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Search for Contact Interactions in Dimuon Events from pp Collisions at $\sqrt{s} = 7$ TeV with the ATLAS Detector

The ATLAS Collaboration

A search for contact interactions has been performed using dimuon events recorded with the ATLAS detector in proton-proton collisions at $\sqrt{s} = 7$ TeV. The data sample corresponds to an integrated luminosity of 42 pb^{-1}. No significant deviation from the Standard Model is observed in the dimuon mass spectrum, allowing the following 95% C.L. limits to be set on the energy scale of contact interactions: $\Lambda > 4.9$ TeV (4.5 TeV) for constructive (destructive) interference in the left-left isoscalar compositeness model. These limits are the most stringent to date for $\mu\mu qq$ contact interactions.

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Phenomena beyond the Standard Model (SM), such as large extra spatial dimensions in the ADD model [1] or quark/lepton compositeness [2], may be described as a four-fermion contact interaction (CI) in the low energy limit. Such an approach is similar to that used by Fermi to describe nuclear β decay [3] long before the discovery of the W boson. One can describe a new interaction at a higher energy scale with an effective Lagrangian of the form [2]

$$\begin{aligned}\mathcal{L} = \tfrac{g^2}{2\Lambda^2}\, [\quad & \eta_{LL}\ \overline{\psi}_L\gamma_\mu\psi_L\,\overline{\psi}_L\gamma^\mu\psi_L \\ & + \eta_{RR}\ \overline{\psi}_R\gamma_\mu\psi_R\,\overline{\psi}_R\gamma^\mu\psi_R \\ & +2\eta_{LR}\,\overline{\psi}_L\gamma_\mu\psi_L\,\overline{\psi}_R\gamma^\mu\psi_R\ ]\ ,\end{aligned} \qquad (1)$$

where g is a coupling constant, Λ is the energy scale below which fermion constituents are bound (in the context of compositeness models), and $\psi_{L,R}$ are left-handed and right-handed fermion fields, respectively. The scale Λ is defined by the choices $g^2/4\pi = 1$ and $\eta_{LL}, \eta_{LR}, \eta_{RR} = \pm 1$. Different choices of the parameters η_{LL}, η_{LR} and η_{RR} determine the helicity structure of the new interaction. For example, the analysis presented in this Letter applies specifically to the left-left isoscalar model (LLIM) commonly used as a benchmark for contact interactions searches [4]. This model is defined by setting $\eta_{LL} = \pm 1$ and $\eta_{LR} = \eta_{RR} = 0$. With the introduction of a contact interaction, the differential cross section for the process $q\bar{q} \to \mu^+\mu^-$ becomes

$$\frac{d\sigma}{dm_{\mu\mu}} = \frac{d\sigma_{DY}}{dm_{\mu\mu}} - \eta_{LL}\frac{F_I(m_{\mu\mu})}{\Lambda^2} + \frac{F_C(m_{\mu\mu})}{\Lambda^4}\ , \qquad (2)$$

where $m_{\mu\mu}$ is the final-state dimuon mass. The expression above includes a SM Drell-Yan (DY) term, as well as DY-CI interference (F_I) and pure contact interaction (F_C) terms. DY here incorporates both photon and Z^0 boson contributions.

This Letter presents the results of a search for contact interactions in the dimuon channel, taking advantage of the high pp collision energy of the LHC and the capabilities of ATLAS to detect and measure muons. The search strategy focuses on identifying a deviation from the SM in the dimuon mass spectrum, which is expected to be dominated by DY. Contributions from a new interaction would undergo either constructive ($\eta_{LL} = -1$) or destructive ($\eta_{LL} = +1$) interference with the DY contribution. If present, a signal would result in a broad deviation from the SM expectation rather than a peak in the mass spectrum. Given current experimental bounds on Λ (see below), such a deviation would appear at masses well above the Z^0 boson peak. Therefore, the measurement requires excellent muon identification and reconstruction at high momentum. A separate Letter presents the results of a search for new heavy resonances in the dimuon mass spectrum [5]. Previous searches for contact interactions have been carried out in neutrino scattering [6], as well as at electron-positron [7–10], electron-proton [11, 12] and hadron colliders [13–21]. For the channel under study, the best limits in the LLIM are $\Lambda^- > 4.2$ TeV for constructive interference and $\Lambda^+ > 2.9$ TeV for destructive interference, at 95% C.L. [13].

