

Jacopo Forneris

Curriculum vitæ et studiorum

Personal data and biography	2
Personal data _____	2
Biography _____	2
Scientific affiliations _____	4
Scientific activities	5
Scientific research _____	5
Bibliometric indexes _____	7
Awards and highlights _____	8
Coordination of experiments and research projects _____	8
as Principal Investigator _____	8
as Co-investigator _____	9
Editorial roles _____	10
Commissions of trust _____	11
Other research products _____	11
Scientific production: publications	12
Peer Reviewed publications _____	12
Other publications _____	17
Scientific production: Conference contributions	20
Invited talks _____	20
Contributed talks as presenting author _____	20
Poster contributions _____	22
Teaching, outreach and dissemination activities	25
Graduate and undergraduate courses at University of Torino _____	25
Lecturer at international schools _____	25
Advisor of M.Sc and B.Sc Theses _____	25
Second-advisor of M.Sc and B.Sc Theses _____	27
Second advisor of Ph.D Theses _____	28
Seminars at universities and research institutes _____	28
Scientific dissemination initiatives _____	28

Personal data and biography

Personal data

Name	Jacopo Forneris
Residence	Torino, Italia
Address	
post	Physics Department, University of Torino, via P. Giuria 1, 10125 Torino, Italy
e-mail	jacopo.forneris@unito.it
Skype	jacopo.forneris
Degrees	B. Sc. Degree in Physics M. Sc. Degree in Physics of Fundamental Interactions Ph.D in Physics and Astrophysics
Qualification	Abilitazione Scientifica Nazionale alle funzioni di Professore Universitario di Seconda Fascia per il settore concorsuale "02/B1 - Fisica Sperimentale della Materia" Procedura del 2017 - III trimestre, bando D.D. 1532/2016
Current position	Associate Professor Physics Department, University of Torino, 10125 Torino, Italy Subject: Condensed Matter Physics (FIS/03)

Biography

1998 - 2003	High School Leaving Certificate Liceo Classico Statale Massimo D'Azeglio, Torino
Final mark	100/100
2003 - 2006	B.Sc. Degree in Physics , University of Torino Thesis: "Charge and current conservation in gauge theories" Advisor: Prof. Lorenzo Fatibene, University of Torino Thesis defense: 27/10/2006 Final mark: 108/110
2007/01 - 06	Erasmus Programme, Umeå Universitet , Sweden Relevant courses: "Quantum information", "Statistical Physics"
2006 - 2009	M.Sc. Degree in Physics of Fundamental Interactions, curriculum in theoretical physics curriculum, University of Torino Thesis: "Corrections to the eikonal amplitude for the Drell-Yan process" Thesis defense: 22/07/2009 Mark: 110 / 110 cum laude Advisor: Prof. Lorenzo Magnea, University of Torino
2010 - 2012	Doctoral School in Physics and Astrophysics, University of Torino Ph.D in Physics and Astrophysics , XXV cycle, Thesis: "Theory and applications of the Ion Beam Induced Charge (IBIC) technique" Thesis defense: 07/03/2013 Supervisor: Prof. Ettore Vittone, University of Torino Examiner: Dr. Takeshi Ohshima, Takasaki Advanced Radiation Research Inst.
2011/05	School of Physics, University of Melbourne , Australia Visiting Scientist , Research activity at the Micro-Analytical Research group Development of finite element method models of "charge sharing" effects in

silicon multi-electrode devices
Contact: Prof. David N. Jamieson

- 2012/09 - 12** **International Atomic Energy Agency (IAEA)**, Vienna, Austria,
Division of Physical and Chemical Sciences
Internship, Design of the Accelerator Knowledge Portal for the official website of the Agency, equipped with worldwide database of electrostatic ion accelerators [<https://tinyurl.com/y48yjf2o>]. Development of a simulation software for the ion beam analysis of semiconductor devices [<https://tinyurl.com/y4lf44cd>]
Supervisor: Dr. Aliz Simon
- 2013/02-2016/01** **Physics Department, University of Torino**
Research Fellowship “Fabrication of diamond devices as a platform for applied photonics”, in the framework of the Project FIRB 2010 “Development of Microfabrication techniques in diamond for applications in bio-sensing and photonics”
Contact person: Prof. Paolo Olivero
- 2013/11, 2014/01** **Laboratory for Ion Beam Interactions, Institut Ruder Boskovic**, Croazia
Invited visiting scientist as expert in single-ion detection techniques in semiconductor devices and solid state ionizing radiation detectors. Activities in the framework of the Project EU FP7 256783 “Particle Detectors”
Contact person: Dr. Stjepko Fazinic
- 2015/01 - 03** **Institute for Quantum Optics**, Università di Ulm, Germania
Visiting Scientist, quantum sensing techniques based on diamond color centers
Contact person: Prof. Fedor Jelezko
- 2016/02 - 2018/02** **National Institute of Nuclear Physics (INFN) - Torino Section**
Young Researcher Grant, National Coordinator/Principal Investigator of the Research Project “DiESiS” - Diamond-based electrically-stimulated single-photon sources. **Budget:** ~110 k€
Appointed by the 5th INFN National Scientific Commission upon an international **competitive** call :**1st rank** over >70 applications
- 2018/03 - 06** **Ruder Boskovic Institute, Zagreb, Croatia - Technical consultant**
Development and assessment of a strategic plan for the development of quantum technologies (based on single-photon sources) tailored on the capacities of the Laboratories for Ion Beam Interactions
Contact person: Dr. Milko Jaksic
- 2018/09 - 2019/02** **International Atomic Energy Agency, Vienna, Austria - Technical Consultancy**
Dept. of Nuclear Sciences and Applications.
Tasks: Design and implementation of a [database](https://tinyurl.com/y6qka254) of Cyclotrons used for Radionuclide production for the IAEA website [<https://tinyurl.com/y6qka254>]
Contact person: Dr. Amir R. Jalilian
- 2018/11 - 2019/10** **National Institute of Nuclear Physics (INFN) - Torino Section**
Fellowship Holder, National Coordinator of the INFN Research unit in the EU EMPIR “SIQUST” Metrology Research Project, funded by Euramet and the European Commission - H2020 framework
Consortium budget: 1.8 M€
- since **2019/11** **Physics Department, University of Torino**
Associate Professor
Physics of Matter della Materia
Experimental Physics of Condensed Matter

Scientific affiliations

since 2010 INFN - Istituto Nazionale di Fisica Nucleare
2010/01 - 2016/01 Centro Interdipartimentale NIS, Nanostructured Interfaces and Surfaces, UniTo
since 2012 CNISM - Consorzio Nazionale Interuniversitario per le Scienze Fisiche della Materia
since 2013 CERN - Collaborazione RD42 "CVD Diamond Radiation Detector Development"

Scientific activities

Scientific research

My main research activities since the very beginning of my PhD have been focused on the fabrication of micro-devices exploiting the interaction of MeV ions with solid state materials and devices. Such topics can be mainly subdivided in the following research areas:

1. Investigation in the mechanisms underlying the detection of single ions in solid state devices and their exploitation for emerging quantum technologies. Such research topic involves the development of theoretical models based on the Shockley-Ramo-Gunn theory, and their practical exploitation - using the Ion Beam Induced Charge (IBIC) technique - for **detectors design and characterization**, and for the development of deterministic single-ion implantation techniques.

