

**Part A. PERSONAL INFORMATION****CV date**

12/09/2022

|                       |                                  |                     |  |
|-----------------------|----------------------------------|---------------------|--|
| First and Family name | Juan Antonio Caballero Carretero |                     |  |
| ID number             | ██████████                       |                     |  |
| Researcher numbers    | Researcher ID                    | K-6609-2014         |  |
|                       | ORCID code                       | 0000-0001-9691-0874 |  |
|                       | Scopus                           | 35556445900         |  |

**A.1. Current position**

|                     |  |        |  |
|---------------------|--|--------|--|
| Institution         | University of Seville  |        |  |
| Department          | Atomic, Molecular and Nuclear Physics  |        |  |
| Address and Country | Seville, Andalusia, Spain  |        |  |
| Phone number        | 954559505  | E-mail | <a href="mailto:jac@us.es">jac@us.es</a> |
| Current position    | Full Professor ("Catedrático")   | From   | 21/11/2007                               |
| UNESCO code         | 220719   |        |  |
| Key words           | Electroweak interactions, hadron and nuclear structure, electron and neutrino scattering, parity violation |        |  |

**A.2. Education**

| Degree/PhD              | University                      | Year |
|-------------------------|---------------------------------|------|
| Degree ("Licenciatura") | University of Extremadura       | 1985 |
| PhD                     | Autonomous University of Madrid | 1989 |

**A.3. JCR articles, h Index, thesis supervised...**

Six-year research ("sexenios de investigación"): 6. Last one: 2016-2021.

Five-year teaching activities ("quinquenios de docencia"): 6

PhD thesis supervised (last 10 years): 2.

Publ. in scientific journals: 143 (WoS), 149 (Scopus), 160 (ORCID).

Total cites: 3392 (WoS), 3706 (Scopus).

H-index: 36 (WoS), 36 (Scopus).

Publications with high impact factor: 2 Physics Reports (25.010 impact factor), 6 Physical Review Letters (7.489) y 12 Physics Letters B (5.043).

**Part B. CV SUMMARY** (max. 3500 characters, including spaces)

My research activities have focused on the study of hadron and nuclear systems through the analysis of electroweak scattering processes at intermediate energies. In particular, I have carried out studies on electron-nucleus scattering reactions by analyzing kinematic regions corresponding to different reaction mechanisms: quasi-elastic scattering, delta and higher resonance production, meson-exchange currents, etc. In all cases, we have evaluated the observables of interest: cross sections and response functions, including polarization degrees of freedom. Fully relativistic studies, with kinematic and dynamic relativistic effects embodied, have been performed by comparing the theoretical predictions with data. Some relevant examples are: spectroscopic factors, reduced cross sections, polarization ratios, nucleon momentum distributions, nuclear structure functions, nucleon form factors, etc. Particular interest in the analysis of electron-nucleus scattering processes has been devoted to the investigation of parity violating effects linked to the weak interaction (see Phys. Rep. 524, 1-35, 2013). All these studies have been published in high impact factor peer-review journals (see, e.g., Research ID profile).

In the last years, my main research activities have been related to the study of neutrino-nucleus and nucleon interaction. This topic is of great interest; not only does it provide precise information on neutrino oscillations, but it also has important implications in nuclear astrophysics. This is clearly shown through the significant number of international labs and research centers where neutrino-nucleus experiments are carried out. The analysis of data requires the use of theoretical models capable of providing a good, precise enough, description

of the neutrino-nucleus interaction. This means not only to describe the reaction mechanism (or elementary vertex) but also the complex nuclear structure of the target. In this sense, it is essential to include effects beyond the impulse approximation, such as meson exchange currents, two-particle two-hole contributions, correlations, radiative corrections, etc. Also, because of the high energies involved in the experiments, it is mandatory to make use of a fully relativistic description of the process that includes kinematical and dynamical relativistic effects linked to the reaction mechanism/nuclear structure. The validity of the so-called scaling phenomenon has been clearly proved through the analysis of electron-nucleus scattering data. We have performed detailed investigations on this topic and applied it to the case of neutrino reactions. This approach has allowed us to study neutrino scattering processes without relying upon any particular nuclear model. The results, in very good agreement with data, have been presented and discussed in detail in high impact international scientific journals (see list of publications).

These projects have led to three Ph.D. theses, two of them with 'international mention' and 'extraordinary doctoral prize' from the University of Seville. Of these two, one (Raúl González) received the 'third prize for the best national PhD thesis in nuclear physics' by the Spanish Royal Society of Physics (2016 call), and the other (Guillermo Megías) has been selected as the most relevant PhD thesis in Theoretical Nuclear Physics (2019 GEFN-ATI call). Likewise, our results have been presented in a large number of scientific events. The quality and real impact of our work is clearly demonstrated by the number of relevant publications and citations received.

