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Search for Supersymmetry in Events with b Jets and Missing Transverse Momentum at the LHC

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Abstract

A search for supersymmetry is presented using a sample of events with b jets and missing transverse momentum. The search uses a data sample of proton-proton collisions at a centre-of-mass energy of 7 TeV, corresponding to an integrated luminosity of 35 pb^{-1}, collected with the CMS detector. A total of $0.33\,^{+0.43}_{-0.33}$ (stat.) $\pm$ 0.13 (syst.) events is predicted, using control samples in the data, to arise from standard model processes, and one event is observed in the data. Upper limits are set at the 95% confidence level on the cross sections of benchmark supersymmetric models.

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1 Introduction

Supersymmetry (SUSY) [1–5] is an extension of the standard model (SM) of particle physics, which can solve the "hierarchy problem" [6, 7] and provide a candidate for cold dark matter [8]. For a large class of supersymmetric parameter sets, squarks ($\tilde{q}$), the SUSY partners of quarks, are relatively light. In this case, significant event yields at the Large Hadron Collider (LHC) can result from strong production of squarks, which subsequently decay giving a weakly interacting lightest supersymmetric particle (LSP). If bottom and top squarks, which can decay to b quarks, are relatively light, there may be an abundance of events with one or more b-quark jets and momentum imbalance transverse to the beam line due to the undetectable LSPs.

This Letter describes a search for events with two or more hadronic jets, at least one of which must be b tagged [9], and significant transverse momentum imbalance. It extends a similar search without a b-tag requirement [10]. The momentum imbalance is characterized [11] by the ratio of the p_{T} of the second-highest-p_{T} jet and the invariant mass formed from the two highest-p_{T} jets. This ratio can be estimated by $\alpha_{\mathrm{T}} = \frac{1}{2}\frac{H_{\mathrm{T}}-\Delta H_{\mathrm{T}}}{\sqrt{H_{\mathrm{T}}^2-\not{H}_{\mathrm{T}}^2}}$, where $\not{H}_{\mathrm{T}} = |\sum_i \vec{p}_{\mathrm{T}}^{\,\mathrm{jet}_i}|$, $H_{\mathrm{T}} = \sum_i p_{\mathrm{T}}^{\mathrm{jet}_i}$, and $p_{\mathrm{T}}^{\mathrm{jet}_i}$ is the momentum transverse to the beam line for jet i in an event. The jets in an event are grouped into two pseudo-jets and ΔH_{T} is the minimal value of $|p_{\mathrm{T}}^{\mathrm{pseudojet1}} - p_{\mathrm{T}}^{\mathrm{pseudojet2}}|$ over all combinations; this approach optimizes rejection of backgrounds with apparent $\not{H}_{\mathrm{T}}$ from instrumental effects and other sources.

The main backgrounds are due to standard model multijet production (hereafter denoted "QCD background"), electroweak W and Z boson production (EWK), and top quark pair production ($\mathrm{t\bar{t}}$). Owing to low average $\not{H}_{\mathrm{T}}$, the QCD background is effectively rejected by a requirement on α_{T}. The b-tag requirement further suppresses the QCD and EWK backgrounds.

The results of the search are characterized in terms of the mSUGRA/CMSSM [12, 13] scenario of SUSY. These models are described by four parameters and one sign: the universal scalar and gaugino mass parameters, m_0 and $m_{1/2}$, respectively; the universal trilinear coupling, A_0; the ratio of the two Higgs doublet vacuum expectation values, $\tan\beta$; and the sign of the Higgs mixing parameter, sign(μ). Three signal points are considered as benchmarks: LM0, LM1, both discussed in Ref. [10], and LMB (corresponding to $m_0 = 400$ GeV, $m_{1/2} = 200$ GeV, $A_0 = 0$ GeV, $\tan\beta = 50$, and $\mathrm{sign}(\mu) > 0$), chosen to be near the edge of sensitivity of this search in mSUGRA/CMSSM parameter space.

