



## GERVASI HERRANZ

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I am a Condensed Matter Physicist working in *Materials Science*, *Quantum Transport* and *Nanophotonics* at the Institute for Materials Science of Barcelona (ICMAB), which belongs to CSIC (Consejo Superior de Investigaciones Científicas, the Spanish National Research Council). I got my current position in 2008, and recently I promoted to CSIC-Scientific Researcher. Before my incorporation to CSIC, I spent four years (2004-2008) as a postdoc at the Unité Mixte Physique-CNRS Thalès, led by Prof. Albert Fert (recipient of the Nobel Prize in Physics in 2007), where I worked in Spintronics.

**My research.** The potential of transition metal oxides, a class of strongly correlated systems, motivates my research to find pathways to fundamental discoveries and applications in electronics and photonics. These materials are distinguished by their rich variety of physical properties, which come from a delicate balance of different energy scales. This makes them particularly susceptible to external perturbations, inducing transitions among different electronic phases (magnetic, ferroelectric or superconductive).

Along these lines, my scientific activity has led to fundamental discoveries related to *quantum transport in oxide quantum wells* (QWs) at the LaAlO<sub>3</sub>/SrTiO<sub>3</sub> interfaces. This regards the basic understanding of these QWs (PRL 2007, Nat. Mater. 2008, PRL 2017) and the pioneering discovery of these QWs at nonconventional crystal orientations (Sci. Rep. 2012, PRL 2014). These unexpected QWs have led to further findings related to *low-dimensional superconductivity and Rashba spin-orbit coupling* (Nat. Comms. 2015, Nat. Mater. 2019) and the discovery of unusual phototransport (PRL 2020). My push for a deep understanding of many other oxides has led to collaborations with other groups, contributing, e.g., to basic knowledge of the subband structure of QWs at the SrTiO<sub>3</sub> surface (Nature 2011) or topological Hall effect in some manganites (Nat. Phys. 2019).

In parallel, my curiosity has run along the investigation of *light-matter interactions*, especially in photonic and plasmonic crystals (ACS Nano 2011, Nanoscale 2012, Opt. Express 2018). My interest in this field has spurred important contributions to the understanding of *dynamic transport of polarons* in manganites (PRB 2009, PRB 2014), which have led to the discovery of spin-dependent polaron transport (PRL 2016). Findings related to this field are at the root of my proposition for manganites as prospective materials for quantum computation, which is outlined in this project.

**My activity.** Over the last 10 years, I have *supervised seven Doctoral Theses* and another is *currently under supervision*. In the same period, I have supervised *two postdocs* (one in 2011-11, and a *MSCA-IF fellow* in 2017-2020). Since 2009 I delivered more than 20 invited talks (including APS March Meeting 2009 & 2015, MRS Spring 2013, E-MRS Fall 2018, SPIE Photonics 2010 & 2019, MMM-Intermag 2012, META-conferences 2019 & 2020) and more than 60 oral communications. I am co-author of two *book chapters* in the field of photonics (Ed. By Royal Soc. Of Chem., 2013, ISBN: 978-1-84973-653-4) and 2DEGs (“Oxide Spintronics”, Pan Stanford Publishing, 2019, ISBN 9814774995). I have organized symposia at the MRS Spring and EMRS (MRS Spring 2011 and 2013 and E-MRS Spring 2015) and I participated in the organization of the International School of Oxide Electronics 2011 (Cargèse, France). I have lectured at schools for

researchers and specialists, as well as at *invited seminars* for students and general audience at various centres in *Europe, America* and *Asia*. I have participated in *PhD Committees across Europe* (Spain, France, the Netherlands, Switzerland, Czech Republic, Finland). I have been *Management Committee member* of EU-COST Action MP1308 “Towards Oxide-Based Electronics”.

I have published more than 100 articles. Over the *last 6 years* the list includes 1 *Nature Materials*, 1 *Nature Physics*, 2 *Nature Communications*, 1 *ACS Appl. Mater. Interfaces* and 5 *Physical Review Letters*. Publications before 2014 include also 1 *Nature*, 1 more *Nature Materials*, 5 more *Physical Review Letters* and 1 *ACS Nano*, among many others (16 PRBs, 14 APLs, etc.). My h index is  $h = 29$  (as of August 2020) and the number of citations is  $> 3470$ . My scientific record is available at Researcher ID: <http://www.researcherid.com/rid/G-2770-2014> and ORCID: <http://orcid.org/0000-0003-4633-4367>, and [Google Scholar](https://gervasi-herranz.blog/). News about my research can be found at the *website* <https://gervasi-herranz.blog/>.

**Representative publications 2010-2020 (with short explanatory sentence).** All publications listed below are either the direct result of my activity or research developed under my supervision.