2. Study of the structural effects of MeV ion irradiation on solid state devices, and their exploitation for technological applications. In this research area my work covered different ranges of irradiation fluences. High doses were adopted to **modify and tailor the structural, mechanical and electrical properties of materials**, with a particular emphasis on ion-implanted diamond. Intermediate irradiation fluences enable to assess the degradation of the electronic properties of electronic devices to quantify their **radiation hardness**.

3. Finally, low fluence implantation of selected ion species enables the **fabrication and engineering of individual lattice defects** in semiconductors (diamond, silicon), with appealing opto-physical properties for practical applications in **photonics** and **quantum technologies**, such as **single-photon emitters** or **ultra-sensitive field probes** at the **nanoscale**. The exploitation of individual single-photon emitting defects requires the availability of a mature **fabrication technology**, relying on deterministic implantation techniques and mature materials processing procedures. My activity in these research topics is focused on the **exploitation of nuclear-based techniques** as a tool for the **fabrication of integrated devices** enabling **quantum computing and quantum sensing with individual defect spins**.

A more detailed discussion of the scientific results is discussed in the following.

2010 - 2012: devices fabrication and characterization with focussed ion beams

After my graduation 2009 with a curriculum in mathematical, theoretical and high-energy Physics, I started my **PhD** in 2010 under the supervision of Prof. Ettore Vittone at the group in Solid State Physics, University of Torino, where I combined my competences in **theoretical modelling and numerical simulations** with the **experimental activities** for the fabrication and characterization of **solid state devices**.

The activities revolved around the utilization of **single MeV ion detection in electronic devices** as a probe to map the electronic properties of the latter. My studies relied on the exploitation and modelling of Ion Beam Induced Charge (**IBIC**) technique.

The results achieved on these topics can be summarized as follows:

1a. Development and experimental validation of a suitable model, based on the Shockley-Ramo-Gunn theory, for the induced charge pulse formation in **multi-electrode devices**. My efforts resulted, in particular, in a general demonstration of the **Gunn's theorem** and in a quantitative model describing **charge sharing effects** in semiconductor devices.

1b. Development and validation of **numerical modelling** techniques for the analysis of semiconductor devices. Simulations were performed both using the **finite element method (FEM)** approach to the **analysis of electrical and electronic properties of devices**, and a custom-developed C++ open source **Monte Carlo software (IBIC Simulation Tool)**.

1c. Development and testing of new concepts of **solid-state ionizing radiation detectors**. Particularly, I studied the charge collection and charge transport properties of **diamond detectors**

(partly in the framework of the INFN DiaMed experiment), both at the INFN Legnaro and at the Ruder Boskovic Institute laboratories.

1d. As a visiting scientist at the MARC group at the School of Physics - University of Melbourne in 2011 I worked at the characterization of **position sensitive silicon detectors**, with the purpose to optimize a **deterministic doping technique** for the **fabrication of individual spin registers in ^{28}Si** . In particular, I demonstrated that the exploitation of charge sharing effects enables to reconstruct the position of incidence of individual ions, with a projected **position sensitivity well below 1 μm** .

I also actively worked at the analysis and qualification of **radiation damage effects** on the properties of semiconductors and insulators.

2a. Particularly, I worked at the **ion beam micro-fabrication of buried graphitic electrodes in diamond**, resulting from the amorphisation of the crystal lattice at high MeV ion implantation fluences and its conversion to a graphitic phase upon thermal treatment. Such technique was adopted to fabricate devices for bio-sensing and radiation detection applications, in the framework of the INFN DiaMed experiment and other research projects funded by the MIUR.

2b. In the framework of the IAEA Coordinated Research Project (CRP) (n. F11016) I worked at the development of a quantitative approach to **define a universal parameter to quantify the radiation hardness of materials**, based on the degradation of the charge transport properties of irradiated devices. In addition to the experimental and modelling activities performed in this framework, I also developed an ad hoc package for the Monte Carlo IBIC Simulation Tool software, simulating **IBIC experiments in irradiated diodes**. The software, presented in June 2013 at the 21st International Conference on Ion Beam Analysis, Seattle, USA and in the Conference proceedings, has been awarded with the **Elsevier's "Best young researcher manuscript"** prize.

2c. In addition, I collaborated with the CIBA group at the National University of Singapore to model the **carriers' diffusion mechanism in selectively proton-irradiated silicon wafers**. My work enabled to identify the role of the radiation-induced variation in the effective doping concentration of silicon, which was exploited to selectively fabricate **porous silicon nano-structures** by electrochemical anodization. Such results enabled the availability of an innovative strategy for the **silicon micro- and nano-machining** of free standing **nanowires, photonic structures and micro-electro-mechanical systems**.

My participation in the IAEA CRP network was further strengthened by a four months **internship** at the International Atomic Energy Agency in 2012, under the supervision of Dr. Aliz Simon, in which I designed an upgrade to the web-based ion accelerator database for the Physics Section' Agency website.

2013- 2015: ion beam lithography techniques for diamond-based quantum devices

During my post-doctoral fellowship at the University of Torino I further focused my activities on the micro-fabrication of **diamond devices** as a platform for **applied photonics and quantum optics**.

I applied the Deep Ion Beam Lithography and the MeV-ion-induced defect creation in solids to the production, the study and the characterization of color centers in diamond, i.e. point lattice defects with optical transitions in the visible range. I worked at the study of **new classes of individual point defects** and their qualification for use as **single-photon sources** for applications in quantum optics. The characterization of individual quantum emitters in diamond color centers was performed under laser excitation pump in **photoluminescence** regime, and by the injection of electrical currents in **electroluminescence** regime.

