

## Erratum: search for dark matter in proton-proton collisions at 8 TeV with missing transverse momentum and vector boson tagged jets

---



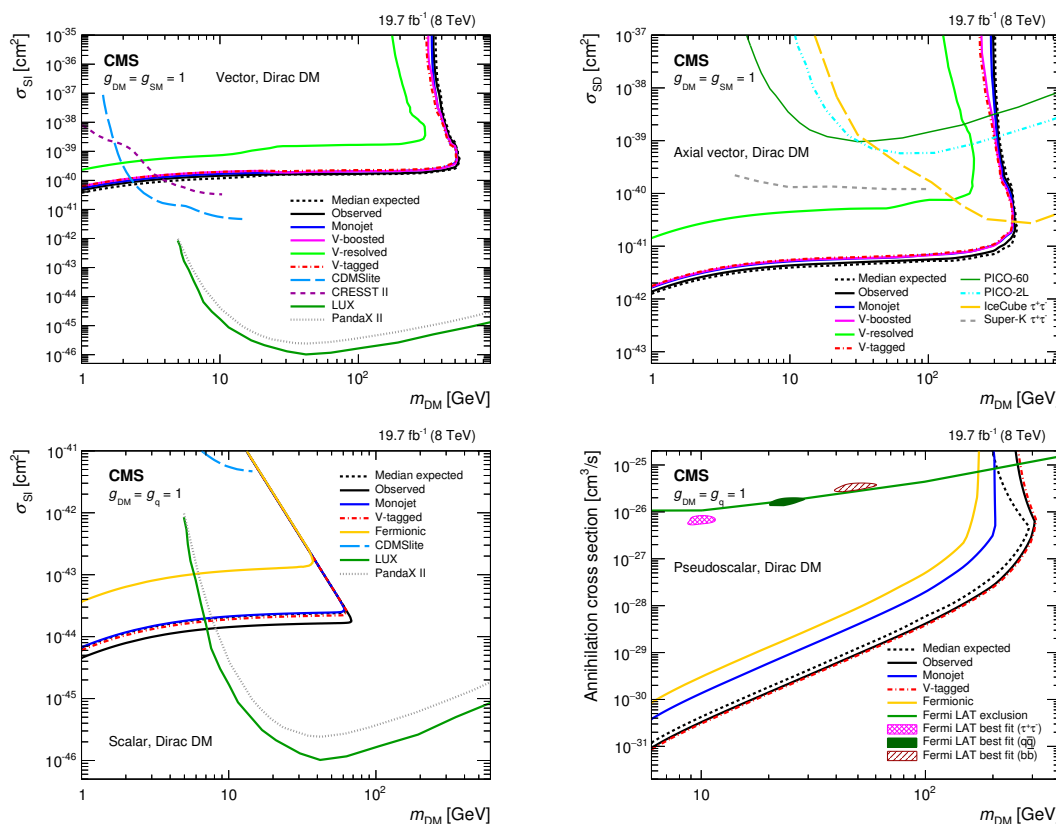
### The CMS collaboration

*E-mail:* [cms-publication-committee-chair@cern.ch](mailto:cms-publication-committee-chair@cern.ch)

ERRATUM TO: [JHEP12\(2016\)083](#)

ARXIV EPRINT: [1607.05764](#)

In the published version, the limits shown in the bottom-right panel of figure 11 were produced using an incorrect formula to translate the  $m_{\text{MED}} - m_{\text{DM}}$  limits into the plane of DM pair annihilation cross section versus  $m_{\text{DM}}$ . The corrected figure is shown below.



**Figure 11.** The 90% CL exclusion contours in the  $m_{\text{DM}} - \sigma_{\text{SI}}$  or  $m_{\text{DM}} - \sigma_{\text{SD}}$  plane assuming vector (top-left), axial vector (top-right), scalar (bottom-left) mediators. Also shown is the 90% CL exclusion in DM annihilation cross section as a function of  $m_{\text{DM}}$  for a pseudoscalar mediator (bottom-right). For the scalar and pseudoscalar mediators, the exclusion contours assuming the mediator only couples to fermions (fermionic) is also shown. The excluded region in all plots is to the top-left of the contours for the results from this analysis while the DD experiments and Fermi LAT excluded regions are above the lines shown. In the vector and axial vector models, limits are shown independently for monojet, V-boosted, and V-resolved categories. The red dot-dashed line shows the partial combination of the V-tagged categories for which the V-boosted category provides the dominant contribution. In all of the mediator models, a minimum mediator width is assumed. For the pseudoscalar mediator, 68% CL preferred regions, obtained using data from Fermi LAT, for DM annihilation to light-quarks ( $q\bar{q}$ ),  $\tau^+\tau^-$ , and  $b\bar{b}$  are given by the solid green, hatched pink, and shaded brown coloured regions, respectively.

**Open Access.** This article is distributed under the terms of the Creative Commons Attribution License ([CC-BY 4.0](https://creativecommons.org/licenses/by/4.0/)), which permits any use, distribution and reproduction in any medium, provided the original author(s) and source are credited.

**The CMS collaboration****Yerevan Physics Institute, Yerevan, Armenia**

V. Khachatryan, A.M. Sirunyan, A. Tumasyan

**Institut für Hochenergiephysik der OeAW, Wien, Austria**

W. Adam, E. Asilar, T. Bergauer, J. Brandstetter, E. Brondolin, M. Dragicevic, J. Erö, M. Flechl, M. Friedl, R. Frühwirth<sup>1</sup>, V.M. Ghete, C. Hartl, N. Hörmann, J. Hrubec, M. Jeitler<sup>1</sup>, A. König, I. Krätschmer, D. Liko, T. Matsushita, I. Mikulec, D. Rabady, N. Rad, B. Rahbaran, H. Rohringer, J. Schieck<sup>1</sup>, J. Strauss, W. Treberer-Treberspurg, W. Waltenberger, C.-E. Wulz<sup>1</sup>

**National Centre for Particle and High Energy Physics, Minsk, Belarus**

V. Mossolov, N. Shumeiko, J. Suarez Gonzalez

**Universiteit Antwerpen, Antwerpen, Belgium**

S. Alderweireldt, E.A. De Wolf, X. Janssen, J. Lauwers, M. Van De Klundert, H. Van Haevermaet, P. Van Mechelen, N. Van Remortel, A. Van Spilbeeck

**Vrije Universiteit Brussel, Brussel, Belgium**

S. Abu Zeid, F. Blekman, J. D'Hondt, N. Daci, I. De Bruyn, K. Deroover, N. Heracleous, S. Lowette, S. Moortgat, L. Moreels, A. Olbrechts, Q. Python, S. Tavernier, W. Van Doninck, P. Van Mulders, I. Van Parijs

**Université Libre de Bruxelles, Bruxelles, Belgium**

H. Brun, C. Caillol, B. Clerbaux, G. De Lentdecker, H. Delannoy, G. Fasanella, L. Favart, R. Goldouzian, A. Grebenyuk, G. Karapostoli, T. Lenzi, A. Léonard, J. Luetic, T. Maerschalk, A. Marinov, A. Randle-conde, T. Seva, C. Vander Velde, P. Vanlaer, R. Yonamine, F. Zenoni, F. Zhang<sup>2</sup>

**Ghent University, Ghent, Belgium**

A. Cimmino, T. Cornelis, D. Dobur, A. Fagot, G. Garcia, M. Gul, D. Poyraz, S. Salva, R. Schöfbeck, M. Tytgat, W. Van Driessche, E. Yazgan, N. Zaganidis

**Université Catholique de Louvain, Louvain-la-Neuve, Belgium**

H. Bakhshiansohi, C. Beluffi<sup>3</sup>, O. Bondu, S. Brochet, G. Bruno, A. Caudron, S. De Visscher, C. Delaere, M. Delcourt, L. Forthomme, B. Francois, A. Giammanco, A. Jafari, P. Jez, M. Komm, V. Lemaitre, A. Magitteri, A. Mertens, M. Musich, C. Nuttens, K. Piotrkowski, L. Quertenmont, M. Selvaggi, M. Vidal Marono, S. Wertz

**Université de Mons, Mons, Belgium**

N. Bely

**Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil**

W.L. Aldá Júnior, F.L. Alves, G.A. Alves, L. Brito, C. Hensel, A. Moraes, M.E. Pol, P. Rebello Teles

**Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil**

E. Belchior Batista Das Chagas, W. Carvalho, J. Chinellato<sup>4</sup>, A. Custódio, E.M. Da Costa, G.G. Da Silveira, D. De Jesus Damiao, C. De Oliveira Martins, S. Fonseca De Souza, L.M. Huertas Guativa, H. Malbouisson, D. Matos Figueiredo, C. Mora Herrera, L. Mundim, H. Nogima, W.L. Prado Da Silva, A. Santoro, A. Sznajder, E.J. Tonelli Manganote<sup>4</sup>, A. Vilela Pereira

**Universidade Estadual Paulista <sup>a</sup>, Universidade Federal do ABC <sup>b</sup>, São Paulo, Brazil**

S. Ahuja<sup>a</sup>, C.A. Bernardes<sup>b</sup>, S. Dogra<sup>a</sup>, T.R. Fernandez Perez Tomei<sup>a</sup>, E.M. Gregores<sup>b</sup>, P.G. Mercadante<sup>b</sup>, C.S. Moon<sup>a</sup>, S.F. Novaes<sup>a</sup>, Sandra S. Padula<sup>a</sup>, D. Romero Abad<sup>b</sup>, J.C. Ruiz Vargas

**Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria**

A. Aleksandrov, R. Hadjiiska, P. Iaydjiev, M. Rodozov, S. Stoykova, G. Sultanov, M. Vutova

**University of Sofia, Sofia, Bulgaria**

A. Dimitrov, I. Glushkov, L. Litov, B. Pavlov, P. Petkov

**Beihang University, Beijing, China**

W. Fang<sup>5</sup>

**Institute of High Energy Physics, Beijing, China**

M. Ahmad, J.G. Bian, G.M. Chen, H.S. Chen, M. Chen, Y. Chen<sup>6</sup>, T. Cheng, C.H. Jiang, D. Leggat, Z. Liu, F. Romeo, S.M. Shaheen, A. Spiezia, J. Tao, C. Wang, Z. Wang, H. Zhang, J. Zhao

**State Key Laboratory of Nuclear Physics and Technology, Peking University, Beijing, China**

Y. Ban, G. Chen, Q. Li, S. Liu, Y. Mao, S.J. Qian, D. Wang, Z. Xu

**Universidad de Los Andes, Bogota, Colombia**

C. Avila, A. Cabrera, L.F. Chaparro Sierra, C. Florez, J.P. Gomez, C.F. González Hernández, J.D. Ruiz Alvarez, J.C. Sanabria

**University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split, Croatia**

N. Godinovic, D. Lelas, I. Puljak, P.M. Ribeiro Cipriano

**University of Split, Faculty of Science, Split, Croatia**

Z. Antunovic, M. Kovac

**Institute Rudjer Boskovic, Zagreb, Croatia**

V. Brigljevic, D. Ferencek, K. Kadija, S. Micanovic, L. Sudic, T. Susa

**University of Cyprus, Nicosia, Cyprus**

A. Attikis, G. Mavromanolakis, J. Mousa, C. Nicolaou, F. Ptochos, P.A. Razis, H. Rykaczewski

**Charles University, Prague, Czech Republic**

M. Finger<sup>7</sup>, M. Finger Jr.<sup>7</sup>

**Universidad San Francisco de Quito, Quito, Ecuador**

E. Carrera Jarrin

**Academy of Scientific Research and Technology of the Arab Republic of Egypt,  
Egyptian Network of High Energy Physics, Cairo, Egypt**

A.A. Abdelalim<sup>8,9</sup>, Y. Mohammed<sup>10</sup>, E. Salama<sup>11,12</sup>

**National Institute of Chemical Physics and Biophysics, Tallinn, Estonia**

B. Calpas, M. Kadastik, M. Murumaa, L. Perrini, M. Raidal, A. Tiko, C. Veelken

**Department of Physics, University of Helsinki, Helsinki, Finland**

P. Eerola, J. Pekkanen, M. Voutilainen

**Helsinki Institute of Physics, Helsinki, Finland**

J. Härkönen, V. Karimäki, R. Kinnunen, T. Lampén, K. Lassila-Perini, S. Lehti, T. Lindén,  
P. Luukka, T. Peltola, J. Tuominiemi, E. Tuovinen, L. Wendland

**Lappeenranta University of Technology, Lappeenranta, Finland**

J. Talvitie, T. Tuuva

**IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France**

M. Besancon, F. Couderc, M. Dejardin, D. Denegri, B. Fabbro, J.L. Faure, C. Favaro,  
F. Ferri, S. Ganjour, S. Ghosh, A. Givernaud, P. Gras, G. Hamel de Monchenault, P. Jarry,  
I. Kucher, E. Locci, M. Machet, J. Malcles, J. Rander, A. Rosowsky, M. Titov, A. Zghiche

**Laboratoire Leprince-Ringuet, Ecole Polytechnique, IN2P3-CNRS, Palaiseau,  
France**

A. Abdulsalam, I. Antropov, S. Baffioni, F. Beaudette, P. Busson, L. Cadamuro,  
E. Chapon, C. Charlot, O. Davignon, R. Granier de Cassagnac, M. Jo, S. Lisniak, P. Miné,  
M. Nguyen, C. Ochando, G. Ortona, P. Paganini, P. Pigard, S. Regnard, R. Salerno,  
Y. Sirois, T. Strebler, Y. Yilmaz, A. Zabi

**Institut Pluridisciplinaire Hubert Curien, Université de Strasbourg, Univer-  
sité de Haute Alsace Mulhouse, CNRS/IN2P3, Strasbourg, France**

J.-L. Agram<sup>13</sup>, J. Andrea, A. Aubin, D. Bloch, J.-M. Brom, M. Buttignol, E.C. Chabert,  
N. Chanon, C. Collard, E. Conte<sup>13</sup>, X. Coubez, J.-C. Fontaine<sup>13</sup>, D. Gelé, U. Goerlach,  
A.-C. Le Bihan, J.A. Merlin<sup>14</sup>, K. Skovpen, P. Van Hove

**Centre de Calcul de l'Institut National de Physique Nucleaire et de Physique  
des Particules, CNRS/IN2P3, Villeurbanne, France**

S. Gadrat

**Université de Lyon, Université Claude Bernard Lyon 1, CNRS-IN2P3, Institut  
de Physique Nucléaire de Lyon, Villeurbanne, France**

S. Beauceron, C. Bernet, G. Boudoul, E. Bouvier, C.A. Carrillo Montoya, R. Chierici,  
D. Contardo, B. Courbon, P. Depasse, H. El Mamouni, J. Fan, J. Fay, S. Gascon,

M. Gouzevitch, G. Grenier, B. Ille, F. Lagarde, I.B. Laktineh, M. Lethuillier, L. Mirabito, A.L. Pequegnot, S. Perries, A. Popov<sup>15</sup>, D. Sabes, V. Sordini, M. Vander Donckt, P. Verdier, S. Viret

**Georgian Technical University, Tbilisi, Georgia**

T. Toriashvili<sup>16</sup>

**Tbilisi State University, Tbilisi, Georgia**

Z. Tsamalaidze<sup>7</sup>

**RWTH Aachen University, I. Physikalisches Institut, Aachen, Germany**

C. Autermann, S. Beranek, L. Feld, A. Heister, M.K. Kiesel, K. Klein, M. Lipinski, A. Ostapchuk, M. Preuten, F. Raupach, S. Schael, C. Schomakers, J.F. Schulte, J. Schulz, T. Verlage, H. Weber, V. Zhukov<sup>15</sup>

**RWTH Aachen University, III. Physikalisches Institut A, Aachen, Germany**

M. Brodski, E. Dietz-Laursonn, D. Duchardt, M. Endres, M. Erdmann, S. Erdweg, T. Esch, R. Fischer, A. Güth, M. Hamer, T. Hebbeker, C. Heidemann, K. Hoepfner, S. Knutzen, M. Merschmeyer, A. Meyer, P. Millet, S. Mukherjee, M. Olschewski, K. Padeken, T. Pook, M. Radziej, H. Reithler, M. Rieger, F. Scheuch, L. Sonnenschein, D. Teyssier, S. Thüer

**RWTH Aachen University, III. Physikalisches Institut B, Aachen, Germany**

V. Cherepanov, G. Flügge, W. Haj Ahmad, F. Hoehle, B. Kargoll, T. Kress, A. Künsken, J. Lingemann, A. Nehr Korn, A. Nowack, I.M. Nugent, C. Pistone, O. Pooth, A. Stahl<sup>14</sup>

**Deutsches Elektronen-Synchrotron, Hamburg, Germany**

M. Aldaya Martin, C. Asawatangtrakuldee, K. Beernaert, O. Behnke, U. Behrens, A.A. Bin Anuar, K. Borras<sup>17</sup>, A. Campbell, P. Connor, C. Contreras-Campana, F. Costanza, C. Diez Pardos, G. Dolinska, G. Eckerlin, D. Eckstein, E. Eren, E. Gallo<sup>18</sup>, J. Garay Garcia, A. Geiser, A. Gizhko, J.M. Grados Luyando, P. Gunnellini, A. Harb, J. Hauk, M. Hempel<sup>19</sup>, H. Jung, A. Kalogeropoulos, O. Karacheban<sup>19</sup>, M. Kasemann, J. Keaveney, J. Kieseler, C. Kleinwort, I. Korol, D. Krücker, W. Lange, A. Lelek, J. Leonard, K. Lipka, A. Lobanov, W. Lohmann<sup>19</sup>, R. Mankel, I.-A. Melzer-Pellmann, A.B. Meyer, G. Mittag, J. Mnich, A. Mussgiller, E. Ntomari, D. Pitzl, R. Placakyte, A. Raspereza, B. Roland, M.Ö. Sahin, P. Saxena, T. Schoerner-Sadenius, C. Seitz, S. Spannagel, N. Stefaniuk, K.D. Trippkewitz, G.P. Van Onsem, R. Walsh, C. Wissing

**University of Hamburg, Hamburg, Germany**

V. Blobel, M. Centis Vignali, A.R. Draeger, T. Dreyer, E. Garutti, K. Goebel, D. Gonzalez, J. Haller, M. Hoffmann, A. Junkes, R. Klanner, R. Kogler, N. Kovalchuk, T. Lapsien, T. Lenz, I. Marchesini, D. Marconi, M. Meyer, M. Niedziela, D. Nowatschin, J. Ott, F. Pantaleo<sup>14</sup>, T. Peiffer, A. Perieanu, J. Poehlsen, C. Sander, C. Scharf, P. Schleper, A. Schmidt, S. Schumann, J. Schwandt, H. Stadie, G. Steinbrück, F.M. Stober, M. Stöver, H. Tholen, D. Troendle, E. Usai, L. Vanelderen, A. Vanhoefer, B. Vormwald

