

MATTEO SALVATO

CURRICULUM VITAE ET STUDIORUM

English Version

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Date and place of birth: 26/07/1964 Roccapiemonte (SA)

Nationality: Italy

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e-mail: matteo.salvato@roma2.infn.it

Educational qualifications: 1983 High School "Liceo Scientifico V. Cuoco"- Napoli.
1992 Physics graduate (110/110 cum laude) University of Napoli "Federico II"
Thesis: "Scanning Photoacoustic Microscopy: Experimental set up for non destructive detection of inhomogeneity in solid samples"
Supervisor: Prof. U. Bernini

Actual position: Researcher (Assistant Professor) in Physics of Matter (FIS/03), Competition Sector 02/B1, at the Physics Department of the University of Rome "Tor Vergata". Eligible for National Scientific Qualification since 2013 as Associate Professor 02/B1- Experimental Physics of Matter

Research Field: **Experimental Condensed Matter Physics.** Innovative materials for photoconductive applications. Fabrication and electrical, optical, and structural characterization of thin films, nanostructures, and hetero structures. Electric transport phenomena in thin films, hetero structures, and nano structures. x-ray diffraction. Carbon nanotubes, graphene and topological insulators, electrical transport properties and applications in opto and nanoelectronic devices. Synthesis of electrical transport properties in superconducting films.
Author of more than **125** papers published in journals and proceedings in international conferences and speaker of more than **30** communications at national and international conferences. Source **ISI WEB:** number of products **112**, **h index=18**, citations **1100**. Source **SCOPUS:** number of products **118**, **h index=18**, citations **1122**. Source **GOOGLE SCHOLAR:** number of products **154**, **h index=21**, total citations **1478**.

Teaching Field Electronics, Thin Film Fabrication, Superconductivity, Electrical Conduction in Mesoscopic Systems

Mother tongue: Italian

Other Languages: Written and spoken English

POSITIONS HELD

- 2005 Researcher at the Faculty of Sciences of the University of Rome "Tor Vergata" for the scientific disciplinary sector FIS/03 banned with D.R. on 08/04/2003 (ref. 0782) G. U. - IV special series - n. 30 of 14/04/2003.
- 2001 Technical Officer (VIII qualification) in the Technical Scientific Functional Area at the Physics Department of the University of Salerno, Decree 16.07.2001 No. 4173.
- 2000 INFN researcher in the context of the CIPE program in the period 2000-2002.
- 1996 INFN researcher within the European Union's 1994-99 ERDF program for the project "Non-destructive analysis with eddy currents using superconducting devices" approved with resolution 156/95 by the INFN board of 28/07/1995
- 1993 Researcher of Physics at the National Electricity and Alternative Energy (ENEL S.p.A.)

TITLES AND AWARDS

Fellowships:

- 2020 Short Term Scientific Mission Scholarship within the European Union COST-STSM-ECOST-STSM-CA16218 project for the period 03/11/2020-19/12/2020 at Chalmers Institute of Technology-Goteborg (Sweden).
- 2019 EMM Master Nanoscience & Nanotechnology funding under the Erasmus Mundus Program in collaboration with the Chalmers Institute of Technology-Goteborg (Sweden).
- 2018 Short Term Scientific Mission Scholarship within the COST-STSM-ECOST-STSM-CA16218 project of the European Union for the period 23/09/2018-14/12/2018 at Chalmers Institute of Technology-Goteborg (Sweden).
- 2016 Short Term Scientific Mission Scholarship within the COST-STSM-ECOST-STSM-MP1308-080216-071524 European Union project for the period 21/02/2016-20/03/2016 at Chalmers Institute of Technology- Goteborg (Sweden).
- 2015 Short Term Scientific Mission Scholarship within the COST-STSM-ECOST-STSM-MP1201-240815-063902 European Union project for the period 08/24/2015-23/10/2015 at Chalmers Institute of Technology- Goteborg (Sweden).

- 1995 Scholarship of the National Research Council-National Group of Structure of Matter, grouping n. 02.02.27, under the topic "Structure of Matter and Physics of Materials".
- 1994 Scholarship on the topic "Creation of superconducting thin layers of BSCCO using molecular beam epitaxy", within the INFN Pic-Stride Italy 91701618 project.
- 1992 Scholarship theme 22 National Plan of Innovative Advanced Materials for the training of a researcher with the qualification level of responsible for scientific management oriented to the deposition methodologies of highly oriented superconducting ceramic layers.

Postgraduate schools:

- 1992 "**II National School of Superconductivity**" organized by the National Interuniversity Consortium for the Physics of Matter and by the Innovative Research Consortium for the South held in Vietri sul Mare (SA)

Eligibility in national competitions:

- 2013 Eligibility for the procedure for obtaining the National Scientific Qualification for the functions of second-tier university professor for the competition sector 02 / B1-EXPERIMENTAL PHYSICS OF MATTER-D.D MIUR 222 of 20 July 2013.
- 2004 Eligibility for the competition of Research Director (call n.856) at the INFN National Institute for Physics of Matter.
- 2002 Eligibility for the second level Senior Researcher competition at ENEA, Body for New Technologies, Energy and the Environment, Official Gazette dated 1/6/2001 n. 43.
- 2001 Eligibility for the second level Senior Researcher competition at the CNR - National Research Council, call n. 310.2.91 sector code PZ 95/1.
- 2001 Winner of a physics researcher competition at ENEA, Body for New Technologies, Energy and the Environment, G.U. 9/6 / 2000-4 special series "Competitions and Exams" n. 45, Pos. L2, professional level classification 8.
- 1999 Winner of the selection for 1 position as a researcher (senior level) at PIRELLI CAVI E SISTEMI for the production of superconducting tapes and cables (ref. Dr. Nassi, Pirelli Cavi e Sistemi, Viale Sarca Milano).

AWARDS

2019 special award of the Lazio Region StartCup Project 2019 "Nano-Carbon on Steel: carbon nanotube film for waterproof and protective coatings for steel". Winner of the competition for participation in the National "Maker Faire" event, Rome 18-20 October 2019.

RESEARCH STAYS ABROAD

- Scientific activity at the Chalmers Institute of Technology-Goteborg (Sweden), for the realization of a photodetector prototype based on Topological Insulators in collaboration with INFN-Roma 2 and Prof. Floriana Lombardi (October-December 2019).
- Scientific activity at the Chalmers Institute of Technology-Goteborg (Sweden), for the realization of thin layers of Topological Insulators in collaboration with Prof. Floriana Lombardi (February-March 2019).
- Scientific activity at the Belarusian State University of Informatics and Radioelectronics, Minsk Belarus for the realization of graphene/Si junctions for photodetectors in collaboration with Prof. Serghej Prischepa (June 2019).
- Scientific activity at the Chalmers Institute of Technology-Goteborg (Sweden), for the realization of nanowires of topological insulators in collaboration with Prof. Floriana Lombardi (September-December 2018).
- Scientific activity at the Belarusian State University of Informatics and Radioelectronics, Minsk Belarus for the realization of carbon-Si nano tube joints for photodetectors in collaboration with Prof. Serghej Prischepa (May-June 2018).
- X-ray diffraction experiment with synchrotron light for the study of the crystalline structure of silicene deposited on graphene grown on silicon carbide (SiC) substrates at the ESRF laboratory at the Sincrotron Radiation Facility in Grenoble (March 2018).
- Scientific activity at the Chalmers Institute of Technology-Goteborg (Sweden), for the study of superconductivity at the interface in $\text{CaCuO}_2 / \text{SrTiO}_3$ heterostructures in collaboration with Prof. Floriana Lombardi (Chalmers), Prof. Giuseppe Balestrino and Prof. Daniele di Castro (Rome "Tor Vergata") (February-March 2016).
- Scientific activity at the Chalmers Institute of Technology-Goteborg (Sweden), for the realization of superconducting nanostructures with bottom-up techniques starting from porous

substrates, in collaboration with Prof. Floriana Lombardi (Chalmers), Prof. Serghej Prischepa (Minsk-Belarus), Prof. Carmine Attanasio (University of Salerno) (August-October 2015).

