# Search for a Charged Higgs Boson Produced in the Vector-Boson Fusion Mode with Decay $H^{\pm} \to W^{\pm}Z$ using $pp$ Collisions at $\sqrt{s} = 8$ TeV with the ATLAS Experiment

G. Aad *et al.*[*]
(ATLAS Collaboration)
(Received 13 March 2015; published 9 June 2015)

A search for a charged Higgs boson, $H^{\pm}$, decaying to a $W^{\pm}$ boson and a $Z$ boson is presented. The search is based on 20.3 $\mathrm{fb}^{-1}$ of proton-proton collision data at a center-of-mass energy of 8 TeV recorded with the ATLAS detector at the LHC. The $H^{\pm}$ boson is assumed to be produced via vector-boson fusion and the decays $W^{\pm} \to q\bar{q}'$ and $Z \to e^+e^-/\mu^+\mu^-$ are considered. The search is performed in a range of charged Higgs boson masses from 200 to 1000 GeV. No evidence for the production of an $H^{\pm}$ boson is observed. Upper limits of 31–1020 fb at 95% C.L. are placed on the cross section for vector-boson fusion production of an $H^{\pm}$ boson times its branching fraction to $W^{\pm}Z$. The limits are compared with predictions from the Georgi-Machacek Higgs triplet model.

DOI: 10.1103/PhysRevLett.114.231801 PACS numbers: 14.80.Fd, 12.60.Fr

After the discovery of a Higgs boson at the LHC in 2012 [1,2], an important question now is whether the newly discovered particle is part of an extended scalar sector. The discovery of additional scalar or pseudoscalar bosons would provide spectacular evidence that this is the case.

A charged Higgs boson $H^{\pm}$ appears in many models with an extended scalar sector such as the two Higgs doublet model, where a second Higgs doublet is introduced [3], and the Higgs Triplet Models [4,5], where a triplet is added to the Higgs doublet of the standard model (SM). While $H^{\pm} \to \tau^{\pm}\nu, cs, tb$ decays dominate in the two Higgs doublet model at tree level, $H^{\pm} \to W^{\pm}Z$ decays are allowed at loop level [6] and are predicted at tree level in Higgs triplet models. In the search presented in this Letter, the $H^{\pm}$ boson is assumed to couple to $W^{\pm}$ and $Z$ bosons. In this case, it is produced via vector-boson fusion (VBF), $W^{\pm}Z \to H^{\pm}$, at the LHC and decays to $W^{\pm}Z$. The search is performed in the channel with subsequent decays of $W^{\pm} \to q\bar{q}'$ and $Z \to \ell^+\ell^-$, over the $H^{\pm}$ mass range $200 < m_{H^{\pm}} < 1000$ GeV. The data are compared with the Georgi-Machacek Higgs triplet model (GMHTM) [4].

Searches at LEP have looked for pair-produced charged Higgs bosons [7]. Previous searches at the Tevatron and LHC have looked for a charged Higgs boson produced in top quark decays or in associated production with a top quark [8–11]. Searches for a $W^{\pm}Z$ resonance have also been performed in non-Higgs-specific models [12–18], but this search is the first to look specifically for the VBF production mechanism.

[*]Full author list given at the end of the article.



The data used in this search were recorded with the ATLAS detector in proton-proton collisions at a center-of-mass energy of $\sqrt{s} = 8$ TeV. In the ATLAS coordinate system, the polar angle $\theta$ is measured with respect to the LHC beam line and the azimuthal angle $\phi$ is measured in the plane transverse to the beam line. Pseudorapidity is defined as $\eta = -\ln\tan(\theta/2)$.

The ATLAS detector is described in detail elsewhere [19]. It consists of an inner tracking detector covering the range $|\eta| < 2.5$, surrounded by a superconducting solenoid providing a 2 T magnetic field, electromagnetic and hadronic calorimeters ($|\eta| < 4.9$), and an external muon spectrometer ($|\eta| < 2.7$), consisting of three air-core toroidal magnets, interspersed with high-precision tracking chambers. The integrated luminosity of the data sample, considering only data-taking periods where all relevant detector subsystems were operational, is $20.3 \pm 0.6\ \mathrm{fb}^{-1}$ [20]. The data were collected using a combination of single-electron, single-muon, electron-electron, and muon-muon triggers. The higher level $p_T$ thresholds for both electrons and muon triggers are 24 GeV for the single-lepton triggers and 13 GeV for the dilepton triggers.

Monte Carlo simulated events are used to estimate distributions of expected signal and background events. Signal events are generated for a narrow-width $H^{\pm}$ boson produced via VBF with MADGRAPH5 [21] using CTEQ6L1 [22] parton distribution functions (PDFs). The parton showering is performed with PYTHIA8 [23,24]. The dominant background is the production of $Z$ bosons in association with jets, which is simulated with SHERPA [25] using CT10 PDFs [26]. Top quark pair, single top quark and diboson production are simulated with POWHEG [27–29] using CTEQ6L1 PDFs.

All simulated samples are passed through the ATLAS GEANT4-based detector simulation [30,31]. The simulated events are overlaid with additional minimum-bias events to account for the effect of multiple $pp$ interactions (pileup) occurring in the same and neighboring bunch crossings [32].

Electrons are identified for $|\eta| < 2.47$ and $p_T > 7$ GeV from energy clusters in the electromagnetic calorimeter that are matched to tracks in the inner detector [33]. Quality requirements on the calorimeter clusters and tracks are applied to reduce contamination from jets. The jet background is further reduced by applying isolation requirements that are based on tracking information within a cone around the electron candidate [34].

Muons are reconstructed in the muon spectrometer in the range $|\eta| < 2.7$ and $p_T > 7$ GeV [35]. For $|\eta| < 2.5$, the muon spectrometer track must be matched with a track in the inner detector and information from both is used to reconstruct the momentum. The muon candidates are required to pass isolation requirements similar to those for electrons.

Jets are reconstructed using the anti-$k_t$ algorithm [36] with size parameter $R = 0.4$ and are restricted to $|\eta| < 4.5$ in order to fully contain each of the jets in the calorimeters. Those jets with $|\eta| < 2.5$, where there is good tracking coverage, are called central jets and are required to have $p_T > 20$ GeV. Those jets with $2.5 < |\eta| < 4.5$ are required to have $p_T > 30$ GeV. Low-$p_T$ central jets from pileup are suppressed with the following requirement: for jets with $|\eta| < 2.4$ and $p_T < 50$ GeV, tracks associated with the primary vertex must contribute over 50% to the scalar sum of the $p_T$ of all the tracks associated with the jet. Jets originating from $b$-quark fragmentation are selected using a multivariate tagging algorithm ($b$-tagging) [37]. The $b$-tagging algorithm is only applied to central jets and its operating point is chosen such that the efficiency to select $b$-quark jets is approximately 70%.

The magnitude of the missing transverse momentum ($E_T^{\text{miss}}$) is computed using fully calibrated electrons, muons, jets, and calorimeter clusters not associated with other physics objects [38].

The $Z \to \ell^+\ell^-$ decay is reconstructed from two electrons or two muons. In events with muons, where there is a very low charge misidentification probability, the leptons must be oppositely charged. In order to match the single-lepton trigger threshold and reduce the multijet background, tighter requirements are placed on one of the leptons. These requirements are that the lepton has $p_T > 25$ GeV and, if it is a muon, is restricted to $|\eta| < 2.5$. The mass of the $Z$ boson candidate is reconstructed from the two leptons and must satisfy $83 < m_{\ell\ell} < 99$ GeV.

The VBF process generally contains two reconstructed jets, referred to as tag jets, with high $|\eta|$ in opposite directions. The tag-jet selection begins by requiring two non-$b$-tagged jets in opposite hemispheres. If more than one such pair is found, the one with the highest invariant mass is selected. The tag-jet pair must have an invariant mass greater than 500 GeV and $|\Delta\eta| > 4$.

Once a tag-jet pair has been identified, the $W^\pm \to q\bar{q}'$ decay is reconstructed from the two highest-$p_T$ remaining central jets. These jets are referred to as signal jets. In order to reduce the $Z+$ jets background, at least one signal jet is required to have $p_T > 45$ GeV. A cut on the dijet invariant mass of $60 < m_{jj} < 95$ GeV, consistent with the $W^\pm$ mass, is made.

Background from top quark production is reduced by rejecting events with two or more $b$-tagged jets and requiring the $E_T^{\text{miss}}$ significance $E_T^{\text{miss}}/\sqrt{H_T} < 6\ \text{GeV}^{0.5}$, where $H_T$ is the scalar sum of the transverse momenta of all jets and leptons in the event.

The invariant mass of the two leptons and two signal jets $m_{\ell\ell jj}$ is used to reconstruct the charged Higgs boson mass, $m_{H^\pm}$. The resolution is improved by using the $W^\pm$ mass [39], $m_W = 80.4$ GeV, as a constraint by scaling the energy of each jet by $m_W/m_{jj}$. The resulting experimental resolution on $m_{\ell\ell jj}$, determined from simulation, is on average 2.4% and is approximately independent of $m_{\ell\ell jj}$ over the range of the analysis.

In order to reduce the $Z+$ jets background, cuts are imposed on the transverse momentum and azimuthal angular separation of the lepton pair: $p_T^{\ell\ell} > \min[0.46 m_{\ell\ell jj} - 54\ \text{GeV}, 275\ \text{GeV}]$ and $\Delta\phi_{\ell\ell} < 1 + (270\ \text{GeV}/m_{\ell\ell jj})^{3.5}$, and also on the transverse momentum of the signal jets $p_T^j > 0.1 m_{\ell\ell jj}$. These cuts depend on the reconstructed charged Higgs boson mass since the decay products of the $W^\pm$ and $Z$ bosons in signal events tend to be at higher transverse momentum and more collimated as $m_{\ell\ell jj}$ increases. The cut values were chosen which maximized the sensitivity of the analysis.

After all cuts, a total of 506 data events are selected. The efficiency of the signal selection is 5% for a narrow width $H^\pm$ at $m_{H^\pm} = 200$ GeV, rising to a maximum of 9% at $m_{H^\pm} = 600$ GeV. The efficiency rises with increasing $m_{H^\pm}$ because the $W$ and $Z$ bosons receive a higher transverse boost, so fewer events fail the minimum transverse momentum requirements on the leptons and jets. The efficiency falls to 2% at 1 TeV since the products from the $W$ decay begin to overlap to form a single jet.

The dominant background after all cuts is $Z+$ jets. Other smaller backgrounds that are taken into account are top pair production, single top production, diboson production, and multijet background. The shapes of all backgrounds are determined from simulation, apart from the multijet background, which is estimated from data.

In the electron channel, the multijet background is determined by selecting a sample of events with a reversed isolation requirement on the electron. This is normalized by performing a fit to the $m_{\ell\ell}$ distribution of the data, with the normalizations of the multijet background and of a template made from the sum of the remaining backgrounds left as free parameters. The systematic error on the multijet normalization is evaluated to be 50%. It is determined by looking at the difference in scale factors obtained for a sample of events with either two or three central jets. The multijet background in the muon channel is found to be negligible.

The normalization of the $Z+$jets background is determined from the signal region by leaving it as a free parameter of the profile likelihood fit as discussed below. The contribution to the expected number of events in the signal region due to top quark production is constrained by comparing the observed and expected yields in a control region enriched in top quark pairs. This control region is defined by selecting events with the same cuts as those for the signal region but with an electron and a muon, rather than two same-flavor leptons, and two $b$-tagged jets with $50 < m_{jj} < 180$ GeV replacing the central-jet requirements. A total of 261 data events are selected. The other backgrounds, diboson and single top quark production, are normalized according to the theory cross section calculated at next-to-leading order as listed in Ref. [34].

The largest systematic uncertainties arise from the signal acceptance modeling, the normalization, and modeling of the $Z+$jets and top backgrounds and from the jet energy scale.

The jet energy scale systematic uncertainty arises from several sources including uncertainties from the *in situ* calibration, pileup-dependent corrections, and the jet flavor composition [32]. A systematic error on the jet energy resolution is also included. These uncertainties are propagated to the $E_{\mathrm{T}}^{\mathrm{miss}}$, which also has a contribution from hadronic energy that is not included in jets [38]. The uncertainty in the pileup is accounted for by varying the cut against pileup jets and varying the assumed number of pileup interactions in the simulated events. The $b$-tagging efficiency uncertainty is dependent on jet $p_T$ and comes mainly from the uncertainty on the measurement of the efficiency in top quark pair events [37]. Other experimental systematic uncertainties that are included arise from the lepton energy scale, lepton identification efficiency, and the uncertainty on the multijet background prediction.

In addition to the experimental systematic uncertainties, modeling systematic uncertainties are included to account for possible differences between the data and the simulation model that is used for each background process, following closely the procedure described in Ref. [34]. The $Z+$jets background includes uncertainties on the relative fractions of the different flavor components, the shape of distributions of $m_{jj}$, the azimuthal separation of the central jet pair, and the transverse momentum of the lepton pair. For top quark pair production, uncertainties on the top quark transverse momentum and $m_{jj}$ distributions are included. Uncertainties on the ratio of the numbers of events containing two and three reconstructed signal jets are also included for each background.

Modeling uncertainties on the signal acceptance are taken into account by varying the factorization and normalization scale up and down by a factor of 2, varying the amount of initial- and final-state radiation and comparing the default CTEQ6L1 PDFs to MSTW2008lo68cl [40] and NNPDF21_lo_as_0119_100 [41] PDFs. The combined signal acceptance uncertainty is $\sim$10% and approximately constant with $m_{H^\pm}$.

The contribution of the various sources of uncertainty for an example production scenario is given in Table I.

TABLE I. The percentage impact of the various sources of uncertainty on the expected $H^\pm$ production cross section for $m_{H^\pm} = 400$ GeV and $\sigma \times \mathrm{BR}(H^\pm \to W^\pm Z) = 1$ pb.

| Source of uncertainty | Impact (%) |
| --- | --- |
| Total | 20 |
| Statistical | 14 |
| Systematic | 14 |
| Experimental uncertainties | |
| Jets + $E_T^{\mathrm{miss}}$ | 8.8 |
| Luminosity | 2.8 |
| Leptons | 0.9 |
| $b$-tagging | 0.2 |
| Theoretical and modeling uncertainties | |
| Signal | 10 |
| Top | 3.8 |
| $Z+$jets | 3.7 |
| Multijet | 0.1 |

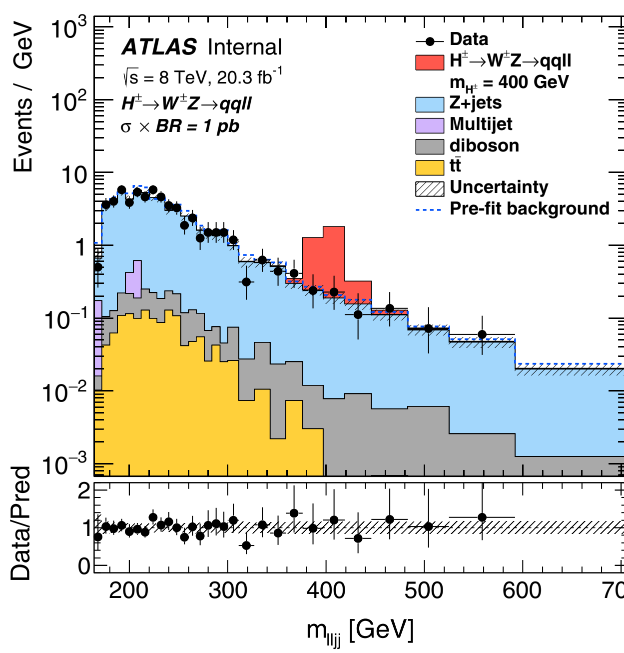


FIG. 1 (color online). The $m_{\ell\ell jj}$ distribution for data and the expected SM background. The hashed band indicates the postfit systematic uncertainty. Included in the plot is an example signal sample with $m_{H^\pm} = 400$ GeV, which has been plotted with a cross section times branching fraction, $\sigma \times \mathrm{BR}(H^\pm \to W^\pm Z) = 1$ pb for illustration. No data events are observed for values of $m_{\ell\ell jj} > 600$ GeV.