**Institut für Experimentelle Kernphysik, Karlsruhe, Germany**

C. Barth, C. Baus, J. Berger, E. Butz, T. Chwalek, F. Colombo, W. De Boer, A. Dierlamm, S. Fink, R. Friese, M. Giffels, A. Gilbert, P. Goldenzweig, D. Haitz, F. Hartmann<sup>14</sup>,

S.M. Heindl, U. Husemann, I. Katkov<sup>15</sup>, P. Lobelle Pardo, B. Maier, H. Mildner, M.U. Mozer, T. Müller, Th. Müller, M. Plagge, G. Quast, K. Rabbertz, S. Röcker, F. Roscher, M. Schröder, I. Shvetsov, G. Sieber, H.J. Simonis, R. Ulrich, J. Wagner-Kuhr, S. Wayand, M. Weber, T. Weiler, S. Williamson, C. Wöhrmann, R. Wolf

**Institute of Nuclear and Particle Physics (INPP), NCSR Demokritos, Aghia Paraskevi, Greece**

G. Anagnostou, G. Daskalakis, T. Gerasis, V.A. Giakoumopoulou, A. Kyriakis, D. Loukas, I. Topsis-Giotis

**National and Kapodistrian University of Athens, Athens, Greece**

A. Agapitos, S. Kesisoglou, A. Panagiotou, N. Saoulidou, E. Tziaferi

**University of Ioánnina, Ioánnina, Greece**

I. Evangelou, G. Flouris, C. Foudas, P. Kokkas, N. Loukas, N. Manthos, I. Papadopoulos, E. Paradas

**MTA-ELTE Lendület CMS Particle and Nuclear Physics Group, Eötvös Loránd University, Budapest, Hungary**

N. Filipovic

**Wigner Research Centre for Physics, Budapest, Hungary**

G. Bencze, C. Hajdu, P. Hidas, D. Horvath<sup>20</sup>, F. Sikler, V. Veszpremi, G. Vesztergombi<sup>21</sup>, A.J. Zsigmond

**Institute of Nuclear Research ATOMKI, Debrecen, Hungary**

N. Beni, S. Czellar, J. Karancsi<sup>22</sup>, A. Makovec, J. Molnar, Z. Szillasi

**University of Debrecen, Debrecen, Hungary**

M. Bartók<sup>21</sup>, P. Raics, Z.L. Trocsanyi, B. Ujvari

**National Institute of Science Education and Research, Bhubaneswar, India**

S. Bahinipati, S. Choudhury<sup>23</sup>, P. Mal, K. Mandal, A. Nayak<sup>24</sup>, D.K. Sahoo, N. Sahoo, S.K. Swain

**Panjab University, Chandigarh, India**

S. Bansal, S.B. Beri, V. Bhatnagar, R. Chawla, U.Bhawandeep, A.K. Kalsi, A. Kaur, M. Kaur, R. Kumar, A. Mehta, M. Mittal, J.B. Singh, G. Walia

**University of Delhi, Delhi, India**

Ashok Kumar, A. Bhardwaj, B.C. Choudhary, R.B. Garg, S. Keshri, S. Malhotra, M. Naimuddin, N. Nishu, K. Ranjan, R. Sharma, V. Sharma

**Saha Institute of Nuclear Physics, Kolkata, India**

R. Bhattacharya, S. Bhattacharya, K. Chatterjee, S. Dey, S. Dutt, S. Dutta, S. Ghosh, N. Majumdar, A. Modak, K. Mondal, S. Mukhopadhyay, S. Nandan, A. Purohit, A. Roy, D. Roy, S. Roy Chowdhury, S. Sarkar, M. Sharan, S. Thakur

**Indian Institute of Technology Madras, Madras, India**

P.K. Behera

**Bhabha Atomic Research Centre, Mumbai, India**

R. Chudasama, D. Dutta, V. Jha, V. Kumar, A.K. Mohanty<sup>14</sup>, P.K. Netrakanti, L.M. Pant, P. Shukla, A. Topkar

**Tata Institute of Fundamental Research-A, Mumbai, India**

T. Aziz, S. Dugad, G. Kole, B. Mahakud, S. Mitra, G.B. Mohanty, B. Parida, N. Sur, B. Sutar

**Tata Institute of Fundamental Research-B, Mumbai, India**

S. Banerjee, S. Bhowmik<sup>25</sup>, R.K. Dewanjee, S. Ganguly, M. Guchait, Sa. Jain, S. Kumar, M. Maity<sup>25</sup>, G. Majumder, K. Mazumdar, T. Sarkar<sup>25</sup>, N. Wickramage<sup>26</sup>

**Indian Institute of Science Education and Research (IISER), Pune, India**

S. Chauhan, S. Dube, V. Hegde, A. Kapoor, K. Kothekar, A. Rane, S. Sharma

**Institute for Research in Fundamental Sciences (IPM), Tehran, Iran**

H. Behnamian, S. Chenarani<sup>27</sup>, E. Eskandari Tadavani, S.M. Etesami<sup>27</sup>, A. Fahim<sup>28</sup>, M. Khakzad, M. Mohammadi Najafabadi, M. Naseri, S. Paktinat Mehdiabadi, F. Rezaei Hosseinabadi, B. Safarzadeh<sup>29</sup>, M. Zeinali

**University College Dublin, Dublin, Ireland**

M. Felcini, M. Grunewald

**INFN Sezione di Bari <sup>a</sup>, Università di Bari <sup>b</sup>, Politecnico di Bari <sup>c</sup>, Bari, Italy**

M. Abbrescia<sup>a,b</sup>, C. Calabria<sup>a,b</sup>, C. Caputo<sup>a,b</sup>, A. Colaleo<sup>a</sup>, D. Creanza<sup>a,c</sup>, L. Cristella<sup>a,b</sup>, N. De Filippis<sup>a,c</sup>, M. De Palma<sup>a,b</sup>, L. Fiore<sup>a</sup>, G. Iaselli<sup>a,c</sup>, G. Maggi<sup>a,c</sup>, M. Maggi<sup>a</sup>, G. Miniello<sup>a,b</sup>, S. My<sup>a,b</sup>, S. Nuzzo<sup>a,b</sup>, A. Pompili<sup>a,b</sup>, G. Pugliese<sup>a,c</sup>, R. Radogna<sup>a,b</sup>, A. Ranieri<sup>a</sup>, G. Selvaggi<sup>a,b</sup>, L. Silvestris<sup>a,14</sup>, R. Venditti<sup>a,b</sup>, P. Verwilligen<sup>a</sup>

**INFN Sezione di Bologna <sup>a</sup>, Università di Bologna <sup>b</sup>, Bologna, Italy**

G. Abbiendi<sup>a</sup>, C. Battilana, D. Bonacorsi<sup>a,b</sup>, S. Braibant-Giacomelli<sup>a,b</sup>, L. Brigliadori<sup>a,b</sup>, R. Campanini<sup>a,b</sup>, P. Capiluppi<sup>a,b</sup>, A. Castro<sup>a,b</sup>, F.R. Cavallo<sup>a</sup>, S.S. Chhibra<sup>a,b</sup>, G. Codispoti<sup>a,b</sup>, M. Cuffiani<sup>a,b</sup>, G.M. Dallavalle<sup>a</sup>, F. Fabbri<sup>a</sup>, A. Fanfani<sup>a,b</sup>, D. Fasanella<sup>a,b</sup>, P. Giacomelli<sup>a</sup>, C. Grandi<sup>a</sup>, L. Guiducci<sup>a,b</sup>, S. Marcellini<sup>a</sup>, G. Masetti<sup>a</sup>, A. Montanari<sup>a</sup>, F.L. Navarria<sup>a,b</sup>, A. Perrotta<sup>a</sup>, A.M. Rossi<sup>a,b</sup>, T. Rovelli<sup>a,b</sup>, G.P. Siroli<sup>a,b</sup>, N. Tosi<sup>a,b,14</sup>

**INFN Sezione di Catania <sup>a</sup>, Università di Catania <sup>b</sup>, Catania, Italy**

S. Albergo<sup>a,b</sup>, M. Chiorboli<sup>a,b</sup>, S. Costa<sup>a,b</sup>, A. Di Mattia<sup>a</sup>, F. Giordano<sup>a,b</sup>, R. Potenza<sup>a,b</sup>, A. Tricomi<sup>a,b</sup>, C. Tuve<sup>a,b</sup>

**INFN Sezione di Firenze <sup>a</sup>, Università di Firenze <sup>b</sup>, Firenze, Italy**

G. Barbagli<sup>a</sup>, V. Ciulli<sup>a,b</sup>, C. Civinini<sup>a</sup>, R. D'Alessandro<sup>a,b</sup>, E. Focardi<sup>a,b</sup>, V. Gori<sup>a,b</sup>, P. Lenzi<sup>a,b</sup>, M. Meschini<sup>a</sup>, S. Paoletti<sup>a</sup>, G. Sguazzoni<sup>a</sup>, L. Viliani<sup>a,b,14</sup>

**INFN Laboratori Nazionali di Frascati, Frascati, Italy**

L. Benussi, S. Bianco, F. Fabbri, D. Piccolo, F. Primavera<sup>14</sup>

**INFN Sezione di Genova <sup>a</sup>, Università di Genova <sup>b</sup>, Genova, Italy**

V. Calvelli<sup>a,b</sup>, F. Ferro<sup>a</sup>, M. Lo Vetere<sup>a,b</sup>, M.R. Monge<sup>a,b</sup>, E. Robutti<sup>a</sup>, S. Tosi<sup>a,b</sup>