## Part C. RELEVANT MERITS

### C.1. Publications (10 cited publications [WOS] in the last 10 years)

1. Title: Meson-exchange currents and quasielastic neutrino cross sections in the superscaling approximation model. Author(s): Amaro, J. E.; Barbaro, M. B.; Caballero, J. A.; et al. Physics Letters B, Volume: 696 Issue: 1-2 Pages: 151-155 Published: JAN 24 2011. Times Cited: 106, DOI: 10.1016/j.physletb.2010.12.007.
2. Title: Relativistic analyses of quasielastic neutrino cross sections at MiniBooNE kinematics Author(s): Amaro, J. E.; Barbaro, M. B.; Caballero, J. A.; et al. Physical Review D Volume: 84 Issue: 3 Published: AUG 8 2011. Times Cited: 68, DOI: 10.1103/PhysRevD.84.033004.
3. Title: Meson-Exchange Currents and Quasielastic Antineutrino Cross Sections in the Superscaling Approximation. Author(s): Amaro, J. E.; Barbaro, M. B.; Caballero, J. A.; et al. Physical Review Letters Volume: 108 Issue: 15 Published: APR 12 2012. Times Cited: 62, DOI: 10.1103/PhysRevLett.108.152501.
4. Title: Extensions of superscaling from relativistic mean field theory: The SuSAv2 model. Author(s): Gonzalez-Jimenez, R.; Megias, G. D.; Barbaro, M. B.; et al. Physical Review C Volume: 90 Issue: 3 Published: SEP 15 2014. Times Cited: 65, DOI: 10.1103/PhysRevC.90.035501.
5. Title: Charged-current neutrino-nucleus reactions within the superscaling meson-exchange current approach. Author(s): Megias, G.D.; Barbaro, M.B.; Caballero, J.A.; Donnelly, T.W.; Ruiz-Simo, I. Physical Review D 94, 093004 (2016). Times cited: 52. DOI: [10.1103/PhysRevD.94.093004](https://doi.org/10.1103/PhysRevD.94.093004)
6. Title: Relativistic Descriptions of Final-State Interactions in Charged-Current Quasielastic Neutrino-Nucleus Scattering at MiniBooNE Kinematics. Author(s): Meucci, Andrea; Barbaro, M. B.; Caballero, J. A.; et al. Physical Review Letters Volume: 107 Issue: 17 Published: OCT 17 2011. Times Cited: 48, DOI: 10.1103/PhysRevLett.107.172501.
7. Title: Meson-exchange currents and quasielastic predictions for charged-current neutrino-C-12 scattering in the superscaling approach. Author(s): Megias, G. D.; Donnelly, T. W.;

Moreno, O.; et al. Physical Review D Volume: 91 Issue: 7 Published: APR 7 2015. Times Cited: 52, DOI: 10.1103/PhysRevD.91.073004.

8. Title: Inclusive electron scattering within the SuSAv2 meson exchange current approach. Author(s): Megias, G.D.; Amaro, J.E.; Barbaro, M.B; Caballero, J.A.; Donnelly, T.W. Physical Review D 94, 013012 (2016). Times cited: 46, DOI: [10.1103/PHYSREVD.94.013012](https://doi.org/10.1103/PHYSREVD.94.013012)

9. Title: Parity violation in elastic electron-nucleon scattering: Strangeness content in the nucleon. Author(s): Gonzalez-Jimenez, R.; Caballero, J. A.; Donnelly, T. W. Physics Reports-Review Section of Physics Letters, Volume: 524 Issue: 1. Pages: 1-35. Published: MAR 2013. Times Cited: 34, DOI: 10.1016/j.physrep.2012.10.003.

10. Title: Neutrino and antineutrino CCQE scattering in the Superscaling Approximation from MiniBooNE to NOMAD energies. Author(s): Megias, G.D.; Amaro, J.E.; Barbaro, M.B.; Caballero, J.A., Donnelly, T.W. Physics Letters B 725, 1-3, (2013). Pages: 170-174. Times cited: 28, DOI: [10.1016/J.PHYSLETB.2013.07.004](https://doi.org/10.1016/J.PHYSLETB.2013.07.004)

## C.2. Research projects and grants (2013-present)

1.- Neutrino Oscillation Analysis at T2K and SuperKamiokande experiments: Can neutrinos explain the matter-antimatter asymmetry in the Universe? (NEUTON). Horizon 2020. Individual Global Fellowships (IF-GF). Standard European Fellowships (Acción Marie Curie H2020). 271227,84 EUR. 01/09/2019 – 31/08/2022. Invest. Responsables: T. Kajita (University of Tokyo) and Juan Antonio Caballero (University of Seville).

2.- Procesos de dispersión fuerte, electromagnética y débil con núcleos a energías bajas e intermedias. Ministerio de Ciencia e Innovación. Caballero Carretero, Juan Antonio (University of Seville). 2021-2023. 130000 €. Referencia: PID2020-114687GB-I00.

3. Estudios de procesos de dispersión fuerte y electrodébil con núcleos a energías bajas e intermedias. Ministerio de Economía, Industria y Competitividad. Caballero-Carretero, Juan Antonio (University of Seville). 2018-2020. 90750 EUR. Referencia: FIS2017-88410-P.

