

P. Abreu^{1,2}, A. Albert³, R. Alfaro⁴, A. Alfonso⁵, C. Álvarez⁶, Q. An⁷, M. Andrade⁸, E. O. Angüner⁹, O. Aquines-Gutiérrez¹⁰, C. Arcaro¹¹, R. Arceo⁶, S. Arias¹², H. Arnaldi¹³, P. Assis^{1,2}, H. A. Ayala Solares¹⁴, A. Bakalova¹⁵, U. Barres de Almeida^{16,17}, I. Batković^{11,18}, J. Bazo¹⁹, J. Bellido^{20,21}, E. Belmont⁴, J. Bennemann²², S. Y. BenZvi²³, A. Bernal²⁴, W. Bian²⁵, C. Bigongiari²⁶, P. Brogueira^{1,2}, T. Bulik²⁷, K. S. Caballero-Mora⁶, P. Camarri^{28,29}, S. Campos³⁰, W. Cao⁷, Z. Cao⁷, Z. Cao³¹, T. Capistrán²⁴, M. Cardillo²⁶, E. Carquin³², A. Carramiñana³³, C. Casentini^{26,28}, C. Castromonte³⁴, J. Chang³¹, S. Chen²⁵, M. Chianese^{35,36}, A. Chiavassa^{37,38}, L. Chytka¹⁵, R. Colallillo^{35,36}, R. Conceição^{1,2}, G. Consolati^{39,41}, R. Cordero⁴¹, P. J. Costa^{1,2}, J. Cotzomi⁴², R. Covarelli^{37,38}, S. Dasso⁴³, A. De Angelis^{11,18}, H. de León Hidalgo⁶, P. Desiati⁴⁴, F. Di Pierro³⁸, G. Di Sciascio²⁷, J. C. Díaz Vélez⁴⁴, C. Dib³², B. Dingus³, J. Djuvsland²², C. Dobrigkeit⁴⁵, L. M. Domingues Mendes^{1,46}, T. Dorigo^{11,47,48}, M. Doro^{11,18}, A. C. dos Reis¹⁶, M. Du Vernois⁴⁴, M. Echiburú⁵, D. Elsaesser⁴⁹, K. Engel^{2,50}, T. Ergin⁵¹, F. Espinoza⁵, K. Fang⁴⁴, A. Fazzi^{40,52}, C. Feng⁵³, M. Feroci²⁶, N. Fraija²⁴, S. Fraija²⁴, A. Franceschini¹⁸, G. F. Franco¹⁶, S. Funk⁵⁴, A. Fuster⁵⁵, S. Garcia¹², J. A. García-González⁵⁶, F. Garfias²⁴, G. Giacinti²⁵, L. Gibilisco^{1,2}, J. Glombitza⁵⁴, H. Goksu²², G. Gong⁵⁷, B. S. González^{1,2}, M. M. Gonzalez²⁴, J. Goodman⁵⁰, M. Gu³¹, F. Guarino^{35,36}, S. Gupta⁵⁸, F. Haist²², H. Hakobyan³², G. Han⁵⁹, P. Hansen⁶⁰, J. P. Harding³, J. Helo⁵, I. Herzog⁶¹, J. Hinton²², K. Hu⁵³, D. Huang⁵⁰, P. Huentemeyer⁶², F. Hueyotl-Zahuantla⁶, A. Insolia⁶³, A. Iriarte²⁴, J. Isaković⁶⁴, V. Joshi⁵⁴, J. Juryšek¹⁵, S. Kaci²⁵, D. Kieda⁶⁵, F. La Monaca²⁶, G. La