ATLAS is a multipurpose particle detector [22] designed for physics at the TeV scale. Charged particle tracking is provided by an inner detector consisting of a pixel detector, a silicon-strip tracker and a transition radiation tracker, immersed in a 2 T solenoidal magnetic field. A high-granularity liquid-argon electromagnetic calorimeter surrounds the solenoid. Hadron calorimetry is provided by an iron-scintillator tile calorimeter in the central rapidity range and a liquid-argon calorimeter in the endcap and forward rapidity range. A key detector component for this analysis is the muon spectrometer, which is designed to identify muons and measure both their trajectories and momenta with high accuracy: the design momentum resolution is 10% at momenta transverse to the beam line (p_T) of 1 TeV. The muon spectrometer comprises three toroidal magnet systems consisting of eight coils each with a bending power $\int B d\ell = 1 - 7.5$ Tm, a trigger system consisting of both resistive plate chambers and thin-gap chambers, and a

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set of precision monitored drift tubes and cathode strip chambers with a single-hit spatial resolution better than 100 μm to accurately measure muon curvature. Precision chambers are continuously monitored by an optical alignment system designed to determine relative chamber positions to an accuracy of 50 μm or better.

The data sample for this analysis was collected during LHC operations in 2010 and corresponds to a total integrated luminosity of 42 pb^{-1} collected with stable beam conditions and fully operational inner detector and muon spectrometer systems. Events with muons were selected by requiring the presence of at least one high-momentum muon passing all three rejection levels of the muon trigger system. The p_T threshold was initially set to 10 GeV but was raised to 13 GeV in the later parts of the data taking due to increasing luminosity.

This analysis follows the same event selection as the search for new heavy resonances. A summary is provided below; see Ref. [5] for a more complete description. Events with a good primary vertex are selected to suppress cosmic-ray events. Muon tracks reconstructed independently in the inner detector and muon spectrometer are combined with a fit to all associated hits, taking the energy loss in the calorimeter into account. The energy loss estimate uses either the parameterized expected energy loss or the energy measured in the calorimeter if this energy significantly exceeds the most probable energy loss. The combined tracks are required to have hits in all inner detector tracking systems, have at least one hit in the non-bending plane and at least three hits in each of the inner, middle and outer precision chambers of the muon spectrometer. Tracks passing through poorly aligned chambers are rejected. The above hit requirements guarantee a reliable momentum measurement and good modeling by the detector simulation. Muon tracks are required to have $p_T > 25$ GeV, pseudorapidity $|\eta| < 2.4$ [23] to be within the acceptance of the inner detector tracking and muon spectrometer trigger systems, and a relative track isolation $\sum p_T^i/p_T < 0.05$, where the sum is over all inner detector tracks i within a $\Delta R = \sqrt{\Delta\eta^2 + \Delta\phi^2}$ cone of 0.3 around the muon trajectory, to suppress backgrounds from heavy flavor decays. Additional requirements are placed on the impact parameter of the muon track to reduce cosmic-ray backgrounds to a negligible level. Finally, dimuon candidates are formed from all pairs of opposite-charge muons satisfying the above criteria and the mass of those pairs is required to be greater than 70 GeV. There are 7743 dimuon events passing all selection requirements.