4. Estructura de Núcleos, Moléculas y Hadrones y su Dinámica en Procesos de Dispersión Fuerte y Electrodébil. Ministerio de Economía y Competitividad. Caballero-Carretero, Juan Antonio (Univ. de Sevilla). 2015-2017. 72600 EUR. Referencia: FIS2014-53448-C2-1-P.

5. La Física Nuclear Fuera del Valle de Beta-Estabilidad: Sus Implicaciones en Astrofísica. JUNTA DE ANDALUCÍA - CONSEJERÍA DE INNOVACIÓN, CIENCIA Y EMPRESAS. Lozano-Leyva, Manuel Luis (U. of Seville). 2013-2017. 176918,3 EUR.

## C.3. Contracts

Professor in charge of the following postdoc/sabbatical periods:

1.- Dra. Chiara Maieron (June, 2002 - March, 2003). Programme: “Estancias de doctores y tecnólogos extranjeros en España”. Ref.: SB2000-0427, project: 2002/1115.

2.- Prof. Maria B. Barbaro (Univ. of Turin): Sept. 2002 – Dec. 2002. Programme: “Estancias de profesores e investigadores extranjeros, de acreditada experiencia, en régimen de año sabático en España”. Ref.: SAB2001-0025, project: 2002/1036.

## C.4. Patents

## C.5 PhD and Master Theses supervised (last 10 years)

Title: “Violación de paridad en dispersión elástica y cuasielástica de electrones por nucleones y núcleos”. PhD Thesis by Raúl González Jiménez. Defense: 04/04/2014. Mark: Sobresaliente cum laude. International Mention. Extrordinary doctoral prize. Third prize to the best PhD Thesis in Nuclear Physics by Spanish Royal Society of Physics.

Title: "Charged-current neutrino interactions with nucleons and nuclei at intermediate energies". PhD Thesis by Guillermo D. Megías Vázquez. Defense: 20/09/2017. Mark: Sobresaliente cum laude. International Mention. Extraordinary doctoral prize. Award to the best PhD Thesis in Theoretical Nuclear Physics by Spanish Royal Society of Physics.

Title: "Violación de paridad en dispersión elástica de electrones por nucleones". Master Thesis by Raúl González Jiménez. Defense: 30/09/2010. Mark: Sobresaliente.

Title: "Interacción neutrino-núcleo mediada por corrientes cargadas". Master Thesis by Guillermo Daniel Megías Vázquez. Defense: 23/11/2012. Mark: Sobresaliente (MH).

Title: "Estudio del proceso de dispersión electrón-núcleo en la aproximación de impulso". Master Thesis by Alejandro Barba Lobo. Defense: Sept. 2017. Mark: Sobresaliente.

### C.6 Science Outreach (2013-present)

Title: "Dirac. La antimateria. El reflejo oscuro de la materia". Book: "Grandes ideas de la Ciencia". RBA editores. Barcelona (2013). ISBN: 978-84-473-7676-6. Available in French, Spanish, Italian, and Russian.

Title: "Pauli. El espín. Los electrones bailan". Book: "Grandes ideas de la Ciencia". RBA editores. Barcelona (2014). ISBN: 978-84-473-7777-0. Available in French, Italian and Spanish.

Title: "Los neutrinos. Las partículas elementales que todo lo atraviesan". Book: "Un paseo por el Cosmos". RBA editores. Barcelona (2015). ISBN: 978-84-473-8307-8. Available in French, Italian and Spanish.

Title: "Los neutrinos. Las partículas elementales que todo lo atraviesan". Conference in the Faculty of Physics (US) 15/12/2015 to celebrate the Nobel Prize in Physics 2015.

### C.7 Institutional responsibilities

Director of Scientific Research of the University of Seville: Feb. 2021 to present. Head of the Atomic, Molecular and Nuclear Physics Department (US): June 2017 to Feb. 2021. Academic Secretary of the Faculty of Physics (US): June 2008 – June 2017.

### C.8 Participation in National and International Scientific Committees

Referee for several JCR journals: Physical Review C and D (more than 10 times), Physical Review Letters (>5), Review of Modern Physics (1), Physics Letters B (>5), Nuclear Physics A (>5), Physics Reports (1), Journal of Physics G (>3), and Annals of Physics (2-3).

Referee of research projects for the ANEP, Spanish Government, from 2005. Member of the Ramón y Cajal committee (2019). Referee of international research projects for the FWO (Belgium), Bulgarian Academy of Science, INFN-Science Ministry (Italy), and IN2P3 (France).

Member of scientific committee for the international workshop NUINT, last time in 2017 (Toronto).

Director of the "International Scientific Meeting on Nuclear Physics" celebrated in La Rábida in 2009 and 2012. Member of the scientific committee in the years 2015 and 2018.

National Coordinator of the Spanish Nuclear Physics Network (FNUC): period 2012-2014. Coordinator (Seville) of the Interuniversity Institute Carlos I for Theoretical and Computational Physics.