**INFN Sezione di Milano-Bicocca <sup>a</sup>, Università di Milano-Bicocca <sup>b</sup>, Milano, Italy**

L. Brianza<sup>14</sup>, M.E. Dinardo<sup>a,b</sup>, S. Fiorendi<sup>a,b</sup>, S. Gennai<sup>a</sup>, A. Ghezzi<sup>a,b</sup>, P. Govoni<sup>a,b</sup>, S. Malvezzi<sup>a</sup>, R.A. Manzoni<sup>a,b,14</sup>, B. Marzocchi<sup>a,b</sup>, D. Menasce<sup>a</sup>, L. Moroni<sup>a</sup>, M. Paganoni<sup>a,b</sup>, D. Pedrini<sup>a</sup>, S. Pigazzini, S. Ragazzi<sup>a,b</sup>, T. Tabarelli de Fatis<sup>a,b</sup>

**INFN Sezione di Napoli <sup>a</sup>, Università di Napoli 'Federico II' <sup>b</sup>, Napoli, Italy, Università della Basilicata <sup>c</sup>, Potenza, Italy, Università G. Marconi <sup>d</sup>, Roma, Italy**

S. Buontempo<sup>a</sup>, N. Cavallo<sup>a,c</sup>, G. De Nardo, S. Di Guida<sup>a,d,14</sup>, M. Esposito<sup>a,b</sup>, F. Fabozzi<sup>a,c</sup>, A.O.M. Iorio<sup>a,b</sup>, G. Lanza<sup>a</sup>, L. Lista<sup>a</sup>, S. Meola<sup>a,d,14</sup>, P. Paolucci<sup>a,14</sup>, C. Sciacca<sup>a,b</sup>, F. Thyssen

**INFN Sezione di Padova <sup>a</sup>, Università di Padova <sup>b</sup>, Padova, Italy, Università di Trento <sup>c</sup>, Trento, Italy**

P. Azzi<sup>a,14</sup>, N. Bacchetta<sup>a</sup>, L. Benato<sup>a,b</sup>, D. Bisello<sup>a,b</sup>, A. Boletti<sup>a,b</sup>, R. Carlin<sup>a,b</sup>, A. Carvalho Antunes De Oliveira<sup>a,b</sup>, P. Checchia<sup>a</sup>, M. Dall'Osso<sup>a,b</sup>, P. De Castro Manzano<sup>a</sup>, T. Dorigo<sup>a</sup>, U. Dosselli<sup>a</sup>, F. Gasparini<sup>a,b</sup>, U. Gasparini<sup>a,b</sup>, A. Gozzelino<sup>a</sup>, S. Lacaprara<sup>a</sup>, M. Margoni<sup>a,b</sup>, A.T. Meneguzzo<sup>a,b</sup>, J. Pazzini<sup>a,b,14</sup>, N. Pozzobon<sup>a,b</sup>, P. Ronchese<sup>a,b</sup>, F. Simonetto<sup>a,b</sup>, E. Torassa<sup>a</sup>, M. Zanetti, P. Zotto<sup>a,b</sup>, A. Zucchetta<sup>a,b</sup>, G. Zumerle<sup>a,b</sup>

**INFN Sezione di Pavia <sup>a</sup>, Università di Pavia <sup>b</sup>, Pavia, Italy**

A. Braghieri<sup>a</sup>, A. Magnani<sup>a,b</sup>, P. Montagna<sup>a,b</sup>, S.P. Ratti<sup>a,b</sup>, V. Re<sup>a</sup>, C. Riccardi<sup>a,b</sup>, P. Salvini<sup>a</sup>, I. Vai<sup>a,b</sup>, P. Vitulo<sup>a,b</sup>

**INFN Sezione di Perugia <sup>a</sup>, Università di Perugia <sup>b</sup>, Perugia, Italy**

L. Alunni Solestizi<sup>a,b</sup>, G.M. Bilei<sup>a</sup>, D. Ciangottini<sup>a,b</sup>, L. Fanò<sup>a,b</sup>, P. Lariccia<sup>a,b</sup>, R. Leonardi<sup>a,b</sup>, G. Mantovani<sup>a,b</sup>, M. Menichelli<sup>a</sup>, A. Saha<sup>a</sup>, A. Santocchia<sup>a,b</sup>

**INFN Sezione di Pisa <sup>a</sup>, Università di Pisa <sup>b</sup>, Scuola Normale Superiore di Pisa <sup>c</sup>, Pisa, Italy**

K. Androsov<sup>a,30</sup>, P. Azzurri<sup>a,14</sup>, G. Bagliesi<sup>a</sup>, J. Bernardini<sup>a</sup>, T. Boccali<sup>a</sup>, R. Castaldi<sup>a</sup>, M.A. Ciocci<sup>a,30</sup>, R. Dell'Orso<sup>a</sup>, S. Donato<sup>a,c</sup>, G. Fedi, A. Giassi<sup>a</sup>, M.T. Grippo<sup>a,30</sup>, F. Ligabue<sup>a,c</sup>, T. Lomtadze<sup>a</sup>, L. Martini<sup>a,b</sup>, A. Messineo<sup>a,b</sup>, F. Palla<sup>a</sup>, A. Rizzi<sup>a,b</sup>, A. Savoy-Navarro<sup>a,31</sup>, P. Spagnolo<sup>a</sup>, R. Tenchini<sup>a</sup>, G. Tonelli<sup>a,b</sup>, A. Venturi<sup>a</sup>, P.G. Verdini<sup>a</sup>

**INFN Sezione di Roma <sup>a</sup>, Università di Roma <sup>b</sup>, Roma, Italy**

L. Barone<sup>a,b</sup>, F. Cavallari<sup>a</sup>, M. Cipriani<sup>a,b</sup>, G. D'imperio<sup>a,b,14</sup>, D. Del Re<sup>a,b,14</sup>, M. Diemoz<sup>a</sup>, S. Gelli<sup>a,b</sup>, C. Jorda<sup>a</sup>, E. Longo<sup>a,b</sup>, F. Margaroli<sup>a,b</sup>, P. Meridiani<sup>a</sup>, G. Organtini<sup>a,b</sup>, R. Paramatti<sup>a</sup>, F. Preiato<sup>a,b</sup>, S. Rahatlou<sup>a,b</sup>, C. Rovelli<sup>a</sup>, F. Santanastasio<sup>a,b</sup>

**INFN Sezione di Torino <sup>a</sup>, Università di Torino <sup>b</sup>, Torino, Italy, Università del Piemonte Orientale <sup>c</sup>, Novara, Italy**

N. Amapane<sup>a,b</sup>, R. Arcidiacono<sup>a,c,14</sup>, S. Argiro<sup>a,b</sup>, M. Arneodo<sup>a,c</sup>, N. Bartosik<sup>a</sup>, R. Bellan<sup>a,b</sup>, C. Biino<sup>a</sup>, N. Cartiglia<sup>a</sup>, F. Cenna<sup>a,b</sup>, M. Costa<sup>a,b</sup>, R. Covarelli<sup>a,b</sup>, A. Degano<sup>a,b</sup>, N. Demaria<sup>a</sup>, L. Finco<sup>a,b</sup>, B. Kiani<sup>a,b</sup>, C. Mariotti<sup>a</sup>, S. Maselli<sup>a</sup>, E. Migliore<sup>a,b</sup>, V. Monaco<sup>a,b</sup>, E. Monteil<sup>a,b</sup>, M.M. Obertino<sup>a,b</sup>, L. Pacher<sup>a,b</sup>, N. Pastrone<sup>a</sup>

M. Pelliccioni<sup>a</sup>, G.L. Pinna Angioni<sup>a,b</sup>, F. Ravera<sup>a,b</sup>, A. Romero<sup>a,b</sup>, M. Ruspa<sup>a,c</sup>,  
R. Sacchi<sup>a,b</sup>, K. Shchelina<sup>a,b</sup>, V. Sola<sup>a</sup>, A. Solano<sup>a,b</sup>, A. Staiano<sup>a</sup>, P. Traczyk<sup>a,b</sup>

**INFN Sezione di Trieste<sup>a</sup>, Università di Trieste<sup>b</sup>, Trieste, Italy**

S. Belforte<sup>a</sup>, M. Casarsa<sup>a</sup>, F. Cossutti<sup>a</sup>, G. Della Ricca<sup>a,b</sup>, C. La Licata<sup>a,b</sup>, A. Schizzi<sup>a,b</sup>,  
A. Zanetti<sup>a</sup>

**Kyungpook National University, Daegu, Korea**

D.H. Kim, G.N. Kim, M.S. Kim, S. Lee, S.W. Lee, Y.D. Oh, S. Sekmen, D.C. Son,  
Y.C. Yang

**Chonbuk National University, Jeonju, Korea**

A. Lee

**Hanyang University, Seoul, Korea**

J.A. Brochero Cifuentes, T.J. Kim

**Korea University, Seoul, Korea**

S. Cho, S. Choi, Y. Go, D. Gyun, S. Ha, B. Hong, Y. Jo, Y. Kim, B. Lee, K. Lee, K.S. Lee,  
S. Lee, J. Lim, S.K. Park, Y. Roh