- Thermal neutron detection experiment using a detector based on superconducting Nb film at the ISIS beam-line of the Rutherford Appleton Laboratory in Oxford-UK, in collaboration with Prof. Matteo Cirillo (Rome "Tor vergata") (June 2014).
- Scientific collaboration with Prof. J.N. Eckstein at the University of Hillinois at Urbana Champaign for the realization of superconducting epitaxial structures using Molecular Beam Epitaxy (June 1998).

FINANCING OBTAINED AND PARTICIPATION IN RESEARCH PROJECTS

- 2022 Principal Investigator** Project "ISTRICE-Topological Insulators for the Detection of Polarized Light" funded as part of the 2021 University Scientific Research Projects.
- 2022 Local Unit Manager** of the "Topological Insulator Bismuth Selenide based single photon detector" project presented as part of the Projects of Relevant National Interest (PRIN 2022).
- 2021 Principal Investigator** Project "Topological Insulator/Si heterojunctions for low power consumption broadband photodetectors" presented as part of the Projects of Great Relevance of the Ministry of Foreign Affairs and International Cooperation (MAECI Italy-India) under review.
- 2020 Work Package Coordinator** of the Research Project "FOTONICS Manufacture and optimization of a broadband photodetector based on topological insulator and silicon" funded by the Lazio Region as part of the POR FESR Lazio 2014-2020 program. Project T0002E0001 "Research Group Projects".
- 2020 Work Package Coordinator** of the CALL INFN Research Project "QUANTEP QUANTum Technologies Experimental Platform" funded by the INFN National Scientific Commission 5, responsible for Dr. A. Salamon.
- 2019 INFN Research Project Preventivi** "QUICHE-QUANTum Integrated Chip Experiment" funded by the INFN National Disclosure Commission 5, coordinated by Dr. A. Salamon.
- 2019 INFN Research Project Preventivi** "SLICE-Soc eLectronIcs Compact dEtector" funded by the INFN National Disclosure Commission 5, local manager Dr. V. Bocci.

- 2019** StartCup Project 2019 Lazio Region "Nano-Carbon on Steel: carbon nanotube film for waterproof and protective coatings for steel". The project obtained a special prize from the Lazio Region and won the competition to participate in the National "Maker Faire" event, Rome 18-20 October 2019.
- 2018** EU Horizon2020 Scientific Research Project entitled "Dirac Semimetals Based Terahertz Components-DiSetCom" responsible for Prof. O. Pulci.
- 2018** University Scientific Research Project Mission Sustainability: "Synthetic nanosponges vs. natural sponges: biomimicry for sustainable management of emerging pollutants in water "funded by the University of Rome "Tor Vergata ", head of Prof. M. Scarselli.
- 2018** Funding of basic research activities (FFABR) – ANVUR.
- 2017** Project of great bilateral importance Italy-Canada "Silicon nanowires for potential applications in optical, electronic and optoelectronic devices" approved by the MAECI for the years 2017-19 responsible Prof. P. Castrucci.
- 2016** University Scientific Research Project Consolidate The Foundations: "Silicene and Germanene: novel two-dimensional materials" coordinated by Prof. P. Castrucci.
- 2015** EU Horizon2020 Scientific Reloading Project entitled "Collective Excitations in Advanced Nanostructures-COEXAN", coordinated by Prof. O. Pulci.
- 2010** PRIN project "Classical-quantum interactions in coupled Josephson systems", national coordinator Prof. M. Cirillo, University of Rome "Tor Vergata".
- 2002** Project PRIN "Effect of the strain on the insulating metal transition and on the metal phase of thin films and manganite heterostructures", national coordinator Prof. L. Maritato, University of Cagliari.
- 2000** PON Project - National Operational Program "Laboratory for the growth of advanced materials and the study of nanostructures in superconducting materials and devices", national manager Prof. S. Pace, University of Salerno.
- 1995** South Project - European Union ERDF 1994-99 program for the project "Non-destructive analysis with eddy currents using superconducting devices", national manager Prof. A. Barone, University of Naples Federico II.

1992 National Advanced Innovative Materials Program (PNMIA) Ministry of University and Scientific Research, national manager Prof. R. Vaglio, University of Salerno.

SPEAKER AT SCIENTIFIC CONFERENCES IN ITALY AND ABROAD

- “*Nanometric stripes formation on topological insulator Bi_2Se_3 thin films and nanobelts*” workshop **HiTime-High frequency Topological Insulator devices for Metrology** Ischia, 29-31 October 2019 **(INVITED SPEAKER)**.
- “*Gate effect on time response and responsivity in single walled carbon nanotube/Si photodetectors*” **Interphotonics 2018 - International Conference in Photonics Research** Kemer-Antalya-Turkey 8-12 October 2018 **(INVITED SPEAKER)**
- “*Single Walled Carbon Nanotube/ n -Si heterojunctions for femtosecond pulse photodetectors*” INVITED SPEAKER nell’ambito del “Workshop on Fundamental and Applied Nanoelectromagnetics-II THZ Circuits, Materials Devices” **FANEM 2018**, Minsk, Belarus, 5-7 June 2018 **(INVITED SPEAKER)**
- “*Increasing efficiency of single walled carbon nanotube/ n -Si photodetectors*” **Nanosea 2018 International Conference** July 2-6 2018 7th International Conference NANOSEA NANO-structures and nanomaterials SELF-Assembly
- “*Vortex Dynamics in $(CaCuO_2)_n/(SrTiO_3)_m$ Superlattices*” tenuto nell’ambito del “11th European Conference on Applied Superconductivity”, **EUCAS XI** Genova-Italy from 15/09/2013 to 18/09/2013.
- “*Transport Properties in Ni Decorated Carbon Nanotube Fibers*” within “Multifunctional hybrids and organics” **MAMA-HYBRIDS**, Ischia (Napoli), Italy, dal 22/10/2012 al 24/10/2012 **(INVITED SPEAKER)**.
- “*Carbon Nanotubes Array as Template for Metallic Interconnections*”, within the International Conference on the Science and Application of Nanotubes, **NT11** Cambridge (UK) dal 10/07/2011 al 16/07/2011 **(INVITED SPEAKER)**.
- “*Localization and Tunneling Mechanism in Carbon Nanotubes Aggregates*”, within the "International Conference on the Science and Application of Nanotubes", **NT11**, Cambridge (UK) dal 10/07/2011 al 16/07/2011.
- “*Single electron tunnelling and I-V singularity in single walled carbon nanotube bundles*”, within "Processing and Manufacturing in Advance Materials" **Thermec 2009**-Berlin 24/08/2009-29/08/2009. **(INVITED SPEAKER)**.