Mura^{1,66}, R. G. Lang⁵⁴, J. S. Lapington⁶⁷, R. Laspiur³⁰, L. Lavitola³⁴, J. Lee⁶⁸, F. Leitl⁵⁴, L. Lessio²⁶, C. Li³¹, J. Li⁷, K. Li³¹, T. Li²⁵, B. Liberti^{28,29}, S. Lin⁶⁹, D. Liu⁵³, J. Liu³¹, R. Liu⁷⁰, F. Longo^{71,72}, Y. Luo²⁵, J. Lv⁷³, E. Macerata^{40,52}, K. Malone³, A. Mancilla⁵⁵, D. Mandat¹⁵, M. Manganaro⁶⁴, M. Mariani^{40,52}, A. Mariazzi⁶⁰, M. Mariotti^{11,18}, T. Marrodan²², J. Martínez-Castro⁷⁴, H. Martínez-Huerta¹⁰, S. Medina⁵, D. Melo⁵⁵, L. F. Mendes², E. Meza^{75,76}, D. Miceli¹¹, S. Miozzi²⁷, L. S. Miranda⁸, P. E. Mirón Enriquez⁴, A. Mitchell⁵⁴, A. Molinaro^{38,77}, O. G. Morales-Olivares⁶, E. Moreno⁴², A. Morselli^{28,29}, E. Mossini^{40,52}, M. Mostafá¹⁴, F. Muleri²⁶, F. Nardi^{11,18}, A. Negro^{37,38}, L. Nellen⁷⁸, V. Novotny¹⁵, L. Olivera-Nieto²², E. Orlando^{71,72}, M. Osorio²⁴, L. Otiniano⁷⁶, M. Peresano^{37,38}, Y. Pérez Araujo⁴, G. Piano²⁶, A. Pichel⁴³, M. Pihet^{11,18}, M. Pimenta^{1,2}, E. Prandini^{11,18}, A. Pratts⁴, J. Qin⁷, S. Rainò⁷⁹, E. Rangel²⁴, L. Recabarren^{11,18}, A. Reisenegger⁵⁸, H. X. Ren²², F. Rescic^{64,80}, B. Reville²², C. D. Rho⁸¹, M. Riquelme⁸², G. Rodriguez Fernandez²⁷, Y. Roh⁶⁸, G. E. Romero⁸³, F. F. Rosales-Ortega³³, B. Rossi³⁴, A. C. Rovero⁴³, A. Ruina¹¹, E. Ruiz-Velasco²², G. Salazar³⁰, J. Samanes⁷⁶, F. Sanchez⁵⁵, A. Sandoval⁴, M. Santander⁸⁴, R. Santonico^{28,29}, G. L. P. Santos¹⁶, D. Sartirana³⁸, N. Saviano^{35,36}, M. Schneider⁵⁰, M. Schneider⁵⁴, H. Schoorlemmer⁸⁵, J. Serna-Franco⁴, M. Shoib¹¹, A. Smith⁵⁰, Y. Son⁶⁸, O. Soto⁵, R. W. Springer⁶⁵, J. Stewart⁶⁷, P. Strazzeri⁵⁵, L. A. Stuari⁸⁶, H. Sun⁵³, R. Tang²⁵, Z. Tang⁷, S. Tapia³², M. Tavani²⁶, T. Terzić⁶⁴, K. Tollefson⁶¹, B. Tomé^{1,2}, I. Torres³³, R. Torres-Escobedo²⁵, G. C. Trinchero^{38,77}, R. Turner⁶², P. Ulloa⁵, L. Valore^{35,36}, C. van Eldik⁵⁴, I. D. Vergara Quispe⁶⁰, A. Viana⁸, J. Vícha¹⁵, C. F. Vigorito^{37,38}, V. Vittorini²⁶, B. Wang⁵³, J. Wang²², L. Wang³¹, X. Wang⁶², X. Wang⁷⁰, X. Wang⁸⁷, Z. Wang²⁵, M. Waqas^{35,36}, I. J. Watson⁶⁸, F. Werner²², R. White²², C. Wiebusch⁸⁸, E. J. Willox⁵⁰, F. Wohlleben²², S. Wu³¹, S. Xi³¹, G. Xiao³¹, L. Yang⁶⁹, R. Yang⁷, R. Yanyachi²⁰, Z. Yao³¹, D. Zavrtanik⁸⁹, H. Zhang²⁵, H. Zhang⁷⁰, S. Zhang⁹⁰, X. Zhang³¹, Y. Zhang⁷⁰, J. Zhao³¹, L. Zhao⁷, H. Zhou²⁵, C. Zhu⁵³, P. Zhu⁹¹, and X. Zuo³¹