**Seoul National University, Seoul, Korea**

J. Almond, J. Kim, S.B. Oh, S.h. Seo, U.K. Yang, H.D. Yoo, G.B. Yu

**University of Seoul, Seoul, Korea**

M. Choi, H. Kim, H. Kim, J.H. Kim, J.S.H. Lee, I.C. Park, G. Ryu, M.S. Ryu

**Sungkyunkwan University, Suwon, Korea**

Y. Choi, J. Goh, C. Hwang, J. Lee, I. Yu

**Vilnius University, Vilnius, Lithuania**

V. Dudenas, A. Juodagalvis, J. Vaitkus

**National Centre for Particle Physics, Universiti Malaya, Kuala Lumpur, Malaysia**

I. Ahmed, Z.A. Ibrahim, J.R. Komaragiri, M.A.B. Md Ali<sup>32</sup>, F. Mohamad Idris<sup>33</sup>,  
W.A.T. Wan Abdullah, M.N. Yusli, Z. Zolkapli

**Centro de Investigacion y de Estudios Avanzados del IPN, Mexico City, Mexico**

H. Castilla-Valdez, E. De La Cruz-Burelo, I. Heredia-De La Cruz<sup>34</sup>, A. Hernandez-Almada,  
R. Lopez-Fernandez, R. Magaña Villalba, J. Mejia Guisao, A. Sanchez-Hernandez

**Universidad Iberoamericana, Mexico City, Mexico**

S. Carrillo Moreno, C. Oropeza Barrera, F. Vazquez Valencia

**Benemerita Universidad Autonoma de Puebla, Puebla, Mexico**

S. Carpinteyro, I. Pedraza, H.A. Salazar Ibarguen, C. Uribe Estrada

**Universidad Autónoma de San Luis Potosí, San Luis Potosí, Mexico**

A. Morelos Pineda

**University of Auckland, Auckland, New Zealand**

D. Krofcheck

**University of Canterbury, Christchurch, New Zealand**

P.H. Butler

**National Centre for Physics, Quaid-I-Azam University, Islamabad, Pakistan**

A. Ahmad, M. Ahmad, Q. Hassan, H.R. Hoorani, W.A. Khan, M.A. Shah, M. Shoaib, M. Waqas

**National Centre for Nuclear Research, Swierk, Poland**

H. Bialkowska, M. Bluj, B. Boimska, T. Frueboes, M. Górski, M. Kazana, K. Nawrocki, K. Romanowska-Rybinska, M. Szleper, P. Zalewski

**Institute of Experimental Physics, Faculty of Physics, University of Warsaw, Warsaw, Poland**

K. Bunkowski, A. Byszuk<sup>35</sup>, K. Doroba, A. Kalinowski, M. Konecki, J. Krolikowski, M. Misiura, M. Olszewski, M. Walczak

**Laboratório de Instrumentação e Física Experimental de Partículas, Lisboa, Portugal**

P. Bargassa, C. Beirão Da Cruz E Silva, A. Di Francesco, P. Faccioli, P.G. Ferreira Parracho, M. Gallinaro, J. Hollar, N. Leonardo, L. Lloret Iglesias, M.V. Nemallapudi, J. Rodrigues Antunes, J. Seixas, O. Toldaiev, D. Vadrucio, J. Varela, P. Vischia

**Joint Institute for Nuclear Research, Dubna, Russia**

S. Afanasiev, P. Bunin, M. Gavrilenko, I. Golutvin, I. Gorbunov, A. Kamenev, V. Karjavin, A. Lanev, A. Malakhov, V. Matveev<sup>36,37</sup>, P. Moiseenz, V. Palichik, V. Perelygin, S. Shmatov, S. Shulha, N. Skatchkov, V. Smirnov, N. Voytishin, A. Zarubin

**Petersburg Nuclear Physics Institute, Gatchina (St. Petersburg), Russia**

L. Chtchipounov, V. Golovtsov, Y. Ivanov, V. Kim<sup>38</sup>, E. Kuznetsova<sup>39</sup>, V. Murzin, V. Oreshkin, V. Sulimov, A. Vorobyev

**Institute for Nuclear Research, Moscow, Russia**

Yu. Andreev, A. Dermenev, S. Gninenko, N. Golubev, A. Karneyeu, M. Kirsanov, N. Krasnikov, A. Pashenkov, D. Tlisov, A. Toropin

**Institute for Theoretical and Experimental Physics, Moscow, Russia**

V. Epshteyn, V. Gavrilov, N. Lychkovskaya, V. Popov, I. Pozdnyakov, G. Safronov, A. Spiridonov, M. Toms, E. Vlasov, A. Zhokin

**MIPT**

A. Bylinkin<sup>37</sup>

**National Research Nuclear University 'Moscow Engineering Physics Institute' (MEPhI), Moscow, Russia**

R. Chistov<sup>40</sup>, M. Danilov<sup>40</sup>, V. Rusinov

**P.N. Lebedev Physical Institute, Moscow, Russia**

V. Andreev, M. Azarkin<sup>37</sup>, I. Dremin<sup>37</sup>, M. Kirakosyan, A. Leonidov<sup>37</sup>, S.V. Rusakov, A. Terkulov

**Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, Russia**

A. Baskakov, A. Belyaev, E. Boos, M. Dubinin<sup>41</sup>, L. Dudko, A. Ershov, A. Gribushin, V. Klyukhin, O. Kodolova, I. Lokhtin, I. Miagkov, S. Obraztsov, S. Petrushanko, V. Savrin, A. Snigirev

**Novosibirsk State University (NSU), Novosibirsk, Russia**

V. Blinov<sup>42</sup>, Y.Skovpen<sup>42</sup>

**State Research Center of Russian Federation, Institute for High Energy Physics, Protvino, Russia**

I. Azhgirey, I. Bayshev, S. Bitiukov, D. Elumakhov, V. Kachanov, A. Kalinin, D. Konstantinov, V. Krychkine, V. Petrov, R. Ryutin, A. Sobol, S. Troshin, N. Tyurin, A. Uzunian, A. Volkov

**University of Belgrade, Faculty of Physics and Vinca Institute of Nuclear Sciences, Belgrade, Serbia**

P. Adzic<sup>43</sup>, P. Cirkovic, D. Devetak, M. Dordevic, J. Milosevic, V. Rekovic

**Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT), Madrid, Spain**

J. Alcaraz Maestre, M. Barrio Luna, E. Calvo, M. Cerrada, M. Chamizo Llatas, N. Colino, B. De La Cruz, A. Delgado Peris, A. Escalante Del Valle, C. Fernandez Bedoya, J.P. Fernández Ramos, J. Flix, M.C. Fouz, P. Garcia-Abia, O. Gonzalez Lopez, S. Goy Lopez, J.M. Hernandez, M.I. Josa, E. Navarro De Martino, A. Pérez-Calero Yzquierdo, J. Puerta Pelayo, A. Quintario Olmeda, I. Redondo, L. Romero, M.S. Soares

**Universidad Autónoma de Madrid, Madrid, Spain**

J.F. de Trocóniz, M. Missiroli, D. Moran

**Universidad de Oviedo, Oviedo, Spain**

J. Cuevas, J. Fernandez Menendez, I. Gonzalez Caballero, J.R. González Fernández, E. Palencia Cortezon, S. Sanchez Cruz, I. Suárez Andrés, J.M. Vizán García

**Instituto de Física de Cantabria (IFCA), CSIC-Universidad de Cantabria, Santander, Spain**

I.J. Cabrillo, A. Calderon, J.R. Castiñeiras De Saa, E. Curras, M. Fernandez, J. Garcia-Ferrero, G. Gomez, A. Lopez Virto, J. Marco, C. Martinez Rivero, F. Matorras, J. Piedra Gomez, T. Rodrigo, A. Ruiz-Jimeno, L. Scodellaro, N. Trevisani, I. Vila, R. Vilar Cortabitarte

**CERN, European Organization for Nuclear Research, Geneva, Switzerland**

D. Abbaneo, E. Auffray, G. Auzinger, M. Bachtis, P. Baillon, A.H. Ball, D. Barney, P. Bloch, A. Bocci, A. Bonato, C. Botta, T. Camporesi, R. Castello, M. Cepeda,

G. Cerminara, M. D'Alfonso, D. d'Enterria, A. Dabrowski, V. Daponte, A. David, M. De Gruttola, F. De Guio, A. De Roeck, E. Di Marco<sup>44</sup>, M. Dobson, B. Dorney, T. du Pree, D. Duggan, M. Dünser, N. Dupont, A. Elliott-Peisert, S. Fartoukh, G. Franzoni, J. Fulcher, W. Funk, D. Gigi, K. Gill, M. Girone, F. Glege, D. Gulhan, S. Gundacker, M. Guthoff, J. Hammer, P. Harris, J. Hegeman, V. Innocente, P. Janot, H. Kirschenmann, V. Knünz, A. Kornmayer<sup>14</sup>, M.J. Kortelainen, K. Kousouris, M. Krammer<sup>1</sup>, P. Lecoq, C. Lourenço, M.T. Lucchini, L. Malgeri, M. Mannelli, A. Martelli, F. Meijers, S. Mersi, E. Meschi, F. Moortgat, S. Morovic, M. Mulders, H. Neugebauer, S. Orfanelli, L. Orsini, L. Pape, E. Perez, M. Peruzzi, A. Petrilli, G. Petrucciani, A. Pfeiffer, M. Pierini, A. Racz, T. Reis, G. Rolandi<sup>45</sup>, M. Rovere, M. Ruan, H. Sakulin, J.B. Sauvan, C. Schäfer, C. Schwick, M. Seidel, A. Sharma, P. Silva, M. Simon, P. Sphicas<sup>46</sup>, J. Steggemann, M. Stoye, Y. Takahashi, M. Tosi, D. Treille, A. Triossi, A. Tsirou, V. Veckalns<sup>47</sup>, G.I. Veres<sup>21</sup>, N. Wardle, A. Zagozdzińska<sup>35</sup>, W.D. Zeuner