Drell-Yan, W+jets and multi-jet events were generated with PYTHIA 6.421 [24] and MRST2007 LO* parton distribution functions (PDFs) [25]. Diboson (WW, WZ, and ZZ) events were produced with HERWIG 6.510 [26] and MRST2007 LO* PDFs. In the case of $t\bar{t}$, events were generated with MC@NLO 3.41 [27] to compute matrix elements, JIMMY 4.31 [28] to simulate the underlying event, HERWIG 6.510 to model parton showering and hadronization, and CTEQ 6.6 [29] for PDFs. For signal samples, PYTHIA 6.421 was used to produce DY and CI simultaneously in order to properly account for the interference between the two processes. A mass-dependent QCD K-factor corresponding to the ratio between NNLO [30] and PYTHIA LO* DY differential cross sections was applied to these signal samples as well as pure DY samples. Similarly, a mass-dependent electroweak K-factor was applied to account for higher order electroweak effects due to virtual gauge boson loops [31]. This correction was only applied to the DY cross section since the new physics included in the CI term has unknown couplings to SM gauge bosons. The QCD (electroweak) K-factor varies between 1.16 (1.04) at low dimuon mass and 0.86 (0.85) at a mass of 2 TeV. The response of the ATLAS detector to these generated event samples was simulated with GEANT 4 [32, 33].

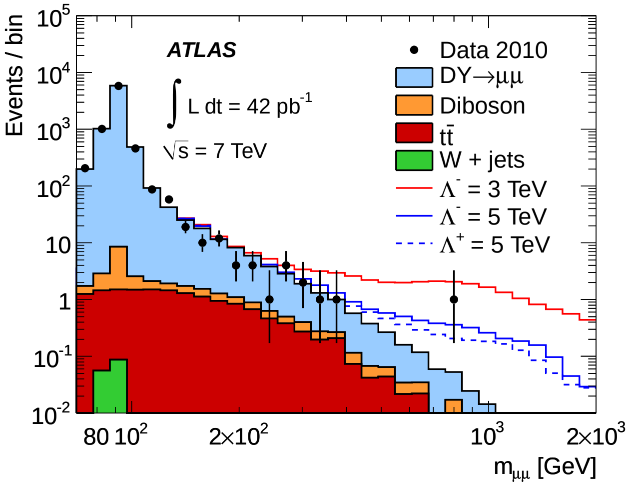

FIG. 1. Dimuon invariant mass distribution for data (points) and Monte Carlo (histograms). The red (blue) line corresponds to the distribution expected in the presence of contact interactions with $\Lambda^- = 3$ TeV (5 TeV) for constructive interference. The dashed blue line corresponds to $\Lambda^+ = 5$ TeV for destructive interference.

Figure 1 shows the dimuon mass distribution for all selected events along with the predicted contributions from SM processes and CI for selected Λ values. Predictions for the various background processes are extracted from the Monte Carlo (MC) simulation. Besides the dominant DY contribution, we also account for a small dimuon yield from $t\bar{t}$ and diboson production. The small predicted yield from $t\bar{t}$ has been confirmed in the data by selecting events with high-mass electron-muon pairs, see Ref. [5]. Backgrounds from W production are effectively suppressed by requiring two selected muons in the event. Likewise, multi-jet backgrounds are reduced to a negligible amount (< 0.1 events in the selected sample) by the muon p_T and isolation requirements.

Table I presents the number of events in different bins of dimuon mass for data and MC simulation. The sum of MC predictions is normalized to the number of data events in the Z^0 peak mass region between 70 and 110 GeV. It should be noted that, prior to normalization, data and MC event yields agree within the uncertainty in the integrated luminosity. This normalization procedure removes sensitivity to mass-independent uncertainties such as the luminosity uncertainty. The overall acceptance of the selection is estimated to be 36% for simulated DY events in the signal region defined by $m_{\mu\mu} > 150$ GeV.