¹Laboratório de Instrumentação de Física Experimental de Partículas - LIP, Av. Prof. Gama Pinto, 2, 1649-003 Lisboa, Portugal

²Departamento de Física, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal

³Physics Division, Los Alamos National Laboratory, Los Alamos, NM, USA

- ⁴Instituto de Física, Universidad Nacional Autónoma de México, Circuito de la Investigación Científica, C.U., A. Postal 70-364, 04510 Cd. de México, México
- ⁵Universidad de La Serena, Chile
- ⁶Facultad de Ciencias en Física y Matemáticas, Universidad Autónoma de Chiapas, C. P. 29050, Tuxtla Gutiérrez, Chiapas, México
- ⁷School of physical science, University of Science and Technology of China, 96 Jinzhai Road, Hefei, Anhui 230026, China
- ⁸Instituto de Física de São Carlos, Universidade de São Paulo, Av. Trabalhador São-carlense 400, São Carlos, Brasil
- ⁹TÜBİTAK Research Institute for Fundamental Sciences, 41470 Gebze, Turkey
- ¹⁰Departamento de Física y Matemáticas, Universidad de Monterrey, Av. Morones Prieto 4500, 66238, San Pedro Garza García NL, México
- ¹¹INFN - Sezione di Padova, I-35131, Padova, Italy
- ¹²Universidad Nacional de San Antonio Abad del Cusco, Av. de la Cultura, Nro. 733, Cusco - Perú
- ¹³Centro Atómico Bariloche (CNEA-CONICET-IB/UNCuyo), Av. E. Bustillo 9500, (8400) San Carlos de Bariloche, Rio Negro, Argentina
- ¹⁴Department of Physics, Pennsylvania State University, University Park, PA, USA
- ¹⁵Institute of Physics of the Czech Academy of Sciences, Prague, Czech Republic
- ¹⁶Centro Brasileiro de Pesquisas Físicas (CBPF), Rua Dr. Xavier Sigaud 150, 22290-180 Rio de Janeiro, Brasil
- ¹⁷Universidade de São Paulo, Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Departamento de Astronomia, Rua do Matão 1226, 05508-090 São Paulo, Brasil
- ¹⁸Università di Padova, I-35131, Padova, Italy
- ¹⁹Pontificia Universidad Católica del Perú, Av. Universitaria 1801, San Miguel, 15088, Lima, Perú
- ²⁰Universidad Nacional de San Agustín de Arequipa, Santa Catalina Nro. 117. Arequipa
- ²¹University of Adelaide, Adelaide, S.A., Australia
- ²²Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany
- ²³Department of Physics and Astronomy, University of Rochester, Rochester, NY, USA
- ²⁴Instituto de Astronomía, Universidad Nacional Autónoma de México, Circuito Exterior, C.U., A. Postal 70-264, 04510 Cd. de México, México
- ²⁵Tsung-Dao Lee Institute & School of Physics and Astronomy, Shanghai Jiao Tong University, 520 Shengrong Road, Shanghai 201210, China
- ²⁶Istituto Nazionale Di Astrofisica (INAF), Roma, Italy
- ²⁷Astronomical Observatory Warsaw University, 00-478 Warsaw, Poland
- ²⁸INFN, Roma Tor Vergata, Italy
- ²⁹Department of Physics, University of Roma Tor Vergata, Viale della Ricerca Scientifica 1, I-00133 Roma, Italy
- ³⁰Facultad de Ciencias Exactas, Universidad Nacional de Salta, Avda. Bolivia 5150, A4408FVY, Salta, Argentina
- ³¹Institute of High Energy Physics, Chinese Academy of Science, 19B Yuquan Road, Shijingshan District, Beijing 100049, China
- ³²CCTVal, Universidad Tecnica Federico Santa Maria, Chile
- ³³Instituto Nacional de Astrofísica, Óptica y Electrónica, Puebla, Mexico
- ³⁴Universidad Nacional de Ingeniería, Av. Túpac Amaru 210 - Rímac. Apartado 1301, Lima Perú
- ³⁵Università di Napoli "Federico II", Dipartimento di Fisica "Ettore Pancini", Napoli, Italy
- ³⁶INFN, Sezione di Napoli, Napoli, Italy
- ³⁷Università degli Studi di Torino, I-10125 Torino, Italy
- ³⁸INFN, Sezione di Torino, Torino, Italy
- ³⁹Politecnico di Milano, Dipartimento di Scienze e Tecnologie Aerospaziali, Milano, Italy
- ⁴⁰INFN, sezione di Milano, Milano, Italy
- ⁴¹Departamento de Física, Universidad de Santiago de Chile, Chile
- ⁴²Facultad de Ciencias Físico Matemáticas, Benemérita Universidad Autónoma de Puebla, Av. San Claudio y 18 Sur, Ciudad Universitaria 72570, Puebla, Mexico.
- ⁴³Instituto de Astronomía y Física del Espacio (IAFE (CONICET-UBA)), Ciudad Universitaria, CABA, Argentina

