

## CARDANI LAURA

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URL for web site: <http://www.roma1.infn.it/~cardani/>

### • EDUCATION

- 2014 PhD, Physics Department - Sapienza, University of Rome, Italy  
Supervisor: Fernando Ferroni (Thesis Title: "ZnSe and ZnMoO<sub>4</sub> scintillating bolometers to search for double beta decay")
- 2010 Master degree, Physics Department - University of Milano-Bicocca, Italy. 110 cum laude.  
Supervisor: Chiara Brofferio (Thesis Title: "Development of scintillating bolometers for rare events searches")

### • CURRENT POSITION

- 2017 Staff Researcher, Istituto Nazionale di Fisica Nucleare (INFN), Rome Division, Italy

### • PREVIOUS POSITIONS

- 2014 – 2017 Visiting Postdoctoral Research Associate (Dicke Fellowship), Physics Department - **Princeton University**, Princeton, New Jersey, US
- 2016 – 2017 Fixed Term Researcher, Istituto Nazionale di Fisica Nucleare (INFN), Rome Division, Italy
- 2014 – 2016 Postdoctoral Research Associate, Sapienza, University of Rome, Italy

### • FELLOWSHIPS AND AWARDS

- 2014 – 2017 Dicke Fellowship, Princeton University, Princeton, New Jersey, US.
- 2012 Award for the Best Italian Young Physicist (granted by the Italian Physics Society).
- 2010 Enrico Legler Award for the Best Graduate Students.
- 2010 – 2011 Scholar Fellowship at the INFN Gran Sasso National Laboratories (L'Aquila, Italy).

### • SUPERVISION OF GRADUATE STUDENTS

- 2021 – today Co-supervisor of a PhD student (F. De Dominicis) at Gran Sasso Science Institute, Italy
- 2020 – today Co-supervisor of a PhD student (A. Ressa) at Sapienza, University of Rome, Italy
- 2019 – 2020 Two master students (A. Ressa and F. de Dominicis) at Sapienza, University of Rome, Italy
- 2018 – 2019 Two master students (E. Celi and S. Sorbino) and a bachelor student (A. Irace) at Sapienza, University of Rome, Italy
- 2017 – 2018 One master student (E. Bossio) and a bachelor student (A.L. Dastoli) at Sapienza, University of Rome, Italy
- 2015 – 2016 One master student (A. Balzoni) at Sapienza, University of Rome, Italy

### • TEACHING ACTIVITIES

- 2017 – today Teaching Assistant – Laboratory of Nuclear and Subnuclear Physics - Sapienza, University of Rome, Italy
- 2016 – 2018 Teaching Assistant – Thermodynamic and Thermodynamic Laboratory - Sapienza, University of Rome, Italy
- 2014 – 2016 Teaching Assistant – Signals and Circuits Laboratory - Sapienza, University of Rome, Italy
- 2012 – 2014 Teaching Assistant – Thermodynamic and Thermodynamic Laboratory - Sapienza, University of Rome, Italy
- 2012 – 2013 Teaching Assistant – Radiation Detectors - Sapienza, University of Rome, Italy

- **ORGANISATION OF SCIENTIFIC MEETINGS**

- 2021 Co-organizer of the Summer School “Quantum Computation and Sensing” at the Galileo Galilei Institute (21 June – 2 July), about 60 students.
- 2019 Member of the Scientific Advisory Committee for the Low Temperature Detector International Conference (22-26 July 2019, Milano, Italy), about 400 participants.
- 2019 Organizer of the WE-Heraeus-Seminar “Superconducting Kinetic Inductances” (11-13 November 2019, Physikzentrum Bad Honnef, Germany), about 65 registered participants. The co-organizers are prof. M.Schaeffler (Stuttgart University, Germany) and dr. I. Pop (KIT, Karlsruhe, Germany).

- **INSTITUTIONAL RESPONSIBILITIES**

- 2022 – today **Co-PI and INFN Coordinator** of the project COLD (Coating for Optimized Low Temperature Device) funded with an italian “PRIN” grant.
- 2020 – today **Co-PI and Co-Leader of the thrust “quantum devices”** for the SQMS centre, to develop a new superconducting quantum processor (about 150 collaborators, mainly from US).
- 2021 – today **L1 Italian Manager, and L2 Manager of the “Detector Design” thrust** for the CUPID experiment, to search for double beta decay with background free detectors (about 150 collaborators, mainly from IT, FR and US).
- 2018 – today **Local Coordinator** of the INFN Rome division for CUPID (about 15 members).
- 2019 – 2021 **Co-convener of the Detector Group** for the CUPID experiment.
- 2018 – 2021 **Principal Investigator** of DEMETRA, to suppress radioactivity in superconducting circuits (about 20 collaborators mainly from IT and GE).
- 2015 – 2019 **Analysis Coordinator** of CUPID-0, the pilot experiment for CUPID (about 60 researchers mainly from IT and FR).
- 2014 – 2016 **Coordinator** of the cryogenic laboratory of CALDER, to develop light detectors based on superconducting circuits (Kinetic Inductance Detectors).