**Paul Scherrer Institut, Villigen, Switzerland**

W. Bertl, K. Deiters, W. Erdmann, R. Horisberger, Q. Ingram, H.C. Kaestli, D. Kotlinski, U. Langenegger, T. Rohe

**Institute for Particle Physics, ETH Zurich, Zurich, Switzerland**

F. Bachmair, L. Bäni, L. Bianchini, B. Casal, G. Dissertori, M. Dittmar, M. Donegà, P. Eller, C. Grab, C. Heidegger, D. Hits, J. Hoss, G. Kasieczka, P. Lecomte<sup>†</sup>, W. Lustermann, B. Mangano, M. Marionneau, P. Martinez Ruiz del Arbol, M. Masciovecchio, M.T. Meinhard, D. Meister, F. Micheli, P. Musella, F. Nessi-Tedaldi, F. Pandolfi, J. Pata, F. Pauss, G. Perrin, L. Perrozzi, M. Quittnat, M. Rossini, M. Schönenberger, A. Starodumov<sup>48</sup>, V.R. Tavolaro, K. Theofilatos, R. Wallny

**Universität Zürich, Zurich, Switzerland**

T.K. Aarrestad, C. AMSler<sup>49</sup>, L. Caminada, M.F. Canelli, A. De Cosa, C. Galloni, A. Hinzmann, T. Hreus, B. Kilminster, C. Lange, J. Ngadiuba, D. Pinna, G. Rauco, P. Robmann, D. Salerno, Y. Yang

**National Central University, Chung-Li, Taiwan**

V. Candelise, T.H. Doan, Sh. Jain, R. Khurana, M. Konyushikhin, C.M. Kuo, W. Lin, Y.J. Lu, A. Pozdnyakov, S.S. Yu

**National Taiwan University (NTU), Taipei, Taiwan**

Arun Kumar, P. Chang, Y.H. Chang, Y.W. Chang, Y. Chao, K.F. Chen, P.H. Chen, C. Dietz, F. Fiori, W.-S. Hou, Y. Hsiung, Y.F. Liu, R.-S. Lu, M. Miñano Moya, E. Paganis, A. Psallidas, J.f. Tsai, Y.M. Tzeng

**Chulalongkorn University, Faculty of Science, Department of Physics, Bangkok, Thailand**

B. Asavapibhop, G. Singh, N. Srimanobhas, N. Suwonjandee

**Cukurova University, Adana, Turkey**

A. Adiguzel, S. Cerci<sup>50</sup>, S. Damarseckin, Z.S. Demiroglu, C. Dozen, I. Dumanoglu, S. Girgis, G. Gokbulut, Y. Guler, E. Gurpinar, I. Hos, E.E. Kangal<sup>51</sup>, O. Kara, U. Kiminsu,

M. Oglakci, G. Onengut<sup>52</sup>, K. Ozdemir<sup>53</sup>, D. Sunar Cerci<sup>50</sup>, B. Tali<sup>50</sup>, H. Topakli<sup>54</sup>, S. Turkcapar, I.S. Zorbakir, C. Zorbilmez

**Middle East Technical University, Physics Department, Ankara, Turkey**

B. Bilin, S. Bilmis, B. Isildak<sup>55</sup>, G. Karapinar<sup>56</sup>, M. Yalvac, M. Zeyrek

**Bogazici University, Istanbul, Turkey**

E. Gülmez, M. Kaya<sup>57</sup>, O. Kaya<sup>58</sup>, E.A. Yetkin<sup>59</sup>, T. Yetkin<sup>60</sup>

**Istanbul Technical University, Istanbul, Turkey**

A. Cakir, K. Cankocak, S. Sen<sup>61</sup>

**Institute for Scintillation Materials of National Academy of Science of Ukraine, Kharkov, Ukraine**

B. Grynyov

**National Scientific Center, Kharkov Institute of Physics and Technology, Kharkov, Ukraine**

L. Levchuk, P. Sorokin

**University of Bristol, Bristol, United Kingdom**

R. Aggleton, F. Ball, L. Beck, J.J. Brooke, D. Burns, E. Clement, D. Cussans, H. Flacher, J. Goldstein, M. Grimes, G.P. Heath, H.F. Heath, J. Jacob, L. Kreczko, C. Lucas, D.M. Newbold<sup>62</sup>, S. Paramesvaran, A. Poll, T. Sakuma, S. Seif El Nasr-storey, D. Smith, V.J. Smith

**Rutherford Appleton Laboratory, Didcot, United Kingdom**

K.W. Bell, A. Belyaev<sup>63</sup>, C. Brew, R.M. Brown, L. Calligaris, D. Cieri, D.J.A. Cockerill, J.A. Coughlan, K. Harder, S. Harper, E. Olaiya, D. Petyt, C.H. Shepherd-Themistocleous, A. Thea, I.R. Tomalin, T. Williams

**Imperial College, London, United Kingdom**

M. Baber, R. Bainbridge, O. Buchmuller, A. Bundock, D. Burton, S. Casasso, M. Citron, D. Colling, L. Corpe, P. Dauncey, G. Davies, A. De Wit, M. Della Negra, R. Di Maria, P. Dunne, A. Elwood, D. Futyan, Y. Haddad, G. Hall, G. Iles, T. James, R. Lane, C. Laner, R. Lucas<sup>62</sup>, L. Lyons, A.-M. Magnan, S. Malik, L. Mastrolorenzo, J. Nash, A. Nikitenko<sup>48</sup>, J. Pela, B. Penning, M. Pesaresi, D.M. Raymond, A. Richards, A. Rose, C. Seez, S. Summers, A. Tapper, K. Uchida, M. Vazquez Acosta<sup>64</sup>, T. Virdee<sup>14</sup>, J. Wright, S.C. Zenz

**Brunel University, Uxbridge, United Kingdom**

J.E. Cole, P.R. Hobson, A. Khan, P. Kyberd, D. Leslie, I.D. Reid, P. Symonds, L. Teodorescu, M. Turner

**Baylor University, Waco, U.S.A.**

A. Borzou, K. Call, J. Dittmann, K. Hatakeyama, H. Liu, N. Pastika

**The University of Alabama, Tuscaloosa, U.S.A.**

O. Charaf, S.I. Cooper, C. Henderson, P. Rumerio

**Boston University, Boston, U.S.A.**

D. Arcaro, A. Avetisyan, T. Bose, D. Gastler, D. Rankin, C. Richardson, J. Rohlf, L. Sulak, D. Zou

**Brown University, Providence, U.S.A.**

G. Benelli, E. Berry, D. Cutts, A. Garabedian, J. Hakala, U. Heintz, J.M. Hogan, O. Jesus, E. Laird, G. Landsberg, Z. Mao, M. Narain, S. Piperov, S. Sagir, E. Spencer, R. Syarif

**University of California, Davis, Davis, U.S.A.**

R. Breedon, G. Breto, D. Burns, M. Calderon De La Barca Sanchez, S. Chauhan, M. Chertok, J. Conway, R. Conway, P.T. Cox, R. Erbacher, C. Flores, G. Funk, M. Gardner, W. Ko, R. Lander, C. Mclean, M. Mulhearn, D. Pellett, J. Pilot, F. Ricci-Tam, S. Shalhout, J. Smith, M. Squires, D. Stolp, M. Tripathi, S. Wilbur, R. Yohay

**University of California, Los Angeles, U.S.A.**

R. Cousins, P. Everaerts, A. Florent, J. Hauser, M. Ignatenko, D. Saltzberg, E. Takasugi, V. Valuev, M. Weber

**University of California, Riverside, Riverside, U.S.A.**

K. Burt, R. Clare, J. Ellison, J.W. Gary, G. Hanson, J. Heilman, P. Jandir, E. Kennedy, F. Lacroix, O.R. Long, M. Malberti, M. Olmedo Negrete, M.I. Paneva, A. Shrinivas, H. Wei, S. Wimpenny, B. R. Yates

**University of California, San Diego, La Jolla, U.S.A.**

J.G. Branson, G.B. Cerati, S. Cittolin, M. Derdzinski, R. Gerosa, A. Holzner, D. Klein, V. Krutelyov, J. Letts, I. Macneill, D. Olivito, S. Padhi, M. Pieri, M. Sani, V. Sharma, S. Simon, M. Tadel, A. Vartak, S. Wasserbaech<sup>65</sup>, C. Welke, J. Wood, F. Würthwein, A. Yagil, G. Zevi Della Porta

**University of California, Santa Barbara, Santa Barbara, U.S.A.**

R. Bhandari, J. Bradmiller-Feld, C. Campagnari, A. Dishaw, V. Dutta, K. Flowers, M. Franco Sevilla, P. Geffert, C. George, F. Golf, L. Gouskos, J. Gran, R. Heller, J. Incandela, N. Mccoll, S.D. Mullin, A. Ovcharova, J. Richman, D. Stuart, I. Suarez, C. West, J. Yoo

**California Institute of Technology, Pasadena, U.S.A.**

D. Anderson, A. Apresyan, J. Bendavid, A. Bornheim, J. Bunn, Y. Chen, J. Duarte, J.M. Lawhorn, A. Mott, H.B. Newman, C. Pena, M. Spiropulu, J.R. Vlimant, S. Xie, R.Y. Zhu

**Carnegie Mellon University, Pittsburgh, U.S.A.**

M.B. Andrews, V. Azzolini, B. Carlson, T. Ferguson, M. Paulini, J. Russ, M. Sun, H. Vogel, I. Vorobiev