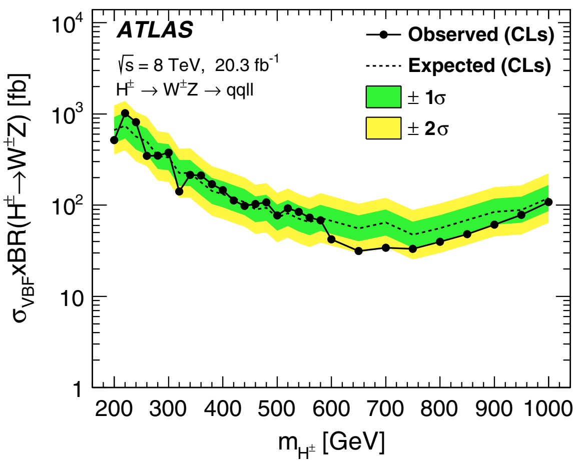


FIG. 2 (color online). Exclusion limits in fb at the 95% C.L. for the vector-boson fusion production cross section of a $H^{\pm}$ boson times its branching fraction to $W^{\pm}Z$, assuming the signal has a narrow intrinsic width. Also included on the plot are the median, $\pm 1\sigma$, and $\pm 2\sigma$ values within which the limit is expected to lie in the absence of a signal.

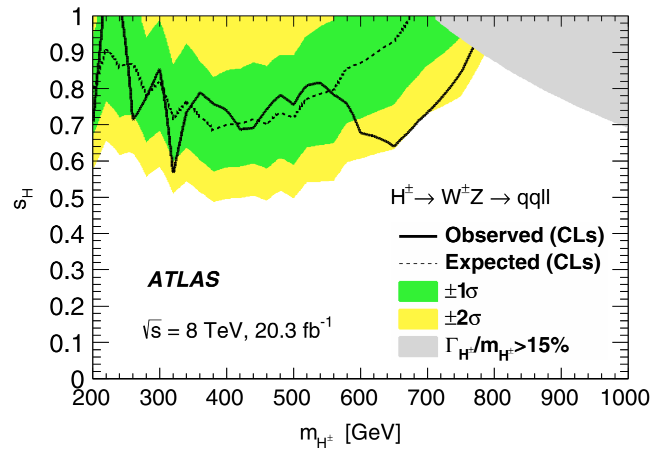


FIG. 3 (color online). Exclusion limits at the 95% C.L. for $s_H$ versus $m_{H^{\pm}}$ in the Georgi-Machacek Higgs triplet model. Also included on the plot are the median, $\pm 1\sigma$, and $\pm 2\sigma$ values within which the limit is expected to lie in the absence of a signal.

The data are compared with the SM expectation in Fig. 1. The expectation is determined with a profile likelihood fit [42] using the modified frequentist method, also known as $\mathrm{CL}_s$ [43]. The fit is performed on the $m_{\ell\ell jj}$ mass distribution in the signal region and the number of events in the top quark control region. No significant excess of events is observed in the data compared with the SM expectation.

Figure 2 shows the exclusion limits at the 95% confidence level (C.L.) on the VBF production cross section times the branching fraction $\mathrm{BR}(H^{\pm} \to W^{\pm}Z)$ as a function of $m_{H^{\pm}}$, assuming the signal has a small intrinsic width, i.e. much smaller than the experimental resolution. The observed limits range from 31 fb at $m_{H^{\pm}} = 650$ GeV to 1020 fb at $m_{H^{\pm}} = 220$ GeV; the corresponding expected limits are 55 fb and 719 fb, respectively. The observed limits are better for masses less than around 800 GeV than those obtained from the inclusive ATLAS $WZ$ resonance search, presented in Ref. [17], by up to a factor of 6.

The exclusion limits are compared with predicted charged Higgs boson production cross sections in the GMHTM [44], calculated at $\sqrt{s} = 8$ TeV [45]. In this model, the quantity $s_H^2$ is a free parameter that represents the fraction of the square of the gauge boson masses $m_W^2$ and $m_Z^2$ that is generated by the vacuum expectation value of the triplet, while $1 - s_H^2$ represents the fraction generated by the SM Higgs doublet. The production cross section and $H^{\pm}$ width are proportional to $s_H^2$. The branching fraction of $H^{\pm} \to W^{\pm}Z$ is expected to be very high above the $W^{\pm}Z$ threshold, so for simplicity it is set to 1. For this comparison, a nonzero intrinsic $H^{\pm}$ width must be taken into account. This is done by smearing the signal $m_{\ell\ell jj}$ distributions with a relativistic Breit-Wigner distribution with a width as calculated in Ref. [45]. The fractional width $\Gamma_{H^{\pm}}/m_{H^{\pm}}$ for $s_H = 1$ increases from 0.2% at $m_{H^{\pm}} = 200$ GeV to 31% at $m_{H^{\pm}} = 1000$ GeV. Comparisons with the GMHTM are only shown for $\Gamma_{H^{\pm}}/m_{H^{\pm}} < 0.15$, since higher values may violate perturbative unitarity of the $W^{\pm}Z \to W^{\pm}Z$ scattering amplitudes. As shown in Fig. 3, the data exclude a charged Higgs boson over the range $240 < m_{H^{\pm}} < 700$ GeV for $s_H = 1$, with weaker limits for smaller values of $s_H$.

In conclusion, data recorded by the ATLAS experiment at the LHC, corresponding to an integrated luminosity of 20.3 $\mathrm{fb}^{-1}$ at a center-of-mass energy of 8 TeV, have been used to search for a charged Higgs boson, produced via vector-boson fusion and decaying to $W^{\pm}Z$, over the charged Higgs boson mass range 200–1000 GeV. This is the first search for this process. No deviation from the SM background prediction is observed. Upper limits at the 95% confidence level on the cross section of a VBF-produced $H^{\pm}$ boson times its branching fraction to $W^{\pm}Z$ are set between 31 and 1020 fb for a narrow $W^{\pm}Z$ resonance. The data exclude a charged Higgs boson in the range $240 < m_{H^{\pm}} < 700$ GeV within the Georgi-Machacek Higgs triplet model with parameter $s_H = 1$ and 100% branching fraction of $H^{\pm} \to W^{\pm}Z$.

We thank CERN for the very successful operation of the LHC, as well as the support staff from our institutions without whom ATLAS could not be operated efficiently. We acknowledge the support of ANPCyT, Argentina; YerPhI, Armenia; ARC, Australia; BMWFW and FWF, Austria; ANAS, Azerbaijan; SSTC, Belarus; CNPq and FAPESP, Brazil; NSERC, NRC and CFI, Canada; CERN; CONICYT, Chile; CAS, MOST and NSFC, China; COLCIENCIAS, Colombia; MSMT CR, MPO CR and VSC CR, Czech Republic; DNRF, DNSRC and Lundbeck

Foundation, Denmark; EPLANET, ERC and NSRF, European Union; IN2P3-CNRS, CEA-DSM/IRFU, France; GNSF, Georgia; BMBF, DFG, HGF, MPG and AvH Foundation, Germany; GSRT and NSRF, Greece; RGC, Hong Kong SAR, China; ISF, MINERVA, GIF, I-CORE and Benoziyo Center, Israel; INFN, Italy; MEXT and JSPS, Japan; CNRST, Morocco; FOM and NWO, Netherlands; BRF and RCN, Norway; MNiSW and NCN, Poland; GRICES and FCT, Portugal; MNE/IFA, Romania; MES of Russia and ROSATOM, Russian Federation; JINR; MSTD, Serbia; MSSR, Slovakia; ARRS and MIZŠ, Slovenia; DST/NRF, South Africa; MINECO, Spain; SRC and Wallenberg Foundation, Sweden; SER, SNSF and Cantons of Bern and Geneva, Switzerland; NSC, Taiwan; TAEK, Turkey; STFC, the Royal Society and Leverhulme Trust, United Kingdom; DOE and NSF, USA. The crucial computing support from all WLCG partners is acknowledged gratefully, in particular from CERN and the ATLAS Tier-1 facilities at TRIUMF (Canada), NDGF (Denmark, Norway, Sweden), CC-IN2P3 (France), KIT/GridKA (Germany), INFN-CNAF (Italy), NL-T1 (Netherlands), PIC (Spain), ASGC (Taiwan), RAL (UK), and BNL (USA) and in the Tier-2 facilities worldwide.

[1] ATLAS Collaboration, Phys. Lett. B **716**, 1 (2012).
[2] CMS Collaboration, Phys. Lett. B **716**, 30 (2012).
[3] G. C. Branco, P. M. Ferreira, L. Lavoura, M. N. Rebelo, M. Sher, and J. P. Silva, Phys. Rep. **516**, 1 (2012).
[4] H. Georgi and M. Machacek, Nucl. Phys. **B262**, 463 (1985).
[5] K. Cheung and D. K. Ghosh, J. High Energy Phys. 11 (2002) 048.
[6] J. Diaz-Cruz, J. Hernandez-Sanchez, and J. Toscano, Phys. Lett. B **512**, 339 (2001).
[7] ALEPH, DELPHI, L3, and OPAL Collaborations, Eur. Phys. J. C **73**, 2463 (2013).
[8] D0 Collaboration, Phys. Lett. B **682**, 278 (2009).
[9] CMS Collaboration, J. High Energy Phys. 07 (2012) 143.
[10] CDF Collaboration, Phys. Rev. D **89**, 091101 (2014).
[11] ATLAS Collaboration, J. High Energy Phys. 03 (2015) 088.
[12] CMS Collaboration, Phys. Rev. Lett. **109**, 141801 (2012).
[13] CMS Collaboration, J. High Energy Phys. 02 (2013) 036.
[14] ATLAS Collaboration, Phys. Rev. D **85**, 112012 (2012).
[15] ATLAS Collaboration, Phys. Rev. D **87**, 112006 (2013).
[16] CMS Collaboration, J. High Energy Phys. 08 (2014) 174.
[17] ATLAS Collaboration, Phys. Lett. B **737**, 223 (2014).
[18] CMS Collaboration, Phys. Lett. B **740**, 83 (2014).
[19] ATLAS Collaboration, JINST **3**, S08003 (2008).
[20] ATLAS Collaboration, Eur. Phys. J. C **73**, 2518 (2013).
[21] J. Alwall, M. Herquet, F. Maltoni, O. Mattelaer, and T. Stelzer, J. High Energy Phys. 06 (2011) 128.
[22] J. Pumplin, D. Robert Stump, J. Huston, H.-L. Lai, P. Nadolsky, and W.-K. Tung, J. High Energy Phys. 07 (2002) 012.
[23] T. Sjöstrand, S. Mrenna, and P. Skands, J. High Energy Phys. 05 (2006) 026.
[24] T. Sjöstrand, S. Mrenna, and P. Skands, Comput. Phys. Commun. **178**, 852 (2008).
[25] T. Gleisberg, S. Höche, F. Krauss, M. Schönherr, S. Schumann, F. Siegert, and J. Winter, J. High Energy Phys. 02 (2009) 007.
[26] H. L. Lai, M. Guzzi, J. Huston, Z. Li, P. M. Nadolsky, J. Pumplin, and C.-P. Yuan, Phys. Rev. D **82**, 074024 (2010).
[27] P. Nason, J. High Energy Phys. 11 (2004) 040.
[28] S. Frixione, P. Nason, and C. Oleari, J. High Energy Phys. 11 (2007) 070.
[29] S. Alioli, P. Nason, C. Oleari, and E. Re, J. High Energy Phys. 06 (2010) 043.
[30] GEANT4 Collaboration, Nucl. Instrum. Methods Phys. Res., Sect. A **506**, 250 (2003).
[31] ATLAS Collaboration, Eur. Phys. J. C **70**, 823 (2010).
[32] ATLAS Collaboration, Eur. Phys. J. C **75**, 17 (2015).
[33] ATLAS Collaboration, Eur. Phys. J. C **74**, 2941 (2014).
[34] ATLAS Collaboration, J. High Energy Phys. 01 (2015) 069.
[35] ATLAS Collaboration, Eur. Phys. J. C **74**, 3130 (2014).
[36] M. Cacciari, G. P. Salam, and G. Soyez, J. High Energy Phys. 04 (2008) 063.
[37] ATLAS Collaboration, Report No. ATLAS-CONF-2014-004, 2014, http://cds.cern.ch/record/1664335.
[38] ATLAS Collaboration, Report No. ATLAS-CONF-2013-082, 2013, http://cds.cern.ch/record/1570993.
[39] K. A. Olive *et al.*, Chin. Phys. C **38**, 090001 (2014).
[40] A. D. Martin *et al.*, Eur. Phys. J. C **63**, 189 (2009).
[41] R. D. Ball *et al.*, Nucl. Phys. **B849**, 296 (2011).
[42] A. L. Read, J. Phys. G **28**, 2693 (2002).
[43] G. Cowan, K. Cranmer, E. Gross, and O. Vitells, Eur. Phys. J. C **71**, 1554 (2011).
[44] P. Bolzoni, F. Maltoni, S.-O. Moch, and M. Zaro, Phys. Rev. D **85**, 035002 (2012).
[45] H. Logan and M. Zaro, CERN Report No. LHCHXSWG-INT-2015-002, http://cds.cern.ch/record/2002132, 2015.

G. Aad,[85] B. Abbott,[113] J. Abdallah,[151] O. Abdinov,[11] R. Aben,[107] M. Abolins,[90] O. S. AbouZeid,[158] H. Abramowicz,[153] H. Abreu,[152] R. Abreu,[30] Y. Abulaiti,[146a,146b] B. S. Acharya,[164a,164b,b] L. Adamczyk,[38a] D. L. Adams,[25] J. Adelman,[108] S. Adomeit,[100] T. Adye,[131] A. A. Affolder,[74] T. Agatonovic-Jovin,[13] J. A. Aguilar-Saavedra,[126a,126f] S. P. Ahlen,[22] F. Ahmadov,[65,c] G. Aielli,[133a,133b] H. Akerstedt,[146a,146b] T. P. A. Åkesson,[81] G. Akimoto,[155] A. V. Akimov,[96] G. L. Alberghi,[20a,20b] J. Albert,[169] S. Albrand,[55] M. J. Alconada Verzini,[71] M. Aleksa,[30] I. N. Aleksandrov,[65] C. Alexa,[26a] G. Alexander,[153] T. Alexopoulos,[10] M. Alhroob,[113] G. Alimonti,[91a] L. Alio,[85] J. Alison,[31] S. P. Alkire,[35]

