ Higgs analysis:

The root file contains histograms (TH2F) for each search bin called: $\text{EfficiencyMap}_{[HT]}_{[M_{bb}]}$ where

- $[HT]$ is the $H_T$ region under consideration, i.e. lowHT, or highHT,
- $[M_{bb}]$ is the $M_{bb}$ signal bin, e.g. $M_{bb}$-125to140.

As an example: For the signal region with low $H_T$, and $M_{bb}$ = 125-140 GeV the histograms name is EfficiencyMap_lowHT_3to5j2b_Mbb-125to140.
topological regions used are \(3 \leq N_j \leq 5, N_b = 0\), \(3 \leq N_j \leq 5, N_b = 1\), \(N_j \geq 6, N_b = 0\), \(N_j \geq 6, N_b = 1\).

\[ \text{Signal efficiency for gluino pair production, with } \bar{g} \rightarrow b \bar{b} \tilde{\chi}_1^0. \] The
topological regions used are \(3 \leq N_j \leq 5, N_b = 1\), \(3 \leq N_j \leq 5, N_b = 2\), \(N_j \geq 6, N_b = 1\), \(N_j \geq 6, N_b = 2\), \(N_j \geq 3, N_b \geq 3\).

\[ \text{Signal efficiency for gluino pair production, with } \bar{g} \rightarrow t \bar{t} \tilde{\chi}_1^0. \] The
topological regions used are \(N_j \geq 6, N_b = 1\), \(N_j \geq 6, N_b = 2\), \(N_j \geq 3, N_b \geq 3\).

\[ \text{Signal efficiency for gluino pair production with } \bar{g} \rightarrow q \tilde{\chi}_2^0, \tilde{\chi}_1^0 \rightarrow h \tilde{\chi}_1^0, \] and \(\bar{g} \rightarrow q \tilde{\chi}_1^+, \tilde{\chi}_1^- \rightarrow W^\pm \tilde{\chi}_1^0\). In this
scenario, neutralino \(\tilde{\chi}_2^0\) and chargino \(\tilde{\chi}_1^\pm\)
are degenerate, with a mass
\[ m(\tilde{\chi}_2^0) = m(\tilde{\chi}_1^+) = m(\tilde{\chi}_1^-) + 200 \text{ GeV}. \]

**Figure:** The ratios of the data yields divided by the data-driven background estimates for the three \(H_T\) signal regions as well as the topological regions in the jet – b-jet multiplicity. The \(M_{T2}\) signal regions are summed up for each of the \(H_T\) and topological regions. The uncertainties on the ratio is only the statistical uncertainty of the data. The uncertainties of the data-driven background estimates are shown in the shaded uncertainty band. The data correspond to an integrated luminosity of 19.5 fb\(^{-1}\).

We evaluate the compatibility of the data and the standard model prediction by computing the pull value for every signal bin.

The pull is defined via
\[ P_{\text{pull}} = \frac{N_{\text{obs}} - N_{\text{bkg}}}{\sqrt{\sigma_{\text{obs}}^2 + \sigma_{\text{bkg}}^2}}, \]
where \(N_{\text{obs}}\) is the observed number of events with its statistical uncertainty and \(N_{\text{bkg}}\) is the background estimate with a total uncertainty. A study using simulated pseudo-data shows that the observed pull distribution in data is compatible with the prediction with a probability of 11\%.
### Table: Estimated background event yields in the various $H_T$ and topological (number of jets and number of b jets) regions for the inclusive $M_{T2}$ analysis.