- ⁴⁴Department of Physics, University of Wisconsin-Madison, Madison, WI, USA
- ⁴⁵Departamento de Raios C6smicos e Cronologia, Instituto de F6sica "Gleb Wataghin", Universidade Estadual de Campinas, C.P. 6165, 13083-970 Campinas, Brasil
- ⁴⁶Centro Federal de Educa73o Tecnol6gica Celso Suckow da Fonseca (CEFET), Rio de Janeiro, Brasil
- ⁴⁷Lule6 University of Technology, Laboratoriev6gen 14, SE-971 87 LULE6, Sweden
- ⁴⁸Universal Scientific Education and Research Network, Italy
- ⁴⁹Technische Universit6t Dortmund, D-44221 Dortmund, Germany
- ⁵⁰Department of Physics, University of Maryland, College Park, MD, USA
- ⁵¹Middle East Technical University, Northern Cyprus Campus, 99738 Kalkanli via Mersin 10, Turkey
- ⁵²Politecnico di Milano, Dipartimento di Energia, Milano, Italy
- ⁵³Key Laboratory of Particle Physics and Particle Irradiation (MOE), Institute of Frontier and Interdisciplinary Science, Shandong University, Qingdao, Shandong 266237, China
- ⁵⁴Friedrich-Alexander-Universit6t Erlangen-N6rnberg, Erlangen Centre for Astroparticle Physics, Nikolaus-Fiebiger-Str. 2, D 91058 Erlangen, Germany
- ⁵⁵Instituto de Tecnolog6as en Detecci6n y Astrop6rticulas (CNEA, CONICET, UNSAM), Buenos Aires, Argentina
- ⁵⁶Tecnologico de Monterrey, Escuela de Ingenier6a y Ciencias, Ave. Eugenio Garza Sada 2501, Monterrey, N.L., Mexico, 64849
- ⁵⁷Dept. of Engineering Physics, Tsinghua University, 1 Tsinghua Yuan, Haidian District, Beijing 100084, China
- ⁵⁸Departamento de F6sica, Facultad de Ciencias B6sicas, Universidad Metropolitana de Ciencias de la Educaci6n, Av. Jos6 Pedro Alessandri 774, N6u6oa, Chile
- ⁵⁹School of Mechanical Engineering and Electronic Information, China University of Geosciences, Wuhan, Hubei 430074, China
- ⁶⁰IFLP, Universidad Nacional de La Plata and CONICET, La Plata, Argentina
- ⁶¹Department of Physics and Astronomy, Michigan State University, East Lansing, MI, USA
- ⁶²Michigan Technological University, Houghton, Michigan, 49931, USA
- ⁶³Universit6 di Catania, Catania, Italy
- ⁶⁴University of Rijeka, Faculty of Physics, 51000 Rijeka, Croatia
- ⁶⁵Department of Physics and Astronomy, University of Utah, Salt Lake City, UT, USA
- ⁶⁶INAF - Osservatorio Astronomico di Cagliari, Via della Scienza 5, 09047 Selargius, Italy
- ⁶⁷University of Leicester, School of Physics and Astronomy, University Road, Leicester, LE1 7RH, United Kingdom
- ⁶⁸University of Seoul, Seoul, Rep. of Korea
- ⁶⁹School of Physics and Astronomy, Sun Yat-sen University, Zhuhai, Guangdong 519082, China
- ⁷⁰School of Astronomy and Space Science, Nanjing University, Xianlin Avenue 163, Qixia District, Nanjing, Jiangsu 210023, China
- ⁷¹Dipartimento di Fisica, Universit6 degli Studi di Trieste, via Valerio 2, I-34127 Trieste, Italy
- ⁷²INFN - Sezione di Trieste, via Valerio 2, I-34127 Trieste, Italy
- ⁷³Aerospace Information Research Institute, Chinese Academy of Science, 9 Dengzhuang South Road, Haidian District, Beijing 100094, China
- ⁷⁴Centro de Investigaci6n en Computaci6n, Instituto Polit6cnico Nacional, Ciudad de M6xico, Mexico
- ⁷⁵Comisi6n Nacional de Investigaci6n y Desarrollo Aeroespacial, Calle Luis Felipe Villar6n 1069, 15046, Lima, Per6
- ⁷⁶Universidad Nacional de Moquegua, Calle Ancash S/N, 18001, Moquegua, Per6
- ⁷⁷Instituto Nazionale Di Astrofisica (INAF), Torino, Italy
- ⁷⁸Instituto de Ciencias Nucleares, Universidad Nacional Aut6noma de M6xico, Circuito Exterior, C.U., A. Postal 70-543, 04510 Cd. de M6xico, M6xico
- ⁷⁹Universit6 degli Studi di Bari Aldo Moro, Italy
- ⁸⁰Departamento de F6sica Te6rica, Universidad de Zaragoza, Zaragoza 50009, Spain
- ⁸¹Department of Physis, Sungkyunkwan University, Suwon, South Korea
- ⁸²Universidad de Chile, Chile
- ⁸³Instituto Argentino de Radioastronom6a (CONICET, CIC, UNLP), Camino Gral. Belgrano Km 40, Berazategui,