Finally, during a three-months visit at the Institute for Quantum Optics, University of Ulm, Germany, I started a new research activity on the **optical detection and control** of the **electronic and nuclear spin** of individual NV centers in diamond. I am currently working at the implementation and development of a high-sensitivity nano-magnetometry setup in collaboration with the researchers of the Italian National Institute for Metrological Research (INRiM) and on its applications in the fields of quantum sensing in electronic devices and biological systems.

Since 2016:

In January 2016 I have been awarded a two-year **Young Researcher Grant** by the 5th Scientific Commission of the Italian National Institute for Nuclear Physics (INFN). The research project (“**DiESiS**” - Diamond-based Electrically-stimulated Single-photon Sources) is focused at assessing the role of **nuclear-based techniques, such as MeV ion implantation**, to fill the existing **gaps** in diamond fabrication for applications in emerging **quantum technologies**.

Particularly, as the **electrical control** of color centers and lattice defects is made difficult by the insulating properties of diamond with respect to competing materials (e.g. SiC, ²⁸Si, ...), a further refinement of the existing fabrication techniques is proposed to define **integrated multi-electrodes devices**, with the purpose of stimulating **electroluminescence**, controlling and stabilizing the **charge state of color centers** and source static and oscillating fields for the **coherent control** and optical readout of their **spin state**. A strategy to overcome such challenge has to be identified by exploiting high-resolution fabrication techniques, and to be integrated with innovative approaches (e.g., position-sensitive, deterministic single-ion implantation) for the realization of integrated solid-state devices with requested physical and quantum properties.

In addition, I worked at the exploitation of ion implantation to systematically investigate the formation of new classes of color centers in bulk and nanocrystalline diamond. The **implantation of selected impurities** in the diamond lattice has enabled so far the demonstration and qualification of **new promising optically-active defects** (such as He-, Sn-, Pb-, F-related centers) with appealing spectral, spin and lifetime properties for selected quantum technology applications. At the present time, I have been actively involved in the **discovery of 40%** of those currently known **classes of single-photon emitters in diamond**, which can be consistently fabricated upon ion implantation - and thus consistently adopted for the development of integrated quantum devices.

The quest for **new classes of color centers** with appealing emission properties for **quantum-enhanced sensing** and new **metrological standards** (narrow band, high repetition rate, polarized emission, electrical excitability, field-sensitive spin) is the current goal of the EMPIR “**SIQUST**” **Metrological Research Project**, co-funded by EURAMET and EU H2020. I am the coordinator of the Research Unit of the INFN (starting date: June 2018), which is involved as member of a Consortium including 6 National Metrology Institutes and 8 EU external partners.

Bibliometric indexes

As of 06/01/2022, on the Scopus database

ORCID	0000-0003-2583-7424
ResearcherID	K-6294-2013
First publication year	2011/06
Peer-reviewed publications	48
of which as corresponding author	17
of which as first author	10
of which as last author	8
h-index	14
h5-index [h-index for publications within 2014-2018]	8
Total citations.....	724
Invited talks	6
Contributed talks as presenting author	17
Poster contributions as presenting author	9

Awards and highlights

- 2010** Honorable mention for the poster “Focused ion beam fabrication and IBIC characterization of a diamond detector with buried interdigitated electrodes” (presenting author) at the “ICNMTA 2010 Conference”, 26-30 July 2010, Leipzig, Germania
- 2013** Elsevier’s IBA2013 Conference “Young researcher best manuscript” prize for the article “A Monte Carlo software for the 1-dimensional simulation of IBIC experiments”s”
- 2016** Italian Society of Physics (SIF) “Premio Sergio Panizza” award, for a standing out young researcher working in the fields of Optoelectronics or Photonics
- 2017** Corresponding author of “Photo-physical properties of He-related color centers in diamond”, APL 111 (2017) 111105, selected as Applied Physics Letters Editor’s Pick
- 2018** Front cover illustration of the December issue of ACS Photonics for the publication of the research article Single-Photon Emitters in Lead-Implanted Single-Crystal Diamond (corresponding author)
- 2019** The paper “Feasibility study towards comparison of the $g^{(2)}(0)$ measurement in the visible range”, Metrologia 56 (2019) 015016 was featured in the Research Highlights of “Nature Physics” (vol. 15, February 2019, page 110)
- 2019** Back cover illustration on the June issue of Wiley Advanced Quantum journal for the publication of the review paper “Quantum Micro–Nano Devices Fabricated in Diamond by Femtosecond Laser and Ion Irradiation” [<https://tinyurl.com/y23kt487>]

Coordination of experiments and research projects

as Principal Investigator

- 2016/02 - 2018/02** “DIESIS” Research project - Grant for Young Researchers
“Diamond-based electrically-stimulated single-photon sources”,
Local and National Coordinator
Budget: 110,000 €
Appointed and funded by the 5th INFN National Scientific Commission upon an **international competitive** call (17367/2015).
Application **ranked 1st** over >70 applications
- 2018/06 - 2021/06** “SIQUST” 17-FUN06 Coordinated Research Project
“Single-photon sources as new quantum standards” [<https://www.siqust.eu>]
Funded by EURAMET and the European Commission (H2020) in the framework of “EMPIR - Fundamental 2017”
Coordinator of the Research Unit of INFN
Consortium Budget: 1.8 M€
- 2021/06 - 2023/06** “SEQUME” 20FUN05 Coordinated Research Project
“Single- and entangled photon sources for quantum metrology”
[<https://www.sequme.eu>]
Funded by EURAMET and the European Commission (H2020) in the framework of “EMPIR - Fundamental 2020”
Coordinator of the Research Unit of INFN
Consortium Budget: 1.8 M€
- 2021/06 - 2023/06** “QADET” 20IND5 Coordinated Research Project
“Quantum sensors for metrology based on single-atom-like device technology”
Funded by EURAMET and the European Commission (H2020) in the framework of “EMPIR - Industry 2020”

