Dr Giacomo Prando

Curriculum Vitae et Studiorum [redacted])

Studies and education

March 2012	Defence of the **Ph. D. thesis** "Phase Diagrams of $REFeAsO_{1-x}F_x$ Materials: Macroscopic and Nanoscopic Experimental Investigation", supervisor Prof. Pietro Carretta.
November 2008 – December 2011	**Ph. D.** in "Physical Sciences of Matter" with a grant awarded by the National Interuniversity Consortium for the Physical Sciences of Matter (C.N.I.S.M.) at **Università degli Studi Roma Tre** – Roma, Italy.
September 2006 – September 2008	**Master of Science** in "Physical Sciences" (specialization in Condensed Matter Physics) at **Università degli Studi di Pavia** – Pavia, Italy. Thesis "Dilution effects in $Ho_{2-x}Y_xSn_2O_7$. From the Spin Ice to the single-ion magnet", full marks with distinction (110/110 e lode), supervisor Prof. [redacted].
September 2003 – December 2006	**Bachelor** in "Physics" at **Università degli Studi di Pavia** – Pavia, Italy. Thesis "*Fluttuazioni superconduttive e diamagnetiche nella regione critica di nanoparticelle metalliche*", full marks with distinction (110/110 e lode), supervisor Prof. [redacted].
September 2003 – May 2009	Class of Science e Technologies (VIII cycle) at the **I.U.S.S. – School for Advanced Studies** – Pavia, Italy. Graduation thesis "Power-law distributions in nature and society", supervisor Prof. [redacted].
September 2003 – July 2008	Fellow of **Collegio Ghislieri** (Pavia, Italy), ranked by the Italian Ministry of Education and University as Highly Qualifying Institution under the High Patronage of the Presidency of the Italian Republic, with first-year admission by national competitive examination.

Language skills

Italian	Mother tongue.
English	Spoken: *fluent*. Written: *fluent*. Oral comprehension: *fluent*.
Spanish	Spoken: *good*. Written: *good*. Oral comprehension: *good*.
German	Spoken: *fair*. Written: *good*. Oral comprehension: *fair*.

Working positions

Current position

November 2017 – to date	**Research associate** (*ricercatore RTDA*) at the **Department of Physics of the University of Pavia**, Italy.

Past positions

March 2016 – November 2017	**Associate editor** at **Nature Nanotechnology**, Springer Nature – London, UK.
July 2015 – February 2016	**Post-doctoral researcher** at **Technische Universität Dresden** – Dresden, Germany.
January 2012 – June 2015	**Post-doctoral researcher** at **Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden** – Dresden, Germany.

Honors and awards

March 2018	Successfully evaluated, with excellent ("*ottimo*") remarks, within the **Italian National Scientific Qualification** (*Abilitazione Scientifica Nazionale*). Formally qualified to become **Associate Professor** in Italy until 30th March 2027.
July 2013 – June 2015	**Post-doctoral research fellow** of the **Alexander von Humboldt Stiftung** with an individual "Research Fellowship for Postdoctoral Researchers" (63.6 k€). My research activity was carried out at Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden – Dresden, Germany.
July 2012 – June 2013	**Post-doctoral research fellow** of **Deutscher Akademischer Austausch Dienst** with an individual "Leibniz-DAAD Research Fellowship" (23 k€). My research activity was carried out at Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden – Dresden, Germany.
September 2011	**Awardee** of the **"Augusto Righi" Prize for Scientific Industry of Young Scientists**. The prize was awarded by S.I.F. (Italian Physical Society).

Research activity: bibliometrics

Publications in peer-reviewed journals	**37** I am first author in 16 papers. Out of these 16, 1 paper is published on *Nano Letters*, 1 on *Physical Review Letters* and 11 on *Physical Review B*.
Peer-reviewed conference proceedings	**2** (both as first author)
Other publications	**29** Out of these 29 publications, 27 are single-author contributions on *Nature Nanotechnology* (News&views, Research Highlights, In The Classroom) and on *Nature Physics*.

Citations	**590** **599**	(Web of Science) (Scopus)	***h* index**	**17** **17**	(Web of Science) (Scopus)

Research interests

My research activity concerns solid state physics and, in particular, **magnetism and superconductivity in condensed matter** from an experimental perspective. Starting from the measurements I performed in 2006 within the framework of my Bachelor thesis, and up to my current work as research associate, I have been researching on **superconductors**, both conventional (lead nanoparticles) and unconventional with high critical transition temperatures (iron-based oxy-pnictides). I have focused on the microscopic study of electronic phase diagrams and of the ***coexistence of magnetism and superconductivity*** as a function of different tuning parameters, both chemical (substitutions) and physical (pressure). I have studied physical phenomena characteristic of the superconducting phase as well, such as the ***vortex motion*** and the ***amplitude and/or phase fluctuations of the superconducting order parameter*** at temperatures higher than the critical T_c. I have worked on electronic phase diagrams and magnetic properties of several **strongly-correlated electron systems** such as cuprates and, more recently, of **topological phases of matter** resulting from the coexistence of electronic correlations and spin-orbit interaction (iridium-based oxides). Finally, I have investigated the exotic magnetism arising in **geometrically-frustrated magnets** on tri-dimensional lattices (spin-ice, molybdenum-based pyrochlores).