To estimate the level of agreement between the observed mass spectrum and the SM prediction, a large ensemble of SM-only pseudo-experiments was generated. For each such pseudo-experiment, a binned likelihood was computed to quantify the deviation from the SM expectation. In 56% of these pseudo-experiments, the deviation was found to be more significant than that observed in the data for the signal region, indicating good consistency between the data and the predicted spectrum. This level of agreement is illustrated in Fig. 2, which shows the number of events above a minimum mass $m_{\mu\mu}^{\mathrm{min}}$. Since no significant deviation is observed in the dimuon mass spectrum, we proceed with setting a limit on the energy scale Λ using a Bayesian method. Here, the prior probability distribution is chosen to be flat in $1/\Lambda^2$, motivated by the form of Eq. (2). Systematic uncertainties are incorporated in the limit setting by treating them as nuisance parameters ($\bar{\nu}$) that are marginalized in the calculation of the posterior probability $\mathcal{P}$. The 95% confidence level limit is then obtained by finding the value Λ_{lim} that satisfies $\int_0^{\theta_{\mathrm{lim}}} \mathcal{P}(\theta \mid \bar{n}, \bar{\nu})\, d\theta = 0.95$, where $\theta = 1/\Lambda^2$ and $\bar{n}$ represents the observed number of events in the mass bins above 150 GeV, with bin boundaries as defined in Table I. Table II shows the expected number of events in each mass bin within the signal region for different scales Λ, as used in the calculation of the posterior probability.

Systematic errors are of both theoretical and experimental origins. Because the expected event yields are normalized to the Z^0 peak region, only momentum- or mass-dependent uncertainties are relevant. Theoretical uncertainties include PDF variations evaluated using the MSTW2008 PDF error set [34] in the absence of a full error set for the MRST2007 LO* PDF. This choice leads to conservative uncertainties in the event yields that grow from 3% at the Z^0 pole to 6% (9%) at a mass of 1 TeV (1.5 TeV). A cross-check was made by computing cross sections for both MSTW2008 and CTEQ 6.6 PDFs for a wide range of dimuon masses. Differences between the two choices of PDF were always found to be smaller than the assigned uncertainty obtained from the MSTW2008 PDF set. The QCD K-factor uncertainty in the DY and DY+CI cross sections is taken to be the difference between NNLO and NLO DY cross sections as a function of dimuon mass. The electroweak K-factor uncertainty in the DY cross section is taken to be the entire magnitude of the correction relative to the LO cross section. Uncertainties in the QCD (electroweak) K-factor are mass dependent; for example, they amount to 3.0% (4.5%) at a mass of 1 TeV. Uncertainties in the $t\bar{t}$, diboson and W+jets cross sections have a negligible impact on the limit. Finally, the statistical error of the DY+CI MC (shown in Table II) is included as a source of systematic error.

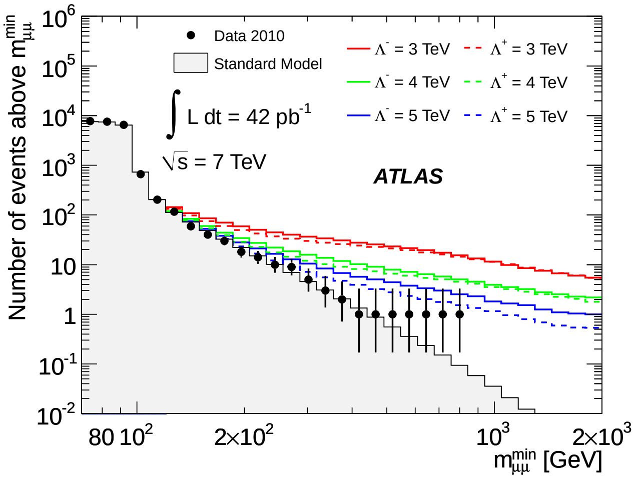

FIG. 2. Distribution of the number of events with dimuon mass above $m_{\mu\mu}^{\mathrm{min}}$ for data (points) and Monte Carlo (histograms). The SM prediction is shown as the shaded grey histogram, whereas the solid (dashed) histograms correspond to the expected distributions in the presence of contact interactions with various scales Λ for constructive (destructive) interference.