Coordinator of the Research Unit of University of Torino
 Consortium Budget: 1.8 M€

as Coordinator/Spokeperson of experiments/beamtime at international facilities

- 2011** Experiment "IBIC characterization of position sensing diamond detectors",
 "SPIRIT" Integrated Infrastructure Initiative
 Trans-national access to the facility supported by the European Commission, FP7
 "Capacities" Framework [<http://www.spirit-ion.eu>]
- 2016** "Ion-beam fabrication of artificial diamond for the characterization and the
 electrical control of single-photon sources"
 Experiment in the CERIC-ERIC - European Research Infrastructure Consortium
 Transnational access to the facility supported by the European Commission
- 2016** "Dia.Color" - Fabrication of luminescent defects in artificial diamond
 Beam-time at the INFN - Laboratori Nazionali del Sud, Catania

as Co-investigator

- 2010 - 2012** PRIN (Project of National Interest) "Synthetic single crystal diamond
 dosimeters for application in clinical radiotherapy"
 Funded by Italian Ministry for Teaching, University and Research (MIUR)
 Coordinator: Prof. Marco Marinelli (University of Roma "Tor Vergata")
 Local coordinator: Dr. Alessandro Lo Giudice (University of Torino)
- 2011** Experiment "FARE: FAsci Rarefatti in Esterno"
 Funded by INFN - 5th National Scientific Commission
 "Capacities" programme
 Coordinator: Dr. Paolo Olivero
- 2011** Experiment "Ion beam microfabrication of artificial diamond", within "SPIRIT" Integrated
 Infrastructure Initiative
 Funded by the European Commission, FP7 "Capacities" Framework
 Coordinator: Dr. Paolo Olivero
- 2011-2015** Coordinated Research Project F11016 (Contract agreement n. 17028
 between International Atomic Energy Agency ([IAEA](http://www.iaea.org)) and Experimental Physics
 Department, University of Torino)
 "Modelling and validation of ion beam induced damage in semiconductors"
 Coordinator: Prof. Ettore Vittone (University of Torino)
- 2012-2013** DIAMED project, "Development of innovative
 dosimeters for applications in advanced radiotherapy applications"
 Funded by INFN - 5th National Scientific Commission
 Coordinator: prof. Gianluca Verona-Rinati (University of Roma "Tor Vergata")
 Local coordinator: Dr. Alessandro Lo Giudice (University of Torino)
- 2012-2015** Research Project "Development of microfabrication techniques in diamond
 for applications in bio-sensing and photonics"
 Funded by Italian Ministry for Teaching, University and Research (MIUR)
 "FIRB - Future in Research 2010" programme
 Coordinator: Dr. Paolo Olivero

- since 2013** Experiment “Dia.Fab.” at the AN2000 microbeam line AN2000 INFN National Laboratories of Legnaro
Coordinator: Dr. Federico Picollo
- 2013-2015** Project “Advanced Diamond-based Nano-Technologies” (A.Di.N-Tech.)
Funded by the University of Torino, “University Research Projects - Junior PI Grants” scheme
Coordinator: Dr. Paolo Olivero
- 2014-2015** Project “DINAMO - Development of ion beam nanofabrication techniques in diamond for applications in bio-sensing” (2014-2015)
Funded by INFN - 5th National Scientific Commission
Coordinator: Dr. Federico Picollo
- 2017-2019** Coordinated Research Project F11020 “Ion beam induced spatio-temporal structural evolution of materials: Accelerators for a new technology era”
Research agreement between IAEA and University of Torino: “Development of ion beam techniques for the implementation of solid-state quantum devices”
Coordinator: Dr. Paolo Olivero (University of Torino)
- 2018-2021** “ASIDI” Experiment - “Advances in Single Ion Deterministic Irradiation”
Funded by INFN - 5th National Scientific Commission
Coordinator: Dr. Valentino Rigato (INFN National Laboratories of Legnaro)

Organization of Workshops and Meetings

- 2016** International Atomic Energy Agency [Technical Meeting](#) TM-52976
“Spatio-temporal structural evolution of matter induced by ion beams: towards new quantum technologies”
May, 23-27 2016, Torino, Italy
- 2016** International Atomic Energy Agency Technical Meeting TM-52976
“Spatio-temporal structural evolution of matter induced by ion beams: towards new quantum technologies” [<http://www.iaea-tm.unito.it>]
23-27 May 2016, Torino, Italia
Member of the Organizing Committee
- 2017** “Quantum 2017” Workshop on “Advances in Foundations of Quantum Mechanics and Quantum Technologies with atoms and photons”
[<http://www.quantum2017.unito.it>]
8-13 May 2017, Torino, Italia
Member of the Organizing Committee
Chair of Session IX
- 2019** “Quantum 2019” Workshop “Advances in Foundations of Quantum Mechanics and Quantum Technologies with atoms and photons”
[<http://www.quantum2019.unito.it>]
26 May - 1 June 2019, Torino, Italia
Member of the Organizing Committee
Chair of Session XVI

Editorial roles

- since 2013** Peer reviewer for Nuclear Instr. and Methods in Physics Research B, Elsevier
- since 2015** Peer reviewer for la Surface & Coatings Technology, Elsevier

since 2016	Peer reviewer for Diamond and Related Materials, Elsevier
since 2016	Peer reviewer for Scientific Reports, Nature Publishing Group
2016	Project evaluator for the Call 2016 ERC - Advanced Grants of the European Commission
since 2017	Editorial Board Member of Nature Scientific Reports [tinyurl.com/y65xcb7x]
2019	Project evaluator for the Hong Kong Research Grants Council (RGC) - Engineering Panel
since 2021	Peer reviewer for Advanced Quantum Technologies, Wiley

Commissions of trust

Evaluation commissions for research scholarships, personnel selection:

- n. 19/**2020** at University of Torino, Physics Department, "Mechanic-acoustic characterization of brake pads", scholarship
- n. 19/**2020** at University of Torino, Physics Department, "Characterization of metallica materials by ion and electron microscopy", scholarship
- n. 08/**2021** at University of Torino, Physics Department, "Tribological characterization of brake pads", scholarship
- n. 09/**2021** at University of Torino, Physics Department, "Modellizzazione dell'usura delle pastiglie freno in prova veicolo", scholarship

since 2021

Member of the Public Engagement Commission, Physics Department, University of Torino

Other research products

IBIC Simulation Tool - An **open source software** with graphical user interface for the simulation of IBIC experiments in 1-dimensional geometries

The code is based on a Monte Carlo approach to the solution of the continuity equations for excess charge carriers, and relies on the Shockley-Ramo-Gunn theory for the evaluation of the total induced charge. Extended information on the project is available at [<http://www.solid.unito.it/RICERCA/IBA/IST.html>].