- G. Herranz et al., *Scientific Reports* 2, 758, (2012). Seminal work reporting on the observation of (110)-oriented LaAlO<sub>3</sub>/SrTiO<sub>3</sub> quantum wells (only (001)-oriented wells were conceivable at that time).
- J. M. Caicedo, J. Fontcuberta, and G. Herranz. *Phys. Rev. B* 89, 045121 (2014). It summarizes our findings over the previous years on magneto-optics derived from polaron dynamics in manganites.
- D. Pesquera et al., *Physical Review Letters* 113, 156802 (2014). Discovery of the subband state hierarchy of LaAlO<sub>3</sub>/SrTiO<sub>3</sub> quantum wells and its relation to the orbital symmetries.
- G. Herranz et al., *Nature Communications* 6, 6028 (2015). 2D-superconductivity and Rashba spin-orbit coupling in LaAlO<sub>3</sub>/SrTiO<sub>3</sub> quantum wells explained by selective orbital occupancy.
- B. Casals et al., *Physical Review Letters*, 117, 026401 (2016). Discovery of spin-dependent polaron transport, resulting in giant magneto-optical activity in manganites.
- J. Gazquez et al., *Physical Review Letters*, 119, 106102 (2017). Observation of polar lattice distortions in LaAlO<sub>3</sub>/SrTiO<sub>3</sub> quantum wells due to extreme confinement of phonon modes,
- B. Casals et al., *Physical Review Letters*, 120, 217601 (2018). Elucidation of the driving mechanism for ferroelastic motion in SrTiO<sub>3</sub>, due to a previously unreported excitation of an IR-active lattice mode.
- R. Cicheler et al., *Optics Express*, (2018). Non-reciprocal diffraction in magnetoplasmonic gratings.
- Y. Chen et al., *Physical Review Letters*, 124, 246804 (2020). Unconventional phototransport in LaAlO<sub>3</sub>/SrTiO<sub>3</sub> QWs, with carrier population modulated by the relative timing of optical pulses.

Selected publications resulting from collaborations with other groups

- A.F. Santander-Syro et al., *Nature* 469, 189–193 (2011). Discovery of the subband structure of QWs at the SrTiO<sub>3</sub> surface.
- Vistoli et al., *Nature Physics* 15, 67–72 (2019). Giant topological Hall effect in a correlated manganite.
- G. Singh et al., *Nature Materials* 18, 948–954 (2019) First observation of a multi-condensate superconductor tuneable by electrostatic gating in LaAlO<sub>3</sub>/SrTiO<sub>3</sub> quantum wells.

#### **Invited Lectures at Schools, Universities & Research Centres (2010-2020)**

**Schools (2010-2020):** 6<sup>th</sup> *European School on Multiferroics* (ESMF6) July 21-26, 2013 Wittenberg, Germany; *International School of Oxide Electronics 2013* Lectures, September 2-14, 2013, Cargèse, France

#### **Invited Lectures in Research Centres & Institutions (2010-2020):**

*Chalmers University*, Göteborg (Sweden) February 2010, *University of Mainz* (Germany) January 2012, *ESPCI-ParisTech* (Paris, France) November 2013, *Technical University of Darmstadt*, Germany, November 2014, *University of the Basque Country*, Spain, June 2015, *Institute for Basic Science Centre for Correlated Electron Systems* (IBS CCES) Seoul, South Korea, December 2017; *INN-CNEA, Buenos Aires*, Argentina, December 2017.

**Invited talks (2010-2020)** (selection of most relevant): *SPIE Optics + Photonics*, San Diego, USA, August 2010. *MMM-Intermag 2012, Vancouver*, Canada, May 2012. *APS March Meeting* 2015, New Orleans (USA),

March, **2015**. 10<sup>th</sup> Int. Conf. on Advanced Materials and Devices (ICAMD2017) Jeju (South Korea), December, **2017**. E-MRS Fall Meeting 2018, Warsaw, Poland, September **2018**. META 2019, 10<sup>th</sup> Intl. Conference on Metamaterials, Photonic Crystals and Plasmonics, Lisbon, Portugal, July **2019**, SPIE Optics + Photonics, San Diego, USA, August **2019**. META 2020, 11<sup>th</sup> Intl. Conference on Metamaterials, Photonic Crystals and Plasmonics, Warsaw, Poland, July **2020** (postponed to 2021).

**Participation in PhD Committees (supervisors indicated):** Sorbonne University, ESPI-ParisTech, France, (Prof. J. Lesueur), **2015**; Université Paris Sud, France (Prof. M. Gabay), **2016**; Autonomous University of Barcelona-ICN2, Spain (Prof. G. Catalán), **2016**, Autonomous University of Barcelona-ICN2, Spain, (Profs. J. Santiso & F. Sandiumenge), **2017**; Delft University, the Netherlands (Prof. A. Caviglia), **2019**; University of Geneva, Switzerland (Prof. J.-M. Triscone), **2019**; Charles University in Prague, Czech Republic (Profs. M. Veis & P. Lecoœur), **2019**; Aalto University, Finland (Prof. S. van Dijken), **2019**; ICFO-Institute for Photonic Science, Spain (Prof. V. Pruneri) **2019**; Autonomous University of Barcelona-ICN2, Spain, (Prof. J. Mompart), **2020**; Université Paris Sud, France, (Prof. M. Gabay) **2020** (November).