The MC simulation is used to determine all acceptance and efficiency effects. Therefore, detailed comparisons between data and Monte Carlo were performed to make sure that the simulation models the data well for our choice of muon track selection criteria, especially at higher p_T. Experimental uncertainties arise from the slight p_T-dependence of muon efficiencies and from the impact of the intrinsic detector spatial resolution on the momentum resolution. At transverse momenta above 200 GeV, radiative losses due to bremsstrahlung in the detector material begin to affect the muon track pattern recognition. An uncertainty of 3% per TeV is assigned to the muon efficiency to conservatively account for the small p_T dependence predicted by the simulation. Muon momentum resolution at high p_T is most affected by the quality of the muon spectrometer alignment. The latter has been studied with high-momentum cosmic ray muons traversing the center of the detector. It has also been studied in collision data with muons passing through detector regions with overlapping muon spectrometer chambers, thereby providing independent track fits from the redundant sets of hits in neighbor-

TABLE I. Expected and observed number of events in the dimuon channel. The errors quoted originate from the limited MC statistics. Entries of 0.0 indicate a value < 0.05.

$m_{\mu\mu}$ [GeV]	70-110	110-130	130-150	150-170	170-200	200-240	240-300	300-400	400-550	550-800	800-1200	1200-2000
DY	7547 ± 7	98.4 ± 0.8	33.4 ± 0.5	17.2 ± 0.3	12.8 ± 0.3	7.8 ± 0.2	5.1 ± 0.1	2.5 ± 0.0	1.0 ± 0.0	0.3 ± 0.0	0.1 ± 0.0	0.0 ± 0.0
$t\bar{t}$	6.0 ± 0.2	2.4 ± 0.1	1.7 ± 0.1	1.2 ± 0.0	1.2 ± 0.0	1.0 ± 0.0	0.73 ± 0.0	0.4 ± 0.0	0.1 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Diboson	10.1 ± 0.1	0.8 ± 0.2	0.6 ± 0.0	0.5 ± 0.0	0.4 ± 0.0	0.3 ± 0.0	0.24 ± 0.0	0.2 ± 0.0	0.1 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
W+jets	0.14 ± 0.08	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Total	7563 ± 7	101.6 ± 0.8	35.7 ± 0.5	18.9 ± 0.3	14.4 ± 0.3	9.1 ± 0.2	6.0 ± 0.1	3.0 ± 0.1	1.2 ± 0.0	0.3 ± 0.0	0.1 ± 0.0	0.0 ± 0.0
Data	7563	101	41	11	11	7	6	2	0	1	0	0

TABLE II. Expected number of events in the signal region of the analysis for various contact interaction scales with constructive (Λ^-) and destructive (Λ^+) interference. The errors quoted originate from the limited MC statistics.

$m_{\mu\mu}$ [GeV]	150-170	170-200	200-240	240-300	300-400	400-550	550-800	800-1200	1200-2000
$\Lambda^- = 3$ TeV	19.1 ± 0.5	15.7 ± 0.4	11.2 ± 0.4	8.5 ± 0.3	7.9 ± 0.3	6.0 ± 0.3	6.5 ± 0.3	5.1 ± 0.2	3.0 ± 0.2
$\Lambda^- = 4$ TeV	18.8 ± 0.4	14.3 ± 0.4	10.0 ± 0.3	6.5 ± 0.2	5.0 ± 0.2	3.0 ± 0.2	2.3 ± 0.2	1.5 ± 0.1	1.1 ± 0.1
$\Lambda^- = 5$ TeV	17.4 ± 0.4	14.3 ± 0.4	9.4 ± 0.3	6.2 ± 0.2	4.3 ± 0.2	2.0 ± 0.1	1.3 ± 0.1	0.7 ± 0.1	0.4 ± 0.1
$\Lambda^- = 7$ TeV	17.3 ± 0.4	13.8 ± 0.4	9.3 ± 0.3	6.3 ± 0.2	3.3 ± 0.2	1.3 ± 0.1	0.6 ± 0.1	0.2 ± 0.0	0.1 ± 0.0
$\Lambda^+ = 2$ TeV	21.6 ± 0.6	19.3 ± 0.6	15.8 ± 0.5	15.2 ± 0.5	21.2 ± 0.6	21.6 ± 0.6	25.5 ± 0.6	21.4 ± 0.6	15.1 ± 0.5
$\Lambda^+ = 3$ TeV	18.6 ± 0.4	15.2 ± 0.4	10.1 ± 0.3	7.2 ± 0.3	5.5 ± 0.2	4.6 ± 0.2	5.3 ± 0.2	4.3 ± 0.2	3.1 ± 0.2
$\Lambda^+ = 4$ TeV	18.2 ± 0.4	14.3 ± 0.4	8.8 ± 0.3	6.1 ± 0.2	3.6 ± 0.2	2.1 ± 0.1	1.6 ± 0.1	1.5 ± 0.1	0.8 ± 0.1
$\Lambda^+ = 5$ TeV	18.5 ± 0.4	13.6 ± 0.3	8.8 ± 0.3	5.4 ± 0.2	2.9 ± 0.2	1.6 ± 0.1	0.9 ± 0.1	0.5 ± 0.1	0.3 ± 0.1