Scientific production: publications**Peer Reviewed publications**

1. P. Olivero, **J. Forneris**, M. Jaksic, Z. Pastuovic, F. Picollo, N. Skukan, E. Vittone
“Focused Ion Beam fabrication and IBIC characterization of a diamond detector with buried electrodes”
Nuclear Instruments and Methods in Physics Research B, 269 (2011) 2340
doi: 10.1016/j.nimb.2011.02.021
2. P. Olivero, **J. Forneris**, P. Gamarra, M. Jaksic, A. Lo Giudice, C. Manfredotti, Z. Pastuovic, N. Skukan, E. Vittone
“Monte Carlo analysis of a lateral IBIC experiment on a 4H-SiC Schottky diode”
Nuclear Instruments and Methods in Physics Research B, 269 (2011) 2350
doi: 10.1016/j.nimb.2011.02.020
3. J. Song, Z. Y. Dang, S. Azimi, M. B. H. Breese, **J. Forneris**, E. Vittone
“On the formation of 50 nm diameter free-standing silicon wires produced by ion irradiation”
ECS Journal of Solid State Science and Technology, 1 (2) (2012) P66
doi: 10.1149/2.015202jss
4. **J. Forneris***, D. N. Jamieson, G. Giacomini, C. Yang, E. Vittone
“Modeling of Ion Beam Induced Charge Sharing experiments for the design of high resolution position sensitive detectors”
Nuclear Instruments and Methods in Physics Research B 306 (2013) 169
doi: 10.1016/j.nimb.2012.12.025
5. **J. Forneris***, V. Grilj, M. Jaksic, A. Lo Giudice, P. Olivero, F. Picollo, N. Skukan, C. Verona, G. Verona Rinati, E. Vittone
“IBIC characterization of an ion-beam-micromachined multi-electrode diamond detector”
Nuclear Instruments and Methods in Physics Research B 306 (2013) 181
doi: 10.1016/j.nimb.2012.12.056
6. J. Song, Z. Y. Dang, S. Azimi, M. B. H. Breese, **J. Forneris**, E. Vittone
“On the formation of silicon wires produced by high-energy ion Irradiation”
Nuclear Instruments and Methods in Physics Research B 296 (2013) 32
doi: 10.1016/j.nimb.2012.11.018
7. S. Azimi, Z. Y. Dang, J. Song, M. B. H. Breese, E. Vittone, **J. Forneris**
“Defect enhanced funneling of diffusion current in silicon”
Applied Physics Letters 102 (2013) 042102
doi: 10.1063/1.4789849
8. **J. Forneris***, V. Grilj, M. Jaksic, A. Lo Giudice, P. Olivero, F. Picollo, N. Skukan, C. Verona, G. Verona Rinati, E. Vittone
“Measurement and modelling of anomalous polarity pulses in a multi-electrode diamond detector”
EPL, 104 (2013) 28005
doi: 10.1209/0295-5075/104/28005
9. Z. Pastuovic, I. Capan, R. Siegele, R. Jacimovic, **J. Forneris**, D. D. Cohen, E. Vittone
“Generation of vacancy cluster-related defects during single MeV silicon ion implantation of silicon”
Nuclear Instruments and Methods in Physics Research B 332 (2014) 298
doi: 10.1016/j.nimb.2014.02.082
10. **J. Forneris***, M. Jaksic, Z. Pastuovic, E. Vittone
“A Monte Carlo software for the 1-dimensional simulation of IBIC experiments”
Nuclear Instruments and Methods in Physics Research B 332 (2014) 257

doi: 10.1016/j.nimb.2014.02.073

Award-winner: Elsevier's IBA2013 Conference "Young researcher best manuscript" prize

11. D. Gatto Monticone, P. Traina, E. Moreva, **J. Forneris**, P. Olivero, I. P. Degiovanni, F. Taccetti, L. Giuntini, G. Brida, G. Amato, M. Genovesex
"Native NIR-emitting single colour centres in CVD diamond"
New Journal of Physics 16 (2014) 053005
doi: 10.1088/1367-2630/16/5/053005
12. D. Gatto Monticone, K. Katamadze, P. Traina, E. Moreva, **J. Forneris**, I. Ruo Berchera, P. Olivero, I. P. Degiovanni, G. Brida, M. Genovese
"Beating Abbe diffraction limit in confocal microscopy via non-classical photon statistics"
Physical Review Letters 113 (2014) 143602
doi: 10.1103/PhysRevLett.113.143602
13. **J. Forneris**, A. Lo Giudice, P. Olivero, F. Picollo, A. Re, Marco Marinelli, F. Pompili, C. Verona, G. Verona Rinati, M. Benetti, D. Cannata, F. Di Pietrantonio
"A 3-dimensional interdigitated electrode geometry for the enhancement of charge collection efficiency in diamond detectors"
EPL, 108 (2014) 18001
doi: 10.1209/0295-5075/108/18001
14. L. Grassi, **J. Forneris**, D. Torresi, L. Acosta, A. Di Pietro, P. Figuera, M. Fisichella, V. Grilj, M. Jaksic, M. Lattuada, T. Mijatovic, M. Milin, L. Prepolec, N. Skukan, N. Soic, V. Tokic, M. Uroic
"Study of the inter-strip gap effects on the response of Double Sided Silicon Strip Detectors using proton micro-beams"
Nuclear Instruments and Methods in Physics Research A 767 (2014) 99
doi: 10.1016/j.nima.2014.08.009
15. D. Gatto Monticone, **J. Forneris**, M. Levi, A. Battiato, F. Picollo, P. Olivero, P. Traina, E. Moreva, E. Enrico, G. Brida, I. P. Degiovanni, M. Genovese, G. Amato, L. Boarino
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“Focused ion beam micro-fabrication and IBIC characterization of a multi-electrode diamond detector with buried graphitic electrodes”,
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14-19 July 2013, Rio de Janeiro, Brasil), contribution n. 612
4. D. Gatto Monticone, P. Traina, E. Moreva, **J. Forneris**, M. Levi, G. Brida, I. P. Degiovanni, G. Amato, L. Boarino, P. Olivero, M. Genovese
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“Conductive-AFM Study of Emerging Graphitic Channels Implanted in CVD Diamond”
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15. William Trischuk on behalf of the RD42 Collaboration
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16. **J. Forneris**, A. Battiato, S. Ditalia Tchernij, F. Picollo, A. Tengattini, P. Traina, E. Moreva, I.P. Degiovanni, M. Genovese, L. La Torre, V. Rigato, P. Olivero
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“Super-resolution from single photon emission: toward biological application”
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“Proton Beam Induced Fluorescence in 5 nm Detonation Nanodiamond”
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21. E. Moreva, P. Traina; **J. Forneris**; S. Ditalia Tchernij, F. Picollo, I. P. Degiovanni, V. Carabelli, P. Olivero, M. Genovese
“Color centres in diamond from single photon sources to ODMR in cells”
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22. L. Bani et al., (CERN RD42 Collaboration)
“Diamond detectors for high energy physics experiments”
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Scientific production: Conference contributions