B. M. M. Allbrooke,[18] P. P. Allport,[74] A. Aloisio,[104a,104b] A. Alonso,[36] F. Alonso,[71] C. Alpigiani,[76] A. Altheimer,[35] B. Alvarez Gonzalez,[90] D. Álvarez Piqueras,[167] M. G. Alviggi,[104a,104b] B. T. Amadio,[15] K. Amako,[66] Y. Amaral Coutinho,[24a] C. Amelung,[23] D. Amidei,[89] S. P. Amor Dos Santos,[126a,126c] A. Amorim,[126a,126b] S. Amoroso,[48] N. Amram,[153] G. Amundsen,[23] C. Anastopoulos,[139] L. S. Ancu,[49] N. Andari,[30] T. Andeen,[35] C. F. Anders,[58b] G. Anders,[30] J. K. Anders,[74] K. J. Anderson,[31] A. Andreazza,[91a,91b] V. Andrei,[58a] S. Angelidakis,[9] I. Angelozzi,[107] P. Anger,[44] A. Angerami,[35] F. Anghinolfi,[30] A. V. Anisenkov,[109,d] N. Anjos,[12] A. Annovi,[124a,124b] M. Antonelli,[47] A. Antonov,[98] J. Antos,[144b] F. Anulli,[132a] M. Aoki,[66] L. Aperio Bella,[18] G. Arabidze,[90] Y. Arai,[66] J. P. Araque,[126a] A. T. H. Arce,[45] F. A. Arduh,[71] J-F. Arguin,[95] S. Argyropoulos,[42] M. Arik,[19a] A. J. Armbruster,[30] O. Arnaez,[30] V. Arnal,[82] H. Arnold,[48] M. Arratia,[28] O. Arslan,[21] A. Artamonov,[97] G. Artoni,[23] S. Asai,[155] N. Asbah,[42] A. Ashkenazi,[153] B. Åsman,[146a,146b] L. Asquith,[149] K. Assamagan,[25] R. Astalos,[144a] M. Atkinson,[165] N. B. Atlay,[141] B. Auerbach,[6] K. Augsten,[128] M. Aurousseau,[145b] G. Avolio,[30] B. Axen,[15] M. K. Ayoub,[117] G. Azuelos,[95,e] M. A. Baak,[30] A. E. Baas,[58a] C. Bacci,[134a,134b] H. Bachacou,[136] K. Bachas,[154] M. Backes,[30] M. Backhaus,[30] E. Badescu,[26a] P. Bagiacchi,[132a,132b] P. Bagnaia,[132a,132b] Y. Bai,[33a] T. Bain,[35] J. T. Baines,[131] O. K. Baker,[176] P. Balek,[129] T. Balestri,[148] F. Balli,[84] E. Banas,[39] Sw. Banerjee,[173] A. A. E. Bannoura,[175] H. S. Bansil,[18] L. Barak,[30] S. P. Baranov,[96] E. L. Barberio,[88] D. Barberis,[50a,50b] M. Barbero,[85] T. Barillari,[101] M. Barisonzi,[164a,164b] T. Barklow,[143] N. Barlow,[28] S. L. Barnes,[84] B. M. Barnett,[131] R. M. Barnett,[15] Z. Barnovska,[5] A. Baroncelli,[134a] G. Barone,[49] A. J. Barr,[120] F. Barreiro,[82] J. Barreiro Guimarães da Costa,[57] R. Bartoldus,[143] A. E. Barton,[72] P. Bartos,[144a] A. Bassalat,[117] A. Basye,[165] R. L. Bates,[53] S. J. Batista,[158] J. R. Batley,[28] M. Battaglia,[137] M. Bauce,[132a,132b] F. Bauer,[136] H. S. Bawa,[143,f] J. B. Beacham,[111] M. D. Beattie,[72] T. Beau,[80] P. H. Beauchemin,[161] R. Beccherle,[124a,124b] P. Bechtle,[21] H. P. Beck,[17,g] K. Becker,[120] M. Becker,[83] S. Becker,[100] M. Beckingham,[170] C. Becot,[117] A. J. Beddall,[19c] A. Beddall,[19c] V. A. Bednyakov,[65] C. P. Bee,[148] L. J. Beemster,[107] T. A. Beermann,[175] M. Begel,[25] J. K. Behr,[120] C. Belanger-Champagne,[87] P. J. Bell,[49] W. H. Bell,[49] G. Bella,[153] L. Bellagamba,[20a] A. Bellerive,[29] M. Bellomo,[86] K. Belotskiy,[98] O. Beltramello,[30] O. Benary,[153] D. Benchekroun,[135a] M. Bender,[100] K. Bendtz,[146a,146b] N. Benekos,[10] Y. Benhammou,[153] E. Benhar Noccioli,[49] J. A. Benitez Garcia,[159b] D. P. Benjamin,[45] J. R. Bensinger,[23] S. Bentvelsen,[107] L. Beresford,[120] M. Beretta,[47] D. Berge,[107] E. Bergeaas Kuutmann,[166] N. Berger,[5] F. Berghaus,[169] J. Beringer,[15] C. Bernard,[22] N. R. Bernard,[86] C. Bernius,[110] F. U. Bernlochner,[21] T. Berry,[77] P. Berta,[129] C. Bertella,[83] G. Bertoli,[146a,146b] F. Bertolucci,[124a,124b] C. Bertsche,[113] D. Bertsche,[113] M. I. Besana,[91a] G. J. Besjes,[106] O. Bessidskaia Bylund,[146a,146b] M. Bessner,[42] N. Besson,[136] C. Betancourt,[48] S. Bethke,[101] A. J. Bevan,[76] W. Bhimji,[46] R. M. Bianchi,[125] L. Bianchini,[23] M. Bianco,[30] O. Biebel,[100] S. P. Bieniek,[78] M. Biglietti,[134a] J. Bilbao De Mendizabal,[49] H. Bilokon,[47] M. Bindi,[54] S. Binet,[117] A. Bingul,[19c] C. Bini,[132a,132b] C. W. Black,[150] J. E. Black,[143] K. M. Black,[22] D. Blackburn,[138] R. E. Blair,[6] J.-B. Blanchard,[136] J. E. Blanco,[77] T. Blazek,[144a] I. Bloch,[42] C. Blocker,[23] W. Blum,[83,a] U. Blumenschein,[54] G. J. Bobbink,[107] V. S. Bobrovnikov,[109,d] S. S. Bocchetta,[81] A. Bocci,[45] C. Bock,[100] M. Boehler,[48] J. A. Bogaerts,[30] A. G. Bogdanchikov,[109] C. Bohm,[146a] V. Boisvert,[77] T. Bold,[38a] V. Boldea,[26a] A. S. Boldyrev,[99] M. Bomben,[80] M. Bona,[76] M. Boonekamp,[136] A. Borisov,[130] G. Borissov,[72] S. Borroni,[42] J. Bortfeldt,[100] V. Bortolotto,[60a,60b,60c] K. Bos,[107] D. Boscherini,[20a] M. Bosman,[12] J. Boudreau,[125] J. Bouffard,[2] E. V. Bouhova-Thacker,[72] D. Boumediene,[34] C. Bourdarios,[117] N. Bousson,[114] A. Boveia,[30] J. Boyd,[30] I. R. Boyko,[65] I. Bozic,[13] J. Bracinik,[18] A. Brandt,[8] G. Brandt,[54] O. Brandt,[58a] U. Bratzler,[156] B. Brau,[86] J. E. Brau,[116] H. M. Braun,[175,a] S. F. Brazzale,[164a,164c] K. Brendlinger,[122] A. J. Brennan,[88] L. Brenner,[107] R. Brenner,[166] S. Bressler,[172] K. Bristow,[145c] T. M. Bristow,[46] D. Britton,[53] D. Britzger,[42] F. M. Brochu,[28] I. Brock,[21] R. Brock,[90] J. Bronner,[101] G. Brooijmans,[35] T. Brooks,[77] W. K. Brooks,[32b] J. Brosamer,[15] E. Brost,[116] J. Brown,[55] P. A. Bruckman de Renstrom,[39] D. Bruncko,[144b] R. Bruneliere,[48] A. Bruni,[20a] G. Bruni,[20a] M. Bruschi,[20a] L. Bryngemark,[81] T. Buanes,[14] Q. Buat,[142] P. Buchholz,[141] A. G. Buckley,[53] S. I. Buda,[26a] I. A. Budagov,[65] F. Buehrer,[48] L. Bugge,[119] M. K. Bugge,[119] O. Bulekov,[98] H. Burckhart,[30] S. Burdin,[74] B. Burghgrave,[108] S. Burke,[131] I. Burmeister,[43] E. Busato,[34] D. Büscher,[48] V. Büscher,[83] P. Bussey,[53] C. P. Buszello,[166] J. M. Butler,[22] A. I. Butt,[3] C. M. Buttar,[53] J. M. Butterworth,[78] P. Butti,[107] W. Buttinger,[25] A. Buzatu,[53] R. Buzykaev,[109,d] S. Cabrera Urbán,[167] D. Caforio,[128] V. M. Cairo,[37a,37b] O. Cakir,[4a] P. Calafiura,[15] A. Calandri,[136] G. Calderini,[80] P. Calfayan,[100] L. P. Caloba,[24a] D. Calvet,[34] S. Calvet,[34] R. Camacho Toro,[49] S. Camarda,[42] P. Camarri,[133a,133b] D. Cameron,[119] L. M. Caminada,[15] R. Caminal Armadans,[12] S. Campana,[30] M. Campanelli,[78] A. Campoverde,[148] V. Canale,[104a,104b] A. Canepa,[159a] M. Cano Bret,[76] J. Cantero,[82] R. Cantrill,[126a] T. Cao,[40] M. D. M. Capeans Garrido,[30] I. Caprini,[26a] M. Caprini,[26a] M. Capua,[37a,37b] R. Caputo,[83] R. Cardarelli,[133a] T. Carli,[30] G. Carlino,[104a] L. Carminati,[91a,91b] S. Caron,[106] E. Carquin,[32a] G. D. Carrillo-Montoya,[8] J. R. Carter,[28] J. Carvalho,[126a,126c] D. Casadei,[78] M. P. Casado,[12] M. Casolino,[12] E. Castaneda-Miranda,[145b] A. Castelli,[107]

V. Castillo Gimenez,[167] N. F. Castro,[126a,h] P. Catastini,[57] A. Catinaccio,[30] J. R. Catmore,[119] A. Cattai,[30] J. Caudron,[83] V. Cavaliere,[165] D. Cavalli,[91a] M. Cavalli-Sforza,[12] V. Cavasinni,[124a,124b] F. Ceradini,[134a,134b] B. C. Cerio,[45] K. Cerny,[129] A. S. Cerqueira,[24b] A. Cerri,[149] L. Cerrito,[76] F. Cerutti,[15] M. Cerv,[30] A. Cervelli,[17] S. A. Cetin,[19b] A. Chafaq,[135a] D. Chakraborty,[108] I. Chalupkova,[129] P. Chang,[165] B. Chapleau,[87] J. D. Chapman,[28] D. G. Charlton,[18] C. C. Chau,[158] C. A. Chavez Barajas,[149] S. Cheatham,[152] A. Chegwidden,[90] S. Chekanov,[6] S. V. Chekulaev,[159a] G. A. Chelkov,[65,i] M. A. Chelstowska,[89] C. Chen,[64] H. Chen,[25] K. Chen,[148] L. Chen,[33d,j] S. Chen,[33c] X. Chen,[33f] Y. Chen,[67] H. C. Cheng,[89] Y. Cheng,[31] A. Cheplakov,[65] E. Cheremushkina,[130] R. Cherkaoui El Moursli,[135e] V. Chernyatin,[25,a] E. Cheu,[7] L. Chevalier,[136] V. Chiarella,[47] J. T. Childers,[6] G. Chiodini,[73a] A. S. Chisholm,[18] R. T. Chislett,[78] A. Chitan,[26a] M. V. Chizhov,[65] K. Choi,[61] S. Chouridou,[9] B. K. B. Chow,[100] V. Christodoulou,[78] D. Chromek-Burckhart,[30] M. L. Chu,[151] J. Chudoba,[127] A. J. Chuinard,[87] J. J. Chwastowski,[39] L. Chytka,[115] G. Ciapetti,[132a,132b] A. K. Ciftci,[4a] D. Cinca,[53] V. Cindro,[75] I. A. Cioara,[21] A. Ciocio,[15] Z. H. Citron,[172] M. Ciubancan,[26a] A. Clark,[49] B. L. Clark,[57] P. J. Clark,[46] R. N. Clarke,[15] W. Cleland,[125] C. Clement,[146a,146b] Y. Coadou,[85] M. Cobal,[164a,164c] A. Coccaro,[138] J. Cochran,[64] L. Coffey,[23] J. G. Cogan,[143] B. Cole,[35] S. Cole,[108] A. P. Colijn,[107] J. Collot,[55] T. Colombo,[58c] G. Compostella,[101] P. Conde Muiño,[126a,126b] E. Coniavitis,[48] S. H. Connell,[145b] I. A. Connelly,[77] S. M. Consonni,[91a,91b] V. Consorti,[48] S. Constantinescu,[26a] C. Conta,[121a,121b] G. Conti,[30] F. Conventi,[104a,k] M. Cooke,[15] B. D. Cooper,[78] A. M. Cooper-Sarkar,[120] T. Cornelissen,[175] M. Corradi,[20a] F. Corriveau,[87,l] A. Corso-Radu,[163] A. Cortes-Gonzalez,[12] G. Cortiana,[101] G. Costa,[91a] M. J. Costa,[167] D. Costanzo,[139] D. Côté,[8] G. Cottin,[28] G. Cowan,[77] B. E. Cox,[84] K. Cranmer,[110] G. Cree,[29] S. Crépé-Renaudin,[55] F. Crescioli,[80] W. A. Cribbs,[146a,146b] M. Crispin Ortuzar,[120] M. Cristinziani,[21] V. Croft,[106] G. Crosetti,[37a,37b] T. Cuhadar Donszelmann,[139] J. Cummings,[176] M. Curatolo,[47] C. Cuthbert,[150] H. Czirr,[141] P. Czodrowski,[3] S. D'Auria,[53] M. D'Onofrio,[74] M. J. Da Cunha Sargedas De Sousa,[126a,126b] C. Da Via,[84] W. Dabrowski,[38a] A. Dafinca,[120] T. Dai,[89] O. Dale,[14] F. Dallaire,[95] C. Dallapiccola,[86] M. Dam,[36] J. R. Dandoy,[31] N. P. Dang,[48] A. C. Daniells,[18] M. Danninger,[168] M. Dano Hoffmann,[136] V. Dao,[48] G. Darbo,[50a] S. Darmora,[8] J. Dassoulas,[3] A. Dattagupta,[61] W. Davey,[21] C. David,[169] T. Davidek,[129] E. Davies,[120,m] M. Davies,[153] P. Davison,[78] Y. Davygora,[58a] E. Dawe,[88] I. Dawson,[139] R. K. Daya-Ishmukhametova,[86] K. De,[8] R. de Asmundis,[104a] S. De Castro,[20a,20b] S. De Cecco,[80] N. De Groot,[106] P. de Jong,[107] H. De la Torre,[82] F. De Lorenzi,[64] L. De Nooij,[107] D. De Pedis,[132a] A. De Salvo,[132a] U. De Sanctis,[149] A. De Santo,[149] J. B. De Vivie De Regie,[117] W. J. Dearnaley,[72] R. Debbe,[25] C. Debenedetti,[137] D. V. Dedovich,[65] I. Deigaard,[107] J. Del Peso,[82] T. Del Prete,[124a,124b] D. Delgove,[117] F. Deliot,[136] C. M. Delitzsch,[49] M. Deliyergiyev,[75] A. Dell'Acqua,[30] L. Dell'Asta,[22] M. Dell'Orso,[124a,124b] M. Della Pietra,[104a,k] D. della Volpe,[49] M. Delmastro,[5] P. A. Delsart,[55] C. Deluca,[107] D. A. DeMarco,[158] S. Demers,[176] M. Demichev,[65] A. Demilly,[80] S. P. Denisov,[130] D. Derendarz,[39] J. E. Derkaoui,[135d] F. Derue,[80] P. Dervan,[74] K. Desch,[21] C. Deterre,[42] P. O. Deviveiros,[30] A. Dewhurst,[131] S. Dhaliwal,[107] A. Di Ciaccio,[133a,133b] L. Di Ciaccio,[5] A. Di Domenico,[132a,132b] C. Di Donato,[104a,104b] A. Di Girolamo,[30] B. Di Girolamo,[30] A. Di Mattia,[152] B. Di Micco,[134a,134b] R. Di Nardo,[47] A. Di Simone,[48] R. Di Sipio,[158] D. Di Valentino,[29] C. Diaconu,[85] M. Diamond,[158] F. A. Dias,[46] M. A. Diaz,[32a] E. B. Diehl,[89] J. Dietrich,[16] S. Diglio,[85] A. Dimitrievska,[13] J. Dingfelder,[21] F. Dittus,[30] F. Djama,[85] T. Djobava,[51b] J. I. Djuvsland,[58a] M. A. B. do Vale,[24c] D. Dobos,[30] M. Dobre,[26a] C. Doglioni,[49] T. Dohmae,[155] J. Dolejsi,[129] Z. Dolezal,[129] B. A. Dolgoshein,[98,a] M. Donadelli,[24d] S. Donati,[124a,124b] P. Dondero,[121a,121b] J. Donini,[34] J. Dopke,[131] A. Doria,[104a] M. T. Dova,[71] A. T. Doyle,[53] E. Drechsler,[54] M. Dris,[10] E. Dubreuil,[34] E. Duchovni,[172] G. Duckeck,[100] O. A. Ducu,[26a,85] D. Duda,[175] A. Dudarev,[30] L. Duflot,[117] L. Duguid,[77] M. Dührssen,[30] M. Dunford,[58a] H. Duran Yildiz,[4a] M. Düren,[52] A. Durglishvili,[51b] D. Duschinger,[44] M. Dyndal,[38a] C. Eckardt,[42] K. M. Ecker,[101] R. C. Edgar,[89] W. Edson,[2] N. C. Edwards,[46] W. Ehrenfeld,[21] T. Eifert,[30] G. Eigen,[14] K. Einsweiler,[15] T. Ekelof,[166] M. El Kacimi,[135c] M. Ellert,[166] S. Elles,[5] F. Ellinghaus,[83] A. A. Elliot,[169] N. Ellis,[30] J. Elmsheuser,[100] M. Elsing,[30] D. Emeliyanov,[131] Y. Enari,[155] O. C. Endner,[83] M. Endo,[118] R. Engelmann,[148] J. Erdmann,[43] A. Ereditato,[17] G. Ernis,[175] J. Ernst,[2] M. Ernst,[25] S. Errede,[165] E. Ertel,[83] M. Escalier,[117] H. Esch,[43] C. Escobar,[125] B. Esposito,[47] A. I. Etienvre,[136] E. Etzion,[153] H. Evans,[61] A. Ezhilov,[123] L. Fabbri,[20a,20b] G. Facini,[31] R. M. Fakhrutdinov,[130] S. Falciano,[132a] R. J. Falla,[78] J. Faltova,[129] Y. Fang,[33a] M. Fanti,[91a,91b] A. Farbin,[8] A. Farilla,[134a] T. Farooque,[12] S. Farrell,[15] S. M. Farrington,[170] P. Farthouat,[30] F. Fassi,[135e] P. Fassnacht,[30] D. Fassouliotis,[9] M. Faucci Giannelli,[77] A. Favareto,[50a,50b] L. Fayard,[117] P. Federic,[144a] O. L. Fedin,[123,n] W. Fedorko,[168] S. Feigl,[30] L. Feligioni,[85] C. Feng,[33d] E. J. Feng,[6] H. Feng,[89] A. B. Fenyuk,[130] P. Fernandez Martinez,[167] S. Fernandez Perez,[30] S. Ferrag,[53] J. Ferrando,[53] A. Ferrari,[166] P. Ferrari,[107] R. Ferrari,[121a] D. E. Ferreira de Lima,[53] A. Ferrer,[167] D. Ferrere,[49] C. Ferretti,[89] A. Ferretto Parodi,[50a,50b] M. Fiascaris,[31] F. Fiedler,[83] A. Filipčič,[75] M. Filipuzzi,[42] F. Filthaut,[106] M. Fincke-Keeler,[169] K. D. Finelli,[150] M. C. N. Fiolhais,[126a,126c]