- “*Current Induced Transition in the Vortex Dynamics of MgB₂ Thin Films*” within the “VI European Conference of Applied Superconductivity”, **EUCAS VI**, Sorrento (Napoli, Italy) from 14/09/2003 to 18/09/2003.
- “*Nucleation of Superconductivity in Finite Metallic Multilayers: Effect of the Symmetry*” within the “XII Congresso Nazionale di Fisica della Materia”, **INFEM-XII**, Genova from 24/06/2003 to 25/06/2003.
- “*High Quality Fully in situ MgB₂ Thin Films Obtained by dc Magnetron Sputtering*” within the “XI Congresso Nazionale sulla Superconduttività ad Alta Temperatura di Transizione”, **SATT11**, Vietri sul Mare (Salerno-Italy) from 19/03/2002 to 23/03/2002.
- “*Anisotropy and Transport Properties of (Bi₂Sr₂CuO_{6+x})_m/(CaCuO₂)_n Multilayers obtained by Molecular Beam Epitaxy*” within the “XI Congresso Nazionale di Fisica della Materia”, **INFEM-XI** Genova from 12/06/2000 to 16/06/2000.
- “*Upper Critical Field and Irreversibility Line in (Bi₂Sr₂CuO_{6+x})/(CaCuO₂) Superconducting Superlattices Obtained by MBE*” within the “X Congresso Nazionale sulla Superconduttività ad Alta Temperatura di Transizione” **SATT10**, Frascati (Roma) from 08/05/2000 to 12/05/2000.
- “*Surface Nanostructure of MBE Grown YBa₂Cu₃O_{7-x}*”, within “**Nanomeeting 99**” Minsk – Bielorussia from 18/05/1999 to 20/05/1999
- “*Superconductivity in Bi₂Sr₂CuO_{6+x}/(Ca,Sr)CuO₂ Multilayers Obtained by Molecular Beam Epitaxy*” within “**Applied Superconductivity Conference**”, Palm Desert (CA) U.S.A. from 12/09/1998 to 19/09/1998.
- “*Pinning Forces in Nb/CuMn multilayers*” within the “Conference of the Society of Photo-Optical Instrumentation Engineers” **SPIE**, S. Diego (CA) U.S.A. from 19/07/1998 to 25/07/1998
- “*Superconducting/Spin Glass Multilayers*” within the X edition of the “Congresso Nazionale di Fisica della Materia” **INFEM X** Rimini from 28/06/1998 to 30/06/1998.
- “*Structural and superconducting properties of MBE-grown Bi₂Sr₂Cu₁O_{6+x} thin films*” within the “3rd European Conference of Applied Superconductivity” **EUCAS III** Eindhoven, Olanda, from 29/06/1997 to 03/07/1997

- “*RHEED Analyses and Structural Properties of MBE Bi₂Sr₂CuO_{6+d} Thin Films*” within the IX edition of “Congresso Nazionale di Fisica della Materia”, **INFM IX** Chia Laguna (CA) from 19/05/1997 to 23/05/1997.
- “*Experimental Investigation of Pinning Potential Shape in BSCCO Thin Films*” within “**Applied Superconductivity Conference**” Pittsburgh (PE) - U.S.A from 25/08/1996 to 30/08/1996.
- “*Flux Motion in HTSC: The Role of Washboard-Type Pinning Potential*” with the International Conference on “**Non Linear Superconducting Devices and High Tc Materials**” Capri (It) from 10/10/1994 to 14/10/1994
- “*BSCCO Thin Films Made by Molecular Beam Epitaxy*” within “Sesto Congresso Nazionale sulla Superconduttività ad Alta Temperatura di Transizione”-**SATT6**, Riccione (FO) from 18/05/1993 to 22/05/1993

Seminars: He has held more than 30 specialist seminars at national and international institutions.

PAPER CONTRIBUTION TO CONFERENCES

The presentations at the various conferences were the subject of scientific articles collected in the proceedings of the respective conferences and listed below:

- 1) "*Fast response Graphene/n-Si photodetectors*" M. Scagliotti, M. Salvato, M. De Crescenzi, P. Castrucci, N.G. Kovalchuk, I.V. Kommissarov, S.L. Prischepa, D. Catone, L. Di Mario **NT19: International Conference and Application of Nanotubes and Low Dimensional Materials. 2019, 21-26 July, Wurzburg, Germany**
- 2) "*Gate effect on time response and responsivity in single walled carbon nanotube/Si photodetectors*" M. Salvato, M. Scagliotti, M. De Crescenze, P. Castrucci **Interphotonics 2018 - International Conference in Photonics Research Kemer-Antalya-Turkey 8-12 October 2018**
- 3) "*Increasing Efficiency of single walled carbon nano tube/n-Si photodetectors*", M. Salvato, M. Scagliotti, F. De Matteis, P. Proposito, M. De Crescenzi and P. Castrucci **7th International Conference NANOSEA (Nano-structures SELF-Assembly), France, 2-6 July 2018**
- 4) "*Innovative Graphene/n-Si heterojunction for photodetectors applications*" M. Scagliotti, M. Salvato, M. De Crescenzi, P. Proposito, F. De Matteis, N.G. Kovalchuk, I.V. Kommissarov, S.L. Prischepa and P. Castrucci, **7th International Conference NANOSEA (Nano-structures SELF-Assembly) France, 2-6 July 2018**
- 5) "*Vortex Dynamics in $(CaCuO_2)_n/(SrTiO_3)_m$ Superlattices*" M. Salvato, I. Ottaviani, M. Lucci, M. Cirillo, D. Di Castro, D. Innocenti, A. Tebano, G. Balestrino "**11th European Conference on Applied Superconductivity-EUCAS**", September 15th-19th 2013
- 6) "*Transport Properties in Ni Decorated Carbon Nanotube Fibers*" M. Salvato, M. Lucci, I. Ottaviani, M. Cirillo, E. Tamburri, S. Orlanducci, M. L. Terranova, M. Notarianni, C. C. Young, N. Behabtu, M. Pasquali **International Workshop "MAMA-Hybrids – Multifunctional Hybrids And Organics" October 22nd-24th 2012, Ischia (Napoli)-Italy**
- 7) "*Carbon Nanotubes Array as Template for Metallic Interconnections*", M. Salvato, M. Lucci, I. Ottaviani, M. Cirillo, E. Tamburri, F. Toschi, V. Guglielmotti, S. Orlanducci, M.L. Terranova, Natnael Behabtu, Matteo Pasquali, **NT11 International Conference on the Science and Application of Nanotubes Cambridge 10-16 luglio 2011. POSTER**
- 8) "*Localization and Tunneling Mechanism in Carbon Nanotubes Aggregates*" M. Salvato, M. Lucci, I. Ottaviani, M. Cirillo, E. Tamburri, F. Toschi, V. Guglielmotti, S. Orlanducci, Colin C. Young,

Natnael Behabtu, Matteo Pasquali **NT11 International Conference on the Science and Application of Nanotubes Cambridge 10-16 luglio 2011. POSTER**