The analysis presented here uses a data sample of proton-proton collisions at 7 TeV, corresponding to an integrated luminosity of 35 pb^{-1}, collected with the Compact Muon Solenoid (CMS) detector, at the LHC. The main components of CMS are a silicon pixel and strip tracker, the crystal electromagnetic calorimeter, and the brass/scintillator hadron calorimeter, all placed in a 3.8 T axial magnetic field, complemented by gas-ionization detectors embedded in the steel return yoke, to measure muons. A detailed description of the detector and its performance can be found in Ref. [14]. In the cylindrical coordinate system of CMS, ϕ is the azimuthal angle and the pseudo-rapidity (η) is defined as $\eta = -\ln[\tan(\theta/2)]$, where θ is the polar angle with respect to the counterclockwise beam direction.

2 Event Selection

The event selection requirements are mostly identical to those in Ref. [10]. Events in the search sample are collected with triggers based on H_{T} computed from jets reconstructed at trigger level. A muon-enriched control sample is collected with triggers requiring a muon. Events

must have a good reconstructed pp collision vertex [15]. Jets are reconstructed as clusters of energy in the calorimeters by the anti-k_T algorithm [16] with a distance parameter of 0.5, and are required to have energy transverse to the beam, E_T, in excess of 50 GeV and $|\eta|$ less than 3.

To perform a fully hadronic final state search and to reduce the backgrounds, events with an isolated lepton (electron or muon) or photon are vetoed, and events consistent with having apparent $\not{H}_T$ [10] are rejected. Selected events are required to have at least two jets, both with $E_T > 100$ GeV, $|\eta| < 2.5$ for the highest-E_T jet, $H_T > 350$ GeV, at least one jet tagged as originating from a b quark, and $\alpha_T > 0.55$.

Jets are b tagged using a discriminator based on the impact parameter significance of tracks in a jet (Track Counting High Purity discriminator, TCHP [9]), with a "tight" selection (TCHP> 3.41) designed to have a light-flavour contamination of less than 0.1%. Looser b-tagging selections are used to produce various control samples. An event is said to be anti-tagged if it contains no jets with a loose b tag (TCHP > 1.19). To remain within the acceptance of the pixel tracker, only jets with a central axis of $|\eta| < 2.4$ are considered for b tagging.

3 Background Estimation

The backgrounds for this search can be categorized into three main groups: namely QCD, EWK, and $t\bar{t}$. The contamination from $t\bar{t}$ is mainly in the tau decay mode. The vast majority of events from the QCD background do not feature large transverse momentum imbalance and are therefore rejected by the $\alpha_T > 0.55$ requirement. The EWK backgrounds consist of W and Z boson production, with genuine missing energy due to decay neutrinos. The requirement of at least one b jet greatly reduces the EWK and QCD backgrounds. The dominant background for the analysis arises from $t\bar{t}$ production, in which b jets and genuine missing energy due to neutrinos can arise from the top quark decay chains.

A procedure based on control data samples, described in Section 3.1, is employed to estimate all backgrounds simultaneously. In this method, the fraction of all events with $\alpha_T > 0.55$, denoted $F(\alpha_T > 0.55)$, is measured in a lower-H_T control region and applied in the signal region.

The $Z \to \nu\bar{\nu}$ and $t\bar{t}$ background yields are cross-checked separately, as discussed in Section 3.2. The $t\bar{t}$ cross-check uses muons to emulate the hadronic decays of taus. The cross-check of $Z \to \nu\bar{\nu}$ utilizes $Z \to \mu^+\mu^-$ events for which α_T is determined after excluding the muons.

3.1 Background Prediction Using α_T vs H_T Extrapolation

In SM simulation studies [10], $F(\alpha_T > 0.55)$ has no H_T dependence in events with large genuine missing transverse energy, i.e., the $t\bar{t}$ and EWK backgrounds. In the QCD background, however, $F(\alpha_T > 0.55)$ is expected to be a decreasing function of H_T because of the H_T dependence of the factors contributing to apparent $\not{H}_T$, such as jet energy resolution and jet E_T threshold effects.