| Signal region | Lowest $M_{T2}$ | Multiplet | Lost lepton | $Z(\ell\ell) +$ jets | Total bkg | Data |
|---------------|----------------|-----------|-------------|---------------------|------------|------|
| $J_1 = 2, N_1 = 0$ | 200 GeV | 0.43 ± 1.9 | 663 ± 74 | 106 ± 18 | 172 ± 13 | 182 |
| $J_1 = 2, N_1 ≥ 1$ | 300 GeV | 0.12 ± 0.3 | 75.2 ± 9.2 | 146 ± 15 | 240 ± 19 | 216 |
| $J_1 ≥ 3, N_1 = 0$ | 200 GeV | 3.1 ± 1.2 | 232 ± 33 | 60 ± 7 | 64 |
| $J_1 ≥ 3, N_1 = 1$ | 300 GeV | 0.84 ± 0.2 | 187 ± 2.4 | 59 ± 3 | 51 |
| $J_1 ≥ 4, N_1 = 0$ | 200 GeV | 0.06 ± 0.01 | 5.5 ± 1.6 | 51 ± 10 | 56 |
| $J_1 ≥ 4, N_1 = 1$ | 300 GeV | 0.02 ± 0.01 | 18 ± 1 | 18 ± 1 | 18 |
| $J_1 ≥ 5, N_1 = 0$ | 200 GeV | 0.01 ± 0.01 | 6.9 ± 2.1 | 52 ± 8 | 58 |
| $J_1 ≥ 5, N_1 = 1$ | 300 GeV | 0.01 ± 0.01 | 18 ± 1 | 18 ± 1 | 18 |
| $J_1 ≥ 6, N_1 = 0$ | 200 GeV | 0.01 ± 0.01 | 5.5 ± 2 | 51 ± 10 | 56 |
| $J_1 ≥ 6, N_1 = 1$ | 300 GeV | 0.01 ± 0.01 | 18 ± 1 | 18 ± 1 | 18 |

### Additional Material: cutflow tables for representative points

| Table: Predicted number of signal events in the inclusive $M_{T2}$ analysis after each stage of the event selection, for direct squark production with $\tilde{q} \rightarrow q \tilde{\chi}_1$, with a squark mass of 400 GeV and an LSP mass of 300 GeV, where the first two generations of squarks are degenerate and light. The baseline selection requires at least two jets with $p_T > 100$ GeV and for the jet/$E_T^{miss}$ quality criteria requirements. The uncertainties are statistical.

| First stage | Second stage | Third stage | Final stage |
|-------------|-------------|-------------|-------------|
| $J_1 = 2, N_1 = 0$ | 120 GeV | 0.62 ± 0.4 | 30 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 = 2, N_1 ≥ 1$ | 100 GeV | 0.25 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 3, N_1 = 0$ | 100 GeV | 0.61 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 3, N_1 = 1$ | 100 GeV | 0.25 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 4, N_1 = 0$ | 100 GeV | 0.61 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 4, N_1 = 1$ | 100 GeV | 0.25 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 4, N_1 = 2$ | 100 GeV | 0.61 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 5, N_1 = 0$ | 100 GeV | 0.61 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 5, N_1 = 1$ | 100 GeV | 0.25 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 5, N_1 = 2$ | 100 GeV | 0.61 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
| $J_1 ≥ 5, N_1 = 3$ | 100 GeV | 0.25 ± 0.3 | 60 ± 10 | 52 ± 14 | 60 ± 11 | 60 |
The uncertainties are statistical.

Table: Predicted number of signal events in the inclusive $M_{T2}$ analysis after each stage of the event selection, gluino pair production with $\tilde{g} \rightarrow \tilde{b}\tilde{\chi}_1^0$, with a gluino mass of 550 GeV and an LSP mass of 500 GeV. The baseline selection requires at least two jets with $p_T > 100$ GeV and for the jet/$E_T^{miss}$ quality criteria requirements. The uncertainties are statistical.

### Table: Predicted number of signal events in the inclusive $M_{T2}$ analysis after each stage of the event selection, gluino pair production with $\tilde{g} \rightarrow \tilde{b}\tilde{\chi}_1^0$, with a gluino mass of 1275 GeV and an LSP mass of 100 GeV. The baseline selection requires at least two jets with $p_T > 100$ GeV and for the jet/$E_T^{miss}$ quality criteria requirements. The uncertainties are statistical.