- 9) “*Single electron tunnelling and I-V singularity in single walled carbon nanotube bundles*” M. Salvato, M. Cirillo, M. Lucci, S. Orlanducci, I. Ottaviani, M.L. Terranova, F. Foschi, **Thermec 2009 Processing and Manufacturing in Advance Materials, Berlin 25-29 August 2009** .
- 10) “*Novel development on superconducting Nb film deposition for RF applications*” A. Cianchi, L. Catani, D. Di Giovenale, J. Lorkiewicz, B. Ruggiero, R. Russo, J. Langner, M Sadowsky, P. Strzyzewski, V. Merlo, M. Salvato, S. Tazzari **EPAC (2006)**.
- 11) “*Progress in fabrication of high quality Tantalum film absorber for STJ radiation detector*” M.P.Lissitski, D. Perez de Lara, R. Cristiano, M.L.Della Rocca, L.Maritato, M. Salvato, **Low Temperature Detector 10** (Genova, 7-11 Luglio 2003, Italia).
- 12) “*Interface Transparency of Nb/Cu and Nb/Pd Layered Systems*” A. Angrisani Armenio, C. Attanasio, A. Aurigemma, C. Cirillo, S.L. Prischepa, A. Romano, M. Salvato, A. Tesauro, **EUCAS 2003**, Sorrento (Italy) September 14th-18th (2003).
- 13) “*Current Induced Transition in the Vortex Dynamics of MgB₂ Thin Films*” S.L. Prischepa, L. Maritato, M. Salvato, **EUCAS 2003**, Sorrento (Italy) September 14th-18th (2003).
- 14) “*Growth and Characterization of highly epitaxial YBa₂Cu₃O₇/La_{0.7}Ca_{0.3}MnO₃ bilayer structures*”, A. De Santis, F.Bobba,^{a*} M.A. Boffa, R. Caciuffo, P. Mangucci, M. Salvato, A. Vecchione. A. M. Cucolo, **M2S-HTSC-VII**, Rio de Janeiro, Brasil, May 25th-30th, (2003).
- 15) “*Interface Influence on Transparency Coefficient in Superconducting/Non Superconducting Layered Systems*”, C. Attanasio, M.L. Della Rocca, A. Romano, M. Salvato, **M2S-HTSC-VII**, Rio de Janeiro, Brasil, May 25th-30th (2003).
- 16) “*Bi₂Sr₂CuO₆/CaCuO₂ Superlattices Obtained by MBE*” M. Salvato, S.L. Prischepa, C. Attanasio, G. Carbone, T. Di Luccio, A. Montella, and L. Maritato **XI Congresso Nazionale di Fisica della Materia**, Genova 12-16 giugno (2000).
- 17) “*Superconducting/Spin Glass Multilayers*” L. Maritato, C. Attanasio, L.V. Mercaldo, S.L. Prischepa, R. Russo, and M. Salvato, **X Congresso Nazionale di Fisica della Materia**, Catania (1999).

- 18) *"Pinning Forces in Nb/CuMn Multilayers"* L. Maritato, C. Attanasio, S. Barbanera, C. Coccorese, T. Di Luccio, L.V. Mercaldo, S.L. Prischepa, R. Russo, M. Salvato, in **Superconducting Superlattices II: Native and Artificial**, Vol. 3480 Ed. I. Bozovic and D. Pavuna, Proceedings of SPIE, pag. 112 (1998)
- 19) *"Eddy Current Non Destructive Evaluation Measurements: Preliminary Results"* A. Barone, G. Peluso, G. Pepe, A. Ruosi, P. Buonadonna, R. Teti, M. Valentino, C. Attanasio, L. Maritato, M. Salvato, C. Camerlingo, S. Pagano, M. Russo, E. Sarnelli, M. Prencipe, **IX Congresso Nazionale di Fisica della Materia**, Chia Laguna (CA), (1997)
- 20) *"HTc SQUID for Non Destructive Evaluation"*, S.Pagano, E.Sarnelli, C.Camerlingo, A.Monaco, M.Russo, G. Peluso, G.Pepe, A.Ruosi, M.Valentino, R.Teti, P.Buonadonna, L.Maritato, M.Salvato, M.Prencipe, **3th International Workshop on Electromagnetic Non Destructive Evaluation**, Reggio Calabria, Italy, September 14-16, 1997.
- 21) *"HTS SQUIDS for Nondestructive Evaluation"* A. Barone, G. Peluso, G. Pepe, A. Ruosi, P. Buonadonna, R. Teti, M. Valentino, C. Attanasio, L. Maritato, M. Salvato, C. Camerlingo, S. Pagano, M. Russo, E. Sarnelli, M. Prencipe, **IX Congresso Nazionale di Fisica della Materia**, Chia Laguna (CA), (1997)
- 22) *"Noise Characterization of Eddy Current NDE Sensors in Real Enviroments"* A. Barone, G. Peluso, G. Pepe, A. Ruosi, P. Buonadonna, R. Teti, M. Valentino, C. Attanasio, L. Maritato, M. Salvato, C. Camerlingo, S. Pagano, M. Russo, E. Sarnelli, M. Prencipe, **IX Congresso Nazionale di Fisica della Materia**, Chia Laguna (CA), (1997)
- 23) *"RHEED Analyses and Structural Properties of MBE Bi₂Sr₂CuO_{6+d} Thin Films"*, C. Attanasio, C. Coccorese, T. Di Luccio, L.V. Mercaldo, S.L. Prischepa, M. Salluzzo, M. Salvato, L. Maritato, **IX Congresso Nazionale di Fisica della Materia**, Chia Laguna (CA) (1997).
- 24) *"Structure and Superconductivity of Nb/Pd(Mn) Multilayers"*, J.M. Slaughter, James Eickmann, U. Hiller, Satoru Kaneko, Charles M. Falco, C. Coccorese, C. Attanasio, L. Maritato and M. Salvato, **Physics of X-ray Multilayer Structures Conference**. Breckenridge, USA, (1996).
- 25) *"Superconducting properties of Nb/Pd(Mn) Superlattices"*, J.M. Slaughter, James Eickmann, U.Hiller, S. Kaneko, Charles M. Falco, C. Coccorese, C. Attanasio, L. Maritato and M. Salvato, **General Meeting of the American Physical Society**, St. Louis Missouri (USA), (1996).

- 26) “*Superconducting π -phase in Nb/CuMn multilayers*”, C. Attanasio, C. Coccorese, L. Maritato, L.V. Mercaldo, S.L. Prischepa, M. Salvato, A. Tuissi, A. Del Vecchio, L. Tapfer, European Physical Society, **15th General Conference of the Condensed Matter Division**, Baveno-Stresa (VO), (1996).
- 27) “*Flux Pinning in MBE $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}_{8+x}$ Thin Films*”, C. Attanasio, C. Coccorese, L. Maritato, S.L. Prischepa, and M. Salvato, European Physical Society, **15th General Conference of the Condensed Matter Division**, Baveno-Stresa (VO), (1996).
- 28) “*Superconducting and Spin-Glass Interaction in Coupled Layered Structures*”, L.V. Mercaldo, C. Attanasio, C. Coccorese, L. Maritato, S.L. Prischepa, M. Salvato, Proceedings of **Non-Linear Physics: Theory and Experiment**, Gallipoli (Le) (1995).
- 29) “*Realization and Characterization of Superconducting (Nb) and Spin Glass (CuMn) Multilayers*”, C. Attanasio, C. Coccorese, L. Maritato, L. V. Mercaldo, M. Salvato, **VIII Congresso Nazionale di Fisica della Materia**, Napoli (1995).
- 30) “*Optimization of Deposition Parameters in the Realization of BSCCO Thin Films by Molecular Beam Epitaxy*”, C. Attanasio, C. Coccorese, L. Maritato, S.L. Prischepa, and M. Salvato, **VII Congresso Nazionale di Fisica della Materia**, Brescia, (1994).
- 31) “*Parallel and Perpendicular Superconducting Critical Magnetic Field Measurement of Nb-CuMn Multilayers*”, C. Attanasio, S.L. Prischepa, M. Salvato, B. Engel and C.M. Falco, **ISEM**, Seoul, Corea del Sud, (1994).

PARTICIPATION IN ORGANIZING COMMITTEES AND CHAIRMAN OF NATIONAL AND INTERNATIONAL CONFERENCES

- 2020 Conference Organizing Committee **NanoSEA2020 NANOSEA (Nano-structures Self-Assembly)**, Rome 8-12 June 2020 (cancelled due to COVID-19)
- 2013 Chairman of the 1M-EL Nanowire Detectors section organized as part of the "11th European Conference on Applied Superconductivity", **EUCAS XI** Genova, Italy, September 15-19, 2013.
- 2003 Conference Organizing Committee "European Conference of Applied Superconductivity" **EUCAS VI** - Sorrento (Naples, Italy) 14-18 September 2003.
- 2002 Conference Organizing Committee 11th National Congress of Superconductivity **SATT11** - Vietri Sul Mare (Salerno, Italy) March 19-23, 2002.