Invited talks

1. "Fabrication and Control of Color Centers in Diamond for Single-photon Generation and Quantum Enhanced Sensing"
Silicon and Diamond Photonics 2019
21-22 March 2019, Braunschweig, Germany [<http://www.silicon-diamond2019.de>]
2. "Fabrication of color centers in diamond by ion implantation for single-photon sources engineering and quantum sensing applications"
Ion Beams for future Technologies 2019
1-3 April 2019, International University Center, Dubrovnik, Croatia [<http://iontech.irb.hr>]
3. "Diamond-based quantum emitters for quantum optics and quantum sensing applications"
ISOLDE Workshop and Users meeting 2019, 5-6/12/2019
CERN, Geneva, Switzerland. <https://indico.cern.ch/event/829302/overview>
4. J. Forneris
"The SIQUST Project: Diamond-based single-photon sources as new quantum standards"
Workshop "Quantum Technologies within INFN: status and perspectives"
20-21 February 2020, Padova, Italy
5. "Deterministic implantation technologies and colour centres"
Workshop "Q@TN: Technologies and platforms for quantum technologies within the Q@TN Joint Lab and their applications"
8-9 September 2021, Trento, Italy
6. "Fabbricazione e caratterizzazione di emettitori quantistici allo stato"
Seminar "Ciclo Seminari INRiM"
25 October 2021, Torino, Italy

Contributed talks as presenting author

2011

1. **J. Forneris***, L. La Torre, A. Lo Giudice, C. Manfredotti, M. Marinelli, P. Olivero, F. Picollo, A. Re, C. Verona, G. Verona-Rinati, E. Vittone
"Fabrication with ion beam lithography and IBIC characterization of a particle detector in single-crystal diamond with integrated graphitic micro-electrodes"
Diamond 2011 Conference
04-08 September 2011, Garmisch - Partenkirchen, Germany

2012

2. **J. Forneris***, V. Grilj, M. Jaksic, A. Lo Giudice, P. Olivero, F. Picollo, N. Skukan, C. Verona, G. Verona-Rinati, E. Vittone
"Sharing of anomalous polarity pulses in a ion-beam-micromachined multi-electrode diamond detector"
2nd RBI Diamond Detectors Workshop
7-9 May 2012, Plitvice, Croazia
3. **J. Forneris***, D. N. Jamieson, C. Yang, G. Giacomini, E. Vittone
"Modeling of Ion Beam Induced Charge sharing experiments for the design of high resolution position sensitive detectors"
ICNMTA 2012 Conference
22-27 July 2012, Lisbona, Portogallo

2013

4. **J. Forneris***, P. Olivero, F. Picollo, E. Vittone
"A Monte Carlo software with graphical user interface for the simulation of IBIC experiments in 1-dimensional geometries"
2° International Atomic Energy Agency Research Coordination Meeting "Utilization of Ion Accelerators for Studying and Modelling of Radiation Induced Defects in Semiconductors and Insulators"
13-17 May 2013, IAEA Headquarters, Vienna, Austria
5. **J. Forneris***, V. Grilj, M. Jaksic, A. Lo Giudice, P. Olivero, F. Picollo, N. Skukan, C. Verona, G. Verona-Rinati, E. Vittone
"Ion beam micro-fabrication and IBIC characterization of a diamond detector with buried graphitic micro-electrodes"
E-MRS Spring 2013 Meeting - Symposium M, Basic research on ionic-covalent materials for nuclear applications
27-31 May 2013, Strasbourg, Francia
6. **J. Forneris***
"A Monte Carlo software for the 1-dimensional simulation of IBIC experiments"
21st International Conference on Ion Beam Analysis
23-29 June 2013, Seattle, USA
7. **J. Forneris***, V. Grilj, M. Jaksic, N. Skukan, C. Verona, G. Verona-Rinati, P. Olivero, F. Picollo, E. Vittone
"Fabrication and characterization by means of focused ion beams of a diamond detector with integrated graphitic micro-electrodes"
FisMat 2013, Italian National Conference on Condensed Matter Physics
9-13 September 2013, Milano, Italia

2014

8. **J. Forneris***, D. Gatto Monticone, P. Traina, V. Grilj, G. Brida, I. P. Degiovanni, E. Moreva, N. Skukan, M. Jaksic, M. Genovese, P. Olivero
"Electroluminescence of NV centers in diamond induced by ion-beam fabricated buried graphitic electrodes"
CAARI 2014 - 23rd Conference on Applications for Accelerators in Research and Industry
25-30 May 2014, San Antonio, Texas, USA

2015

9. **J. Forneris***, P. Traina, D. Gatto Monticone, A. Tengattini, V. Grilj, G. Brida, G. Amato, L. Boarino, E. Enrico, I. P. Degiovanni, E. Moreva, N. Skukan, M. Jakšić, C. Verona, G. Verona-Rinati, M. Genovese, P. Olivero
"Electrical stimulation of colour centres in diamond with ion-beam- micromachined sub-superficial graphitic electrodes"
Hasselt Diamond Workshop 2015
25-27 February 2015 Hasselt, Belgio
10. A. Tengattini, **J. Forneris***, P. Traina, D. Gatto Monticone, V. Grilj, G. Brida, G. Amato, L. Boarino, E. Enrico, I. P. Degiovanni, E. Moreva, N. Skukan, M. Jakšić, C. Verona, G. Verona-Rinati, M. Genovese, P. Olivero
"Fabrication of single-photon electroluminescent devices in single-crystal diamond by means of MeV ion microbeams"
Fotonica 2015 - Italian Congress on Photonics Technologies
6-8 May 2015, Torino, Italia
11. **J. Forneris***, P. Traina, S. Ditalia Tchernij, A. Tengattini, F. Picollo, V. Grilj, G. Brida, G. Amato, L. Boarino, E. Enrico, I. P. Degiovanni, E. Moreva, N. Skukan, M. Jakšić, C. Verona, G. Verona-Rinati, M. Genovese, P.

