Part A. PERSONAL INFORMATION

CV date	07/05/2023

First name	**José Manuel**		
Family name	**Caridad Hernández**		
Gender	Male	Birth date (dd/mm/yyyy)	19/12/1983
ID number	70980947A		
e-mail	jose.caridad@usal.es	URL Web	
Open Researcher and Contributor ID (ORCID) (*)	0000-0001-8943-1170		

A.1. Current position

Position	Senior Scientist / Ramón y Cajal fellow		
Initial date	01/05/2021		
Institution	University of Salamanca		
Department/Center	Applied Physics / USAL-Nanolab		
Country	Spain	Teleph. number	+34 623183404
Key words	Electronic properties, nanomaterials, quantum materials, 2D materials, chiral systems, nanodevices		

A.2. Previous positions

Period	Position /Institution /Country
2020 - 2021	Research scientist / KLA corporation / Denmark and USA
2019 - 2020	Senior researcher / NanoLund, Lund University / Sweden
2018 - 2019	Assist. Professor / Dept. Physics, Tech. Univ. Denmark / Denmark
2014 - 2017	Postdoc / Dept. Nanotechnology, Tech. Univ. Denmark / Denmark
2009 - 2014	PhD student / School of Physics, Trinity College Dublin / Ireland

A.3. Education

	University/Country	Year
PhD in Physics	Trinity College Dublin / Ireland	2014
5 years degree physics (Licenciatura)	University of Salamanca / Spain	2008
BEng Telecommunications Eng.	University of Valladolid / Spain	2005

Part B. CV SUMMARY

Relevant Scientific Achievements

I am a hands-on experimental physicist seasoned in the characterization of the electronic properties of devices/samples made from novel nanomaterials, including quantum materials. My research work in 6 international institutions has led to the observation of several novel and intriguing phenomena which are important from both fundamental and applicative perspectives; for instance:

- *An electrical analogy to Mie scattering* [J.M. Caridad, et al. Nature Communications, 2016]. This effect shows a captivating connection between the known Mie scattering in optics and electronic states in ballistic graphene with circular pn junctions. Moreover, t*his novel creative device comprises the first electron switch working at room temperature using electron-optics principles.* I have also lead follow-up articles describing in detail the working principles of these devices [Chaves et al, Nanoscale, 2019].
- The *suppression of conductance quantization in the quantum Hall regime* [J.M. Caridad, et al. Nature Communications, 2018]. This is a long-predicted, universal phenomenon occurring in clean devices due to Coulomb interactions. To observe it, I have fabricated ballistic graphene devices with very low edge disorder. *The work has profound implications for quantum technologies and the production of resistance standards*.
- The detection of the *Faraday chiral anisotropy* [J.M. Caridad, et al. Physical Review Letters, 2021]. This is a long-sought, directional and general magneto-optical phenomenon occurring in chiral and magnetic systems (i.e. systems breaking both parity and time-reversal

symmetries). As such, this fundamental effect has implications in many scientific disciplines (condensed matter, particle physics…).
- A graphene edge molecular switch [J.M. Caridad, et al. NanoLetters, 2018]. This study reveals the curious and exclusive bi-stable confinement of polar molecules (incl. water) at the 1D edge of a 2D material (graphene). In practical terms, this device is an ultra-sensitive gas sensor. I am a co-inventor of a patent application based on this study (link here) and have tested the performance of this device in an industrial setting (see section C.4 below).

I have communicated all these results in general science websites dedicated to broad audiences (see e.g. link 1, link 2 or link 3) or in book chapters [L.Camilli and J.M.Caridad, "Graphene Nanodot Arrays" Taylor&Francis, eBook ISBN 9780429347290]

Overall, I have coauthored 1 book chapter and 33 research articles (15 of them as first author last author). These articles are published in high-profile journals such as Nature Nanotechnology, x4 Nature Communications, Physical Review Letters or NanoLetters (full publication list here). I have contributed to 20+ international conferences, 9 as invited speaker. My work has led to 2 patent applications, 2 R&D prizes (Spain´05,´06), 1 innovation award (Ireland ´12) and I have been recognized with the MSCA Seal of Excellence (´18). Finally, I have received international competitive grants as PI to pursue my own research ideas and establish my own research team. In particular, a postdoctoral fellowship (20K€, Otto Mønsteds Fond, 2017), a Vinnova fellowship (200K€, Vinnova´19), a Ramón y Cajal fellowship (300K€ MICINN '20), two MICINN projects (320K€ in total, PID '21, TED '21) and the prestigious ERC Starting Grant from the European Commission (1,8Million € ERC Stg ´21).

Socioeconomic contributions
- Communication of results to broad audiences in technological websites and books (see above).
- I have secured >20K€ to lead R&D projects with industrial partners (DTU Discovery grant), and have undertaken commercialization studies of devices described in patent applications (TIDA project, Enterprise Ireland).
- I have worked as research scientist in a metrology company (KLA corporation) within the semiconductor industry. My work consisted in establishing standard protocols to measure the electrical properties of advanced layered nanomaterials.