- **REVIEWING ACTIVITIES**

- 2019 – Referee for the Journal of Physics D: applied physics.
- 2018 – Referee for the European Physics Journal C.
- 2014 – Referee for the Journal of Low Temperature Physics.
- 2016 – Referee for the Journal of Crystals and Alloys.

- **MAJOR COLLABORATIONS**

In the field of Double Beta Decay searches I was member of the LUCIFER and CUPID-0 and CUPID-Mo collaborations, and I am a member of the international collaborations CUORE and CUPID.

In 2018 I started a collaboration with the group led by I. Pop (KIT, Karlsruhe, GE) to investigate the effects of radioactivity in superconducting circuits, both for applications in particle physics and quantum bits. I collaborated with the group of R. McDermott (Wisconsin University, US) to model the effect of radioactivity on quantum error correction. I am now a member of the SQMS center, led by Fermilab, to develop a novel quantum processor.

- **SCIENTIFIC OUTPUT**

- 171 published documents with 3053 citations, h-index: 33 -source: scopus.
- 10 invited seminars (5 on the effects of radioactivity on quantum circuits, 3 on Double Beta Decay searches, 1 on Dark Matter searches with bolometers, 1 on low background technologies), 17 contributions at international conferences, 2 contributions to national conferences
- Coordinators of the experimental seminars in the INFN Department of Rome, Italy.
- Outreach: responsible for the public website of the CUORE (until 2019), CALDER (until 2020) and NUCLEUS-Roma collaborations. Collaboration with many projects for high schools, such as “Lab2Go”, “GiovedìScienza”, “Viaggio in Cuffia nel Dipartimento di Fisica”. Author of two Podcasts on quantum technologies (Fisicast -[link](#), and Co-Scienza - [link](#)) and interview on ScienceShow ([link](#)).

## **Curriculum Vitae Sintetico del Dr. Fabio Chiarello**

Fabio Chiarello, PhD (1999), fisico e ricercatore dell'Istituto di Fotonica e Nanotecnologie CNR di Roma (dal 2001), si occupa di dispositivi e rivelatori superconduttori, tecnologie quantistiche, design, simulazione e studio di dispositivi, misure elettriche in condizioni di bassa temperatura e basso rumore. È associato all'INFN e collabora con i Laboratori Nazionali di Frascati su progetti di rivelazione di Assioni e particelle Axion-like con dispositivi Josephson.

Roma, 14/07/2022

Fabio Chiarello

**PERSONAL INFORMATION** Francesco Mattioli

Enterprise	University	EPR
<input type="checkbox"/> Management Level	<input type="checkbox"/> Full professor	<input type="checkbox"/> Research Director and 1st level Technologist / First Researcher and 2nd level Technologist
<input type="checkbox"/> Mid-Management Level	<input type="checkbox"/> Associate Professor	<input checked="" type="checkbox"/> Level III Researcher and Technologist
<input type="checkbox"/> Employee / worker level	<input type="checkbox"/> Researcher and Technologist of IV, V, VI and VII level / Technical collaborator	<input type="checkbox"/> Researcher and Technologist of IV, V, VI and VII level / Technical collaborator

**WORK EXPERIENCE**

from 16-12-2009 to today

**Permanent position**

Permanent staff researcher since 16/12/2009 at the Istituto di Fotonica e Nanotecnologie of the National research Council in Rome. Competition announcement: n. 364.13 area scientifica "SCIENZE FISICHE" (III), raggruppamento omogeneo III Posizione C, RM36/1.

from 15-07-2007 to 14-07-2009

**Temporary position**

IFN-CNR. temporary staff researcher at the CNR-Istituto di Fotonica e Nanotecnologie in Rome. art. 23 del DPR 171/91. Competition announcement n. IFN/RM 01/2007. CNR/INAF BepiColombo MPO MMO project. Title: "Studio e messa a punto dei processi di nanolavorazione per la realizzazione di parti del rivelatore di atomi neutri "ELENA" ed in particolare per lo sviluppo delle nanogriglie di shuttering per tale rivelatore"

**EDUCATION AND TRAINING**

07-06-2004

**PHD in Physics**

University of Rome "Roma TRE"  
Thesis title: "Dispositivi basati su giunzioni tunnel di dimensioni mesoscopiche".  
Supervisors: Dott. R. Leoni and Dott. M. G. Castellano

25-05-2000

**Degree in Physics**

1992/93 – 1999/00  
University of Rome "La Sapienza", 110 e lode / 110  
Thesis title: "Realizzazione di dispositivi mesoscopici di silicio germanio su silicio".