Olivero

“Electrical excitation and charge state control of deep colour centres in diamond by means of sub-superficial graphitic micro-electrodes”

Diamond 2015 - International Conference on Diamond and Carbon Materials 2015

6-10 September 2015, Bad Homburg, Germania

2016

12. J. Forneris *

“Ion beam fabrication of diamond-based devices for quantum optics and quantum sensing applications”
IAEA Technical Meeting TM-52976

“Ion Beam-Induced Spatio-Temporal Structural Evolution of Matter: Towards New Quantum Technologies”

23-27 May 2016, Torino, Italy

2017

13. J. Forneris *, S. Ditalia Tchernij *, V. Sicari, P. Olivero; B. Naydenov³, F. Jelezko; V. Grilj, N. Skukan, M. Jakšić; G. Amato, L. Boarino, I.P. Degiovanni, E. Enrico, E. Moreva, P. Traina, M. Genovese,

“Fabrication and characterization of graphite-diamond-graphite junctions for the electrical control of diamond color centers”

Hasselt Diamond Workshop 2017

8-10 March 2017, Hasselt, Belgio

14. J. Forneris *

“Fabbricazione di dispositivi in diamante per applicazioni in ottica e sensoristica quantistica”

Space Quantum Technology Workshop

21-23 Marzo 2017, Agenzia Spaziale Italiana (ASI), Roma, Italia

15. J. Forneris *, E. Moreva, A. Tengattini, P. Traina, F. Picollo, S. Ditalia Tchernij, A. Battiato, G. Brida, I. Degiovanni, M. Genovese, P. Olivero

“Fabrication by ion implantation and optical characterization of single-photon emitters in nanodiamonds”

REI-19 – 19th Conference on Radiation Effects in Insulators

2-7 July 2017, Versailles, Francia

2020

16. J. Forneris *, G. Provasas , F. Picollo , S. Ditalia Tchernij , M. Brajkovic, A. Crnjac , V. Rigato , Z. Siketic , M. Jaksic , E. Vittone

“IBIC analysis of a 2D diamond position sensitive detector fabricated by ion beam deep lithography”

14-15 September 2020, ICNMTA2020 - 17th International Conference on Nuclear Microprobe Technology and Applications, <https://icnmta2020.org/>

17. J. Forneris

“Magnetometri a base diamante ad elevate prestazioni”

26 November 2020, Giornate della Ricerca Accademica Spaziale, Agenzia Spaziale Italiana, Italy

Poster contributions

2010

1. P. Olivero, J. Forneris *, P. Gamarra, M. Jaksic, A. Lo Giudice, C. Manfredotti, Z. Pastuovic, N. Skukan, E. Vittone

“Lateral IBIC analysis of a 4H-SiC Schottky diode”

ICNMTA 2010 Conference

26-30 Luglio 2010 Leipzig, Germania

2. P. Olivero, **J. Forneris***, M. Jaksic, Z. Pastuovic, N. Skukan, F. Picollo, E. Vittone
“Focused ion beam fabrication and IBIC characterization of a diamond detector with buried interdigitated electrodes”
ICNMTA 2010 Conference
26-30 July 2010 Leipzig, Germania

2012

3. **J. Forneris***, V. Grilj, M. Jaksic, A. Lo Giudice, P. Olivero, F. Picollo, N. Skukan, C. Verona, G. Verona Rinati, E. Vittone
“IBIC characterization of a lon-beam-micomachined multi-electrode-diamond detector”
ICNMTA 2012 Conference
22-27 July 2012 Lisbona, Portogallo
4. **J. Forneris***, P. Gamarra, M. Jaksic, C. Manfredotti, P. Olivero, Z. Pastuovic, N. Skukan, E. Vittone
“Lateral IBIC characterization of charge transport properties of a 4H-SiC Schottky diode”
ICTP-IAEA Workshop on Physics of Radiation Effect and its Simulation for Non-Metallic Condensed Matter
13-24 August 2012 Trieste, Italia

2014

5. **J. Forneris*** D. Gatto Monticone, P. Olivero V. Grilj, , N. Skukan, M. Jaksic, P. Traina, G. Amato, L. Boarino, G. Brida, I. P. Degiovanni, E. Enrico, E. Moreva, M. Genovese
“lon-beam-fabrication of buried graphitic electrodes for the excitation of electroluminescent NV centers in diamond”
ICNMTA2014 - 13th International Conference on Nuclear Microprobe Technology and Applications
6-11 July 2014, Padova, Italia
6. **J. Forneris*** J. Forneris, A. Lo Giudice, P. Olivero, F. Picollo, E. Vittone, V. Grilj, N. Skukan, M. Jaksic, C. Verona, G. Verona-Rinati, E. Vittone
“IBIC mapping of anomalous polarity pulses in a multi-electrode diamond detector”
ICNMTA2014 - 13th International Conference on Nuclear Microprobe Technology and Applications
6-11 July 2014, Padova, Italia

2017

7. S. Ditalia Tchernij, F. Picollo, A. Battiato, E. Enrico, V. Grilj, N. Skukan, G. Amato, L. Boarino, M. Jakšić, P. Olivero, **J. Forneris***
“Electrical control of NV centers in diamond by means of ion-beam-micromachined sub-superficial graphitic micro-electrodes”
19th International Conference on Radiation Effects in Insulators (REI-19)
2-7 July 2017, Versailles, Francia

2019

8. **J. Forneris***, S. Ditalia Tchernij, P. Traina, E. Moreva, I. P. Degiovanni, T. Lühmann, T. Herzig, S. Pezzagna, J. Meijer, M. Jakšić, M. Genovese, P. Olivero
“Fabrication of diamond-based quantum emitters upon ion implantation”
Single Photon Workshop 2019
21-25 October 2019, Politecnico di Milano, Italy

2020

9. **J. Forneris***, G. Provatas, F. Picollo, S. Ditalia Tchernij, M. Brajkovic, A. Crnjac, V. Rigato, Z. Siketic, M. Jaksic, E. Vittone
“IBIC characterization of a diamond position sensitive detector fabricated by ion beam deep lithography”

14-15 September 2020, ICNMTA2020 - 17th International Conference on Nuclear Microprobe
Technology and Applications, <https://icnmta2020.org/>

Teaching, outreach and dissemination activities

Graduate and undergraduate courses at University of Torino

since **2019-20**

“Structure of Matter with Laboratory”

course of the Bachelor Degree in Physics at the University of Torino, 3rd year, 90 hours

“Physics Today”

course of the Bachelor Degree in Physics at the University of Torino. 2nd year, 4 hours

“Materials for electronics with laboratory”

course of the Bachelor Degree in Materials Science at the University of Torino, 3rd year, 24 hours

since **2020-21**

“Solid State Physics - Optical properties of materials”

course of the Master Degree in Materials Science and MAMASELF
Master at the University of Torino, 1st year, 32 hours



Lecturer at international schools

2018

Lecturer at the International School “ICTP-IAEA Advanced school on ion beam driven materials engineering: accelerators for a new technology era”