Direction of PhD thesis, MSc thesis and R&D management
I have co-supervised two PhD Thesis. Students: Xiaojing Zhao (link here) and Aske Gejl. Also, I have supervised 5 MSc Thesis.
I have been tool owner of a scientific tool (evaporator) during my PhD period (TCD, 2011-2013). I have designed and build-up a quantum electronics laboratory during my postdoctoral period at DTU (2014-2017). Moreover, I am currently building-up a similar laboratory at the nanotechnology center of the University of Salamanca, USAL-Nanolab with funds from my ERC StG project.
In addition, I am referee for high-profile international journals such as Nature Photonics., NanoLett, or Nat. Comm. (details in link).
Finally, I have been a member of the organizing committee in 3 R&D events: i) GEFES 2023 conference (Salamanca 02/2023); *ii)* CMD2020 GEFES minicolloquium "Symmetry and non-linearity in low-dimensional systems" (09/2020, Online due to COVID); *iii)* "Symposium Synthetic Nanocarbon materials" (Dublin 06/2013).

Part C. RELEVANT MERITS

C.1. Publications (10 most relevant articles)

1. ***J.M. Caridad*****,** C. Tserkezis, J.E. Santos, P. Plochocka, M. Venkatesan, J.M.D. Coey, N.A.Mortensen, G.L.J.A. Rikken, V. Krstic (**2021**). "Detection of the Faraday chiral anisotropy". ***Phys. Rev. Lett.*** 126, 177401. *Contribution:* **First author.** *Position:* **1/8.**

2. D.M.A. Mackenzie, M. Galbiati, X.D de Cerio, …, ***J.M Caridad*** (**2021**). "Unraveling the electronic properties of graphene with substitutional oxygen" ***2D Materials***, 8, 045035. *Contribution:* **Last and corresponding author.** *Position:* **14/14.**

3. P.R. Whelan, Q. Shen, B. Zhou, …, ***J.M. Caridad*** (**2020**). "Fermi velocity renormalization in graphene probed by terahertz time-domain spectroscopy". ***2D Materials***, 7, 035009. *Contribution:* **Last and corresponding author.** *Position:* **16/16.**

4. F. Chaves, D. Jiménez, J.E. Santos, P. Bøggild and ***J.M. Caridad***. (**2019)**, "Electrostatics of metal-graphene interfaces: sharp p-n junctions for electron-optical applications", ***Nanoscale***, 11, 21, 10273. *Contribution:* **Last and corresponding author.** *Position:* **5/5.**

5. ***J.M. Caridad***, S.R. Power, A. Shylau, L. Gammelgaard, A.P. Jauho and P. Bøggild (**2019**). "Gate electrostatics and quantum capacitance in ballistic graphene devices", ***Phys. Rev.B***, 99,19, 195408. *Contribution:* **First and corresponding author.** *Position:* **1/6.**

6. ***J.M. Caridad***, S.R. Power, M.R. Lotz, … , P. Bøggild. (**2018**) "Conductance quantization suppression in the quantum Hall regime", ***Nature Comm***. 9, 659. *Contribution:* **First and corresp. author.** *Position:* **1/9.**

7. ***J.M. Caridad***, G.Calogero, P.Pedrinazzi,…,M.Brandbyge.**(2018)**"A graphene-edge ferroelectric molecular switch". ***NanoLetters*** 18, 4675. *Contribution:* **First and corresponding author.** *Position:* **1/9.**

8. ***J.M. Caridad***, S. Winters, D. McCloskey, G.S. Duesberg, J.F. Donegan and V. Krstic. (**2017**) "Hot-volumes as uniform and reproducible SERS-detection enhancers in weakly coupled metallic nanohelices". ***Scientific Reports*** 7, 45548. *Contribution:* **First author.** *Position:* **1/6.**

9. ***J. M. Caridad***, S. Connaughton, C.Ott, H.B. Webber and V. Krstic. (**2016**) "An electrical analogy to Mie scattering". ***Nature Comm.*** 7, 12894. *Contribution:* **First author.** *Position:* **1/5.**

10. ***J. M. Caridad***, D. McCloskey, F. Rossella, V. Bellani, J. F. Donegan, V. Krstic (**2015**). "Effective wavelength scaling of and damping in Plasmonic Helical Antennae". ***ACS Photonics***, 2, 675. *Contribution:* **First author.** *Position:* **1/6.**

C.2. Congress (most relevant)