L. Fiorini,[167] A. Firan,[40] A. Fischer,[2] C. Fischer,[12] J. Fischer,[175] W. C. Fisher,[90] E. A. Fitzgerald,[23] M. Flechl,[48] I. Fleck,[141] P. Fleischmann,[89] S. Fleischmann,[175] G. T. Fletcher,[139] G. Fletcher,[76] T. Flick,[175] A. Floderus,[81] L. R. Flores Castillo,[60a] M. J. Flowerdew,[101] A. Formica,[136] A. Forti,[84] D. Fournier,[117] H. Fox,[72] S. Fracchia,[12] P. Francavilla,[80] M. Franchini,[20a,20b] D. Francis,[30] L. Franconi,[119] M. Franklin,[57] M. Fraternali,[121a,121b] D. Freeborn,[78] S. T. French,[28] F. Friedrich,[44] D. Froidevaux,[30] J. A. Frost,[120] C. Fukunaga,[156] E. Fullana Torregrosa,[83] B. G. Fulsom,[143] J. Fuster,[167] C. Gabaldon,[55] O. Gabizon,[175] A. Gabrielli,[20a,20b] A. Gabrielli,[132a,132b] S. Gadatsch,[107] S. Gadomski,[49] G. Gagliardi,[50a,50b] P. Gagnon,[61] C. Galea,[106] B. Galhardo,[126a,126c] E. J. Gallas,[120] B. J. Gallop,[131] P. Gallus,[128] G. Galster,[36] K. K. Gan,[111] J. Gao,[33b,85] Y. Gao,[46] Y. S. Gao,[143,f] F. M. Garay Walls,[46] F. Garberson,[176] C. García,[167] J. E. García Navarro,[167] M. Garcia-Sciveres,[15] R. W. Gardner,[31] N. Garelli,[143] V. Garonne,[119] C. Gatti,[47] A. Gaudiello,[50a,50b] G. Gaudio,[121a] B. Gaur,[141] L. Gauthier,[95] P. Gauzzi,[132a,132b] I. L. Gavrilenko,[96] C. Gay,[168] G. Gaycken,[21] E. N. Gazis,[10] P. Ge,[33d] Z. Gecse,[168] C. N. P. Gee,[131] D. A. A. Geerts,[107] Ch. Geich-Gimbel,[21] M. P. Geisler,[58a] C. Gemme,[50a] M. H. Genest,[55] S. Gentile,[132a,132b] M. George,[54] S. George,[77] D. Gerbaudo,[163] A. Gershon,[153] H. Ghazlane,[135b] B. Giacobbe,[20a] S. Giagu,[132a,132b] V. Giangiobbe,[12] P. Giannetti,[124a,124b] B. Gibbard,[25] S. M. Gibson,[77] M. Gilchriese,[15] T. P. S. Gillam,[28] D. Gillberg,[30] G. Gilles,[34] D. M. Gingrich,[3,e] N. Giokaris,[9] M. P. Giordani,[164a,164c] F. M. Giorgi,[20a] F. M. Giorgi,[16] P. F. Giraud,[136] P. Giromini,[47] D. Giugni,[91a] C. Giuliani,[48] M. Giulini,[58b] B. K. Gjelsten,[119] S. Gkaitatzis,[154] I. Gkialas,[154] E. L. Gkougkousis,[117] L. K. Gladilin,[99] C. Glasman,[82] J. Glatzer,[30] P. C. F. Glaysher,[46] A. Glazov,[42] M. Goblirsch-Kolb,[101] J. R. Goddard,[76] J. Godlewski,[39] S. Goldfarb,[89] T. Golling,[49] D. Golubkov,[130] A. Gomes,[126a,126b,126d] R. Gonçalo,[126a] J. Goncalves Pinto Firmino Da Costa,[136] L. Gonella,[21] S. González de la Hoz,[167] G. Gonzalez Parra,[12] S. Gonzalez-Sevilla,[49] L. Goossens,[30] P. A. Gorbounov,[97] H. A. Gordon,[25] I. Gorelov,[105] B. Gorini,[30] E. Gorini,[73a,73b] A. Gorišek,[75] E. Gornicki,[39] A. T. Goshaw,[45] C. Gössling,[43] M. I. Gostkin,[65] D. Goujdami,[135c] A. G. Goussiou,[138] N. Govender,[145b] H. M. X. Grabas,[137] L. Graber,[54] I. Grabowska-Bold,[38a] P. Grafström,[20a,20b] K-J. Grahn,[42] J. Gramling,[49] E. Gramstad,[119] S. Grancagnolo,[16] V. Grassi,[148] V. Gratchev,[123] H. M. Gray,[30] E. Graziani,[134a] Z. D. Greenwood,[79,o] K. Gregersen,[78] I. M. Gregor,[42] P. Grenier,[143] J. Griffiths,[8] A. A. Grillo,[137] K. Grimm,[72] S. Grinstein,[12,p] Ph. Gris,[34] J.-F. Grivaz,[117] J. P. Grohs,[44] A. Grohsjean,[42] E. Gross,[172] J. Grosse-Knetter,[54] G. C. Grossi,[79] Z. J. Grout,[149] L. Guan,[33b] J. Guenther,[128] F. Guescini,[49] D. Guest,[176] O. Gueta,[153] E. Guido,[50a,50b] T. Guillemin,[117] S. Guindon,[2] U. Gul,[53] C. Gumpert,[44] J. Guo,[33e] S. Gupta,[120] P. Gutierrez,[113] N. G. Gutierrez Ortiz,[53] C. Gutschow,[44] C. Guyot,[136] C. Gwenlan,[120] C. B. Gwilliam,[74] A. Haas,[110] C. Haber,[15] H. K. Hadavand,[8] N. Haddad,[135e] P. Haefner,[21] S. Hageböck,[21] Z. Hajduk,[39] H. Hakobyan,[177] M. Haleem,[42] J. Haley,[114] D. Hall,[120] G. Halladjian,[90] G. D. Hallewell,[85] K. Hamacher,[175] P. Hamal,[115] K. Hamano,[169] M. Hamer,[54] A. Hamilton,[145a] S. Hamilton,[161] G. N. Hamity,[145c] P. G. Hamnett,[42] L. Han,[33b] K. Hanagaki,[118] K. Hanawa,[155] M. Hance,[15] P. Hanke,[58a] R. Hanna,[136] J. B. Hansen,[36] J. D. Hansen,[36] M. C. Hansen,[21] P. H. Hansen,[36] K. Hara,[160] A. S. Hard,[173] T. Harenberg,[175] F. Hariri,[117] S. Harkusha,[92] R. D. Harrington,[46] P. F. Harrison,[170] F. Hartjes,[107] M. Hasegawa,[67] S. Hasegawa,[103] Y. Hasegawa,[140] A. Hasib,[113] S. Hassani,[136] S. Haug,[17] R. Hauser,[90] L. Hauswald,[44] M. Havranek,[127] C. M. Hawkes,[18] R. J. Hawkings,[30] A. D. Hawkins,[81] T. Hayashi,[160] D. Hayden,[90] C. P. Hays,[120] J. M. Hays,[76] H. S. Hayward,[74] S. J. Haywood,[131] S. J. Head,[18] T. Heck,[83] V. Hedberg,[81] L. Heelan,[8] S. Heim,[122] T. Heim,[175] B. Heinemann,[15] L. Heinrich,[110] J. Hejbal,[127] L. Helary,[22] S. Hellman,[146a,146b] D. Hellmich,[21] C. Helsens,[30] J. Henderson,[120] R. C. W. Henderson,[72] Y. Heng,[173] C. Hengler,[42] A. Henrichs,[176] A. M. Henriques Correia,[30] S. Henrot-Versille,[117] G. H. Herbert,[16] Y. Hernández Jiménez,[167] R. Herrberg-Schubert,[16] G. Herten,[48] R. Hertenberger,[100] L. Hervas,[30] G. G. Hesketh,[78] N. P. Hessey,[107] J. W. Hetherly,[40] R. Hickling,[76] E. Higón-Rodriguez,[167] E. Hill,[169] J. C. Hill,[28] K. H. Hiller,[42] S. J. Hillier,[18] I. Hinchliffe,[15] E. Hines,[122] R. R. Hinman,[15] M. Hirose,[157] D. Hirschbuehl,[175] J. Hobbs,[148] N. Hod,[107] M. C. Hodgkinson,[139] P. Hodgson,[139] A. Hoecker,[30] M. R. Hoeferkamp,[105] F. Hoenig,[100] M. Hohlfeld,[83] D. Hohn,[21] T. R. Holmes,[15] T. M. Hong,[122] L. Hooft van Huysduynen,[110] W. H. Hopkins,[116] Y. Horii,[103] A. J. Horton,[142] J-Y. Hostachy,[55] S. Hou,[151] A. Hoummada,[135a] J. Howard,[120] J. Howarth,[42] M. Hrabovsky,[115] I. Hristova,[16] J. Hrivnac,[117] T. Hryn'ova,[5] A. Hrynevich,[93] C. Hsu,[145c] P. J. Hsu,[151,q] S.-C. Hsu,[138] D. Hu,[35] Q. Hu,[33b] X. Hu,[89] Y. Huang,[42] Z. Hubacek,[30] F. Hubaut,[85] F. Huegging,[21] T. B. Huffman,[120] E. W. Hughes,[35] G. Hughes,[72] M. Huhtinen,[30] T. A. Hülsing,[83] N. Huseynov,[65,c] J. Huston,[90] J. Huth,[57] G. Iacobucci,[49] G. Iakovidis,[25] I. Ibragimov,[141] L. Iconomidou-Fayard,[117] E. Ideal,[176] Z. Idrissi,[135e] P. Iengo,[30] O. Igonkina,[107] T. Iizawa,[171] Y. Ikegami,[66] K. Ikematsu,[141] M. Ikeno,[66] Y. Ilchenko,[31,r] D. Iliadis,[154] N. Ilic,[158] Y. Inamaru,[67] T. Ince,[101] P. Ioannou,[9] M. Iodice,[134a] K. Iordanidou,[35] V. Ippolito,[57] A. Irles Quiles,[167] C. Isaksson,[166] M. Ishino,[68] M. Ishitsuka,[157] R. Ishmukhametov,[111] C. Issever,[120] S. Istin,[19a] J. M. Iturbe Ponce,[84] R. Iuppa,[133a,133b] J. Ivarsson,[81] W. Iwanski,[39] H. Iwasaki,[66] J. M. Izen,[41] V. Izzo,[104a] S. Jabbar,[3] B. Jackson,[122] M. Jackson,[74]