**University of Colorado Boulder, Boulder, U.S.A.**

J.P. Cumalat, W.T. Ford, F. Jensen, A. Johnson, M. Krohn, T. Mulholland, K. Stenson, S.R. Wagner

**Cornell University, Ithaca, U.S.A.**

J. Alexander, J. Chaves, J. Chu, S. Dittmer, K. McDermott, N. Mirman, G. Nicolas Kaufman, J.R. Patterson, A. Rinkevicius, A. Ryd, L. Skinnari, L. Soffi, S.M. Tan, Z. Tao, J. Thom, J. Tucker, P. Wittich, M. Zientek

**Fairfield University, Fairfield, U.S.A.**

D. Winn

**Fermi National Accelerator Laboratory, Batavia, U.S.A.**

S. Abdullin, M. Albrow, G. Apollinari, S. Banerjee, L.A.T. Bauerdick, A. Beretvas, J. Berryhill, P.C. Bhat, G. Bolla, K. Burkett, J.N. Butler, H.W.K. Cheung, F. Chlebana, S. Cihangir, M. Cremonesi, V.D. Elvira, I. Fisk, J. Freeman, E. Gottschalk, L. Gray, D. Green, S. Grünendahl, O. Gutsche, D. Hare, R.M. Harris, S. Hasegawa, J. Hirschauer, Z. Hu, B. Jayatilaka, S. Jindariani, M. Johnson, U. Joshi, B. Klima, B. Kreis, S. Lammel, J. Linacre, D. Lincoln, R. Lipton, T. Liu, R. Lopes De Sá, J. Lykken, K. Maeshima, N. Magini, J.M. Marraffino, S. Maruyama, D. Mason, P. McBride, P. Merkel, S. Mrenna, S. Nahn, C. Newman-Holmes<sup>†</sup>, V. O'Dell, K. Pedro, O. Prokofyev, G. Rakness, L. Ristori, E. Sexton-Kennedy, A. Soha, W.J. Spalding, L. Spiegel, S. Stoynev, N. Strobbe, L. Taylor, S. Tkaczyk, N.V. Tran, L. Uplegger, E.W. Vaandering, C. Vernieri, M. Verzocchi, R. Vidal, M. Wang, H.A. Weber, A. Whitbeck

**University of Florida, Gainesville, U.S.A.**

D. Acosta, P. Avery, P. Bortignon, D. Bourilkov, A. Brinkerhoff, A. Carnes, M. Carver, D. Curry, S. Das, R.D. Field, I.K. Furic, J. Konigsberg, A. Korytov, P. Ma, K. Matchev, H. Mei, P. Milenovic<sup>66</sup>, G. Mitselmakher, D. Rank, L. Shchutska, D. Sperka, L. Thomas, J. Wang, S. Wang, J. Yelton

**Florida International University, Miami, U.S.A.**

S. Linn, P. Markowitz, G. Martinez, J.L. Rodriguez

**Florida State University, Tallahassee, U.S.A.**

A. Ackert, J.R. Adams, T. Adams, A. Askew, S. Bein, B. Diamond, S. Hagopian, V. Hagopian, K.F. Johnson, A. Khatiwada, H. Prosper, A. Santra, M. Weinberg

**Florida Institute of Technology, Melbourne, U.S.A.**

M.M. Baarmand, V. Bhopatkar, S. Colafranceschi<sup>67</sup>, M. Hohlmann, D. Noonan, T. Roy, F. Yumiceva

**University of Illinois at Chicago (UIC), Chicago, U.S.A.**

M.R. Adams, L. Apanasevich, D. Berry, R.R. Betts, I. Bucinskaite, R. Cavanaugh, O. Evdokimov, L. Gauthier, C.E. Gerber, D.J. Hofman, P. Kurt, C. O'Brien, I.D. Sandoval Gonzalez, P. Turner, N. Varelas, H. Wang, Z. Wu, M. Zakaria, J. Zhang

**The University of Iowa, Iowa City, U.S.A.**

B. Bilki<sup>68</sup>, W. Clarida, K. Dilsiz, S. Durgut, R.P. Gandrajula, M. Haytmyradov, V. Khristenko, J.-P. Merlo, H. Mermerkaya<sup>69</sup>, A. Mestvirishvili, A. Moeller, J. Nachtman, H. Ogul, Y. Onel, F. Ozok<sup>70</sup>, A. Penzo, C. Snyder, E. Tiras, J. Wetzel, K. Yi



**Johns Hopkins University, Baltimore, U.S.A.**

I. Anderson, B. Blumenfeld, A. Cocoros, N. Eminizer, D. Fehling, L. Feng, A.V. Gritsan, P. Maksimovic, M. Osherson, J. Roskes, U. Sarica, M. Swartz, M. Xiao, Y. Xin, C. You

**The University of Kansas, Lawrence, U.S.A.**

A. Al-bataineh, P. Baringer, A. Bean, J. Bowen, C. Bruner, J. Castle, R.P. Kenny III, A. Kropivnitskaya, D. Majumder, W. Mcbrayer, M. Murray, S. Sanders, R. Stringer, J.D. Tapia Takaki, Q. Wang

**Kansas State University, Manhattan, U.S.A.**

A. Ivanov, K. Kaadze, S. Khalil, M. Makouski, Y. Maravin, A. Mohammadi, L.K. Saini, N. Skhirtladze, S. Toda

**Lawrence Livermore National Laboratory, Livermore, U.S.A.**

D. Lange, F. Rebassoo, D. Wright

**University of Maryland, College Park, U.S.A.**

C. Anelli, A. Baden, O. Baron, A. Belloni, B. Calvert, S.C. Eno, C. Ferraioli, J.A. Gomez, N.J. Hadley, S. Jabeen, R.G. Kellogg, T. Kolberg, J. Kunkle, Y. Lu, A.C. Mignerey, Y.H. Shin, A. Skuja, M.B. Tonjes, S.C. Tonwar

**Massachusetts Institute of Technology, Cambridge, U.S.A.**

D. Abercrombie, B. Allen, A. Apyan, R. Barbieri, A. Baty, R. Bi, K. Bierwagen, S. Brandt, W. Busza, I.A. Cali, Z. Demiragli, L. Di Matteo, G. Gomez Ceballos, M. Goncharov, D. Hsu, Y. Iiyama, G.M. Innocenti, M. Klute, D. Kovalskyi, K. Krajczar, Y.S. Lai, Y.-J. Lee, A. Levin, P.D. Luckey, A.C. Marini, C. McGinn, C. Mironov, S. Narayanan, X. Niu, C. Paus, C. Roland, G. Roland, J. Salfeld-Nebgen, G.S.F. Stephans, K. Sumorok, K. Tatar, M. Varma, D. Velicanu, J. Veverka, J. Wang, T.W. Wang, B. Wyslouch, M. Yang, V. Zhukova

**University of Minnesota, Minneapolis, U.S.A.**

A.C. Benvenuti, R.M. Chatterjee, A. Evans, A. Finkel, A. Gude, P. Hansen, S. Kalafut, S.C. Kao, Y. Kubota, Z. Lesko, J. Mans, S. Nourbakhsh, N. Ruckstuhl, R. Rusack, N. Tambe, J. Turkewitz

**University of Mississippi, Oxford, U.S.A.**

J.G. Acosta, S. Oliveros

**University of Nebraska-Lincoln, Lincoln, U.S.A.**

E. Avdeeva, R. Bartek, K. Bloom, S. Bose, D.R. Claes, A. Dominguez, C. Fangmeier, R. Gonzalez Suarez, R. Kamalieddin, D. Knowlton, I. Kravchenko, A. Malta Rodrigues, F. Meier, J. Monroy, J.E. Siado, G.R. Snow, B. Stieger

**State University of New York at Buffalo, Buffalo, U.S.A.**

M. Alyari, J. Dolen, J. George, A. Godshalk, C. Harrington, I. Iashvili, J. Kaisen, A. Kharchilava, A. Kumar, A. Parker, S. Rappoccio, B. Roozbahani

**Northeastern University, Boston, U.S.A.**

G. Alverson, E. Barberis, D. Baumgartel, A. Hortiangtham, A. Massironi, D.M. Morse, D. Nash, T. Orimoto, R. Teixeira De Lima, D. Trocino, R.-J. Wang, D. Wood

**Northwestern University, Evanston, U.S.A.**

S. Bhattacharya, K.A. Hahn, A. Kubik, A. Kumar, J.F. Low, N. Mucia, N. Odell, B. Pollack, M.H. Schmitt, K. Sung, M. Trovato, M. Velasco

**University of Notre Dame, Notre Dame, U.S.A.**

N. Dev, M. Hildreth, K. Hurtado Anampa, C. Jessop, D.J. Karmgard, N. Kellams, K. Lannon, N. Marinelli, F. Meng, C. Mueller, Y. Musienko<sup>36</sup>, M. Planer, A. Reinsvold, R. Ruchti, G. Smith, S. Taroni, N. Valls, M. Wayne, M. Wolf, A. Woodard

**The Ohio State University, Columbus, U.S.A.**

J. Alimena, L. Antonelli, J. Brinson, B. Bylsma, L.S. Durkin, S. Flowers, B. Francis, A. Hart, C. Hill, R. Hughes, W. Ji, B. Liu, W. Luo, D. Puigh, B.L. Winer, H.W. Wulsin

**Princeton University, Princeton, U.S.A.**

S. Cooperstein, O. Driga, P. Elmer, J. Hardenbrook, P. Hebda, J. Luo, D. Marlow, T. Medvedeva, K. Mei, M. Mooney, J. Olsen, C. Palmer, P. Piroué, D. Stickland, C. Tully, A. Zuranski