1. IEEE Nanomaterials and Devices Conference, Paestum, Italy (20/09/2023). Organized by the IEEE. ***Invited oral contribution***: "Probing the bandstructure of graphene moiré superlattices by terahertz radiation".
2. Seminar at Nano-optics group SDU, Ødense, Denmark (18/11/2019) . Organized by the Nano-optics group at the Sydanske University. ***Invited oral contribution***: "Exploring novel quantum ballistic transport phenomena in graphene".
3. 2D materials congress 2019, Sochi, Russia (04/10/2019) . Organized by the Moscow Institute of Physics and Technology (MIPT). ***Invited oral contribution***: "A graphene-edge ferroelectric molecular switch".
4. Summer school on quantum technology. Gilleleje, Denmark (26/08/2019). Technical University of Denmark. ***Invited oral contribution***: "2D materials for quantum technologies".
5. IEEE Nanomaterials and Devices Conference, Portland, United States (14/10/2018). Organized by the IEEE. ***Invited oral contribution***: "Edge effects in graphene nanodevices".
6. Gefes 2018, Valencia, Spain (24/01/2018). Organized by the Condensed Matter Division, Spanish Physics Royal Society . ***Invited oral contribution***: "Charge transport in narrow, gated graphene devices".
7. Seminar 2D materials group at IMEC, Leuven, Belgium (27/11/2017). ***Invited oral contribution***: "Edge dependent transport in graphene nanodevices".
8. Carbonhagen 2016, Copenhagen, Denmark (17/08/2016). Organized by the University of Copenhagen and the Technical University of Denmark. ***Invited oral contribution***: "Electron transport in periodically modulated graphene".

C.3. Research projects (most relevant)

1. ***ERC Starting Grant ´21***. Controlling chirality in atomically thin quantum electronic materials-CHIROTRONICS. *European Research Council*. Grant agreement ID 101039754. PI: **J.M. Caridad**, University of Salamanca. Period: 11/2021-10/2027. Amount: **1,8 M€.** Type of participation: **principal investigator**.

2. ***PID2021 MICINN.*** *Refracción y reflexión negativas ajustables en materiales quirales-NR^2, MICINN*. Grant no. PID2021-128154NA-I00. PI: **J.M. Caridad**, University of Salamanca. Period: 09/2021-08/2025. Amount: **100 K€.** Type of participation: **principal investigator**.

3. ***TED 2021 MICINN.*** *Plantillas electrónicas con percepción táctil - eSOLE, MICINN*. Grant no. TED2021-131766A-I00. PI: **J.M. Caridad**, University of Salamanca. Period: 12/2021-11/2024. Amount: **220 K€.** Type of participation: **principal investigator**.

4. ***Ramón y Cajal ´19***. *Ramón y Cajal fellowship, MICINN*. Grant no. RYC2019-028443-I. PI: **J.M. Caridad**, University of Salamanca. Period: 05/2021-04/2026. Amount: **300 K€.** Type of participation: **principal investigator**.

5. ***Contact2D***- Atomistic insights into the formation of metal contacts on two-dimensional materials. *Vinnova fellowship*. Grant no. 2019-02878. PI: **J.M. Caridad**, Lund University. Period: 01/2020-12/2021. Amount: **200 K€.** Type of participation: **principal investigator**.

6. ***NanoGas***- Sensitive graphene-based H_2S gas sensor. *DTU discovery grant*, April 2019. Grant no. 99985-10, G-1. PI: **J.M. Caridad**, DTU Physics, Technical University Denmark. Period: 06/2019-12/2019. Amount: **20 K€.** Type of participation: **principal investigator**.

7. ***EU Graphene Flagship***. *EU H2020, flagship projects call 2012*. Grant no. GrapheneCore2 785219. PI: **P.Bøggild**,, DTU Nanotech, Technical University Denmar. Period: 01/2014-31/2017. Amount: **1 Million €.** Type of participation: **Postdoctoral researcher during 2014-2018, high-frequency electronics workpackage**.

C.4. Technology/knowledge transfer activities (most relevant)

1. ***Research scientist***. KLA corporation (semiconductor industry). Denmark and USA. Period (2020-2021). My roles in this company have been: (i) upgrade advanced industrial tools for the electrical characterization of thin films at wafer scale, (ii) lead researcher in developing 2D materials' metrology with automatic electrical probing.

2. **Patent Application** WO2019219645 "Gas sensor comprising graphene and a method to sense gases". Date: 11/2019. Inventors: **J.M. Caridad**, J.E. Santos and P. Bøggild. Owners: DTU and University of Minho.

3. ***DTU Discovery grant***. Project "***NanoGas***- Test sensitive graphene-based H_2S gas sensor in industrial setting". Knowledge transfer to the company Danish Gas Center (DGC). Grant no. 99985-10, G-1. PI: **J.M. Caridad**, DTU Physics. Period: 06/2019-12/2019. Amount: **20 K€.** Type of participation: **principal investigator**.

4. Project ***Energy harvesting with helical nanoantennae***. Commercial case feasibility grant, Enterprise Ireland. PI: **V. Krstic**, School of Physics, Trinity College Dublin. Period: 01/2012-12/2012. Amount: **100 K€.** Type of participation: **co-supervisor of the study**. This grant aimed to undertake a commercialization test of helical nanostructures, systems I grew up from scratch using a scalable fabrication method [patent application WO/2013/131586]

5. **Patent Application** WO/2013/131586 "Three dimensional nanosculptured structures of high surface-atom mobility materials and method of making the same". Date: 04/2012. Inventors: V. Krstic, **J.M. Caridad** Owner: Trinity College Dublin