P. Jackson,[1] M. R. Jaekel,[30] V. Jain,[2] K. Jakobs,[48] S. Jakobsen,[30] T. Jakoubek,[127] J. Jakubek,[128] D. O. Jamin,[151] D. K. Jana,[79] E. Jansen,[78] R. W. Jansky,[62] J. Janssen,[21] M. Janus,[170] G. Jarlskog,[81] N. Javadov,[65,c] T. Javůrek,[48] L. Jeanty,[15] J. Jejelava,[51a,s] G.-Y. Jeng,[150] D. Jennens,[88] P. Jenni,[48,t] J. Jentzsch,[43] C. Jeske,[170] S. Jézéquel,[5] H. Ji,[173] J. Jia,[148] Y. Jiang,[33b] S. Jiggins,[78] J. Jimenez Pena,[167] S. Jin,[33a] A. Jinaru,[26a] O. Jinnouchi,[157] M. D. Joergensen,[36] P. Johansson,[139] K. A. Johns,[7] K. Jon-And,[146a,146b] G. Jones,[170] R. W. L. Jones,[72] T. J. Jones,[74] J. Jongmanns,[58a] P. M. Jorge,[126a,126b] K. D. Joshi,[84] J. Jovicevic,[159a] X. Ju,[173] C. A. Jung,[43] P. Jussel,[62] A. Juste Rozas,[12,p] M. Kaci,[167] A. Kaczmarska,[39] M. Kado,[117] H. Kagan,[111] M. Kagan,[143] S. J. Kahn,[85] E. Kajomovitz,[45] C. W. Kalderon,[120] S. Kama,[40] A. Kamenshchikov,[130] N. Kanaya,[155] M. Kaneda,[30] S. Kaneti,[28] V. A. Kantserov,[98] J. Kanzaki,[66] B. Kaplan,[110] A. Kapliy,[31] D. Kar,[53] K. Karakostas,[10] A. Karamaoun,[3] N. Karastathis,[10,107] M. J. Kareem,[54] M. Karnevskiy,[83] S. N. Karpov,[65] Z. M. Karpova,[65] K. Karthik,[110] V. Kartvelishvili,[72] A. N. Karyukhin,[130] L. Kashif,[173] R. D. Kass,[111] A. Kastanas,[14] Y. Kataoka,[155] A. Katre,[49] J. Katzy,[42] K. Kawagoe,[70] T. Kawamoto,[155] G. Kawamura,[54] S. Kazama,[155] V. F. Kazanin,[109,d] M. Y. Kazarinov,[65] R. Keeler,[169] R. Kehoe,[40] J. S. Keller,[42] J. J. Kempster,[77] H. Keoshkerian,[84] O. Kepka,[127] B. P. Kerševan,[75] S. Kersten,[175] R. A. Keyes,[87] F. Khalil-zada,[11] H. Khandanyan,[146a,146b] A. Khanov,[114] A. G. Kharlamov,[109,d] T. J. Khoo,[28] V. Khovanskiy,[97] E. Khramov,[65] J. Khubua,[51b,u] H. Y. Kim,[8] H. Kim,[146a,146b] S. H. Kim,[160] Y. Kim,[31] N. Kimura,[154] O. M. Kind,[16] B. T. King,[74] M. King,[167] R. S. B. King,[120] S. B. King,[168] J. Kirk,[131] A. E. Kiryunin,[101] T. Kishimoto,[67] D. Kisielewska,[38a] F. Kiss,[48] K. Kiuchi,[160] O. Kivernyk,[136] E. Kladiva,[144b] M. H. Klein,[35] M. Klein,[74] U. Klein,[74] K. Kleinknecht,[83] P. Klimek,[146a,146b] A. Klimentov,[25] R. Klingenberg,[43] J. A. Klinger,[84] T. Klioutchnikova,[30] P. F. Klok,[106] E.-E. Kluge,[58a] P. Kluit,[107] S. Kluth,[101] E. Kneringer,[62] E. B. F. G. Knoops,[85] A. Knue,[53] A. Kobayashi,[155] D. Kobayashi,[157] T. Kobayashi,[155] M. Kobel,[44] M. Kocian,[143] P. Kodys,[129] T. Koffas,[29] E. Koffeman,[107] L. A. Kogan,[120] S. Kohlmann,[175] Z. Kohout,[128] T. Kohriki,[66] T. Koi,[143] H. Kolanoski,[16] I. Koletsou,[5] A. A. Komar,[96,a] Y. Komori,[155] T. Kondo,[66] N. Kondrashova,[42] K. Köneke,[48] A. C. König,[106] S. König,[83] T. Kono,[66,v] R. Konoplich,[110,w] N. Konstantinidis,[78] R. Kopeliansky,[152] S. Koperny,[38a] L. Köpke,[83] A. K. Kopp,[48] K. Korcyl,[39] K. Kordas,[154] A. Korn,[78] A. A. Korol,[109,d] I. Korolkov,[12] E. V. Korolkova,[139] O. Kortner,[101] S. Kortner,[101] T. Kosek,[129] V. V. Kostyukhin,[21] V. M. Kotov,[65] A. Kotwal,[45] A. Kourkoumeli-Charalampidi,[154] C. Kourkoumelis,[9] V. Kouskoura,[25] A. Koutsman,[159a] R. Kowalewski,[169] T. Z. Kowalski,[38a] W. Kozanecki,[136] A. S. Kozhin,[130] V. A. Kramarenko,[99] G. Kramberger,[75] D. Krasnopevtsev,[98] M. W. Krasny,[80] A. Krasznahorkay,[30] J. K. Kraus,[21] A. Kravchenko,[25] S. Kreiss,[110] M. Kretz,[58c] J. Kretzschmar,[74] K. Kreutzfeldt,[52] P. Krieger,[158] K. Krizka,[31] K. Kroeninger,[43] H. Kroha,[101] J. Kroll,[122] J. Kroseberg,[21] J. Krstic,[13] U. Kruchonak,[65] H. Krüger,[21] N. Krumnack,[64] Z. V. Krumshteyn,[65] A. Kruse,[173] M. C. Kruse,[45] M. Kruskal,[22] T. Kubota,[88] H. Kucuk,[78] S. Kuday,[4c] S. Kuehn,[48] A. Kugel,[58c] F. Kuger,[174] A. Kuhl,[137] T. Kuhl,[42] V. Kukhtin,[65] Y. Kulchitsky,[92] S. Kuleshov,[32b] M. Kuna,[132a,132b] T. Kunigo,[68] A. Kupco,[127] H. Kurashige,[67] Y. A. Kurochkin,[92] R. Kurumida,[67] V. Kus,[127] E. S. Kuwertz,[169] M. Kuze,[157] J. Kvita,[115] T. Kwan,[169] D. Kyriazopoulos,[139] A. La Rosa,[49] J. L. La Rosa Navarro,[24d] L. La Rotonda,[37a,37b] C. Lacasta,[167] F. Lacava,[132a,132b] J. Lacey,[29] H. Lacker,[16] D. Lacour,[80] V. R. Lacuesta,[167] E. Ladygin,[65] R. Lafaye,[5] B. Laforge,[80] T. Lagouri,[176] S. Lai,[48] L. Lambourne,[78] S. Lammers,[61] C. L. Lampen,[7] W. Lampl,[7] E. Lançon,[136] U. Landgraf,[48] M. P. J. Landon,[76] V. S. Lang,[58a] J. C. Lange,[12] A. J. Lankford,[163] F. Lanni,[25] K. Lantzsch,[30] S. Laplace,[80] C. Lapoire,[30] J. F. Laporte,[136] T. Lari,[91a] F. Lasagni Manghi,[20a,20b] M. Lassnig,[30] P. Laurelli,[47] W. Lavrijsen,[15] A. T. Law,[137] P. Laycock,[74] O. Le Dortz,[80] E. Le Guirriec,[85] E. Le Menedeu,[12] M. LeBlanc,[169] T. LeCompte,[6] F. Ledroit-Guillon,[55] C. A. Lee,[145b] S. C. Lee,[151] L. Lee,[1] G. Lefebvre,[80] M. Lefebvre,[169] F. Legger,[100] C. Leggett,[15] A. Lehan,[74] G. Lehmann Miotto,[30] X. Lei,[7] W. A. Leight,[29] A. Leisos,[154] A. G. Leister,[176] M. A. L. Leite,[24d] R. Leitner,[129] D. Lellouch,[172] B. Lemmer,[54] K. J. C. Leney,[78] T. Lenz,[21] B. Lenzi,[30] R. Leone,[7] S. Leone,[124a,124b] C. Leonidopoulos,[46] S. Leontsinis,[10] C. Leroy,[95] C. G. Lester,[28] M. Levchenko,[123] J. Levêque,[5] D. Levin,[89] L. J. Levinson,[172] M. Levy,[18] A. Lewis,[120] A. M. Leyko,[21] M. Leyton,[41] B. Li,[33b,x] H. Li,[148] H. L. Li,[31] L. Li,[45] L. Li,[33e] S. Li,[45] Y. Li,[33c,y] Z. Liang,[137] H. Liao,[34] B. Liberti,[133a] A. Liblong,[158] P. Lichard,[30] K. Lie,[165] J. Liebal,[21] W. Liebig,[14] C. Limbach,[21] A. Limosani,[150] S. C. Lin,[151,z] T. H. Lin,[83] F. Linde,[107] B. E. Lindquist,[148] J. T. Linnemann,[90] E. Lipeles,[122] A. Lipniacka,[14] M. Lisovyi,[42] T. M. Liss,[165] D. Lissauer,[25] A. Lister,[168] A. M. Litke,[137] B. Liu,[151,aa] D. Liu,[151] J. Liu,[85] J. B. Liu,[33b] K. Liu,[85] L. Liu,[165] M. Liu,[45] M. Liu,[33b] Y. Liu,[33b] M. Livan,[121a,121b] A. Lleres,[55] J. Llorente Merino,[82] S. L. Lloyd,[76] F. Lo Sterzo,[151] E. Lobodzinska,[42] P. Loch,[7] W. S. Lockman,[137] F. K. Loebinger,[84] A. E. Loevschall-Jensen,[36] A. Loginov,[176] T. Lohse,[16] K. Lohwasser,[42] M. Lokajicek,[127] B. A. Long,[22] J. D. Long,[89] R. E. Long,[72] K. A. Looper,[111] L. Lopes,[126a] D. Lopez Mateos,[57] B. Lopez Paredes,[139] I. Lopez Paz,[12] J. Lorenz,[100] N. Lorenzo Martinez,[61] M. Losada,[162] P. Loscutoff,[15] P. J. Lösel,[100] X. Lou,[33a] A. Lounis,[117] J. Love,[6] P. A. Love,[72] N. Lu,[89] H. J. Lubatti,[138] C. Luci,[132a,132b] A. Lucotte,[55] F. Luehring,[61]

W. Lukas,[62] L. Luminari,[132a] O. Lundberg,[146a,146b] B. Lund-Jensen,[147] D. Lynn,[25] R. Lysak,[127] E. Lytken,[81] H. Ma,[25] L. L. Ma,[33d] G. Maccarrone,[47] A. Macchiolo,[101] C. M. Macdonald,[139] J. Machado Miguens,[122,126b] D. Macina,[30] D. Madaffari,[85] R. Madar,[34] H. J. Maddocks,[72] W. F. Mader,[44] A. Madsen,[166] S. Maeland,[14] T. Maeno,[25] A. Maevskiy,[99] E. Magradze,[54] K. Mahboubi,[48] J. Mahlstedt,[107] C. Maiani,[136] C. Maidantchik,[24a] A. A. Maier,[101] T. Maier,[100] A. Maio,[126a,126b,126d] S. Majewski,[116] Y. Makida,[66] N. Makovec,[117] B. Malaescu,[80] Pa. Malecki,[39] V. P. Maleev,[123] F. Malek,[55] U. Mallik,[63] D. Malon,[6] C. Malone,[143] S. Maltezos,[10] V. M. Malyshev,[109] S. Malyukov,[30] J. Mamuzic,[42] G. Mancini,[47] B. Mandelli,[30] L. Mandelli,[91a] I. Mandić,[75] R. Mandrysch,[63] J. Maneira,[126a,126b] A. Manfredini,[101] L. Manhaes de Andrade Filho,[24b] J. Manjarres Ramos,[159b] A. Mann,[100] P. M. Manning,[137] A. Manousakis-Katsikakis,[9] B. Mansoulie,[136] R. Mantifel,[87] M. Mantoani,[54] L. Mapelli,[30] L. March,[145c] G. Marchiori,[80] M. Marcisovsky,[127] C. P. Marino,[169] M. Marjanovic,[13] F. Marroquim,[24a] S. P. Marsden,[84] Z. Marshall,[15] L. F. Marti,[17] S. Marti-Garcia,[167] B. Martin,[90] T. A. Martin,[170] V. J. Martin,[46] B. Martin dit Latour,[14] M. Martinez,[12,p] S. Martin-Haugh,[131] V. S. Martoiu,[26a] A. C. Martyniuk,[78] M. Marx,[138] F. Marzano,[132a] A. Marzin,[30] L. Masetti,[83] T. Mashimo,[155] R. Mashinistov,[96] J. Masik,[84] A. L. Maslennikov,[109,d] I. Massa,[20a,20b] L. Massa,[20a,20b] N. Massol,[5] P. Mastrandrea,[148] A. Mastroberardino,[37a,37b] T. Masubuchi,[155] P. Mättig,[175] J. Mattmann,[83] J. Maurer,[26a] S. J. Maxfield,[74] D. A. Maximov,[109,d] R. Mazini,[151] S. M. Mazza,[91a,91b] L. Mazzaferro,[133a,133b] G. Mc Goldrick,[158] S. P. Mc Kee,[89] A. McCarn,[89] R. L. McCarthy,[148] T. G. McCarthy,[29] N. A. McCubbin,[131] K. W. McFarlane,[56,a] J. A. Mcfayden,[78] G. Mchedlidze,[54] S. J. McMahon,[131] R. A. McPherson,[169,l] M. Medinnis,[42] S. Meehan,[145a] S. Mehlhase,[100] A. Mehta,[74] K. Meier,[58a] C. Meineck,[100] B. Meirose,[41] B. R. Mellado Garcia,[145c] F. Meloni,[17] A. Mengarelli,[20a,20b] S. Menke,[101] E. Meoni,[161] K. M. Mercurio,[57] S. Mergelmeyer,[21] P. Mermod,[49] L. Merola,[104a,104b] C. Meroni,[91a] F. S. Merritt,[31] A. Messina,[132a,132b] J. Metcalfe,[25] A. S. Mete,[163] C. Meyer,[83] C. Meyer,[122] J-P. Meyer,[136] J. Meyer,[107] R. P. Middleton,[131] S. Miglioranzi,[164a,164c] L. Mijović,[21] G. Mikenberg,[172] M. Mikestikova,[127] M. Mikuž,[75] M. Milesi,[88] A. Milic,[30] D. W. Miller,[31] C. Mills,[46] A. Milov,[172] D. A. Milstead,[146a,146b] A. A. Minaenko,[130] Y. Minami,[155] I. A. Minashvili,[65] A. I. Mincer,[110] B. Mindur,[38a] M. Mineev,[65] Y. Ming,[173] L. M. Mir,[12] T. Mitani,[171] J. Mitrevski,[100] V. A. Mitsou,[167] A. Miucci,[49] P. S. Miyagawa,[139] J. U. Mjörnmark,[81] T. Moa,[146a,146b] K. Mochizuki,[85] S. Mohapatra,[35] W. Mohr,[48] S. Molander,[146a,146b] R. Moles-Valls,[167] K. Mönig,[42] C. Monini,[55] J. Monk,[36] E. Monnier,[85] J. Montejo Berlingen,[12] F. Monticelli,[71] S. Monzani,[132a,132b] R. W. Moore,[3] N. Morange,[117] D. Moreno,[162] M. Moreno Llácer,[54] P. Morettini,[50a] M. Morgenstern,[44] M. Morii,[57] M. Morinaga,[155] V. Morisbak,[119] S. Moritz,[83] A. K. Morley,[147] G. Mornacchi,[30] J. D. Morris,[76] S. S. Mortensen,[36] A. Morton,[53] L. Morvaj,[103] H. G. Moser,[101] M. Mosidze,[51b] J. Moss,[111] K. Motohashi,[157] R. Mount,[143] E. Mountricha,[25] S. V. Mouraviev,[96,a] E. J. W. Moyse,[86] S. Muanza,[85] R. D. Mudd,[18] F. Mueller,[101] J. Mueller,[125] K. Mueller,[21] R. S. P. Mueller,[100] T. Mueller,[28] D. Muenstermann,[49] P. Mullen,[53] Y. Munwes,[153] J. A. Murillo Quijada,[18] W. J. Murray,[170,131] H. Musheghyan,[54] E. Musto,[152] A. G. Myagkov,[130,bb] M. Myska,[128] O. Nackenhorst,[54] J. Nadal,[54] K. Nagai,[120] R. Nagai,[157] Y. Nagai,[85] K. Nagano,[66] A. Nagarkar,[111] Y. Nagasaka,[59] K. Nagata,[160] M. Nagel,[101] E. Nagy,[85] A. M. Nairz,[30] Y. Nakahama,[30] K. Nakamura,[66] T. Nakamura,[155] I. Nakano,[112] H. Namasivayam,[41] R. F. Naranjo Garcia,[42] R. Narayan,[31] T. Naumann,[42] G. Navarro,[162] R. Nayyar,[7] H. A. Neal,[89] P. Yu. Nechaeva,[96] T. J. Neep,[84] P. D. Nef,[143] A. Negri,[121a,121b] M. Negrini,[20a] S. Nektarijevic,[106] C. Nellist,[117] A. Nelson,[163] S. Nemecek,[127] P. Nemethy,[110] A. A. Nepomuceno,[24a] M. Nessi,[30,cc] M. S. Neubauer,[165] M. Neumann,[175] R. M. Neves,[110] P. Nevski,[25] P. R. Newman,[18] D. H. Nguyen,[6] R. B. Nickerson,[120] R. Nicolaidou,[136] B. Nicquevert,[30] J. Nielsen,[137] N. Nikiforou,[35] A. Nikiforov,[16] V. Nikolaenko,[130,bb] I. Nikolic-Audit,[80] K. Nikolopoulos,[18] J. K. Nilsen,[119] P. Nilsson,[25] Y. Ninomiya,[155] A. Nisati,[132a] R. Nisius,[101] T. Nobe,[157] M. Nomachi,[118] I. Nomidis,[29] T. Nooney,[76] S. Norberg,[113] M. Nordberg,[30] O. Novgorodova,[44] S. Nowak,[101] M. Nozaki,[66] L. Nozka,[115] K. Ntekas,[10] G. Nunes Hanninger,[88] T. Nunnemann,[100] E. Nurse,[78] F. Nuti,[88] B. J. O'Brien,[46] F. O'grady,[7] D. C. O'Neil,[142] V. O'Shea,[53] F. G. Oakham,[29,e] H. Oberlack,[101] T. Obermann,[21] J. Ocariz,[80] A. Ochi,[67] I. Ochoa,[78] S. Oda,[70] S. Odaka,[66] H. Ogren,[61] A. Oh,[84] S. H. Oh,[45] C. C. Ohm,[15] H. Ohman,[166] H. Oide,[30] W. Okamura,[118] H. Okawa,[160] Y. Okumura,[31] T. Okuyama,[155] A. Olariu,[26a] S. A. Olivares Pino,[46] D. Oliveira Damazio,[25] E. Oliver Garcia,[167] A. Olszewski,[39] J. Olszowska,[39] A. Onofre,[126a,126e] P. U. E. Onyisi,[31,r] C. J. Oram,[159a] M. J. Oreglia,[31] Y. Oren,[153] D. Orestano,[134a,134b] N. Orlando,[154] C. Oropeza Barrera,[53] R. S. Orr,[158] B. Osculati,[50a,50b] R. Ospanov,[84] G. Otero y Garzon,[27] H. Otono,[70] M. Ouchrif,[135d] E. A. Ouellette,[169] F. Ould-Saada,[119] A. Ouraou,[136] K. P. Oussoren,[107] Q. Ouyang,[33a] A. Ovcharova,[15] M. Owen,[53] R. E. Owen,[18] V. E. Ozcan,[19a] N. Ozturk,[8] K. Pachal,[142] A. Pacheco Pages,[12] C. Padilla Aranda,[12] M. Pagáčová,[48] S. Pagan Griso,[15] E. Paganis,[139] C. Pahl,[101] F. Paige,[25] P. Pais,[86] K. Pajchel,[119] G. Palacino,[159b] S. Palestini,[30] M. Palka,[38b] D. Pallin,[34] A. Palma,[126a,126b] Y. B. Pan,[173] E. Panagiotopoulou,[10] C. E. Pandini,[80] J. G. Panduro Vazquez,[77] P. Pani,[146a,146b]