In data control samples, $F(\alpha_T > 0.55)$ is consistent with having no H_T dependence, which indicates that the $t\bar{t}$ and EWK backgrounds dominate. The larger anti-tagged data sample is also consistent with having no H_T dependence. Because a tight b-tag requirement further suppresses the QCD background, the tight tagged data sample is expected to have a negligible QCD contribution and therefore $F(\alpha_T > 0.55)$ independent of H_T.

The total background is estimated by measuring $F(\alpha_T > 0.55) = 1.48^{+1.93}_{-1.48} \times 10^{-5}$ in a control region with $250 < H_T < 350$ GeV and multiplying this fraction by the number of events in the signal region before the $\alpha_T > 0.55$ requirement. In data, this procedure yields a prediction of

Table 1: Predicted and observed numbers of events for 35 pb^{-1}. The prediction comes from the α_T vs H_T extrapolation described in Section 3.1.

N-jets	Background Prediction	Data	LM0	LM1	LMB
≥ 2	$0.33\ ^{+0.43}_{-0.33}$ (stat.) $\pm$ 0.13 (syst.)	1	14	2	5

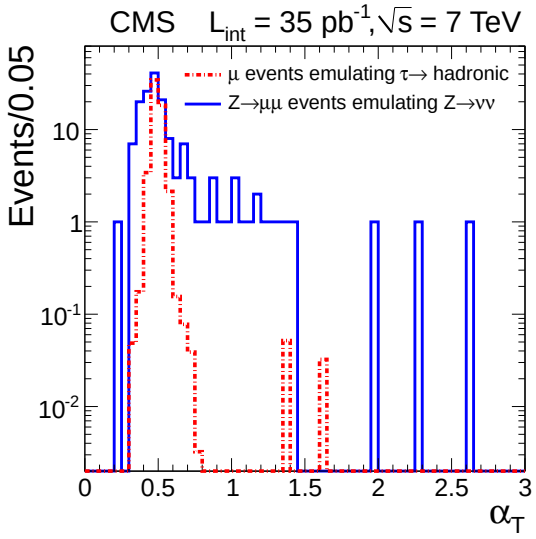

Figure 1: The α_T distributions for $Z \to \mu^+\mu^-$ emulation of $Z \to \nu\bar{\nu}$ (solid blue) and muon emulation of hadronic tau decays (dashed red).

$0.33\ ^{+0.43}_{-0.33}$ (stat.) $\pm$ 0.13 (syst.) events. The statistical uncertainty is dominated by the presence of one event with $\alpha_T > 0.55$ in the control sample. The systematic uncertainty on the prediction is given by the difference in $F(\alpha_T > 0.55)$ measured in the tight and loose tagged control samples. Table 1 lists this background prediction, the observation in data, and the expected contribution of SUSY signal for points LM0, LM1, and LMB.

3.2 Cross-Checks of $Z \to \nu\bar{\nu}$ and $t\bar{t}$ Background Contributions

While the above background estimate is the one used in this search, we perform auxiliary measurements to cross-check the $Z \to \nu\bar{\nu}$ and $t\bar{t}$ background components, which together are expected to comprise the majority of the background. As would be crucial in case of an observed excess, these cross-checks provide an overestimate of the $Z \to \nu\bar{\nu}$ and $t\bar{t}$ background components.