ing chambers and allowing the impact of the alignment of adjacent detector regions to be measured. Curvature smearing parameters derived from these studies are found to be $\delta(q/p_T) = 0.18 \pm 0.04$ TeV^{-1} for $|\eta| < 2.0$ and $\delta(q/p_T) = 0.7 \pm 0.2$ TeV^{-1} for $|\eta| > 2.0$, where q is the charge of the muon track. These parameters reflect the current level of understanding of the detector alignment and are expected to decrease with further data taking. We take the full magnitude of these smearing corrections as the systematic uncertainty in the momentum resolution.

Using the Bayesian method described above, the expected 95% C.L. lower limits on the scale Λ are found to be 5.1 ± 0.3 TeV and 4.8 ± 0.3 TeV for constructive and destructive interference, respectively. The quoted uncertainty range is estimated with a large set of pseudo-experiments and corresponds to a 68% range around the median value of all the limits obtained from those pseudo-experiments. Systematic errors are already folded into the limit setting procedure and result in a decrease of the limit by about 0.1 TeV. The dominant source of uncertainty originates from the limited signal MC statistics. For the selected data sample, we set the following limits at 95% C.L.: $\Lambda^- > 4.9$ TeV for constructive interference and $\Lambda^+ > 4.5$ TeV for destructive interference in the LLIM. These values are compatible with the expected limits.

To conclude, a search for contact interactions has been carried out in a sample of dimuon events recorded by the ATLAS detector in pp collisions from the LHC at $\sqrt{s} = 7$ TeV. No significant deviation from the Standard Model is observed in the dimuon mass spectrum obtained from a data sample corresponding to an integrated luminosity of 42 pb^{-1}. Limits placed on the energy scale Λ are the most stringent to date for $\mu\mu qq$ contact interactions.