S. Panitkin,[25] L. Paolozzi,[133a,133b] Th. D. Papadopoulou,[10] K. Papageorgiou,[154] A. Paramonov,[6] D. Paredes Hernandez,[154] M. A. Parker,[28] K. A. Parker,[139] F. Parodi,[50a,50b] J. A. Parsons,[35] U. Parzefall,[48] E. Pasqualucci,[132a] S. Passaggio,[50a] F. Pastore,[134a,134b,a] Fr. Pastore,[77] G. Pásztor,[29] S. Pataraia,[175] N. D. Patel,[150] J. R. Pater,[84] T. Pauly,[30] J. Pearce,[169] B. Pearson,[113] L. E. Pedersen,[36] M. Pedersen,[119] S. Pedraza Lopez,[167] R. Pedro,[126a,126b] S. V. Peleganchuk,[109] D. Pelikan,[166] H. Peng,[33b] B. Penning,[31] J. Penwell,[61] D. V. Perepelitsa,[25] E. Perez Codina,[159a] M. T. Pérez García-Estañ,[167] L. Perini,[91a,91b] H. Pernegger,[30] S. Perrella,[104a,104b] R. Peschke,[42] V. D. Peshekhonov,[65] K. Peters,[30] R. F. Y. Peters,[84] B. A. Petersen,[30] T. C. Petersen,[36] E. Petit,[42] A. Petridis,[146a,146b] C. Petridou,[154] E. Petrolo,[132a] F. Petrucci,[134a,134b] N. E. Pettersson,[157] R. Pezoa,[32b] P. W. Phillips,[131] G. Piacquadio,[143] E. Pianori,[170] A. Picazio,[49] E. Piccaro,[76] M. Piccinini,[20a,20b] M. A. Pickering,[120] R. Piegaia,[27] D. T. Pignotti,[111] J. E. Pilcher,[31] A. D. Pilkington,[78] J. Pina,[126a,126b,126d] M. Pinamonti,[164a,164c,dd] J. L. Pinfold,[3] A. Pingel,[36] B. Pinto,[126a] S. Pires,[80] M. Pitt,[172] C. Pizio,[91a,91b] L. Plazak,[144a] M.-A. Pleier,[25] V. Pleskot,[129] E. Plotnikova,[65] P. Plucinski,[146a,146b] D. Pluth,[64] R. Poettgen,[83] L. Poggioli,[117] D. Pohl,[21] G. Polesello,[121a] A. Policicchio,[37a,37b] R. Polifka,[158] A. Polini,[20a] C. S. Pollard,[53] V. Polychronakos,[25] K. Pommès,[30] L. Pontecorvo,[132a] B. G. Pope,[90] G. A. Popeneciu,[26b] D. S. Popovic,[13] A. Poppleton,[30] S. Pospisil,[128] K. Potamianos,[15] I. N. Potrap,[65] C. J. Potter,[149] C. T. Potter,[116] G. Poulard,[30] J. Poveda,[30] V. Pozdnyakov,[65] P. Pralavorio,[85] A. Pranko,[15] S. Prasad,[30] S. Prell,[64] D. Price,[84] L. E. Price,[6] M. Primavera,[73a] S. Prince,[87] M. Proissl,[46] K. Prokofiev,[60c] F. Prokoshin,[32b] E. Protopapadaki,[136] S. Protopopescu,[25] J. Proudfoot,[6] M. Przybycien,[38a] E. Ptacek,[116] D. Puddu,[134a,134b] E. Pueschel,[86] D. Puldon,[148] M. Purohit,[25,ee] P. Puzo,[117] J. Qian,[89] G. Qin,[53] Y. Qin,[84] A. Quadt,[54] D. R. Quarrie,[15] W. B. Quayle,[164a,164b] M. Queitsch-Maitland,[84] D. Quilty,[53] S. Raddum,[119] V. Radeka,[25] V. Radescu,[42] S. K. Radhakrishnan,[148] P. Radloff,[116] P. Rados,[88] F. Ragusa,[91a,91b] G. Rahal,[178] S. Rajagopalan,[25] M. Rammensee,[30] C. Rangel-Smith,[166] F. Rauscher,[100] S. Rave,[83] T. Ravenscroft,[53] M. Raymond,[30] A. L. Read,[119] N. P. Readioff,[74] D. M. Rebuzzi,[121a,121b] A. Redelbach,[174] G. Redlinger,[25] R. Reece,[137] K. Reeves,[41] L. Rehnisch,[16] H. Reisin,[27] M. Relich,[163] C. Rembser,[30] H. Ren,[33a] A. Renaud,[117] M. Rescigno,[132a] S. Resconi,[91a] O. L. Rezanova,[109,d] P. Reznicek,[129] R. Rezvani,[95] R. Richter,[101] S. Richter,[78] E. Richter-Was,[38b] O. Ricken,[21] M. Ridel,[80] P. Rieck,[16] C. J. Riegel,[175] J. Rieger,[54] M. Rijssenbeek,[148] A. Rimoldi,[121a,121b] L. Rinaldi,[20a] B. Ristić,[49] E. Ritsch,[62] I. Riu,[12] F. Rizatdinova,[114] E. Rizvi,[76] S. H. Robertson,[87,l] A. Robichaud-Veronneau,[87] D. Robinson,[28] J. E. M. Robinson,[84] A. Robson,[53] C. Roda,[124a,124b] S. Roe,[30] O. Røhne,[119] S. Rolli,[161] A. Romaniouk,[98] M. Romano,[20a,20b] S. M. Romano Saez,[34] E. Romero Adam,[167] N. Rompotis,[138] M. Ronzani,[48] L. Roos,[80] E. Ros,[167] S. Rosati,[132a] K. Rosbach,[48] P. Rose,[137] P. L. Rosendahl,[14] O. Rosenthal,[141] V. Rossetti,[146a,146b] E. Rossi,[104a,104b] L. P. Rossi,[50a] R. Rosten,[138] M. Rotaru,[26a] I. Roth,[172] J. Rothberg,[138] D. Rousseau,[117] C. R. Royon,[136] A. Rozanov,[85] Y. Rozen,[152] X. Ruan,[145c] F. Rubbo,[143] I. Rubinskiy,[42] V. I. Rud,[99] C. Rudolph,[44] M. S. Rudolph,[158] F. Rühr,[48] A. Ruiz-Martinez,[30] Z. Rurikova,[48] N. A. Rusakovich,[65] A. Ruschke,[100] H. L. Russell,[138] J. P. Rutherfoord,[7] N. Ruthmann,[48] Y. F. Ryabov,[123] M. Rybar,[129] G. Rybkin,[117] N. C. Ryder,[120] A. F. Saavedra,[150] G. Sabato,[107] S. Sacerdoti,[27] A. Saddique,[3] H. F-W. Sadrozinski,[137] R. Sadykov,[65] F. Safai Tehrani,[132a] M. Saimpert,[136] H. Sakamoto,[155] Y. Sakurai,[171] G. Salamanna,[134a,134b] A. Salamon,[133a] M. Saleem,[113] D. Salek,[107] P. H. Sales De Bruin,[138] D. Salihagic,[101] A. Salnikov,[143] J. Salt,[167] D. Salvatore,[37a,37b] F. Salvatore,[149] A. Salvucci,[106] A. Salzburger,[30] D. Sampsonidis,[154] A. Sanchez,[104a,104b] J. Sánchez,[167] V. Sanchez Martinez,[167] H. Sandaker,[14] R. L. Sandbach,[76] H. G. Sander,[83] M. P. Sanders,[100] M. Sandhoff,[175] C. Sandoval,[162] R. Sandstroem,[101] D. P. C. Sankey,[131] M. Sannino,[50a,50b] A. Sansoni,[47] C. Santoni,[34] R. Santonico,[133a,133b] H. Santos,[126a] I. Santoyo Castillo,[149] K. Sapp,[125] A. Sapronov,[65] J. G. Saraiva,[126a,126d] B. Sarrazin,[21] O. Sasaki,[66] Y. Sasaki,[155] K. Sato,[160] G. Sauvage,[5,a] E. Sauvan,[5] G. Savage,[77] P. Savard,[158,e] C. Sawyer,[120] L. Sawyer,[79,o] J. Saxon,[31] C. Sbarra,[20a] A. Sbrizzi,[20a,20b] T. Scanlon,[78] D. A. Scannicchio,[163] M. Scarcella,[150] V. Scarfone,[37a,37b] J. Schaarschmidt,[172] P. Schacht,[101] D. Schaefer,[30] R. Schaefer,[42] J. Schaeffer,[83] S. Schaepe,[21] S. Schaetzel,[58b] U. Schäfer,[83] A. C. Schaffer,[117] D. Schaile,[100] R. D. Schamberger,[148] V. Scharf,[58a] V. A. Schegelsky,[123] D. Scheirich,[129] M. Schernau,[163] C. Schiavi,[50a,50b] C. Schillo,[48] M. Schioppa,[37a,37b] S. Schlenker,[30] E. Schmidt,[48] K. Schmieden,[30] C. Schmitt,[83] S. Schmitt,[58b] S. Schmitt,[42] B. Schneider,[159a] Y. J. Schnellbach,[74] U. Schnoor,[44] L. Schoeffel,[136] A. Schoening,[58b] B. D. Schoenrock,[90] E. Schopf,[21] A. L. S. Schorlemmer,[54] M. Schott,[83] D. Schouten,[159a] J. Schovancova,[8] S. Schramm,[158] M. Schreyer,[174] C. Schroeder,[83] N. Schuh,[83] M. J. Schultens,[21] H.-C. Schultz-Coulon,[58a] H. Schulz,[16] M. Schumacher,[48] B. A. Schumm,[137] Ph. Schune,[136] C. Schwanenberger,[84] A. Schwartzman,[143] T. A. Schwarz,[89] Ph. Schwegler,[101] Ph. Schwemling,[136] R. Schwienhorst,[90] J. Schwindling,[136] T. Schwindt,[21] M. Schwoerer,[5] F. G. Sciacca,[17] E. Scifo,[117] G. Sciolla,[23] F. Scuri,[124a,124b] F. Scutti,[21] J. Searcy,[89] G. Sedov,[42] E. Sedykh,[123] P. Seema,[21] S. C. Seidel,[105] A. Seiden,[137] F. Seifert,[128] J. M. Seixas,[24a] G. Sekhniaidze,[104a] K. Sekhon,[89] S. J. Sekula,[40] K. E. Selbach,[46] D. M. Seliverstov,[123,a] N. Semprini-Cesari,[20a,20b]

C. Serfon,[30] L. Serin,[117] L. Serkin,[164a,164b] T. Serre,[85] M. Sessa,[134a,134b] R. Seuster,[159a] H. Severini,[113] T. Sfiligoj,[75] F. Sforza,[101] A. Sfyrla,[30] E. Shabalina,[54] M. Shamim,[116] L. Y. Shan,[33a] R. Shang,[165] J. T. Shank,[22] M. Shapiro,[15] P. B. Shatalov,[97] K. Shaw,[164a,164b] S. M. Shaw,[84] A. Shcherbakova,[146a,146b] C. Y. Shehu,[149] P. Sherwood,[78] L. Shi,[151,ff] S. Shimizu,[67] C. O. Shimmin,[163] M. Shimojima,[102] M. Shiyakova,[65] A. Shmeleva,[96] D. Shoaleh Saadi,[95] M. J. Shochet,[31] S. Shojaii,[91a,91b] S. Shrestha,[111] E. Shulga,[98] M. A. Shupe,[7] S. Shushkevich,[42] P. Sicho,[127] O. Sidiropoulou,[174] D. Sidorov,[114] A. Sidoti,[20a,20b] F. Siegert,[44] Dj. Sijacki,[13] J. Silva,[126a,126d] Y. Silver,[153] S. B. Silverstein,[146a] V. Simak,[128] O. Simard,[5] Lj. Simic,[13] S. Simion,[117] E. Simioni,[83] B. Simmons,[78] D. Simon,[34] R. Simoniello,[91a,91b] P. Sinervo,[158] N. B. Sinev,[116] G. Siragusa,[174] A. N. Sisakyan,[65,a] S. Yu. Sivoklokov,[99] J. Sjölin,[146a,146b] T. B. Sjursen,[14] M. B. Skinner,[72] H. P. Skottowe,[57] P. Skubic,[113] M. Slater,[18] T. Slavicek,[128] M. Slawinska,[107] K. Sliwa,[161] V. Smakhtin,[172] B. H. Smart,[46] L. Smestad,[14] S. Yu. Smirnov,[98] Y. Smirnov,[98] L. N. Smirnova,[99,gg] O. Smirnova,[81] M. N. K. Smith,[35] M. Smizanska,[72] K. Smolek,[128] A. A. Snesarev,[96] G. Snidero,[76] S. Snyder,[25] R. Sobie,[169,l] F. Socher,[44] A. Soffer,[153] D. A. Soh,[151,ff] C. A. Solans,[30] M. Solar,[128] J. Solc,[128] E. Yu. Soldatov,[98] U. Soldevila,[167] A. A. Solodkov,[130] A. Soloshenko,[65] O. V. Solovyanov,[130] V. Solovyev,[123] P. Sommer,[48] H. Y. Song,[33b] N. Soni,[1] A. Sood,[15] A. Sopczak,[128] B. Sopko,[128] V. Sopko,[128] V. Sorin,[12] D. Sosa,[58b] M. Sosebee,[8] C. L. Sotiropoulou,[124a,124b] R. Soualah,[164a,164c] P. Soueid,[95] A. M. Soukharev,[109,d] D. South,[42] S. Spagnolo,[73a,73b] M. Spalla,[124a,124b] F. Spanò,[77] W. R. Spearman,[57] F. Spettel,[101] R. Spighi,[20a] G. Spigo,[30] L. A. Spiller,[88] M. Spousta,[129] T. Spreitzer,[158] R. D. St. Denis,[53,a] S. Staerz,[44] J. Stahlman,[122] R. Stamen,[58a] S. Stamm,[16] E. Stanecka,[39] C. Stanescu,[134a] M. Stanescu-Bellu,[42] M. M. Stanitzki,[42] S. Stapnes,[119] E. A. Starchenko,[130] J. Stark,[55] P. Staroba,[127] P. Starovoitov,[42] R. Staszewski,[39] P. Stavina,[144a,a] P. Steinberg,[25] B. Stelzer,[142] H. J. Stelzer,[30] O. Stelzer-Chilton,[159a] H. Stenzel,[52] S. Stern,[101] G. A. Stewart,[53] J. A. Stillings,[21] M. C. Stockton,[87] M. Stoebe,[87] G. Stoicea,[26a] P. Stolte,[54] S. Stonjek,[101] A. R. Stradling,[8] A. Straessner,[44] M. E. Stramaglia,[17] J. Strandberg,[147] S. Strandberg,[146a,146b] A. Strandlie,[119] E. Strauss,[143] M. Strauss,[113] P. Strizenec,[144b] R. Ströhmer,[174] D. M. Strom,[116] R. Stroynowski,[40] A. Strubig,[106] S. A. Stucci,[17] B. Stugu,[14] N. A. Styles,[42] D. Su,[143] J. Su,[125] R. Subramaniam,[79] A. Succurro,[12] Y. Sugaya,[118] C. Suhr,[108] M. Suk,[128] V. V. Sulin,[96] S. Sultansoy,[4d] T. Sumida,[68] S. Sun,[57] X. Sun,[33a] J. E. Sundermann,[48] K. Suruliz,[149] G. Susinno,[37a,37b] M. R. Sutton,[149] S. Suzuki,[66] Y. Suzuki,[66] M. Svatos,[127] S. Swedish,[168] M. Swiatlowski,[143] I. Sykora,[144a] T. Sykora,[129] D. Ta,[90] C. Taccini,[134a,134b] K. Tackmann,[42] J. Taenzer,[158] A. Taffard,[163] R. Tafirout,[159a] N. Taiblum,[153] H. Takai,[25] R. Takashima,[69] H. Takeda,[67] T. Takeshita,[140] Y. Takubo,[66] M. Talby,[85] A. A. Talyshev,[109,d] J. Y. C. Tam,[174] K. G. Tan,[88] J. Tanaka,[155] R. Tanaka,[117] S. Tanaka,[66] B. B. Tannenwald,[111] N. Tannoury,[21] S. Tapprogge,[83] S. Tarem,[152] F. Tarrade,[29] G. F. Tartarelli,[91a] P. Tas,[129] M. Tasevsky,[127] T. Tashiro,[68] E. Tassi,[37a,37b] A. Tavares Delgado,[126a,126b] Y. Tayalati,[135d] F. E. Taylor,[94] G. N. Taylor,[88] W. Taylor,[159b] F. A. Teischinger,[30] M. Teixeira Dias Castanheira,[76] P. Teixeira-Dias,[77] K. K. Temming,[48] H. Ten Kate,[30] P. K. Teng,[151] J. J. Teoh,[118] F. Tepel,[175] S. Terada,[66] K. Terashi,[155] J. Terron,[82] S. Terzo,[101] M. Testa,[47] R. J. Teuscher,[158,l] J. Therhaag,[21] T. Theveneaux-Pelzer,[34] J. P. Thomas,[18] J. Thomas-Wilsker,[77] E. N. Thompson,[35] P. D. Thompson,[18] R. J. Thompson,[84] A. S. Thompson,[53] L. A. Thomsen,[36] E. Thomson,[122] M. Thomson,[28] R. P. Thun,[89,a] M. J. Tibbetts,[15] R. E. Ticse Torres,[85] V. O. Tikhomirov,[96,hh] Yu. A. Tikhonov,[109,d] S. Timoshenko,[98] E. Tiouchichine,[85] P. Tipton,[176] S. Tisserant,[85] T. Todorov,[5,a] S. Todorova-Nova,[129] J. Tojo,[70] S. Tokár,[144a] K. Tokushuku,[66] K. Tollefson,[90] E. Tolley,[57] L. Tomlinson,[84] M. Tomoto,[103] L. Tompkins,[143,ii] K. Toms,[105] E. Torrence,[116] H. Torres,[142] E. Torró Pastor,[167] J. Toth,[85,jj] F. Touchard,[85] D. R. Tovey,[139] T. Trefzger,[174] L. Tremblet,[30] A. Tricoli,[30] I. M. Trigger,[159a] S. Trincaz-Duvoid,[80] M. F. Tripiana,[12] W. Trischuk,[158] B. Trocmé,[55] C. Troncon,[91a] M. Trottier-McDonald,[15] M. Trovatelli,[134a,134b] P. True,[90] L. Truong,[164a,164c] M. Trzebinski,[39] A. Trzupek,[39] C. Tsarouchas,[30] J. C-L. Tseng,[120] P. V. Tsiareshka,[92] D. Tsionou,[154] G. Tsipolitis,[10] N. Tsirintanis,[9] S. Tsiskaridze,[12] V. Tsiskaridze,[48] E. G. Tskhadadze,[51a] I. I. Tsukerman,[97] V. Tsulaia,[15] S. Tsuno,[66] D. Tsybychev,[148] A. Tudorache,[26a] V. Tudorache,[26a] A. N. Tuna,[122] S. A. Tupputi,[20a,20b] S. Turchikhin,[99,gg] D. Turecek,[128] R. Turra,[91a,91b] A. J. Turvey,[40] P. M. Tuts,[35] A. Tykhonov,[49] M. Tylmad,[146a,146b] M. Tyndel,[131] I. Ueda,[155] R. Ueno,[29] M. Ughetto,[146a,146b] M. Ugland,[14] M. Uhlenbrock,[21] F. Ukegawa,[160] G. Unal,[30] A. Undrus,[25] G. Unel,[163] F. C. Ungaro,[48] Y. Unno,[66] C. Unverdorben,[100] J. Urban,[144b] P. Urquijo,[88] P. Urrejola,[83] G. Usai,[8] A. Usanova,[62] L. Vacavant,[85] V. Vacek,[128] B. Vachon,[87] C. Valderanis,[83] N. Valencic,[107] S. Valentinetti,[20a,20b] A. Valero,[167] L. Valery,[12] S. Valkar,[129] E. Valladolid Gallego,[167] S. Vallecorsa,[49] J. A. Valls Ferrer,[167] W. Van Den Wollenberg,[107] P. C. Van Der Deijl,[107] R. van der Geer,[107] H. van der Graaf,[107] R. Van Der Leeuw,[107] N. van Eldik,[152] P. van Gemmeren,[6] J. Van Nieuwkoop,[142] I. van Vulpen,[107] M. C. van Woerden,[30] M. Vanadia,[132a,132b] W. Vandelli,[30] R. Vanguri,[122] A. Vaniachine,[6] F. Vannucci,[80] G. Vardanyan,[177] R. Vari,[132a] E. W. Varnes,[7] T. Varol,[40] D. Varouchas,[80] A. Vartapetian,[8] K. E. Varvell,[150] F. Vazeille,[34] T. Vazquez Schroeder,[87] J. Veatch,[7] F. Veloso,[126a,126c]