**PERSONAL SKILLS**

Mother tongue(s) Italian

Other language(s)

UNDERSTANDING		SPEAKING		WRITING
Listening	Reading	Spoken interaction	Spoken production	
C1	C1	C1	C1	C1

Digital skills

Beyond the standard computer knowledge( Microsoft Office™, Windows, CADs ecc.), I was involved in the development of "LabVIEW" programs for what concerns measurement automation and data acquisition and analysis.

Job-related skills I have studied issues related to the epitaxial heterostructures growth. I have used HV-CVD (high vacuum chemical vapor deposition) systems and several techniques for the morphological characterization of thin films: RHEED (reflection high energy electron diffraction), AFM (atomic force microscope), XPS (X-ray spectroscopy).

I can use all the typical clean room microelectronics and nanofabrication techniques, such as optical and electron beam lithography, wet etching and dry etching with RIE (reactive ion etching) and the standard deposition techniques such as sputtering and e-beam and thermal evaporation. I can use also SEM (scanning electron microscope) systems.

I have been involved in low temperature and low noise electrical and optical characterization. In particular, I gained experience with liquid helium systems (4.2 K), with different cryogen free refrigerators (12K, 2.5K, 1.6K) with a 3He closed loop refrigerator (300 mK) and with a dilution refrigerator reaching 20 mK..

**SCIENTIFIC ACTIVITIES**

In all the activities listed below I have participated in the design and implementation of the devices, using all the techniques of micro and nano fabrication needed on the purpose. I have used the techniques of morphological analysis for the study and optimization of the processes. I have characterized the transport properties of the devices even at low temperatures when necessary.

Quantum Computation and Quantum Information I attended the creation and characterization of devices for solid state implementation of a two-level system and the reading of its state in the framework of "quantum state engineering" for "quantum computation" and "quantum information". The devices exploit the properties of superconducting Josephson junctions circuits in an appropriate geometry. The manipulation of the quantum state of a single q-bit or two coupled q-bits is done by checking macroscopic quantities (currents and voltages). This work done in the framework of the project RSFQUBIT was aimed at implementation of q-bit control and measure based on RSFQ (Rapid Single Flux Quantum logic) logic.

Superconducting Single Photon Detectors (SSPD) Devices capable of detecting at high-frequency infrared single-photon found a natural application in interplanetary broadband communications, semiconductor circuits analysis and quantum key distribution. The SSPD are photonic devices whose operating principle is based on a combination of the superconducting properties of the material and the size of the nanoscale device. The high frequency of use, low dark count quantum efficiency that have reached with the progress of work under the project SINPHONIA make this class of devices particularly promising for technological applications.

Bolometers and radiation detectors Using the techniques of micro and nanofabrication I participated in the creation and characterization of bolometers for the detection of various types of electromagnetic radiation. Among these were made hot electron bolometer (based on superconductor / insulator / normal metal junctions with size submicrometric), traditional bolometers on suspended silicon nitride membranes (spider web bolometers) and hotspots bolometers. The applications of this class of device ranges from astrophysics to security. Doped semiconductor thermometers were characterized for the implementation in spider web bolometers.

Micromachining I'm using micromachining and nanofabrication techniques to create the shuttering element of a time of flight neutral particle analyzer for the ELENA instrument in the project SERENA that was recently selected by ESA to participate in the scientific mission to Mercury BepiColombo.

Single Electron Transistor (SET) I have realized and characterized at low temperature single electron transistor based on sub micrometric Superconducting / insulator / superconductor junctions for the study of the physics of mesoscopic systems and their application in quantum engineering.