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[1] N. Arkani-Hamed, S. Dimopoulos, and G. Dvali, Phys. Lett. B **429**, 00466 (1998).
[2] E. Eichten, K. Lane, and M. Peskin, Phys. Rev. Lett. **50**, 811 (1983).
[3] E. Fermi, Nuovo Cim. **11**, 1 (1934); Z. Phys. **88**, 161 (1934).
[4] K. Nakamura *et al.* (Particle Data Group), J. Phys. G **37**, 075021 (2010).
[5] ATLAS Collaboration, arXiv:1103.6218 [hep-ex], to appear in Phys. Lett. B.
[6] K. McFarland, Eur. Phys. J. A **24**, 161 (2005).
[7] S. Schael *et al.* (ALEPH Collaboration), Eur. Phys. J. C **49**, 411 (2007).
[8] J. Abdallah *et al.* (DELPHI Collaboration), Eur. Phys. J. C **45**, 589 (2006).
[9] M. Acciarri *et al.* (L3 Collaboration), Phys. Lett. B **489**, 81 (2000).
[10] G. Abbiendi *et al.* (OPAL Collaboration), Eur. Phys. J. C **33**, 173 (2004).
[11] C. Adloff *et al.* (H1 Collaboration), Phys. Lett. B **568**, 35 (2003).
[12] S. Chekanov *et al.* (ZEUS Collaboration), Phys. Lett. B **591**, 23 (2004).
[13] K. Abe *et al.* (CDF Collaboration), Phys. Rev. Lett. **79**, 2198 (1997).
[14] T. Affolder *et al.* (CDF Collaboration), Phys. Rev. Lett. **87**, 231803 (2001).
[15] A. Abulencia *et al.* (CDF Collaboration), Phys. Rev. Lett. **96**, 211801 (2006).
[16] B. Abbott *et al.* (D0 Collaboration), Phys. Rev. Lett. **82**, 4769 (1999).
[17] V.M. Abazov *et al.* (D0 Collaboration), Phys. Rev. Lett. **103**, 191803 (2009).
[18] V. Khachatryan *et al.* (CMS Collaboration), Phys. Rev. Lett. **105**, 262001 (2010).
[19] ATLAS Collaboration, Phys. Lett. B **694**, 327 (2011).
[20] V. Khachatryan *et al.* (CMS Collaboration), arXiv:1102.2020 [hep-ex], to appear in Phys. Rev. Letters.
[21] ATLAS Collaboration, arXiv:1103.3864 [hep-ex], to appear in New J. Phys.
[22] ATLAS Collaboration, J. Inst. **3**, S08003 (2008).
[23] ATLAS uses a right-handed coordinate system with its origin at the nominal interaction point (IP) in the center of the detector and the z-axis along the beam pipe. The x-axis points from the IP to the center of the LHC ring, and the y-axis points upward. Cylindrical coordinates (r, ϕ) are used in the transverse plane, ϕ being the azimuthal angle around the beam pipe. The pseudorapidity is defined in terms of the polar angle θ as $\eta = -\ln\tan(\theta/2)$.
[24] T. Sjostrand, S. Mrenna, and P. Skands, JHEP **05**, 026 (2006).
[25] A. Sherstnev and R.S. Thorne, Eur. Phys. J. C **55**, 189 (2008).
[26] G. Corcella *et al.*, JHEP **01**, 010 (2001); arXiv:hep-ph/0210213.
[27] S. Frixione and B. Webber, JHEP **0206**, 029 (2002).
[28] J.M. Butterworth *et al.*, Z. Phys. C **72**, 637 (1997).
[29] P.M. Nadolsky *et al.*, Phys. Rev. D **78**, 013004 (2008).
[30] S. Catani *et al.*, Phys. Rev. Lett. **103**, 082001 (2009).
[31] C.M. Carloni Calame *et al.*, JHEP **0710**, 109 (2007).
[32] ATLAS Collaboration, Eur. Phys. J. C **70**, 823 (2010).
[33] S. Agnostinelli *et al.* (Geant4 Collaboration), Nucl. Instrum. Meth. **A506**, 250 (2003); J. Allison *et al.*, IEEE Trans. Nucl. Sci. **53**, 270 (2006).
[34] A.D. Martin, W.J. Stirling, R.S. Thorne, and G. Watt, Eur. Phys. J. C **63**, 189 (2009).