For $Z \to \nu\bar{\nu}$, a sample of $Z \to \mu^+\mu^-$ events is selected with two or more jets but no α_T, H_T, or b-tagging requirements. The solid blue line in Figure 1 shows the α_T distribution for the resulting events. The fraction of these events containing a b-tagged jet is measured. Then, a sample is selected with no b-tag requirement, jet $E_T = 75$ GeV thresholds on the two highest-E_T jets, $H_T > 275$ GeV, and $\alpha_T > 0.52$. The number of events in this sample is scaled by the measured b-tag fraction in the other sample, corrected for the muon identification efficiency and acceptance, and multiplied by the ratio of branching fractions $\frac{BR(Z \to \nu\bar{\nu})}{BR(Z \to \mu^+\mu^-)} \approx 6$. This procedure gives an overestimate of the number of $Z \to \nu\bar{\nu}$ events in the signal region owing to less stringent requirements than in the final selection, and yields 0.48 ± 0.39 events.

Simulation studies indicate that most of the $t\bar{t}$ background comes from events with hadronic

Table 2: Cumulative and individual efficiencies for the selection in three SUSY benchmark points. For each point, the left and right columns represent the individual and cumulative efficiencies, respectively. Different benchmarks have different b-tag efficiencies due to different average numbers of b quarks per event. The fraction of events containing at least one b quark before the b-tag selection is 66% in LM0, 18% in LM1, and 91% in LMB.

	LM0		LM1		LMB	
Requirement						
Pre-selection	98%	98%	98%	98%	98%	98%
Lepton/Photon Veto	57%	56%	55%	54%	61%	60%
Jet Requirements	51%	28%	63%	34%	54%	33%
$H_T > 350$ GeV	90%	25%	94%	32%	97%	32%
Trigger	99%	25%	99%	32%	99%	31%
Apparent $\not{H}_T$ Veto	68%	17%	81%	26%	65%	20%
Tight b-tag	31%	5.3%	12%	3.0%	54%	11%
$\alpha_T > 0.55$	14%	0.7%	29%	0.9%	12%	1.3%

tau decays. To estimate the hadronic tau decay yield, $F(\alpha_T > 0.55)$ is first measured in a sample with $E_T = 80$ GeV thresholds on the two leading jets, $H_T > 280$ GeV, at least one medium b-tagged jet (TCHP > 1.91), and one or two muons. These selection requirements are chosen to be less strict than the signal selection in order to increase the number of events in this sample. The muons are used to emulate the hadronic decays of taus. To do so, for each muon the presence of a tau jet is emulated with an E_T value set to a fraction of the muon p_T, using a distribution taken from simulation. The dashed red line in Figure 1 displays the resulting α_T distribution. The measured value of $F(\alpha_T > 0.55)$ in this sample is multiplied by the number of emulated events in the signal region before the α_T requirement. This value is corrected for the muon selection efficiency, acceptance and the hadronic tau decay branching ratio to obtain the hadronic tau decay yield. The predicted hadronic tau decay yield is increased by 38%, as determined in simulation, in order to account for the entire $t\bar{t}$ background. The procedure yields a 25% overestimate of the total $t\bar{t}$ background in simulation. In data, 1.4 ± 0.5 events are predicted.

4 Signal Selection Efficiency

To interpret the results of this search in terms of a given signal model, the selection efficiency for that model must be determined. Table 2 lists the cumulative and individual efficiencies for the event selection in the three SUSY benchmark models LM0, LM1, and LMB, from which events are generated at leading order (LO) via PYTHIA 6.4, tune Z2 [17] using parton distribution functions provided by CTEQ6.6 [18]. Without b tagging, the cumulative efficiencies for LM0 and LM1 are about 85% of those in Ref. [10], because of a more stringent lepton and photon veto. Table 3 lists the relative systematic uncertainties on the signal yield, which are dominated by the uncertainty on the b-tagging efficiency, described below. The other uncertainties and the methods used to obtain them are similar to Ref. [10].

The b-tagging efficiency is measured from inclusive dijet events in which one jet has an associated muon and another "away" jet has a TCHP value of at least 1.0. The relative fraction of jets from b quarks in a data sample is determined by a fit to the distribution of transverse momentum of muons relative to their associated jet axis, p_T^{rel} [9, 19], which is larger for jets from b quarks than from other flavours. This fit is to a linear combination of simulation-derived

Table 3: Relative systematic uncertainties on the signal yield.