Technical skills

I am well-experienced in several techniques of magnetic investigation, of both macroscopic and local nature. **Dc magnetometry** and **magnetic ac susceptometry** belong to the former class. The latter class is composed by most of the magnetic spectroscopies such as **muon-spin rotation** (μ^+SR), **nuclear magnetic resonance** (NMR), and **electron spin resonance** (ESR). For both μ^+SR and dc magnetometry, I have gained a substantial experience with experimental set-ups enabling the application of **external pressures** of low and intermediate values (up to 6 GPa). As complementary techniques, I also have experience in measurements of **electrical transport** (resistivity) and **calorimetry** (specific heat).

Noteworthy results of my research activity

- Within the work for my Ph. D. thesis, I have tackled the topic of the mobility of flux lines in the mixed phase of iron-based superconductors – a topic rich with important implications for both fundamental and application-oriented research. To this aim, I have performed measurements of ac susceptibility on both powder and single-crystal samples. My first results were relative to compounds belonging to the 1111 family and have been published in *Physical Review B* **83** 174514 and *Physical Review B* **85** 144522. Here, I have investigated the magnetic field - temperature phase diagram delimiting, in particular, the regions where flux lines are not static, resulting in energy dissipation. I have also quantified the characteristic energies for the pinning processes involving structural defects. More recently, I have expanded these results to other families of iron-based superconductors (*Journal of Physics: Condensed Matter* **25** 505701), where the phenomenology is different and reveals a critical scaling characteristic of a phase transition between solid and liquid phases for the flux lines.

- One of the first interesting experimental observations about iron-based superconductors belonging to the 1111 family has been the strong dependence of the maximum value of the critical temperature T_c on the lanthanoid element in the material. I have focused on the comprehension of this phenomenology for long time – during both my PhD and my activity as post-doctoral researcher – initially considering undoped, non-superconducting 1111 compounds based on Co. These materials are characterized by a ferromagnetic ground state which I have investigated by means of muon spin spectroscopy under external pressure. Based on the results published in *Physical Review B* **87** 064401 and *Physical Review B* **92** 144414 I have shown that the effect of pressure is quantitatively equivalent to that of the structural distortions induced by progressively increasing the size of the lanthanoid elements. Based on my recent complementary measurements of ferromagnetic resonance, published in *Physical Review B* **94** 024412, I have shown that the increase in chemical pressure also influences sizeably the magneto-crystalline anisotropy. These results have been propaedeutical to the comprehension of superconducting systems under the effect of chemical and external pressures, allowing me to evidence the crucial effect of quenched disorder and non-magnetic defects – as I have shown in *Physical Review Letters* **114** 247004.

Peer review activity

Scientific journals	Physical Review Letters, Physical Review X, Physical Review B, Physical Review Materials, New Journal of Physics, Journal of Physics: Condensed Matter, Superconductor Science and Technology, Physica Status Solidi B, NPG Asia Materials, Journal of Physics: Conference Series.
Publishing houses	Oxford University Press.

Conferences, workshops and seminal activity

Participation

Invited talks at conferences and workshops	**5** (see the list below, numbered It#.)	**Invited talks and seminars in Universities**	**8**	**Contributed talks at conferences and workshops**	**18**

It5. April 2018	International conference "6th International Conference on Superconductivity and Magnetism – ICSM2018" – Antalya, Turkey. Talk "Fe- and Co-based oxypnictides: Structural tuning of electronic ground states".
It4. March 2015	Workshop "3rd ERC Symposium QuantumPuzzle" – Vienna University of Technology, Wien, Austria. Talk "μ^+SR under pressure: investigations of magnetism and superconductivity in iron-based pnictides".
It3. June 2014	Workshop "Itinerant Magnetism and Superconductivity - IMS 2014" – Dresden, Germany. Talk "Chemical dilutions, external and chemical pressures. Electronic phase diagrams of 1111 oxy-pnictides investigated by means of μ^+SR".
It2. October 2013	Workshop "Hot Topics in HTSC: Fe-Based Superconductors" – Zvenigorod, Moscow, Russia. Talk "Electronic phase diagrams of 1111 oxy-pnictides investigated by means of muon spin spectroscopy".
It1. October 2011	Workshop "Highlights in Condensed Matter Physics - Superconductivity and Magnetism" – Università degli Studi di Pavia, Pavia, Italy. Talk "NMR, μ^+SR and AC susceptibility in Fe-based superconductors".

Organization

July 2020	International Conference "Muon Spin Rotation, Relaxation and Resonance μSR2020" – Parma, Italy.
October 2017	Nature Conference "Ferroic Materials: Challenges and opportunities" – Xi'an, China.
July 2014	Workshop "NμM2014: NMR, μ^+SR, Mössbauer spectroscopies in the study of Fe-based and other unconventional high-T_c superconductors", Leibniz-Institut für Festkörper- und Werkstoffforschung – Dresden, Germany.