

Luís D. Carlos

Full Professor of Physics

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RESEARCH PROFILE

Physicist working on luminescence, lanthanide spectroscopy and nanoscale sensing. My research has evolved from fundamental spectroscopy and lanthanide-based photonic materials to the **pioneering development of luminescence thermometry as a quantitative sensing methodology**, and subsequently to the use of luminescent probes to investigate nanoscale physical phenomena.

This work spans local temperature sensing, including intracellular thermometry, heat transport, and ballistic Brownian motion. Current research focuses increasingly on hydration water, using luminescent nanoprobe to explore structural fluctuations and how probe–water interactions shape what becomes experimentally observable.

SELECTED INDICATORS

616 publications · >34,300 citations · h-index 88

121 plenary, keynote and invited lectures

32 research projects led · >€6.5M secured for the University of Aveiro · 6 patents (1 licensed)

32 completed PhD theses · 3 PhD students currently supervised · 35 postdoctoral researchers mentored

Bibliometric data: Scopus, August 2026.

RESEARCH CONTRIBUTIONS

Lanthanide photophysics and luminescent materials. Spectroscopy of lanthanide-based luminescent systems, including complexes, organic–inorganic hybrids, metal–organic frameworks and nanoparticles, with particular emphasis on energy-transfer processes and their role in luminescence.

Molecular photonic and magnetic materials. Lanthanide-based molecular systems combining luminescence with magnetic and information-processing functionalities, including molecular logic, luminescent single-ion and single-molecule magnets, and magnetoelectric coupling.

Luminescence thermometry. Pioneering development of luminescence thermometry as a quantitative sensing methodology, from molecular and materials-based thermometers to nanoscale and intracellular temperature measurements, including applications to magnetic hyperthermia.

Luminescent probes for nanoscale physics. Extension of luminescent probes beyond temperature measurement to investigate nanoscale physical phenomena, including ballistic Brownian motion in nanoparticles and proteins, heat transport, and structural and density fluctuations in hydration water and the role of probe–water interactions.

ACADEMIC APPOINTMENTS & EDUCATION

APPOINTMENTS

2006–present Full Professor, University of Aveiro

1998–2006 Associate Professor, University of Aveiro

1996–1998 Assistant Professor, University of Aveiro

1995–1996 Assistant Professor, University of Évora

1987–1995 Assistant Lecturer, University of Évora

EDUCATION

2004 Habilitation (Agregação) in Physics, University of Aveiro

1995 PhD in Physics, University of Évora

1987 BSc in Physics, University of Coimbra

VISITING APPOINTMENTS São Paulo State University (Brazil) · Université Montpellier 2 (France) · Federal University of Pernambuco (Brazil) · University of Wrocław (Poland) · Nanjing Tech Visiting Professorship (2016)

HONOURS AND DISTINCTIONS

2025 Spanish–Portuguese Medinaveitia–Lourenço Award, Royal Spanish Chemical Society

2022 ICOM Award, for lifetime achievements in optical materials and long-standing support of the International Conference on the Physics of Optical Materials and Devices

2023–present Full Member, Lisbon Academy of Sciences (Physics); Corresponding Member, 2011–2023

2015–present Corresponding Member, Brazilian Academy of Sciences (Chemistry)

2004 Stimulus to Excellence Award, Portuguese Minister for Science and Technology

SCIENTIFIC LEADERSHIP & FUNDING

Founded the **Phantom-g research group and optical spectroscopy laboratory** at the University of Aveiro in 2000. Led **32 research projects**, including **8 European projects**. Across coordinated and collaborative projects, secured more than **€6.5 million** in research funding for the University of Aveiro. Coordinated two EU consortia, including **NanoTBTech**, a FET-OPEN project. NanoTBTech also contributed to the development of the PhotonIMAGER SWIR system (BioSpace Lab), now commercialised and in use.

MENTORING AND TRAINING

Mentored **35 postdoctoral researchers**, including 2 Marie Curie fellows, and supervised **32 completed PhD theses** (18 joint degrees), 19 MSc students and 13 undergraduate students; currently supervising **3 PhD students**. Hosted 11 postdoctoral researchers and 34 PhD students from Europe, Asia and the Americas for research stays of 2–6 months. Alumni include recipients of 1 ERC Starting Grant and 2 ERC Consolidator Grants.