Source	Uncertainty (%)
Luminosity	4
JES	3.5
Jet Energy Resolution	1
Trigger Efficiency	1
Apparent $\not{H}_T$ Veto	4
Lepton/Photon Veto	4
b-tag Efficiency (LMB)	20
Total	22

p_T^{rel} expected distributions from different flavours. The fitted b fractions for jets passing and failing the analysis b-tagging requirement are used in the b-tagging efficiency calculation. This efficiency is measured separately for jets with $|\eta| > 1.4$ and $|\eta| \leq 1.4$, in four ranges of jet E_T. The ratio between the b-tagging efficiency measured in data and in simulation is taken as the efficiency scale factor for a particular range in E_T and $|\eta|$.

Systematic uncertainties on the scale factors arise from potential biases in the p_T^{rel} fitting procedure. These uncertainties are measured by varying the muon-to-jet matching and muon p_T thresholds, fraction of gluon splitting to $b\bar{b}$, jet energy scale and resolution, jet angular resolution, and b-tagging requirement on the away jet. The effect of measuring the scale factors using only semi-leptonic b decays is also accounted for. The scale factors are used to correct the expected event yield at each signal point for differences between the efficiencies in data and simulation. For example, for LMB the application of the scale factors translates into a change in the yield by a factor 0.87 ± 0.18. The systematic and statistical uncertainties give a total relative uncertainty of 20% in LMB, with a similar uncertainty of 23% in LM1.

5 Results

The observation of one data event in the signal region is consistent with background expectations. Combining the expected signal and background prediction from Section 3.1 and using frequentist statistical methods in the manner of Ref. [20] with the Profile Likelihood ratio [21] to handle nuisance parameters, we derive 95% confidence level (CL) cross-section upper limits (σ_{95}^{obs}) of 18.9, 15.4, and 10.2 pb for LM0, LM1, and LMB, respectively. The effect of possibly overestimating the background due to signal contamination in the control regions increases the σ_{95}^{obs} value to 22.1 pb for LM0, 16.7 pb for LM1, but is negligible for LMB. To quantify the sensitivity with reduced dependence on the amount of b-quark production, a 95% CL upper limit on the cross section times branching ratio to at least one b quark of 4.0 pb is determined in LM1.

The resulting excluded region in the (m_0, $m_{1/2}$) plane for a reference model with CMSSM parameters $A_0 = 0$ GeV, $\tan\beta = 50$, and $\mu > 0$ is shown in Figure 2. The expected and observed exclusion regions are calculated using next-to-leading-order (NLO) cross sections, obtained with the program Prospino [22]. The excluded region is extended with respect to that of Ref. [10] without b tagging, also shown, for scenarios with increased b production, such as those with m_0 above 350 GeV.