**SCIENTIFIC / TECHNICAL QUALIFICATION (source: Scopus)**

H-index 22  
 No. publication 130  
 No. citations 1762

SELECTED PROJECTS

- 2022 - 2024 **Qub-IT**  
 is a project funded by National Commission 5 of INFN to develop superconducting qubits for Dark Matter searches and more [local unit 45.000€ ] participant of the IFN CNR
- 2019 - 2021 **SIMP “ Single Microwave Photon Detection”**  
 is a project funded by National Commission 5 of INFN to develop superconducting qubits for Dark Matter searches. Convenzione operativa tra CNR-IFN e LNF-INFN del 4/8/2020 [local unit 45.000€ ] Participant of the IFN CNR unit
- 2017-2020 **PRIN-MIUR 2015 – Plasmon-enhanced vibrational circular dichroism,**  
 (2015FSHNCB), 2017-2020, [total budget 347.000 € (miur) 493.877 € (total costs), local unit 101.900€] Local coordinator of the IFN CNR unit
- 2015-2018 **QUCHIP – Quantum Simulation on a Photonic Chip**  
 FETPROACT-3-2014 - Quantum simulation –, (GA 641039), 2015-2018, [total budget € 2 681 713,75 €, local unit 132.000€] Participant of the IFN CNR unit
- SERENA – Search for Exospheric Refilling and Emitted Natural Abundances Experiment**
- 2010-2016 Realizzazione otturatore (shutter) a nanogriglie per SERENA (AMDL 2010-2016): Unità Operativa 165.819 €.
- 2010-2015 SERENA attività scientifiche fasi B2, C, D (ASI/INAF 2010-2015): Unità Operativa 319.649 €.
- 2011-2014 Griglie d'arresto per il sensore ELENA –per attività industriali progetto SERENA fase C/D, lotto 2 (CGS (Compagnia Generale per lo Spazio) 2011-2014): Unità Operativa 70.863 €.
- 2008 Studio di fattibilità di un prototipo di filtri IR a mesh e per lo sviluppo di un encoder capacitivo (INAF 2008): Unità Operativa 30000€.
- 2008 Realizzazione di Griglie per un analizzatore di particelle neutre (ASI/INAF 2007-2008): Unità Operativa 70000€.
- 2010-2013 **QUANTIP “Quantum integrated photonics”,**  
 FP7-ICT, (244026 FP7-ICT), 2010-2013, [total budget 2 328 674 €, local unit 210.000 €] Participantt of the CNR UNIT
- 2006-2009 **SINPHONIA “Single-photon nanostructured detectors for advanced optical applications”**  
 FP6-ICT, 2006-2009, [total budget 1 916 856 €, local unit 270000 €]  
 Participant of the CNR UNIT
- 2004-2007 **RSFQUBIT - ‘RSFQ control of Josephson Junction Qubits’**  
 IST-2002-2.3.4.1 - FET - Open, 2004-2007, [total budget € 2 150 00] Participant of the CNR UNIT

## Selected Publications

Divochiy, A., Marsili, F., Bitauld, D., Gaggero, A., Leoni, R., Mattioli, et al.

**Superconducting nanowire photon-number-resolving detector at telecommunication wavelengths**

(2008) Nature Photonics, 2 (5), pp. 302-306. DOI: 10.1038/nphoton.2008.51

F. Mattioli, et al.

**Plasmonic Superchiral Lattice Resonances in the Mid-Infrared**

(2020) ACS Photonics 7, 10, 2676–2681 DOI: 10.1021/acsp Photonics.0c00161

D. Alesini, D. Babusci, C. Barone, B. Buonomo, F. Chiarello, et al.

**Status of the SIMP Project: Toward the Single Microwave Photon Detection**

(2020) Journal of Low Temperature Physics 199, pages348–354. DOI: 10.1007/s10909-020-02381-x

Alessandro Gaggero, Francesco Martini, Francesco Mattioli, et al.

**Amplitude-multiplexed readout of single photon detectors based on superconducting nanowires**

(2019) Optica 6 (6), 823-828. DOI: 10.1364/OPTICA.6.000823

F. Mattioli, Z. Zhou, A. Gaggero, R. Gaudio, R. Leoni, A. Fiore

**Photon-counting and analog operation of a 24-pixel photon number resolving detector based on superconducting nanowires**

(2016) Optics express 24 (8), 9067-9076

Sprengers, J.P., Gaggero, A., Sahin, D., Jahanmirinejad, S., Frucci, G., Mattioli, F., et al.

**Waveguide superconducting single-photon detectors for integrated quantum photonic circuits**

(2011) Applied Physics Letters, 99 (18), art. no. 181110. DOI: 10.1063/1.3657518

Ejmaes, M., Cristiano, R., Quaranta, O., Pagano, S., Gaggero, A., Mattioli, et al.

**A cascade switching superconducting single photon detector**

(2007) Applied Physics Letters, 91 (26), art. no. 262509. DOI: 10.1063/1.2828138

Renema, J.J., Gaudio, R., Wang, Q., Zhou, Z., Gaggero, A., Mattioli, F., Leoni, R., Sahin, D., De Dood, M.J.A., Fiore, A., Van Exter, M.P.

**Experimental test of theories of the detection mechanism in a nanowire superconducting single photon detector**

(2014) Physical Review Letters, 112 (11), art. no. 117604. DOI: 10.1103/PhysRevLett.112.117604

Mattioli, F., Leoni, R., Gaggero, A., Castellano, M.G., Carelli, P., Marsili, F., Fiore, A.

**Electrical characterization of superconducting single-photon detectors**

(2007) Journal of Applied Physics, 101 (5), art. no. 054302.

DOI: 10.1063/1.2709527

A Rettaroli, D Alesini, D Babusci, C Barone, B Buonomo, MM Beretta, et al.

**Josephson Junctions as Single Microwave Photon Counters: Simulation and Characterization**

(2021) Instruments 5 (3), 25