INSTITUTIONAL ASSIGNMENT

- 2012 to present Member of the Restricted Didactic Commission of the Bachelor's and Master's Degree in Physics of the University of Rome "Tor Vergata".
- 2010-2012 Member of the Board of the Physics Department of the University of Rome "Tor Vergata".
- 2002-2005 Representative of the Technical Staff at the Physics Department Council of the University of Salerno.
- 2002-2005 Head of the Didactic Laboratories Fund of the Physics Department "E.R. Caianiello" University of Salerno.

MEMBER OF EDITORIAL BOARDS AND REFEREE OF INTERNATIONAL JOURNALS AND RESEARCH PROJECTS

- Editor of the special issue "**Advanced Materials for Heterojunctions**" of the magazine "Materials-MDPI"
https://www.mdpi.com/journal/materials/special_issues/Materials_Heterojunction.
- Member of the Editorial Board of **Advances in Materials**
<http://www.advinmaterials.org/editorialboard>.

- Referee of various international journals including: Scientific Reports, Carbon, Nanomaterials, Applied Physics Letters, Journal of Applied Physics, IEEE Trans. On Appl. Superc., IEEE Trans. on Nanotechnology, Physica C, Superconductor Science and Technology.
- He was evaluator of **PON R&C 2007-2013** Projects for the Ministry of University and Research.

TEACHING ACTIVITY

From the 2011-2012 academic year he has been the **holder** of the *Low Dimensional Systems in Physics* course at the Master's Degree course in Physics and from the 2017-2018 academic year he has been the **holder** of the *Electronics Laboratory* course at the Three-year Degree in Materials Sciences at the University of Rome "Tor Vergata". From the academic year 1996-1997 to today he has been the **holder of 8 different teaching courses** on various disciplines of the University of Salerno and the University of Rome "Tor Vergata", including *Experimentations in Physics I and II, Laboratory II, Thin Film Growth, Experimental Physics I and II*. He has provided laboratory teaching assistance to the *Physics Experimentation II and Laboratory III* courses of the Bachelor's Degree in Physics, to the *Electronics Laboratory* course of the Bachelor's Degree in Materials Science and to the *Electronics Laboratory* course of the Bachelor's Degree in Science and Technology of Media of the University of Rome "Tor Vergata".

He was the **holder** of the Physics of the Environment and Atmosphere course as part of the I.F.T.S. of the Campania Region.

He was **supervisor of 2 graduate theses** in Physics at the University of Salerno and **3 graduate theses** in Physics at the "Tor Vergata" University of Rome.

Assistance was also provided for the experimental part and for the drafting of papers in the case of **2 thesis** in Engineering of the University of Naples "Federico II", **4 theses** in Physics of the University of Salerno, **2 PhD theses** in Physics from the University of Salerno.

He was **tutor** of a **PhD thesis** in Physics.

Teaching course holder:

- **From the 2017-2018 to today:** *Electronics Laboratory* course to the bachelor's degree in Materials Sciences at the Faculty of Sciences of the University of Rome "Tor Vergata" (**6 cfu**).
- **From the 2011-2012 to today:** *Low Dimensional Physic Systems* course to the master's degree course in Physics at the Faculty of Sciences of the University of Rome "Tor Vergata" (**6 cfu**).
- **From 2007-2008 to 2009-2010:** *Experimental Physics II* course to the bachelor's degree course in Media and Communications Science at the Faculty of Sciences of the University of Rome "Tor Vergata" (**6 cfu**).
- **2007-2008:** *Experimental Physics I* course to the three-year degree course in Media and Communications Science at the Faculty of Sciences of the University of Rome "Tor Vergata" (**6 cfu**).

- **From the 2006-2007 to 2008-2009:** *Thin Film Growth* course to the three-year degree course in Materials Science at the Faculty of Sciences of the University of Rome "Tor Vergata" **(6 cfu)**.
- **2000-2001:** *Physics Experimentation II* course of the University Diploma in Physical Methodologies awarded by the Faculty of Sciences of the University of Salerno for the academic year 2000-2001 in accordance with the Ministerial Decree of 21/05/1998 n. 242 **(6 cfu)**.
- **From 1996-1997 to 1999-2000:** *Physics Experimentation I* course of the University Diploma in Physical Methodologies awarded by the Faculty of Sciences of the University of Salerno for the academic year 1996/97 pursuant to art. 100, paragraph d) of the Presidential Decree 382/80 **(60 hours for 1996-1997 and 50 hours of lessons + 50 hours of practice for the years 1997-1998, 1998-1999, 1999-2000)**.

Holder of extra-university teaching courses:

- Contract for teaching the *Physics of the Environment and Atmosphere* training course "in the I.F.T.S. for "Superior Technician for Monitoring and Management of the Territory and the Environment" of the Campania Region (2005) **(50 hours)**.

Course assistance:

- **From the 2006-2007 to 2016-2017:** tutor in the *Laboratory III* course of the Degree Course in Physics and Materials Science at the Faculty of Sciences MM FF NN of the University of Rome "Tor Vergata" (course holder Prof. R. Messi) **(1 cfu)**.

PhD thesis tutor in Physics:

- Dr. Mattia Scagliotti, "*Nanostructured Materials for Photodetector Applications*" (University of Rome "Tor Vergata" 2021)

Supervisor of master's degree in Physics and Scienze e Tecnologie dei Materiali:

- Dott.ssa Anna Paola Panunzi "*Fabrication of stretchable and transparent electrodes based on silve nanowires and their application as bottom contacts for perovskite solar cells?*" (internal speaker University of Rome "Tor Vergata" **2019**).
- Dr. Mattia Scagliotti, "*Carbon Nanotube Films for Photovoltaic and Photodetector Applications?*" (University of Rome "Tor Vergata" **2017**).

- Dr. Giulio Tieri, "*Superconductivity at the interface in CaCuO₂/SrTiO₃*", (University of Rome "Tor Vergata" **2014**).
- Dr. R. Menditto, "*New Condensation Phenomena in Superconductivity*", (University of Rome "Tor Vergata" **2012**).

Supervisor of degree in Physics, old system:

- Dr. A. Guarino, "*Structural properties of thin films of La_{0.67}Sr_{0.22}MnO₃ deposited on substrates (110)*" (University of Salerno **2004**).
- Dr. A. Aurigemma, "*Structural Disorder in Stratified Systems made for Sputtering and MBE*" (University of Salerno **2003**).

Supervisor bachelor's degree in physics:

- Dr. Elena Campagna, "*Deposition and characterization of epitaxial films of Zr: CeO₂ obtained chemically as a buffer layer for superconducting films of YBa₂Cu₃O_{7-x}*" (internal speaker at the University of Rome "Tor Vergata" **2021**).
- Dr. Federica Pieroni, "*Study of the heterojunctions between thin films of Bi₂Se₃ topological insulators and Silicon for new generation photodetectors*", (University of Rome "Tor Vergata" **2020**).
- Dr. Diego Brancato, "*Study of the best dielectric for the optimization of the growth of the active layer in Pentacene in OTFT transistors*", (internal speaker at the University of Rome "Tor Vergata" **2019**).
- Dr. F. Barbato, "*Low Temperature Transport Properties of Carbon Fibers and Nanotubes*", (University of Rome "Tor Vergata" **2010**).

PhD thesis evaluator:

- Dr. Alessandro Grillo, "*Nanostructured materials for a new generation of electronic devices*", (University of Salerno **2021**).