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Phillips[129], G. Piacquadio[29], E. Piccaro[75], M. Piccinini[19a,19b], A. Pickford[53], S.M. Piec[41], R. Piegaia[26], J.E. Pilcher[30], A.D. Pilkington[82], J. Pina[124a,b], M. Pinamonti[164a,164c], A. Pinder[118], J.L. Pinfold[2], J. Ping[32c], B. Pinto[124a,b], O. Pirotte[29], C. Pizio[89a,89b], R. Placakyte[41], M. Plamondon[169], W.G. Plano[82], M.-A. Pleier[24], A.V. Pleskach[128], A. Poblaguev[24], S. Poddar[58a], F. Podlyski[33], L. Poggioli[115], T. Poghosyan[20], M. Pohl[49], F. Polci[55], G. Polesello[119a], A. Policicchio[138], A. Polini[19a], J. Poll[75], V. Polychronakos[24], D.M. Pomarede[136], D. Pomeroy[22], K. Pommès[29], L. Pontecorvo[132a], B.G. Pope[88], G.A. Popeneciu[25a], D.S. Popovic[12a], A. Poppleton[29], X. Portell Bueso[48], R. Porter[163], C. Posch[21], G.E. Pospelov[99], S. Pospisil[127], I.N. Potrap[99], C.J. Potter[149], C.T. Potter[114], G. Poulard[29], J. Poveda[172], R. Prabhu[77], P. Pralavorio[83], S. Prasad[57], R. Pravahan[7], S. Prell[64], K. Pretzl[16], L. Pribyl[29], D. Price[61], L.E. Price[5], M.J. Price[29], P.M. Prichard[73], D. Prieur[123], M. Primavera[72a], K. Prokofiev[108], F. Prokoshin[31b], S. Protopopescu[24], J. Proudfoot[5], X. Prudent[43], H. Przysiezniak[4], S. Psoroulas[20], E. Ptacek[114], J. Purdham[87], M. Purohit[24,w], P. Puzo[115], Y. Pylypchenko[117], J. Qian[87], Z. Qian[83], Z. Qin[41], A. Quadt[54], D.R. Quarrie[14], W.B. Quayle[172], F. Quinonez[31a], M. Raas[104], V. Radescu[58b], B. Radics[20], T. Rador[18a], F. Ragusa[89a,89b], G. Rahal[177], A.M. Rahimi[109], D. Rahm[24], S. Rajagopalan[24], M. Rammensee[48], M. Rammes[141], M. Ramstedt[146a,146b], K. Randrianarivony[28], P.N. Ratoff[71], F. Rauscher[98], E. Rauter[99], M. Raymond[29], A.L. Read[117], D.M. Rebuzzi[119a,119b], A. Redelbach[173], G. Redlinger[24], R. Reece[120], K. Reeves[40], A. Reichold[105], E. Reinherz-Aronis[153], A. Reinsch[114], I. Reisinger[42], D. Reljic[12a], C. Rembser[29], Z.L. Ren[151], A. Renaud[115], P. 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Schmitt[81], S. Schmitt[58b], M. Schmitz[20], A. Schöning[58b], M. Schott[29], D. Schouten[142], J. Schovancova[125], M. Schram[85], C. Schroeder[81], N. Schroer[58c], S. Schuh[29], G. Schuler[29], J. Schultes[174], H.-C. Schultz-Coulon[58a], H. Schulz[15], J.W. Schumacher[20], M. Schumacher[48], B.A. Schumm[137], Ph. Schune[136], C. Schwanenberger[82], A. Schwartzman[143], Ph. Schwemling[78], R. Schwienhorst[88], R. Schwierz[43], J. Schwindling[136], W.G. Scott[129], J. Searcy[114], E. Sedykh[121], E. Segura[11], S.C. Seidel[103], A. Seiden[137], F. Seifert[43], J.M. Seixas[23a], G. Sekhniaidze[102a], D.M. Seliverstov[121], B. Sellden[146a], G. Sellers[73], M. Seman[144b], N. Semprini-Cesari[19a,19b], C. Serfon[98], L. Serin[115], R. Seuster[99], H. Severini[111], M.E. Sevior[86], A. Sfyrla[29], E. Shabalina[54], M. Shamim[114], L.Y. Shan[32a], J.T. Shank[21], Q.T. Shao[86], M. Shapiro[14], P.B. Shatalov[95], L. Shaver[6], C. Shaw[53], K. Shaw[164a,164c], D. Sherman[175], P. 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