[<http://indico.ictp.it/event/8332/>]

1-5 October 2018, Abdus Salam International Centre for Theoretical Physics, Trieste, Italia

Lectures:

“Engineering and control of solid state quantum emitters”

“Quantum sensing with color centers in diamond”

2019

Professor of the course “Experimental implementation of quantum devices”

Doctoral School in Physics and Astrophysics

Università di Torino, September 2019

[http://dottorato.ph.unito.it/c_de.html#15]

Advisor of M.Sc and B.Sc Theses

1. **Emilio Corte**

M.Sc. in Physics

“Confocal microscopy characterization of quantum emitters in diamond”

Graduation: June **2020**

2. **Fabio Picariello**

M.Sc. in Physics

“Functionalization of artificial diamond by means of ion beams for the electrical stimulation of luminescent defects”

Graduation: September **2020**

3. **Daniel Siciliano**

B.Sc. in Physics

“Analisi di un rivelatore multi-elettrodo in diamante sensibile alla posizione”

Graduation: December **2020**

4. **Claudia Stella**

M.Sc. in Physics

Starting date: May **2021**

5. **Vanna Pugliese**

M. Sc. in Physics

Starting date: July **2021**

6. **Gabriele Zanelli**

M. Sc. in Materials Science

Starting date: October **2021**

7. **Matteo Fumero**

B. Sc in Physics

“Electrical Characterization of Diamond-Based Micrometric Junctions”

Graduation: November **2021**

8. **Lorenzo Chiurazzi**

B. Sc in Physics

“Characterization of artificial diamond crystals by means of optical transmission spectroscopy”

Graduation: November **2021**

9. **Elisa Redolfi**

M. Sc in Physics

Starting date: November **2021**

Advisor of Ph.D Theses

1. **Emilio Corte**

Ph.D in Physics

“Department of Excellence” research project of the UniTo Physics Department

Starting date: October 2020

2. **Elena Nieto Hernández**

Ph.D. in Physics

Marie Curie Programme within the LaslonDef Project

Academic Tutor of external curricular stages

1. **Luca Sacchi**

Stage at Italian National Institute of Metrological Research (INRiM)

Local Tutor: Dr. Marco Genovese

May-July **2021**

Opponent to M.Sc. Theses defenses

1. **Carlo Pepe**

M.Sc. in Physics

“Photonic structures for broadband collection of photon pairs”

Thesis advisor: Prof. Paolo Olivero

Graduation: October 2020

2. **Eugenio Sturniolo**

M. Sc. in Physics

“Dielectric materials for photonic quantum devices in the microwave regime”

Thesis advisor: Prof. Paolo Olivero

Graduation: April 2021

3. **Flavio Galaverna**

M.Sc. in Physics

“Modelling and experimental analysis of quantum well active materials for high-power semiconductor lasers

Thesis advisor: Prof. Elena Botta

Graduation: October 2021

Second-advisor of M.Sc and B.Sc Theses

1. **Sviatoslav Ditalia Tchernij**

“Controllo elettrico di centri luminescenti in diamante artificiale”

M.Sc. in Physics

Advisor: Prof. Paolo Olivero, Università di Torino

Graduation date: April **2015**

2. **Matteo Crema**

“Sviluppo di un apparato per la misurazione della risonanza magnetica rivelata otticamente da centri di colore in diamante”

M.Sc. in Physics

Advisor: Prof. Paolo Olivero, Università di Torino

Graduation date: April **2016**

3. **Valerio Sicari**

“Studio delle proprietà di emissione di centri di colore in diamante artificiale stimolati con campi elettromagnetici”

M.Sc. in Physics

Advisor: Prof. Paolo Olivero, Università di Torino

Graduation date: October **2016**

4. **Andrea Alessio**

“Mappatura confocale e caratterizzazione spettrale di singoli difetti luminescenti in diamante artificiale”

B.Sc. in Materials Science

Advisor: Prof. Paolo Olivero, Università di Torino

Graduation date: April **2017**

5. **Santo Santonocito**

“Characterization of the opto-physical properties of diamond color centers in ion implanted diamond”

M.Sc. in Physics

Advisor: Prof. Paolo Olivero, Università di Torino

Graduation date: April **2018**

6. **Chiara Ferrero**

“Processamento e caratterizzazione elettrica di canali conduttivi superficiali in diamante artificiale”

B.Sc. in Physics

Advisor: Prof. Paolo Olivero, Università di Torino

Graduation date: July **2018**

7. **Marwan Channab**

“Caratterizzazione di difetti luminescenti in diamante a temperature criogeniche” (titolo provvisorio)

M.Sc. in Physics

Advisor: Prof. Paolo Olivero, Università di Torino

Graduation date: October **2019**

Second advisor of Ph.D Theses

1. Sviatoslav Ditalia Tchernij

“Use of energetic ion beams for the engineering and control of quantum-optical emitters and sensors in artificial diamond”

Ph.D in Physics and Astrophysics

Advisor: Prof. Paolo Olivero, Università di Torino

Ph.D defense: January **2019**

Seminars at universities and research institutes

1. “Ion Beam Induced Charge: computational tools and numerical simulations”
25 May 2011 School of Physics, University of Melbourne, Australia
2. “MeV ion beams fabrication of diamond: electroluminescence from color centers stimulated by sub-superficial graphitic electrodes”
13 January 2015, Institute for Quantum Optics, Universität Ulm, Germania
3. “Ion beam techniques for the fabrication and control of single-photon emitters in diamond”
4 April 2018, Laboratory for Ion Beam Interactions, Institut Ruder Boskovic, Zagreb, Croazia

Scientific dissemination initiatives

2010 Outreach activity at multi-media stand “Talk with diamond - Devoping tomorrow’s lab-on-a-chip clinics”, ESOF2010 (European Science Open Forum), 5 July 2010, Torino.

2017 Organizer of the “Quantum & the City” outreach event in the framework of the “Quantum2017” Workshop [www.quantum2017.unito.it]
8 May 2017, Torino, Italy

2019 Speaker at the Pint of Science 2019 Festival
Seminario “Il signore degli anelli ma non solo: il diamante per dispositivi quantistici”
[<https://tinyurl.com/y3aj9zex>]
20 May 2019, Torino, Italia

2020 Speaker at “CIM 4.0 Partners MEET UniTo”. Tound Table: Smart Technologies for Industry and Business
Advanced Technologies and solid state materials
15 October 2020, Public event for industrial partners organized by the University of Torino, Industrial Liaison Office

Torino, 8 set 2021

Jacopo Forneris