Assistance was also provided for the experimental part and for the drafting of papers in the case of: **2 degree theses** in Engineering of the University of Naples "Federico II" (Dr. C. Valente (1994), Dr. A. Montella (1998)), **N. 4 degree theses** in Physics of the University of Salerno (Dr. T. Di Luccio (1998), Dr. G. Carbone (1999), Dr. R. Fittipaldi (2000)), Dr. A. Tesauro (2003)), **N. 2 PhD theses** in Physics of the University of Salerno (Dr. M. Salluzzo (1998), Dr. T. Di Luccio (2001)). The theses, of an experimental nature, dealt with issues relating to the fabrication of superconducting oxides and

heteroepitaxial structures obtained by MBE and the study of the transport properties of the obtained samples.

COORDINATOR OF RESEARCH GROUPS AND MAIN COLLABORATIONS

The research activity was carried out in collaboration with various groups, coordinating the research activity in each of the workplaces. During his activity at the Physics Department of the University of Salerno, he coordinated the scientific activity of the *Molecular Beam Epitaxy Laboratory* and the *Laboratory of Transport Measurements on Superconducting Materials*, collaborating with Prof. L. Maritato and Prof. C. Attanasio. He was also scientific director of the *Morphological and Structural Analysis Laboratory* at the same Department. He coordinated the scientific activity of the *Low Temperature Laboratory* of the Physics Department of the University of Rome "Tor Vergata", of which Prof. M. Cirillo is responsible and, subsequently, coordinated the scientific activity of the *Photodetectors and Nanomaterials* of the same Department in collaboration with Prof. P. Castrucci and Prof. M. De Crescenzi. He is currently responsible for the research activity for the construction and study of photodetectors based on nanostructures.

During his research activities, he has also collaborated with national and international laboratories and research centers both in superconductivity and nanomaterials. Below is a list of the major collaborations with the respective topics. Some of them have contributed to the enrichment of this curriculum by writing a reference letter:

- **Prof F. Lombardi** *Department of Microtechnology and Nanoscience, MC2 Chalmers University of Technology Goteborg-Sweden*
Topological insulators. Superconducting nanostructures and 2-Dimensional effects.
- **Prof. S.L. Prischepa** *State University of Informatics and RadioElectronics, Minsk-Belarus*
Vortex dynamics in superconducting systems. Graphene/Si junctions for photodetectors.
- **Prof. C. Attanasio** *Dept. of Physics "E.R. Caianiello", University of Salerno*
superconductivity/magnetism coupling in layered systems.
- **Dr. A. Vecchione** *CNR-SPIN Salerno*
Structural properties of thin films and their influence on transport properties.
- **Prof. G. Balestrino** *Dep. Of Civil and Computer Engineering, University of Rome "Tor Vergata"*
Transport properties in superconducting heterostructures, superconductivity at the interface in layered systems.

- **Prof. M. Pasquali** *Chemical and Biomolecular Engineering, MS-362, Rice University, Houston, Texas-USA*
Transport properties in carbon nanotube fibers.
- **Prof. C.M. Falco** *Dpt. Of Physics University of Arizona, Tucson, Arizona-USA*
Superconductivity/spin glass coupling in layered systems.
- **Prof. I. Aarts** *Kamerlingh Onnes Laboratory, Leiden University, Leiden-The Netherland*
Superconductivity / magnetism coupling in layered systems.
- **Prof. J.N. Eckstein** *University of Hillinois at Urbana Champaign*
Thin film manufacturing using MBE.

DEVELOPMENT OF LABORATORIES AND INSTRUMENTATION

- **From 1993 to 2002** he was responsible for the setting up and development of the "**Growth of thin films by molecular beam epitaxy (MBE)**" laboratory of the Department of Physics "E.R. Caianiello" of the University of Salerno which also belonged to the National Institute of Physics of Matter (INFN). Over the years, the laboratory has acquired two ultra-high vacuum deposition chambers (10^{-10} Torr), one of which was dedicated to the manufacture of oxides and the other to the manufacture of metal heterostructures, the latter designed on site. In total, the facility was equipped with 4 single crucible electron guns, a multiple crucible electron gun and 4 effusive cells, an atomic oxygen source, quartz balance thickness gauges, two RHEED systems with 10kV and 20kV electronic guns, one of which is equipped with differentiated pumping, a source of argon ions for cleaning the substrates. In the chamber dedicated to oxides, **he designed and built an ozone source**, replacing the atomic oxygen source, to improve the oxidation efficiency of the samples. The mixture of ozone and molecular oxygen (10%) was condensed in contact with liquid nitrogen. Thanks to the differences in vapor pressure between ozone and oxygen, the latter was pumped from the container which remained so saturated only with ozone (about 98%) that, when suitably heated, it was re-evaporated inside the deposition chamber. He took care of the hardware and software interface for the synchronization of the sequential opening of the shutters of the various sources and thickness gauges. He did the part relating to the acquisition of the RHEED electron diffraction spectra and their temporal evolution during the deposition process. He followed all the phases of the laboratory set-up and personally carried out the depositions of various types of materials. He made the first BSCCO (high temperature superconductor) films in Italy with this technique.
- **From 2001 to 2005** he was responsible for the setting up and development of the "*Morphological and structural analysis laboratory*" of the Physics Department "E.R. Caianiello" of the University of Salerno which also belonged to the National Institute of Physics of Matter (INFN). The equipment in the laboratory was acquired thanks to a grant obtained from a PON project "*Laboratory for the growth of advanced materials and the study of nanostructures in superconducting materials and devices*" written in collaboration with Dr. A. Vecchione and Prof. S. Pace. Thanks to the creation of the Laboratory, it has equipped the Department and the INFN Unit for the first time with an electron microscope and an x-ray diffractometer for the non-destructive analysis of solid samples. He designed the purchase of the electron microscope (LEO EVO 50) equipping it with EDS (Energy Dispersive Spectroscopy), WDS (Wavelength Dispersive Spectroscopy) and EBSD (Electron Backscatter Diffraction) analysis systems through which it is possible to study accurately, in addition to surface morphology, composition and structure of

the samples. He designed the purchase of the high-resolution diffractometer (X'PERT-PRO Philips) with the aim of studying the crystalline structure of massive materials, thin films, and multilayers. Therefore, he equipped the diffractometer with various interchangeable optics particularly suitable for high resolution and reflectivity measurements. He made measurements of reciprocal lattice maps, reflectivity maps, texture measurements and simple diffraction spectra on thin films and multilayer.

- **From 1993 to 2005** he was responsible for the setting up and development of the "**Fabrication and electrical characterization of thin films and superconducting heterostructures**" laboratory of the "E.R. Caianiello "of the University of Salerno. Over the years he has designed several solutions to adapt new equipment such as superconducting magnets and cryogenic descendants (some specially built) to previously acquired cryostats. He created part of the low-noise electrical circuits for the measurement of physical quantities at low temperatures and took care of the interface between computer and instrumentation. He used the instrumentation to study the transport properties of the samples obtained by MBE.
- **From 2005 to 2014** he was responsible for the setting up and development of part of the "**low temperature laboratory**" of the Physics Department of the University of Rome "Tor Vergata" of which Prof. Matteo Cirillo was the chief responsible. In collaboration with the mechanical workshop of the Department, he designed and built a cryostat for measuring the transport properties of thin films in the temperature range of 300K-2K and in a magnetic field up to 6 T. He equipped the laboratory with a cryostat for electrical measurements in the 4K-0.8K temperature range. He designed the entire vacuum system built by the mechanical workshop of the Department for the isolation of the cryogenic part of a previously purchased cryocooler. He designed and made descendants for electrical measurements at low temperatures and made the wiring for samples, thermometers, and heaters in all the measurement systems mentioned above. He took care of the entire data acquisition part for the electrical measurements in the aforementioned equipment. All the equipment mentioned was created thanks to the reuse of old disused equipment, providing considerable savings in resources for the group and the Department. In collaboration with the cryogenic section of Oxford Instruments he has restored a dilution cryostat (He3-He4) that has long been disused for cryogenic electrical measurements in the 1K-35mK range. He performed transport property measurements on carbon nanotubes and Josephson structures.
- **Since 2014** he designed low noise electrical circuits for photovoltaic measurements on carbon/silicon and graphene/silicon hybrid photodetectors in the "**Carbon Nanotube**

Laboratory" of the Physics Department of the University of Rome "Tor Vergata" of which Prof. Maurizio de Crescenzi was the chief responsible.