Argentina

⁸⁴Department of Physics and Astronomy, University of Alabama, Tuscaloosa, Alabama, 35487, USA

⁸⁵IMAPP, Radboud University Nijmegen, Nijmegen, The Netherlands

⁸⁶Unidade Acadêmica de Física, Universidade Federal de Campina Grande, Av. Aprígio Veloso 882, CY2, 58.429-900 Campina Grande, Brasil

⁸⁷School of Integrated Circuit, Ludong University, 186 Hongqi Middle Road, Zhifu District, Yantai, Shandong, China

⁸⁸III. Physics Institute A, RWTH Aachen University, Templergraben 56, D-52062 Aachen, Germany

⁸⁹Center for Astrophysics and Cosmology (CAC), University of Nova Gorica, Nova Gorica, Slovenia

⁹⁰College of Engineering, Hebei Normal University, 20 South Second Ring East Road, Shijiazhuang, Hebei, China

⁹¹School of mechanical engineering, University of Science and Technology Beijing, 30 Xueyuan Road, Haidian District, Beijing 100083, China

April,2024

Acknowledgments

The SWGO Collaboration acknowledges the support from the agencies and organizations listed here:

<https://www.swgo.org/SWGOwiki/doku.php?id=acknowledgements> and the support from UNAM DGAPA-PAPIIT project number IG101323; ANID PIA/APOYO AFB230003; Fondecyt 1210131; GACR 23-05827S; FCT, under project PTDC/FIS-PAR/4300/2020; FAPERJ Thematic Grant E-26/211.342/2021.; ANID/fondo 2022 quimal/Quimal220008; FONDECYT grants 1201582 and 1210131; Center for Astrophysics and Associated Technologies (CATA; ANID Basal project FB210003).; National Research Foundation of Korea (RS-2023-00280210)