SELECTED PUBLICATIONS

RESEARCH ARTICLES

- 2025** R. S. Raposo Filho, C. D. S. Brites, L. D. Carlos, “Tuning Water Density Fluctuations with Surface-Charged Colloidal Nanoparticles Probed by Luminescence”, *J. Phys. Chem. Lett.* **16**, 11683.
- 2024** E. Maturi, L. D. Carlos et al., “Deciphering Density Fluctuations in the Hydration Water of Brownian Nanoparticles via Upconversion Thermometry”, *J. Phys. Chem. Lett.* **15**, 2606.
- 2020** J. Long, L. D. Carlos et al., “Room Temperature Magnetoelectric Coupling in a Molecular Ferroelectric Ytterbium(III) Complex”, *Science* **367**, 671.
- 2020** R. Piñol, L. D. Carlos et al., “Real-Time Intracellular Temperature Imaging Using Lanthanide-Bearing Polymeric Micelles”, *Nano Lett.* **20**, 6466.
- 2016** C. D. S. Brites, L. D. Carlos et al., “Instantaneous Ballistic Velocity of Suspended Brownian Nanocrystals Measured by Upconversion Nanothermometry”, *Nature Nanotechnol.* **11**, 851.
- 2010** C. D. S. Brites, L. D. Carlos et al., “A Luminescent Molecular Thermometer for Long-Term Absolute Temperature Measurements at the Nanoscale”, *Adv. Mater.* **22**, 4499.
- 2007** L. D. Carlos, V. de Zea Bermudez, V. S. Amaral, S. C. Nunes, N. J. O. Silva, R. A. S. Ferreira, J. Rocha, C. V. Santilli, D. Ostrovskii, “Nanoscopic Photoluminescence Memory as a Fingerprint of Complexity in Self-Assembled Alkyl/Siloxane Hybrids”, *Adv. Mater.* **19**, 341–348.

SELECTED BOOK

- 2016** L. D. Carlos, F. Palacio (eds.), *Thermometry at the Nanoscale – Techniques and Selected Applications*, RSC Nanoscience & Nanotechnology No. 38, Royal Society of Chemistry, Cambridge.

REVIEWS AND PERSPECTIVES

- 2023** C. D. S. Brites, R. Marin, M. Suta, A. N. Carneiro Neto, E. Ximendes, D. Jaque, L. D. Carlos, “Spotlight on Luminescence Thermometry: Basics, Challenges, and Cutting-Edge Applications”, *Adv. Mater.* **35**, 2302749.
- 2016** C. D. S. Brites, A. Millán, L. D. Carlos, “Lanthanides in Luminescent Thermometry”, *Handbook on the Physics and Chemistry of Rare Earths* **49**, 339–427. **Most cited contribution in the series (Scopus, August 2026).**
- 2012** C. D. S. Brites, L. D. Carlos et al., “Thermometry at the Nanoscale”, *Nanoscale* **4**, 4799.
- 2011** L. D. Carlos, R. A. S. Ferreira, V. de Zea Bermudez, B. Julián-López, P. Escribano, “Progress on the Photonic Properties of Lanthanide-based Organic-inorganic Hybrids”, *Chem. Soc. Rev.* **40**, 536–549.

SELECTED ACADEMIC SERVICE

Institutional leadership. Vice-Director, CICECO – Aveiro Institute of Materials (2009–2019); elected member, General Council, University of Aveiro (2021–2025); Chairman, Scientific Board, Department of Physics (2004–2008).

Editorial activity. Editor, Journal of Alloys and Compounds and Physica B; Specialty Chief Editor, Inorganic Chemistry, Frontiers in Chemistry; member of the Scientific Advisory Committee of The European Physical Journal; Editorial Boards, Journal of Rare Earths and Journal of Sol-Gel Science and Technology.

Research evaluation. Evaluator for ERC and national research agencies internationally; coordinator of FCT evaluation panels for the Portugal/CERN cooperation programme and PhD grants in Materials Science and Engineering and Nanotechnology; served on academic-appointment panels across Europe, the USA and Asia, including recent panels in China, Japan and India.