T. Velz,[21] S. Veneziano,[132a] A. Ventura,[73a,73b] D. Ventura,[86] M. Venturi,[169] N. Venturi,[158] A. Venturini,[23] V. Vercesi,[121a] M. Verducci,[132a,132b] W. Verkerke,[107] J. C. Vermeulen,[107] A. Vest,[44] M. C. Vetterli,[142,e] O. Viazlo,[81] I. Vichou,[165] T. Vickey,[139] O. E. Vickey Boeriu,[139] G. H. A. Viehhauser,[120] S. Viel,[15] R. Vigne,[30] M. Villa,[20a,20b] M. Villaplana Perez,[91a,91b] E. Vilucchi,[47] M. G. Vincter,[29] V. B. Vinogradov,[65] I. Vivarelli,[149] F. Vives Vaque,[3] S. Vlachos,[10] D. Vladoiu,[100] M. Vlasak,[128] M. Vogel,[32a] P. Vokac,[128] G. Volpi,[124a,124b] M. Volpi,[88] H. von der Schmitt,[101] H. von Radziewski,[48] E. von Toerne,[21] V. Vorobel,[129] K. Vorobev,[98] M. Vos,[167] R. Voss,[30] J. H. Vossebeld,[74] N. Vranjes,[13] M. Vranjes Milosavljevic,[13] V. Vrba,[127] M. Vreeswijk,[107] R. Vuillermet,[30] I. Vukotic,[31] Z. Vykydal,[128] P. Wagner,[21] W. Wagner,[175] H. Wahlberg,[71] S. Wahrmund,[44] J. Wakabayashi,[103] J. Walder,[72] R. Walker,[100] W. Walkowiak,[141] C. Wang,[33c] F. Wang,[173] H. Wang,[15] H. Wang,[40] J. Wang,[42] J. Wang,[33a] K. Wang,[87] R. Wang,[6] S. M. Wang,[151] T. Wang,[21] X. Wang,[176] C. Wanotayaroj,[116] A. Warburton,[87] C. P. Ward,[28] D. R. Wardrope,[78] M. Warsinsky,[48] A. Washbrook,[46] C. Wasicki,[42] P. M. Watkins,[18] A. T. Watson,[18] I. J. Watson,[150] M. F. Watson,[18] G. Watts,[138] S. Watts,[84] B. M. Waugh,[78] S. Webb,[84] M. S. Weber,[17] S. W. Weber,[174] J. S. Webster,[31] A. R. Weidberg,[120] B. Weinert,[61] J. Weingarten,[54] C. Weiser,[48] H. Weits,[107] P. S. Wells,[30] T. Wenaus,[25] T. Wengler,[30] S. Wenig,[30] N. Wermes,[21] M. Werner,[48] P. Werner,[30] M. Wessels,[58a] J. Wetter,[161] K. Whalen,[29] A. M. Wharton,[72] A. White,[8] M. J. White,[1] R. White,[32b] S. White,[124a,124b] D. Whiteson,[163] F. J. Wickens,[131] W. Wiedenmann,[173] M. Wielers,[131] P. Wienemann,[21] C. Wiglesworth,[36] L. A. M. Wiik-Fuchs,[21] A. Wildauer,[101] H. G. Wilkens,[30] H. H. Williams,[122] S. Williams,[107] C. Willis,[90] S. Willocq,[86] A. Wilson,[89] J. A. Wilson,[18] I. Wingerter-Seez,[5] F. Winklmeier,[116] B. T. Winter,[21] M. Wittgen,[143] J. Wittkowski,[100] S. J. Wollstadt,[83] M. W. Wolter,[39] H. Wolters,[126a,126c] B. K. Wosiek,[39] J. Wotschack,[30] M. J. Woudstra,[84] K. W. Wozniak,[39] M. Wu,[55] M. Wu,[31] S. L. Wu,[173] X. Wu,[49] Y. Wu,[89] T. R. Wyatt,[84] B. M. Wynne,[46] S. Xella,[36] D. Xu,[33a] L. Xu,[33b,kk] B. Yabsley,[150] S. Yacoob,[145b,ll] R. Yakabe,[67] M. Yamada,[66] Y. Yamaguchi,[118] A. Yamamoto,[66] S. Yamamoto,[155] T. Yamanaka,[155] K. Yamauchi,[103] Y. Yamazaki,[67] Z. Yan,[22] H. Yang,[33e] H. Yang,[173] Y. Yang,[151] L. Yao,[33a] W-M. Yao,[15] Y. Yasu,[66] E. Yatsenko,[5] K. H. Yau Wong,[21] J. Ye,[40] S. Ye,[25] I. Yeletskikh,[65] A. L. Yen,[57] E. Yildirim,[42] K. Yorita,[171] R. Yoshida,[6] K. Yoshihara,[122] C. Young,[143] C. J. S. Young,[30] S. Youssef,[22] D. R. Yu,[15] J. Yu,[8] J. M. Yu,[89] J. Yu,[114] L. Yuan,[67] A. Yurkewicz,[108] I. Yusuff,[28,mm] B. Zabinski,[39] R. Zaidan,[63] A. M. Zaitsev,[130,bb] J. Zalieckas,[14] A. Zaman,[148] S. Zambito,[57] L. Zanello,[132a,132b] D. Zanzi,[88] C. Zeitnitz,[175] M. Zeman,[128] A. Zemla,[38a] K. Zengel,[23] O. Zenin,[130] T. Ženiš,[144a] D. Zerwas,[117] D. Zhang,[89] F. Zhang,[173] J. Zhang,[6] L. Zhang,[48] R. Zhang,[33b] X. Zhang,[33d] Z. Zhang,[117] X. Zhao,[40] Y. Zhao,[33d,117] Z. Zhao,[33b] A. Zhemchugov,[65] J. Zhong,[120] B. Zhou,[89] C. Zhou,[45] L. Zhou,[35] L. Zhou,[40] N. Zhou,[163] C. G. Zhu,[33d] H. Zhu,[33a] J. Zhu,[89] Y. Zhu,[33b] X. Zhuang,[33a] K. Zhukov,[96] A. Zibell,[174] D. Zieminska,[61] N. I. Zimine,[65] C. Zimmermann,[83] S. Zimmermann,[48] Z. Zinonos,[54] M. Zinser,[83] M. Ziolkowski,[141] L. Živković,[13] G. Zobernig,[173] A. Zoccoli,[20a,20b] M. zur Nedden,[16] G. Zurzolo,[104a,104b] and L. Zwalinski[30]

(ATLAS Collaboration)

[1]*Department of Physics, University of Adelaide, Adelaide, Australia*
[2]*Physics Department, SUNY Albany, Albany, New York, USA*
[3]*Department of Physics, University of Alberta, Edmonton, Alberta, Canada*
[4a]*Department of Physics, Ankara University, Ankara, Turkey*
[4c]*Istanbul Aydin University, Istanbul, Turkey*
[4d]*Division of Physics, TOBB University of Economics and Technology, Ankara, Turkey*
[5]*LAPP, CNRS/IN2P3 and Université Savoie Mont Blanc, Annecy-le-Vieux, France*
[6]*High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois, USA*
[7]*Department of Physics, University of Arizona, Tucson, Arizona, USA*
[8]*Department of Physics, The University of Texas at Arlington, Arlington, Texas, USA*
[9]*Physics Department, University of Athens, Athens, Greece*
[10]*Physics Department, National Technical University of Athens, Zografou, Greece*
[11]*Institute of Physics, Azerbaijan Academy of Sciences, Baku, Azerbaijan*
[12]*Institut de Física d'Altes Energies and Departament de Física de la Universitat Autònoma de Barcelona, Barcelona, Spain*
[13]*Institute of Physics, University of Belgrade, Belgrade, Serbia*
[14]*Department for Physics and Technology, University of Bergen, Bergen, Norway*
[15]*Physics Division, Lawrence Berkeley National Laboratory and University of California, Berkeley, California, USA*
[16]*Department of Physics, Humboldt University, Berlin, Germany*
[17]*Albert Einstein Center for Fundamental Physics and Laboratory for High Energy Physics, University of Bern, Bern, Switzerland*
[18]*School of Physics and Astronomy, University of Birmingham, Birmingham, United Kingdom*

[19a]Department of Physics, Bogazici University, Istanbul, Turkey
[19b]Department of Physics, Dogus University, Istanbul, Turkey
[19c]Department of Physics Engineering, Gaziantep University, Gaziantep, Turkey
[20a]INFN Sezione di Bologna, Italy
[20b]Dipartimento di Fisica e Astronomia, Università di Bologna, Bologna, Italy
[21]Physikalisches Institut, University of Bonn, Bonn, Germany
[22]Department of Physics, Boston University, Boston, Massachusetts, USA
[23]Department of Physics, Brandeis University, Waltham, Massachusetts, USA
[24a]Universidade Federal do Rio De Janeiro COPPE/EE/IF, Rio de Janeiro, Brazil
[24b]Electrical Circuits Department, Federal University of Juiz de Fora (UFJF), Juiz de Fora, Brazil
[24c]Federal University of Sao Joao del Rei (UFSJ), Sao Joao del Rei, Brazil
[24d]Instituto de Fisica, Universidade de Sao Paulo, Sao Paulo, Brazil
[25]Physics Department, Brookhaven National Laboratory, Upton, New York, USA
[26a]National Institute of Physics and Nuclear Engineering, Bucharest, Romania
[26b]National Institute for Research and Development of Isotopic and Molecular Technologies, Physics Department, Cluj Napoca, Romania
[26c]University Politehnica Bucharest, Bucharest, Romania
[26d]West University in Timisoara, Timisoara, Romania
[27]Departamento de Física, Universidad de Buenos Aires, Buenos Aires, Argentina
[28]Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom
[29]Department of Physics, Carleton University, Ottawa, Ontario, Canada
[30]CERN, Geneva, Switzerland
[31]Enrico Fermi Institute, University of Chicago, Chicago, Illinois, USA
[32a]Departamento de Física, Pontificia Universidad Católica de Chile, Santiago, Chile
[32b]Departamento de Física, Universidad Técnica Federico Santa María, Valparaíso, Chile
[33a]Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China
[33b]Department of Modern Physics, University of Science and Technology of China, Anhui, China
[33c]Department of Physics, Nanjing University, Jiangsu, China
[33d]School of Physics, Shandong University, Shandong, China
[33e]Department of Physics and Astronomy, Shanghai Key Laboratory for Particle Physics and Cosmology, Shanghai Jiao Tong University, Shanghai, China
[33f]Physics Department, Tsinghua University, Beijing 100084, China
[34]Laboratoire de Physique Corpusculaire, Clermont Université and Université Blaise Pascal and CNRS/IN2P3, Clermont-Ferrand, France
[35]Nevis Laboratory, Columbia University, Irvington, New York, USA
[36]Niels Bohr Institute, University of Copenhagen, Kobenhavn, Denmark
[37a]INFN Gruppo Collegato di Cosenza, Laboratori Nazionali di Frascati, Italy
[37b]Dipartimento di Fisica, Università della Calabria, Rende, Italy
[38a]AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, Krakow, Poland
[38b]Marian Smoluchowski Institute of Physics, Jagiellonian University, Krakow, Poland
[39]Institute of Nuclear Physics Polish Academy of Sciences, Krakow, Poland
[40]Physics Department, Southern Methodist University, Dallas, Texas, USA
[41]Physics Department, University of Texas at Dallas, Richardson, Texas, USA
[42]DESY, Hamburg and Zeuthen, Germany
[43]Institut für Experimentelle Physik IV, Technische Universität Dortmund, Dortmund, Germany
[44]Institut für Kern- und Teilchenphysik, Technische Universität Dresden, Dresden, Germany
[45]Department of Physics, Duke University, Durham, North Carolina, USA
[46]SUPA - School of Physics and Astronomy, University of Edinburgh, Edinburgh, United Kingdom
[47]INFN Laboratori Nazionali di Frascati, Frascati, Italy
[48]Fakultät für Mathematik und Physik, Albert-Ludwigs-Universität, Freiburg, Germany
[49]Section de Physique, Université de Genève, Geneva, Switzerland
[50a]INFN Sezione di Genova, Italy
[50b]Dipartimento di Fisica, Università di Genova, Genova, Italy
[51a]E. Andronikashvili Institute of Physics, Iv. Javakhishvili Tbilisi State University, Tbilisi, Georgia
[51b]High Energy Physics Institute, Tbilisi State University, Tbilisi, Georgia
[52]II Physikalisches Institut, Justus-Liebig-Universität Giessen, Giessen, Germany
[53]SUPA - School of Physics and Astronomy, University of Glasgow, Glasgow, United Kingdom
[54]II Physikalisches Institut, Georg-August-Universität, Göttingen, Germany
[55]Laboratoire de Physique Subatomique et de Cosmologie, Université Grenoble-Alpes, CNRS/IN2P3, Grenoble, France
[56]Department of Physics, Hampton University, Hampton, Virginia, USA