- **In 2018** he was invited by the **Chalmers Institute of Technology-Goteborg (Sweden)** for the development of a fabrication system for topological insulators in the form of thin films, nanowires and nanobelts based on the technique CVD / PVD. The system is currently in use at **Process Laboratory 2**. He made thin films, nanowires and nanobelts of the topological insulation Bi₂Se₃, characterizing them morphologically, structurally and electrically.
- **In 2021**, thanks to a substantial funding obtained through his participation as Head of Work Package in the **QUANTEP Project (Quantum Technologies Experimental Platform)** funded by the CALL2020 program of the INFN, he began the development of a laboratory for the fabrication of thin films based on CVD/PVD technique at the Physics Department of the University of Rome "Tor Vergata". The fabrication system is currently used for the construction of a photodetector based on topological insulator integrated on silicon for the purposes of quantum computing which is the object of the project itself. This activity must be considered as the natural transfer of know-how made possible by the experience gained in recent research periods abroad.

SCIENTIFIC ACTIVITY

The scientific activity has been the subject of over **125** publications in international refereed books and journals. Of these, **29** appear as the first author and in **10** as the second author, testifying to the significant contribution provided. As of March 2022, the scientific parameters obtained from the major databases can be summarized as follows:

	ISI WEB of Science	SCOPUS	GOOGLE SCHOLAR
N. pubblicazioni	112	118	154
Indice h	18	18	21
Totale citazioni	1100	1122	1458

Extract from the scientific activity

The research activity has developed in the field of the experimental study of advanced and innovative materials such as **carbon nanotubes, graphene, silicene, topological insulators and superconductors** and structures and devices based on these materials.

In the case of **carbon nanotubes**, electrical measurements at low temperatures and high external magnetic fields have made it possible to study the transport mechanism in films formed by these nanostructures and the role of interfaces. More recently, the properties of **junctions** formed by **films of carbon nanotubes or graphene with Si** for the realization of **photodetectors** have been studied. The devices have provided high responsivity and speed of response that are competitive with the devices currently on the market. Better results were obtained in the case of **graphene/Si junctions** demonstrating the aptitude of the new low-dimensional materials to be used in electro-optical devices. Thanks to the international collaboration with the nanotechnology group of the Chalmers Institute of Nanotechnology (Sweden), **nanowires and thin films of topological insulators (Bi₂Se₃) were obtained using an innovative technique** which was then reproduced at the University of Rome "Tor Vergata" thanks to the acquisition of a fabrication system following an INFN loan. Heterojunctions of topological insulators and Si have shown the excellent performance of these photodetectors in the range of wavelengths from visible to infrared.

In the case of **superconductors**, both at **low and at high transition temperatures**, the research has been focused on the synthesis of thin films and the study of electrical transport properties and their behavior in the presence of a magnetic field. Superconductors and heterostructures based on this material have been synthesized by MBE and by sputtering and their structural and interface properties have been studied by x-ray diffraction. Transport measurements, as a function of temperature and external magnetic field, have been employed to study the mechanisms of charge

transport and interaction between layers of different nature such as superconductors/normal metal and superconductors/magnetic material.

The growth dynamics as well as the morphological and structural properties have been of interest throughout the research activity and, recently, in the realization of silicene layers deposited on graphene and topological insulators (Bi_2Se_3) deposited in the form of thin films and nanowires. The latter issue is the subject of current research which is yielding numerous collaborations and participation in research projects funded or awaiting evaluation.

In carrying out his experimental research activity, he has acquired a consolidated experience in the design and use of high vacuum and ultra-high vacuum systems, in the deposition techniques of thin films from molecular beam epitaxy (MBE), chemical vapor deposition and sputtering, as well as in the use of sputtering systems, thermal evaporators, electron guns, in cryogenics techniques and measurements at low temperatures (down to 35 mK) in the presence of high magnetic fields (up to 11 T), in x-ray diffraction, electron microscopy and analysis, in the processes of lithographic definition of the optical type and by electron beam. As part of his research activity, he has turned his attention to the in-depth study of aspects related to both fundamental issues and those of a more applicative nature and has designed, implemented and guided the experiments up to the interpretation of the experimental data.

The research activity developed over the years can be schematically summarized in the following topics (listed in chronological order):

- 1) Fabrication and study of the structural properties of superconducting materials and heterostructures fabricated by MBE and sputtering.** Publications: 2, 3, 6, 13, 16, 17, 21, 23-25, 43, 46, 47, 55, 60, 62, 65, 75, 88, 103, 106, 110, 112, 115, 117, 119, 120, 123, 124.

He devoted a large part of his initial activity (**from 1993 to 2005**) to the production of thin films of various materials and to the study of their electrical and structural properties. He has made, first in Italy, superconducting films at high transition temperature and hetero structures by molecular beam epitaxy (MBE), of which he has extensively studied the electrical transport properties. He designed and built an ozone source for better oxidation of samples during growth. With the realization of the "Morphological and structural analysis laboratory", financed through the participation in a Campania PON Project, it was able to implement its activity with the study of the structural properties of thin films grown on different substrates and of the interface properties of heterostructures. Thanks to the realization of reciprocal lattice maps of multilayers based on superconducting and metallic oxides he studied the effects of strain and their relationship with transport properties. He created simulation programs of the structures obtained to better estimate the lattice parameters of the studied samples and phenomena related to the lattice distortion induced by the substrate. He studied

the phenomena of lattice distortion and lattice matching in hetero-epitaxial structures and the crystallographic properties at varying concentrations of one or more constituent elements.

2) Electric transport properties of thin and multilayer films based on both low and high transition temperature superconductors. Publications: 4, 5, 8, 11, 12, 14, 15, 18, 22, 27, 28, 30, 33, 36, 39, 41, 44, 47, 48, 50, 51, 54, 55-59, 70, 74, 75, 79, 82, 83, 103, 107, 108, 109, 116, 122.

Since the beginning of his research activity, he has been involved in the study of electrical transport properties in direct current regime of thin and multilayer films based on both low (obtained by sputtering and MBE) and high transition temperature superconducting materials (obtained for electron gun and MBE). Thanks also to the possibility of realizing these systems within the same laboratory, a contribution was made to the understanding of some phenomena observed in superconducting oxides at high transition temperature (stratified materials), discriminating between intrinsic effects and those linked to their strongly anisotropic structure, structure reproduced on artificial superconducting multilayers/normal metal in which the electron coupling between the layers was well described by the proximity effect. In these systems, particular attention was paid to the study of the properties of the interface, the H-T phase diagram, the dynamics of the vortices, including analysis of flux-creep and flux-flow phenomena. In addition to the samples manufactured in its own laboratory, the electrical transport properties of superconducting samples and heterostructures were investigated in collaboration with research groups specialized in fabrication. In particular, the electrical transport properties of the superconductor **MgB₂** were studied a few months after its discovery, by means of critical current measurements and study of vortex dynamics. Furthermore, the transport properties and the possible presence of low-dimensional superconductivity in artificial superconducting heterostructures formed by non-superconducting materials (CaCuO₂/SrTiO₃) were investigated.