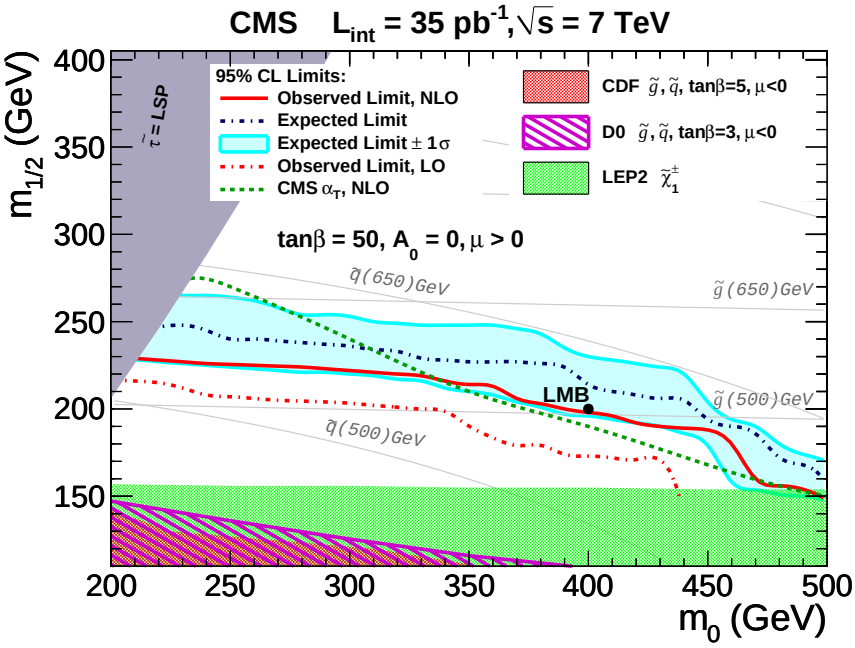

Figure 2: Exclusion regions in the (m_0, $m_{1/2}$) plane for one set of CMSSM parameters, for this analysis (solid red), and the non-b tagged version [10] (dashed green).

6 Summary

A search for events with multiple jets, at least one of which is b tagged, and significant transverse momentum imbalance has been presented. One event is observed, which is consistent with background expectations. The dominant background comes from $t\bar{t}$ production. The results of the search are characterized as an exclusion region in CMSSM parameter space and 95% CL upper limits on representative scenarios with expected cross section of approximately 15 pb. The sensitivity of this search surpasses that of the Tevatron experiments [23, 24] and is comparable to a recent fully hadronic, b-tagged search from ATLAS [25].

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References

[1] J. Wess and B. Zumino, "Supergauge Transformations in Four Dimensions", *Nucl. Phys. B* **70** (1974) 39. doi:10.1016/0550-3213(74)90355-1.

[2] H. P. Nilles, "Supersymmetry, Supergravity and Particle Physics", *Phys. Reports* **110** (1984) 1. doi:10.1016/0370-1573(84)90008-5.

[3] H. E. Haber and G. L. Kane, "The Search for Supersymmetry: Probing Physics Beyond the Standard Model", *Phys. Reports* **117** (1987) 75. doi:10.1016/0370-1573(85)90051-1.

[4] R. Barbieri, S. Ferrara, and C. A. Savoy, "Gauge Models with Spontaneously Broken Local Supersymmetry", *Phys. Lett. B* **119** (1982) 343. doi:10.1016/0370-2693(82)90685-2.

[5] S. Dawson, E. Eichten, and C. Quigg, "Search for Supersymmetric Particles in Hadron-Hadron Collisions", *Phys. Rev. D* **31** (1985) 1581. doi:10.1103/PhysRevD.31.1581.

[6] E. Witten, "Dynamical Breaking of Supersymmetry", *Nucl. Phys. B* **188** (1981) 513. doi:10.1016/0550-3213(81)90006-7.

[7] S. Dimopoulos and H. Georgi, "Softly Broken Supersymetry and SU(5)", *Nucl. Phys. B* **193** (1981) 150. doi:10.1016/0550-3213(81)90522-8.

[8] G. Jungman and M. Kamionkowski, "Supersymmetric Dark Matter", *Phys. Rept.* **267** (1996) 195. doi:10.1016/0370-1573(95)00058-5.

[9] CMS Collaboration, "Commissioning of b-jet identification with pp collisions at $\sqrt{s} = 7$ TeV", *CMS Physics Analysis Summary* **BTV-10-001** (2010).

[10] CMS Collaboration, "Search for supersymmetry in pp collisions at 7 TeV in events with jets and missing transverse energy", *Phys. Lett. B* **698** (2011) 196. doi:10.1016/j.physletb.2011.03.021.

[11] L. Randall and D. Tucker-Smith, "Dijet Searches for Supersymmetry at the LHC", *Phys. Rev. Lett.* **101** (2008) 221803. doi:10.1103/PhysRevLett.101.221803.