[57]Laboratory for Particle Physics and Cosmology, Harvard University, Cambridge, Massachusetts, USA
[58a]Kirchhoff-Institut für Physik, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany
[58b]Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany
[58c]ZITI Institut für technische Informatik, Ruprecht-Karls-Universität Heidelberg, Mannheim, Germany
[59]Faculty of Applied Information Science, Hiroshima Institute of Technology, Hiroshima, Japan
[60a]Department of Physics, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong, China
[60b]Department of Physics, The University of Hong Kong, Hong Kong, China
[60c]Department of Physics, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, China
[61]Department of Physics, Indiana University, Bloomington, Indiana, USA
[62]Institut für Astro- und Teilchenphysik, Leopold-Franzens-Universität, Innsbruck, Austria
[63]University of Iowa, Iowa City Iowa, USA
[64]Department of Physics and Astronomy, Iowa State University, Ames, Iowa, USA
[65]Joint Institute for Nuclear Research, JINR Dubna, Dubna, Russia
[66]KEK, High Energy Accelerator Research Organization, Tsukuba, Japan
[67]Graduate School of Science, Kobe University, Kobe, Japan
[68]Faculty of Science, Kyoto University, Kyoto, Japan
[69]Kyoto University of Education, Kyoto, Japan
[70]Department of Physics, Kyushu University, Fukuoka, Japan
[71]Instituto de Física La Plata, Universidad Nacional de La Plata and CONICET, La Plata, Argentina
[72]Physics Department, Lancaster University, Lancaster, United Kingdom
[73a]INFN Sezione di Lecce, Italy
[73b]Dipartimento di Matematica e Fisica, Università del Salento, Lecce, Italy
[74]Oliver Lodge Laboratory, University of Liverpool, Liverpool, United Kingdom
[75]Department of Physics, Jožef Stefan Institute and University of Ljubljana, Ljubljana, Slovenia
[76]School of Physics and Astronomy, Queen Mary University of London, London, United Kingdom
[77]Department of Physics, Royal Holloway University of London, Surrey, United Kingdom
[78]Department of Physics and Astronomy, University College London, London, United Kingdom
[79]Louisiana Tech University, Ruston, Louisiana, USA
[80]Laboratoire de Physique Nucléaire et de Hautes Energies, UPMC and Université Paris-Diderot and CNRS/IN2P3, Paris, France
[81]Fysiska institutionen, Lunds universitet, Lund, Sweden
[82]Departamento de Fisica Teorica C-15, Universidad Autonoma de Madrid, Madrid, Spain
[83]Institut für Physik, Universität Mainz, Mainz, Germany
[84]School of Physics and Astronomy, University of Manchester, Manchester, United Kingdom
[85]CPPM, Aix-Marseille Université and CNRS/IN2P3, Marseille, France
[86]Department of Physics, University of Massachusetts, Amherst, Massachusetts, USA
[87]Department of Physics, McGill University, Montreal, Québec, Canada
[88]School of Physics, University of Melbourne, Victoria, Australia
[89]Department of Physics, The University of Michigan, Ann Arbor, Michigan, USA
[90]Department of Physics and Astronomy, Michigan State University, East Lansing, Michigan, USA
[91a]INFN Sezione di Milano, Italy
[91b]Dipartimento di Fisica, Università di Milano, Milano, Italy
[92]B.I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Minsk, Republic of Belarus
[93]National Scientific and Educational Centre for Particle and High Energy Physics, Minsk, Republic of Belarus
[94]Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA
[95]Group of Particle Physics, University of Montreal, Montreal, Québec, Canada
[96]P.N. Lebedev Institute of Physics, Academy of Sciences, Moscow, Russia
[97]Institute for Theoretical and Experimental Physics (ITEP), Moscow, Russia
[98]National Research Nuclear University MEPhI, Moscow, Russia
[99]D.V. Skobeltsyn Institute of Nuclear Physics, M.V. Lomonosov Moscow State University, Moscow, Russia
[100]Fakultät für Physik, Ludwig-Maximilians-Universität München, München, Germany
[101]Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München, Germany
[102]Nagasaki Institute of Applied Science, Nagasaki, Japan
[103]Graduate School of Science and Kobayashi-Maskawa Institute, Nagoya University, Nagoya, Japan
[104a]INFN Sezione di Napoli, Italy
[104b]Dipartimento di Fisica, Università di Napoli, Napoli, Italy
[105]Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico, USA
[106]Institute for Mathematics, Astrophysics and Particle Physics, Radboud University Nijmegen/Nikhef, Nijmegen, Netherlands
[107]Nikhef National Institute for Subatomic Physics and University of Amsterdam, Amsterdam, Netherlands
[108]Department of Physics, Northern Illinois University, DeKalb, Illinois, USA
[109]Budker Institute of Nuclear Physics, SB RAS, Novosibirsk, Russia

[110]Department of Physics, New York University, New York, New York, USA
[111]Ohio State University, Columbus Ohio, USA
[112]Faculty of Science, Okayama University, Okayama, Japan
[113]Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma, Norman, Oklahoma, USA
[114]Department of Physics, Oklahoma State University, Stillwater, Oklahoma, USA
[115]Palacký University, RCPTM, Olomouc, Czech Republic
[116]Center for High Energy Physics, University of Oregon, Eugene, Oregon, USA
[117]LAL, Université Paris-Sud and CNRS/IN2P3, Orsay, France
[118]Graduate School of Science, Osaka University, Osaka, Japan
[119]Department of Physics, University of Oslo, Oslo, Norway
[120]Department of Physics, Oxford University, Oxford, United Kingdom
[121a]INFN Sezione di Pavia, Italy
[121b]Dipartimento di Fisica, Università di Pavia, Pavia, Italy
[122]Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania, USA
[123]Petersburg Nuclear Physics Institute, Gatchina, Russia
[124a]INFN Sezione di Pisa, Italy
[124b]Dipartimento di Fisica E. Fermi, Università di Pisa, Pisa, Italy
[125]Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania, USA
[126a]Laboratorio de Instrumentacao e Fisica Experimental de Particulas - LIP, Lisboa, Portugal
[126b]Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal
[126c]Department of Physics, University of Coimbra, Coimbra, Portugal
[126d]Centro de Física Nuclear da Universidade de Lisboa, Lisboa, Portugal
[126e]Departamento de Fisica, Universidade do Minho, Braga, Portugal
[126f]Departamento de Fisica Teorica y del Cosmos and CAFPE, Universidad de Granada, Granada, Spain
[126g]Dep Fisica and CEFITEC of Faculdade de Ciencias e Tecnologia, Universidade Nova de Lisboa, Caparica, Portugal
[127]Institute of Physics, Academy of Sciences of the Czech Republic, Praha, Czech Republic
[128]Czech Technical University in Prague, Praha, Czech Republic
[129]Faculty of Mathematics and Physics, Charles University in Prague, Praha, Czech Republic
[130]State Research Center Institute for High Energy Physics, Protvino, Russia
[131]Particle Physics Department, Rutherford Appleton Laboratory, Didcot, United Kingdom
[132a]INFN Sezione di Roma, Italy
[132b]Dipartimento di Fisica, Sapienza Università di Roma, Roma, Italy
[133a]INFN Sezione di Roma Tor Vergata, Italy
[133b]Dipartimento di Fisica, Università di Roma Tor Vergata, Roma, Italy
[134a]INFN Sezione di Roma Tre, Italy
[134b]Dipartimento di Matematica e Fisica, Università Roma Tre, Roma, Italy
[135a]Faculté des Sciences Ain Chock, Réseau Universitaire de Physique des Hautes Energies - Université Hassan II, Casablanca, Morocco
[135b]Centre National de l'Energie des Sciences Techniques Nucleaires, Rabat, Morocco
[135c]Faculté des Sciences Semlalia, Université Cadi Ayyad, LPHEA-Marrakech, Morocco
[135d]Faculté des Sciences, Université Mohamed Premier and LPTPM, Oujda, Morocco
[135e]Faculté des sciences, Université Mohammed V-Agdal, Rabat, Morocco
[136]DSM/IRFU (Institut de Recherches sur les Lois Fondamentales de l'Univers), CEA Saclay (Commissariat à l'Energie Atomique et aux Energies Alternatives), Gif-sur-Yvette, France
[137]Santa Cruz Institute for Particle Physics, University of California Santa Cruz, Santa Cruz, California, USA
[138]Department of Physics, University of Washington, Seattle, Washington, USA
[139]Department of Physics and Astronomy, University of Sheffield, Sheffield, United Kingdom
[140]Department of Physics, Shinshu University, Nagano, Japan
[141]Fachbereich Physik, Universität Siegen, Siegen, Germany
[142]Department of Physics, Simon Fraser University, Burnaby, British Columbia, Canada
[143]SLAC National Accelerator Laboratory, Stanford, California, USA
[144a]Faculty of Mathematics, Physics & Informatics, Comenius University, Bratislava, Slovak Republic
[144b]Department of Subnuclear Physics, Institute of Experimental Physics of the Slovak Academy of Sciences, Kosice, Slovak Republic
[145a]Department of Physics, University of Cape Town, Cape Town, South Africa
[145b]Department of Physics, University of Johannesburg, Johannesburg, South Africa
[145c]School of Physics, University of the Witwatersrand, Johannesburg, South Africa
[146a]Department of Physics, Stockholm University, Sweden
[146b]The Oskar Klein Centre, Stockholm, Sweden
[147]Physics Department, Royal Institute of Technology, Stockholm, Sweden
[148]Departments of Physics & Astronomy and Chemistry, Stony Brook University, Stony Brook, New York, USA

[149]Department of Physics and Astronomy, University of Sussex, Brighton, United Kingdom
[150]School of Physics, University of Sydney, Sydney, Australia
[151]Institute of Physics, Academia Sinica, Taipei, Taiwan
[152]Department of Physics, Technion: Israel Institute of Technology, Haifa, Israel
[153]Raymond and Beverly Sackler School of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel
[154]Department of Physics, Aristotle University of Thessaloniki, Thessaloniki, Greece
[155]International Center for Elementary Particle Physics and Department of Physics, The University of Tokyo, Tokyo, Japan
[156]Graduate School of Science and Technology, Tokyo Metropolitan University, Tokyo, Japan
[157]Department of Physics, Tokyo Institute of Technology, Tokyo, Japan
[158]Department of Physics, University of Toronto, Toronto, Ontario, Canada
[159a]TRIUMF, Vancouver, British Columbia, Canada
[159b]Department of Physics and Astronomy, York University, Toronto, Ontario, Canada
[160]Faculty of Pure and Applied Sciences, University of Tsukuba, Tsukuba, Japan
[161]Department of Physics and Astronomy, Tufts University, Medford, Massachusetts, USA
[162]Centro de Investigaciones, Universidad Antonio Narino, Bogota, Colombia
[163]Department of Physics and Astronomy, University of California Irvine, Irvine, California, USA
[164a]INFN Gruppo Collegato di Udine, Sezione di Trieste, Udine, Italy
[164b]ICTP, Trieste, Italy
[164c]Dipartimento di Chimica, Fisica e Ambiente, Università di Udine, Udine, Italy
[165]Department of Physics, University of Illinois, Urbana Illinois, USA
[166]Department of Physics and Astronomy, University of Uppsala, Uppsala, Sweden
[167]Instituto de Física Corpuscular (IFIC) and Departamento de Física Atómica, Molecular y Nuclear and Departamento de Ingeniería Electrónica and Instituto de Microelectrónica de Barcelona (IMB-CNM), University of Valencia and CSIC, Valencia, Spain
[168]Department of Physics, University of British Columbia, Vancouver, British Columbia, Canada
[169]Department of Physics and Astronomy, University of Victoria, Victoria, British Columbia, Canada
[170]Department of Physics, University of Warwick, Coventry, United Kingdom
[171]Waseda University, Tokyo, Japan
[172]Department of Particle Physics, The Weizmann Institute of Science, Rehovot, Israel
[173]Department of Physics, University of Wisconsin, Madison, Wisconsin, USA
[174]Fakultät für Physik und Astronomie, Julius-Maximilians-Universität, Würzburg, Germany
[175]Fachbereich C Physik, Bergische Universität Wuppertal, Wuppertal, Germany
[176]Department of Physics, Yale University, New Haven, Connecticut, USA
[177]Yerevan Physics Institute, Yerevan, Armenia
[178]Centre de Calcul de l'Institut National de Physique Nucléaire et de Physique des Particules (IN2P3), Villeurbanne, France

[a]Deceased.
[b]Also at Department of Physics, King's College London, London, United Kingdom.
[c]Also at Institute of Physics, Azerbaijan Academy of Sciences, Baku, Azerbaijan.
[d]Also at Novosibirsk State University, Novosibirsk, Russia.
[e]Also at TRIUMF, Vancouver BC, Canada.
[f]Also at Department of Physics, California State University, Fresno CA, USA.
[g]Also at Department of Physics, University of Fribourg, Fribourg, Switzerland.
[h]Also at Departamento de Fisica e Astronomia, Faculdade de Ciencias, Universidade do Porto, Portugal.
[i]Also at Tomsk State University, Tomsk, Russia.
[j]Also at CPPM, Aix-Marseille Université and CNRS/IN2P3, Marseille, France.
[k]Also at Università di Napoli Parthenope, Napoli, Italy.
[l]Also at Institute of Particle Physics (IPP), Canada.
[m]Also at Particle Physics Department, Rutherford Appleton Laboratory, Didcot, United Kingdom.
[n]Also at Department of Physics, St. Petersburg State Polytechnical University, St. Petersburg, Russia.
[o]Also at Louisiana Tech University, Ruston LA, USA.
[p]Also at Institucio Catalana de Recerca i Estudis Avancats, ICREA, Barcelona, Spain.
[q]Also at Department of Physics, National Tsing Hua University, Taiwan.
[r]Also at Department of Physics, The University of Texas at Austin, Austin TX, USA.
[s]Also at Institute of Theoretical Physics, Ilia State University, Tbilisi, Georgia.
[t]Also at CERN, Geneva, Switzerland.
[u]Also at Georgian Technical University (GTU),Tbilisi, Georgia.
[v]Also at Ochadai Academic Production, Ochanomizu University, Tokyo, Japan.
[w]Also at Manhattan College, New York NY, USA.
[x]Also at Institute of Physics, Academia Sinica, Taipei, Taiwan.
[y]Also at LAL, Université Paris-Sud and CNRS/IN2P3, Orsay, France.

[z]Also at Academia Sinica Grid Computing, Institute of Physics, Academia Sinica, Taipei, Taiwan.
[aa]Also at School of Physics, Shandong University, Shandong, China.
[bb]Also at Moscow Institute of Physics and Technology State University, Dolgoprudny, Russia.
[cc]Also at Section de Physique, Université de Genève, Geneva, Switzerland.
[dd]Also at International School for Advanced Studies (SISSA), Trieste, Italy.
[ee]Also at Department of Physics and Astronomy, University of South Carolina, Columbia SC, USA.
[ff]Also at School of Physics and Engineering, Sun Yat-sen University, Guangzhou, China.
[gg]Also at Faculty of Physics, M.V.Lomonosov Moscow State University, Moscow, Russia.
[hh]Also at National Research Nuclear University MEPhI, Moscow, Russia.
[ii]Also at Department of Physics, Stanford University, Stanford CA, USA.
[jj]Also at Institute for Particle and Nuclear Physics, Wigner Research Centre for Physics, Budapest, Hungary.
[kk]Also at Department of Physics, The University of Michigan, Ann Arbor MI, USA.
[ll]Also at Discipline of Physics, University of KwaZulu-Natal, Durban, South Africa.
[mm]Also at University of Malaya, Department of Physics, Kuala Lumpur, Malaysia.