3) Study of the interaction between superconductivity and magnetism in artificial stratified structures. Publications: 7, 9, 10, 12, 18-20, 26, 29, 31, 32, 34, 35, 39, 40, 45, 49, 52, 53, 61, 111, 113, 114.

The most important scientific results of this part of the research activity were the **observation for the first time of the non-monotonous trend of the superconducting transition temperature T_c, as a function of the thickness of the ferromagnetic material** in Nb/CuMn (spin glass) and Nb/PdNi (weakly ferromagnetic alloy) multilayers. This effect is due to the fact that in superconducting/ferromagnet hybrid structures the superconducting order parameter not only decays in the ferromagnetic layer but, more interestingly, it oscillates and can become negative giving rise to a phase change equal to π . The results obtained with weakly ferromagnetic alloys have

aroused considerable interest in the international scientific community also because they have shown, among other things, the feasibility of creating superconducting/ferromagnet structures with thicker and more controllable ferromagnetic layers from the manufacturing point of view. These materials are of particular interest for the realization of magnetic memories and in the field of spintronics.

4) Study of the transport properties in carbon nanotubes. Publications: 63, 67, 68, 69, 71, 72, 73, 75, 83, 125.

This part of the research activity was developed **starting in 2006** following the transfer to the Physics Department of the University of Rome "Tor Vergata". In collaboration with Prof. Matteo Cirillo, head of the low temperature laboratory, he studied the electrical transport properties in disordered systems formed by aggregates of carbon nanotubes deposited with random orientation, aligned, or arranged in fibers. The comparison between some parameters such as electrical resistance and magnetoresistance has allowed us to highlight some important properties related to the interface between the individual nanotubes. In this way he was able to obtain information on the potential of the barrier that forms at the interface between different nanotubes and the dimensionality of the system. He identified regimes in which the electrical charges are localized and the possible mechanisms by which to increase the conductivity within nanotube fibers such as, for example, doping with metal or superconducting particles.

5) Study of the Josephson effect in different materials and geometries. Publications: 16, 34, 37, 38, 46, 66, 77, 78, 99.

He began to take an interest in this topic in parallel with the study of transport properties in superconducting/ferromagnet multilayers and made the first joints using optical lithography on these structures during his research activity at the University of Salerno. Subsequently, following the transfer to the Physics Department of the University of Rome "Tor Vergata" he was involved by the group of Prof. Matteo Cirillo in Josephson experiments on arrays of junctions to study the possibility of highlighting particular phenomena, including the effects related to the Bose Einstein condensation. **Thanks to the development of appropriate cryogenic systems, he was able to measure the properties of the arrays down to temperatures below 1K**, confirming the desired effect. Recently, in collaboration with the Chalmers University of technology group, he made **Josephson junctions of superconductor/topological insulator nanowires** for the study of the behavior of surface states as a function of the thickness of the topological insulator.

6) **Applications to devices.** Publications: 1, 16, 62, 80, 81, 85, 86, 87, 90, 91, 93, 94, 96, 98, 100, 101, 110, 115, 118, 119, 126.

Starting from 2015 he started a fruitful collaboration with the group of Prof. Maurizio De Crescenzi responsible for the nanostructure laboratory. In this phase, in collaboration with Prof. P. Castrucci, he identified the possibility of obtaining photodetectors based on ultra-thin films of carbon nanotubes and graphene deposited on doped Si substrates. This research was a natural consequence of the joint application of previously studied solar cell detectors and of the experience gained in the study of the transport properties in thin films of carbon nanotubes. Thanks to the dual properties of transparency and good electrical conductivity of carbon nanotubes, **it was possible to obtain photodetectors with responsivity and detectivity comparable to those currently on the market.** A notable leap in the quality of the detection devices took place with the creation of **graphene/Si** and **Topological Insulator/Si junctions** where the greater transparency and conductivity of graphene and the dual semiconductor-Dirac metal nature of topological insulators were exploited. Finally, the design of new substrates contributed to the improvement of the performances of the obtained devices. On this line of research and on the possible development using different substrates and geometries of contacts, he is moving his activity through the presentation of research projects and new scientific publications.

In the field of radiation detectors, he has created thermal neutron detectors based on superconducting strips and characterized at the University of "Tor Vergata". In collaboration with the group of Prof. Matteo Cirillo and Dr. Antonio Pietropaolo from ENEA, he conducted the experiment at the ISIS beam-line of the Rutherford Appleton Laboratory in Oxford-UK where the aforementioned samples were used as thermal neutron detectors.

7) **Study and applications of low-dimensional structures.** Publications: 89, 92, 95, 97, 98, 99, 102, 104, 105.

Within the group of nano structures of Prof. De Crescenzi he was involved in the study of the **growth mechanism of two-dimensional materials** (silicene) on different substrates based on silicon (silicon carbide) and graphite (HOPG). In particular, he dealt with the growth of silicene and the study of its crystalline structure in relation to the substrate used by means of diffraction measurements with synchrotron light. 2-dimensional structures such as silicene, graphene, stanene have unique properties relating to electron mobility and electrical conductivity. The study of structural properties and the possibility of growing them in epitaxial form open very interesting prospects for their integration into the world of nanotechnologies.

Most recent activity

Recently, in collaboration with the group of Prof. Floriana Lombardi of the Chalmers University of Technology in Gothenburg, he made **nanowires of topological insulators and developed a new method of growing films of these materials on different substrates**. The nanowires produced have been the subject of publications with the Chalmers group for the study of the topological and superconducting properties of these materials. Bi_2Se_3 films were also deposited on doped Si substrates equipped with electrical contacts for the realization of photodetectors. The measurements carried out at the Nanostructures Laboratory of the Physics Department of the University of Rome "Tor Vergata" showed, in addition to the photodetection properties in the infrared and in the telecommunications band (1550 nm), fundamental properties linked to the topological nature of these materials. In particular, by means of tunnel microscopy (STM) measurements, surface phenomena related to the **twistronic** field have been highlighted which make topological insulators one of the most promising materials in the field of **spintronics and quantum computation**.

The experience gained on the topic of topological insulators and the growth techniques of this material was transferred to the Physics Department as a result of the normal collaboration process between international research groups. Along this line, **a deposition system for the production of topological insulators in the form of thin films and nanowires, was recently purchased and installed in the laboratories of the Physics Department of the University of Rome "Tor Vergata"**. This was made possible thanks to a financial support obtained from INFN through participation in a **CALL2020** that has chosen to finance the proposing group (of which the INFN Section of Rome2 is the lead partner with Dr. A. Salamon as project manager and **M. Salvato as head of the Work Package-Detectors**) with about **one million euros**. One of the fundamental objectives of the Project is to realize an electromagnetic radiation detector, sensitive to the telecommunication wavelengths, based on topological insulators integrated on a waveguide manufactured in a Si device. This technology uses for the first time the topological insulators and their possible integration into the whole device. This can only take place thanks to the use of the developed deposition system which allows the detector to be manufactured at a relatively low temperature so as not to deteriorate the already integrated optics. The acquisition of the deposition system has helped to consolidate the research topic relating to the synthesis and construction of electronic and optoelectronic devices based on new low-dimensional materials.

The new line of research based on topological insulators has aroused strong interest in the Structure of Matter community belonging to the Physics Department of the University of Rome "Tor Vergata". In fact, on this issue new collaborations have been established that have led to the drafting of the project "FOTONICS: Manufacture and optimization of a broadband photodetector based on topological insulator and silicon" funded by the **Lazio Region**. On the same topic, the entire

research group participated in further National (PRIN 2022) and international (HORIZON-CL4-2021 and MAECI Italy-India) funding calls, which are still under evaluation, and had access to University funding and other entities (INFN).

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