### Additional Material: cutflow tables for representative points 25
Schematic view of the simplified models

| Figure | Formats | Caption |
|--------|---------|---------|
| ![Figure: Diagrams representing the T2 simplified model: Direct squark production: \( \tilde{q} \rightarrow \tilde{q} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T2 simplified model: Direct squark production: \( \tilde{q} \rightarrow \tilde{q} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T2 simplified model: Direct squark production: \( \tilde{q} \rightarrow \tilde{q} \chi_1 \).](pdf, png) |
| ![Figure: Diagrams representing the T2bb simplified model: Direct sbottom production with \( \tilde{b} \rightarrow \tilde{b} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T2bb simplified model: Direct sbottom production with \( \tilde{b} \rightarrow \tilde{b} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T2bb simplified model: Direct sbottom production with \( \tilde{b} \rightarrow \tilde{b} \chi_1 \).](pdf, png) |
| ![Figure: Diagrams representing the T2tt simplified model: Direct stop production with \( \tilde{t} \rightarrow \tilde{t} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T2tt simplified model: Direct stop production with \( \tilde{t} \rightarrow \tilde{t} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T2tt simplified model: Direct stop production with \( \tilde{t} \rightarrow \tilde{t} \chi_1 \).](pdf, png) |
| ![Figure: Diagrams representing the T1 simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T1 simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T1 simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) |
| ![Figure: Diagrams representing the T1bbbb simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T1bbbb simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T1bbbb simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) |
| ![Figure: Diagrams representing the T1tttt simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T1tttt simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T1tttt simplified model: Gluino pair production, with \( \tilde{g} \rightarrow \tilde{g} \chi_1 \).](pdf, png) |
| ![Figure: Diagrams representing the T5Wh simplified model: Gluino pair production with \( \tilde{g}_1 \rightarrow \tilde{g} \chi_1 \), \( \tilde{g}_2 \rightarrow \tilde{g} \chi_1 \), and \( \tilde{g}_3 \rightarrow \tilde{g} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T5Wh simplified model: Gluino pair production with \( \tilde{g}_1 \rightarrow \tilde{g} \chi_1 \), \( \tilde{g}_2 \rightarrow \tilde{g} \chi_1 \), and \( \tilde{g}_3 \rightarrow \tilde{g} \chi_1 \).](pdf, png) | ![Figure: Diagrams representing the T5Wh simplified model: Gluino pair production with \( \tilde{g}_1 \rightarrow \tilde{g} \chi_1 \), \( \tilde{g}_2 \rightarrow \tilde{g} \chi_1 \), and \( \tilde{g}_3 \rightarrow \tilde{g} \chi_1 \).](pdf, png) |

**Event Displays**

except for the very first, only format available are black png (with label)

In the following figures jets are indicated by transparent orange cones. Their energy is indicated by the length of the orange bar. Tracks are indicated by green lines, ECAL deposit by red blocks, HCAL deposits by blue blocks. The \( E_{T\text{miss}} \) is indicated by an cyan (violet) arrow for black (white) background.

| Figure | Caption and Formats |
|--------|---------------------|
| ![Figure:](pdf, png) | ![Figure:](pdf, png) |

Schematic view of the simplified models
Figure: Run:LumiSection:Event = 196349:71:43041508. Highest $M_{T2}$ event.
$M_{T2} = 911$ GeV, $H_T = 1982$ GeV, $E_T^{miss} = 936$ GeV, 3 jets, 0 b jets.
Views:
black with label: 3D png, 3D pdf, png, pdf, z png, z pdf
black without label: 3D png, 3D pdf, png, pdf, z png, z pdf
white with label: 3D png, 3D pdf, png, pdf, z png, z pdf
white without label: 3D png, 3D pdf, png, pdf, z png, z pdf

Figure: Run:LumiSection:Event = 199699:161:208585709. Highest $M_{T2}$ event with 2 jets, ≥ 1 b jets.
$M_{T2} = 817$ GeV, $H_T = 828$ GeV, $E_T^{miss} = 806$ GeV, 2 jets, 1 b jet.
Views:
black with label: 3D png, 3D pdf, png, pdf, z png, z pdf
black without label: 3D png, 3D pdf, png, pdf, z png, z pdf
white with label: 3D png, 3D pdf, png, pdf, z png, z pdf
white without label: 3D png, 3D pdf, png, pdf, z png, z pdf