[12] A. H. Chamseddine, R. Arnowitt, and P. Nath, "Locally Supersymmetric Grand Unification", *Phys. Rev. Lett.* **49** (1982) 970. doi:10.1103/PhysRevLett.49.970.

[13] G. L. Kane, C. Kolda, L. Roszkowski et al., "Study of Constrained Minimal Supersymmetry", *Phys. Rev. D* **49** (1994) 6173. doi:10.1103/PhysRevD.49.6173.

[14] CMS Collaboration, "The CMS experiment at the CERN LHC", *JINST* **03** (2008) S08004. doi:10.1088/1748-0221/3/08/S08004.

[15] CMS Collaboration, "Tracking and Primary Vertex Results in First 7 TeV Collisions", *CMS Physics Analysis Summary* **TRK-10-005** (2010).

[16] M. Cacciari, G. P. Salam, and G. Soyez, "The anti-k_t jet clustering algorithm", *JHEP* **04** (2008) 63. doi:10.1088/1126-6708/2008/04/063.

[17] T. Sjöstrand, S. Mrenna, and P. Skands, "PYTHIA 6.4 Physics and Manual", *JHEP* **05** (2006) 026. doi:10.1088/1126-6708/2006/05/026.

[18] P. M. Nadolsky et al., "Implications of CTEQ global analysis for collider observables", *Phys. Rev. D* **78** (2008) 13004. doi:10.1103/PhysRevD.78.013004.

[19] CMS Collaboration, "Inclusive b-hadron production cross section with muons in pp collisions at $\sqrt{s} = 7$ TeV", *JHEP* **03** (2011) 90. doi:10.1007/JHEP03(2011)090.

[20] G. J. Feldman and R. D. Cousins, "A Unified Approach to the Classical Statistical Analysis of Small Signals", *Phys. Rev. D* **57** (1998) 3873. doi:10.1103/PhysRevD.57.3873.

[21] T. A. Severini, "Likelihood Methods in Statistics". Oxford University Press, 2000.

[22] W. Beenakker, R. Hopker, M. Spira et al., "Squark and gluino production at hadron colliders", *Nucl. Phys. B* **492** (1997) 51. doi:10.1016/S0550-3213(97)80027-2.

[23] T. Altonen et al., "Inclusive Search for Squark and Gluino Production in $p\bar{p}$ Collisions at $\sqrt{s} = 1.96$ TeV", *Phys. Rev. Lett.* **102** (2009) 121801. doi:10.1103/PhysRevLett.102.121801.

[24] V. M. Abazov et al., "Search for squarks and gluinos in events with jets and missing transverse energy using 2.1 fb^{-1} of $p\bar{p}$ collision data at $\sqrt{s} = 1.96$ TeV", *Phys. Lett. B* **660** (2008) 449. doi:10.1016/j.physletb.2008.01.042.

[25] ATLAS Collaboration, "Search for supersymmetry in pp collisions at $\sqrt{s} = 7$ TeV in final states with missing transverse momentum and b-jets", (2011). arXiv:1103.4344v1.

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36: Also at The University of Iowa, Iowa City, USA
37: Also at Mersin University, Mersin, Turkey
38: Also at Izmir Institute of Technology, Izmir, Turkey
39: Also at Kafkas University, Kars, Turkey
40: Also at Suleyman Demirel University, Isparta, Turkey
41: Also at Ege University, Izmir, Turkey
42: Also at Rutherford Appleton Laboratory, Didcot, United Kingdom
43: Also at School of Physics and Astronomy, University of Southampton, Southampton, United Kingdom
44: Also at INFN Sezione di Perugia; Università di Perugia, Perugia, Italy
45: Also at Utah Valley University, Orem, USA
46: Also at Institute for Nuclear Research, Moscow, Russia
47: Also at Los Alamos National Laboratory, Los Alamos, USA
48: Also at Erzincan University, Erzincan, Turkey