**University of Puerto Rico, Mayaguez, U.S.A.**

S. Malik

**Purdue University, West Lafayette, U.S.A.**

A. Barker, V.E. Barnes, S. Folgueras, L. Gutay, M.K. Jha, M. Jones, A.W. Jung, K. Jung, D.H. Miller, N. Neumeister, B.C. Radburn-Smith, X. Shi, J. Sun, A. Svyatkovskiy, F. Wang, W. Xie, L. Xu

**Purdue University Calumet, Hammond, U.S.A.**

N. Parashar, J. Stupak

**Rice University, Houston, U.S.A.**

A. Adair, B. Akgun, Z. Chen, K.M. Ecklund, F.J.M. Geurts, M. Guilbaud, W. Li, B. Michlin, M. Northup, B.P. Padley, R. Redjimi, J. Roberts, J. Rorie, Z. Tu, J. Zabel

**University of Rochester, Rochester, U.S.A.**

B. Betchart, A. Bodek, P. de Barbaro, R. Demina, Y.t. Duh, T. Ferbel, M. Galanti, A. Garcia-Bellido, J. Han, O. Hindrichs, A. Khukhunaishvili, K.H. Lo, P. Tan, M. Verzetti

**Rutgers, The State University of New Jersey, Piscataway, U.S.A.**

J.P. Chou, E. Contreras-Campana, Y. Gershtein, T.A. Gómez Espinosa, E. Halkiadakis, M. Heindl, D. Hidas, E. Hughes, S. Kaplan, R. Kunnawalkam Elayavalli, S. Kyriacou, A. Lath, K. Nash, H. Saka, S. Salur, S. Schnetzer, D. Sheffield, S. Somalwar, R. Stone, S. Thomas, P. Thomassen, M. Walker

**University of Tennessee, Knoxville, U.S.A.**

M. Foerster, J. Heideman, G. Riley, K. Rose, S. Spanier, K. Thapa

**Texas A&M University, College Station, U.S.A.**

O. Bouhali<sup>71</sup>, A. Celik, M. Dalchenko, M. De Mattia, A. Delgado, S. Dildick, R. Eusebi, J. Gilmore, T. Huang, E. Juska, T. Kamon<sup>72</sup>, R. Mueller, Y. Pakhotin, R. Patel, A. Perloff, L. Perniè, D. Rathjens, A. Rose, A. Safonov, A. Tatarinov, K.A. Ulmer

**Texas Tech University, Lubbock, U.S.A.**

N. Akchurin, C. Cowden, J. Damgov, C. Dragoiu, P.R. Duderø, J. Faulkner, S. Kunori, K. Lamichhane, S.W. Lee, T. Libeiro, S. Undleeb, I. Volobouev, Z. Wang

**Vanderbilt University, Nashville, U.S.A.**

A.G. Delannoy, S. Greene, A. Gurrola, R. Janjam, W. Johns, C. Maguire, A. Melo, H. Ni, P. Sheldon, S. Tuo, J. Velkovska, Q. Xu

**University of Virginia, Charlottesville, U.S.A.**

M.W. Arenton, P. Barria, B. Cox, J. Goodell, R. Hirosky, A. Ledovskoy, H. Li, C. Neu, T. Sinthuprasith, X. Sun, Y. Wang, E. Wolfe, F. Xia

**Wayne State University, Detroit, U.S.A.**

C. Clarke, R. Harr, P.E. Karchin, P. Lamichhane, J. Sturdy

**University of Wisconsin - Madison, Madison, WI, U.S.A.**

D.A. Belknap, S. Dasu, L. Dodd, S. Duric, B. Gomber, M. Grothe, M. Herndon, A. Hervé, P. Klabbers, A. Lanaro, A. Levine, K. Long, R. Loveless, I. Ojalvo, T. Perry, G.A. Pierro, G. Polese, T. Ruggles, A. Savin, A. Sharma, N. Smith, W.H. Smith, D. Taylor, N. Woods

†: Deceased

1: Also at Vienna University of Technology, Vienna, Austria

2: Also at State Key Laboratory of Nuclear Physics and Technology, Peking University, Beijing, China

3: Also at Institut Pluridisciplinaire Hubert Curien, Université de Strasbourg, Université de Haute Alsace Mulhouse, CNRS/IN2P3, Strasbourg, France

4: Also at Universidade Estadual de Campinas, Campinas, Brazil

5: Also at Université Libre de Bruxelles, Bruxelles, Belgium

6: Also at Deutsches Elektronen-Synchrotron, Hamburg, Germany

7: Also at Joint Institute for Nuclear Research, Dubna, Russia

8: Also at Helwan University, Cairo, Egypt

9: Now at Zewail City of Science and Technology, Zewail, Egypt

10: Now at Fayoum University, El-Fayoum, Egypt

11: Also at British University in Egypt, Cairo, Egypt

12: Now at Ain Shams University, Cairo, Egypt

13: Also at Université de Haute Alsace, Mulhouse, France

14: Also at CERN, European Organization for Nuclear Research, Geneva, Switzerland

15: Also at Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, Russia

16: Also at Tbilisi State University, Tbilisi, Georgia

17: Also at RWTH Aachen University, III. Physikalisches Institut A, Aachen, Germany

- 18: Also at University of Hamburg, Hamburg, Germany
- 19: Also at Brandenburg University of Technology, Cottbus, Germany
- 20: Also at Institute of Nuclear Research ATOMKI, Debrecen, Hungary
- 21: Also at MTA-ELTE Lendület CMS Particle and Nuclear Physics Group, Eötvös Loránd University, Budapest, Hungary
- 22: Also at University of Debrecen, Debrecen, Hungary
- 23: Also at Indian Institute of Science Education and Research, Bhopal, India
- 24: Also at Institute of Physics, Bhubaneswar, India
- 25: Also at University of Visva-Bharati, Santiniketan, India
- 26: Also at University of Ruhuna, Matara, Sri Lanka
- 27: Also at Isfahan University of Technology, Isfahan, Iran
- 28: Also at University of Tehran, Department of Engineering Science, Tehran, Iran
- 29: Also at Plasma Physics Research Center, Science and Research Branch, Islamic Azad University, Tehran, Iran
- 30: Also at Università degli Studi di Siena, Siena, Italy
- 31: Also at Purdue University, West Lafayette, U.S.A.
- 32: Also at International Islamic University of Malaysia, Kuala Lumpur, Malaysia
- 33: Also at Malaysian Nuclear Agency, MOSTI, Kajang, Malaysia
- 34: Also at Consejo Nacional de Ciencia y Tecnología, Mexico city, Mexico
- 35: Also at Warsaw University of Technology, Institute of Electronic Systems, Warsaw, Poland
- 36: Also at Institute for Nuclear Research, Moscow, Russia
- 37: Now at National Research Nuclear University 'Moscow Engineering Physics Institute' (MEPhI), Moscow, Russia
- 38: Also at St. Petersburg State Polytechnical University, St. Petersburg, Russia
- 39: Also at University of Florida, Gainesville, U.S.A.
- 40: Also at P.N. Lebedev Physical Institute, Moscow, Russia
- 41: Also at California Institute of Technology, Pasadena, U.S.A.
- 42: Also at Budker Institute of Nuclear Physics, Novosibirsk, Russia
- 43: Also at Faculty of Physics, University of Belgrade, Belgrade, Serbia
- 44: Also at INFN Sezione di Roma; Università di Roma, Roma, Italy
- 45: Also at Scuola Normale e Sezione dell'INFN, Pisa, Italy
- 46: Also at National and Kapodistrian University of Athens, Athens, Greece
- 47: Also at Riga Technical University, Riga, Latvia
- 48: Also at Institute for Theoretical and Experimental Physics, Moscow, Russia
- 49: Also at Albert Einstein Center for Fundamental Physics, Bern, Switzerland
- 50: Also at Adiyaman University, Adiyaman, Turkey
- 51: Also at Mersin University, Mersin, Turkey
- 52: Also at Cag University, Mersin, Turkey
- 53: Also at Piri Reis University, Istanbul, Turkey
- 54: Also at Gaziosmanpasa University, Tokat, Turkey
- 55: Also at Ozyegin University, Istanbul, Turkey
- 56: Also at Izmir Institute of Technology, Izmir, Turkey
- 57: Also at Marmara University, Istanbul, Turkey
- 58: Also at Kafkas University, Kars, Turkey
- 59: Also at Istanbul Bilgi University, Istanbul, Turkey
- 60: Also at Yildiz Technical University, Istanbul, Turkey
- 61: Also at Hacettepe University, Ankara, Turkey
- 62: Also at Rutherford Appleton Laboratory, Didcot, United Kingdom

- 63: Also at School of Physics and Astronomy, University of Southampton, Southampton, United Kingdom
- 64: Also at Instituto de Astrofísica de Canarias, La Laguna, Spain
- 65: Also at Utah Valley University, Orem, U.S.A.
- 66: Also at University of Belgrade, Faculty of Physics and Vinca Institute of Nuclear Sciences, Belgrade, Serbia
- 67: Also at Facoltà Ingegneria, Università di Roma, Roma, Italy
- 68: Also at Argonne National Laboratory, Argonne, U.S.A.
- 69: Also at Erzincan University, Erzincan, Turkey
- 70: Also at Mimar Sinan University, Istanbul, Istanbul, Turkey
- 71: Also at Texas A&M University at Qatar, Doha, Qatar
- 72: Also at Kyungpook National University, Daegu, Korea