Figure: Run:LumiSection:Event = 196364:646:606409270. Highest $M_{T2}$ event with ≥ 3 b jets.
$M_{T2} = 432$ GeV, $H_T = 658$ GeV, $E_T^{miss} = 432$ GeV, 9 jets, 3 b jets.
Views:
black with label: 3D png, 3D pdf, png, pdf, z png, z pdf
black without label: 3D png, 3D pdf, png, pdf, z png, z pdf
white with label: 3D png, 3D pdf, png, pdf, z png, z pdf
white without label: 3D png, 3D pdf, png, pdf, z png, z pdf
**Figure:** Run:LumiSection:Event = 205193:655:881234702. Signal event with most b jets. \(M_{T2} = 260 \text{ GeV}, H_T = 857 \text{ GeV}, E_T^{\text{miss}} = 329 \text{ GeV}, 5 \text{ jets}, 5 \text{ b jets}.

Views:
- black with label: 3D png, 3D pdf, png, pdf, z png, z pdf
- black without label: 3D png, 3D pdf, png, pdf, z png, z pdf
- white with label: 3D png, 3D pdf, png, pdf, z png, z pdf
- white without label: 3D png, 3D pdf, png, pdf, z png, z pdf

**Figure:** Run:LumiSection:Event = 195915:514:78521965. Multijet event. \(M_{T2} = 673 \text{ GeV}, H_T = 661 \text{ GeV}, E_T^{\text{miss}} = 701 \text{ GeV}, 7 \text{ jets}, 0 \text{ b jets}.

Views:
- black with label: 3D png, 3D pdf, png, pdf, z png, z pdf
- black without label: 3D png, 3D pdf, png, pdf, z png, z pdf
- white with label: 3D png, 3D pdf, png, pdf, z png, z pdf
- white without label: 3D png, 3D pdf, png, pdf, z png, z pdf

**Figure:** Run:LumiSection:Event = 195948:389:614872569. Highest \(M_{T2}\) event with multiple b jets. \(M_{T2} = 784 \text{ GeV}, H_T = 999 \text{ GeV}, E_T^{\text{miss}} = 786 \text{ GeV}, 4 \text{ jets}, 2 \text{ b jets}.

Views:
- black with label: 3D png, 3D pdf, png, pdf, z png, z pdf
- black without label: 3D png, 3D pdf, png, pdf, z png, z pdf
- white with label: 3D png, 3D pdf, png, pdf, z png, z pdf
- white without label: 3D png, 3D pdf, png, pdf, z png, z pdf
Figure: Run:LumiSection:Event = 202504:1562:1706568804. Typical dijet event. $M_{T2} = 811$ GeV, $H_T = 1273$ GeV, $E_T^{miss} = 881$ GeV, 2 jets, 0 b jets.

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white with label: 3D png, 3D pdf, png, pdf, z png, z pdf
white without label: 3D png, 3D pdf, png, pdf, z png, z pdf

Figure: Run:LumiSection:Event = 196250:315:518244042. This is a high $E_T^{miss}$ event with small $M_{T2}$ that illustrates the power of $M_{T2}$ of suppressing backgrounds with jet energy mismeasurements. $M_{T2} = 13$ GeV, $H_T = 1055$ GeV, $E_T^{miss} = 313$ GeV, 3 jets, 0 b-jets.

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Figure: Run:LumiSection:Event = 204541:109:196009602. This is a high $E_T^{miss}$ event with small $M_{T2}$ that illustrates the power of $M_{T2}$ of suppressing backgrounds with jet energy mismeasurements. $M_{T2} = 28$ GeV, $H_T = 890$ GeV, $E_T^{miss} = 351$ GeV, 4 jets, 0 b-jets.

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-- HannsjoergWeber - 2015-02-17
