


## PERSONAL INFORMATION

## Paolo De Natale



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 ORCID: 0000-0002-3308-8569

Sex Male | Nationality Italian

## EDUCATION AND TRAINING

- 2013 Italian habilitation to full university professor for Experimental Physics-Structure of Matter
- 1993 PhD/Diploma in Optics  
University of Florence – Italy
- 1987 Degree in Physics “magna cum laude”  
University Federico II, Naples - Italy

## WORK EXPERIENCE

- 2003 - present **Research Director**  
National Institute of Optics (INO) of Italian Research Council (CNR), Italy
- 2010 - 2021 **Director**  
Founder and first director of the National Institute of Optics (INO) of the Italian Research Council (CNR), Italy
- 2007 - 2010 **Director**  
National Institute of Applied Optics (INOA) of CNR, Italy
- 2001 - 2007 **Director**  
INOA local unit in Pozzuoli, Italy
- 1997 - 2003 **Senior Research Scientist**  
National Institute of Optics (INO) of Italian Research Council (CNR), Italy
- 1996 - 1997 **Research Scientist**  
National Institute of Optics (INO) of Italian Research Council (CNR), Italy
- 1988 - 1996 **Permanent staff position**  
European Laboratory for Nonlinear Spectroscopy (LENS), University of Florence, Italy

## AWARDS, FELLOWSHIPS

- 2015 Appointed Italian representative of **ICO** – International Commission for Optics
- 2015 Awarded with **OSA** (the Optical Society of America) **Fellowship**
- 2012 “All-Optical Radiocarbon Dating” by D. Mazzotti, S. Bartalini, S. Borri, P. Cancio, I. Galli, G. Giusfredi, and P. De Natale selected as one of the **best 3 contributions in Optics in 2012 by OSA**
- 2012 Awarded with **SPIE** (the International Society for Optical Engineering) **Fellowship**
- 2010 Awarded as one of the best contributions in Optics in 2010 in OPN by **OSA**, *Quiet Cascade*

PERSONAL SKILLS

Mother tongue(s) Italian

Other language(s)

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

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user  
Common European Framework of Reference for Languages

Organisational / managerial skills

ORGANIZATION OF SCIENTIFIC MEETINGS AND PARTICIPATION TO CONFERENCES COMMITTEES (SELECTION)

- 2022-24 Chairman International Quantum Cascade Lasers School and Workshop-IQCLSW 2024
- 2015 - 2017 Program sub-committee member CLEO Europe (Optical Sensing and Metrology)
- 2015 Scientific committee FISMAT (Condensed Matter Physics)
- 2013 - 2015 Sub-committee member CLEO (Laser Science to Photonic Applications)
- 2011 - present Executive and Scientific committee HRMS (High-Resolution Molecular Spectroscopy) - held every 2 years
- 2010 - 2017 Executive committee Fotonica (Photonic Technologies)
- 2009 Chairman HRMS (High-Resolution Molecular Spectroscopy)
- 2009 Co-chairman Fotonica (Photonic Technologies, Italy)
- 2008 Executive committee Elettroottica (Electro-optic methods and instruments, Italy)

MANAGEMENT ACTIVITY

Across 14 years (2/2007-2/2021) PDN directs INOA and then INO-CNR, without any gap. In 2010, INOA becomes part of the scientific Network of CNR with 67 overall employees, the headquarters in Florence and two local Units (Lecce and Naples). Since the foundation of INO-CNR and during the years 2010-2021, the Institute grows and, in 2/2021, at the end of the term of PDN as Director, the Institute has about 300 scientists and employees working throughout the 8 units located all over Italy, with 45 people in the technical and administrative staff. At that date, about 90 national and international projects are active, in the area of Atomic, Molecular and Optical-AMO Physics.

- 2021 - present Member of the Advisory Committee to implement the Framework Agreement between the Italian National Research Council-CNR and the Italian Ministry of Defense-General Secretariat (SegreDifesa)
- 2020 - present Co-founder of the CNR-INO Spin-off company : QTI Srl
- 2019 – present Member of the LENS Executive Council (the only member elected by LENS personnel)
- 2018-2020 President of CNR Research Area (AdR) in Sesto Fiorentino (FI), with about 500 units of personnel operating in the AdR.
- 2016 - present Co-founder of the CNR-INO Spin-off company: ppqSense Srl
- 2017 - Present Italian representative in the Quantum Community Network-QCN Board of the EU Quantum Technologies Flagship
- 2017 - present Italian academic representative within the European Defence Agency-EDA for the CAPTECH Optronics
- 2016 - 2022 Member of the Board of Directors of the Company: Collezione Nazionale dei Composti Chimici e Centro Screening (Italian National Collection of Chemical Compounds and Screening Center) – CNCCS S.c.ar.l.
- 2010-2021 Founder and first Director of INO-CNR, created from the fusion of INOA, INFM and CNR groups
- 2007 - 2010 Director of INOA-CNR
- 2002 - 2012 Member of the Scientific Board and of the Board of Directors of the public consortium for Environmental Risk Analysis and Monitoring - AMRA S.c.ar.l.
- 2001 – 2007 Foundation and direction of the INOA-CNR unit in Pozzuoli. The Unit grew from 2 to 10 employees in that period. 35 ISI papers were published in 2006.
- 2002 - 2005 Member of the Scientific Board of the National Group of Volcanology (GNV)-INGV.

TECHNOLOGY TRANSFER AND START-UP FOUNDATION

In the period 2010-2015, the overall revenues from contracts with companies amounted to about 2.2

MEuros, that is an average of more than 370 kEuros/year.

In order to properly address the theme of Technological Transfer, in 2015 PDN created, at INO, a **Tech Transfer team**, including 6 scientists/technologists, each working in a different INO Unit and already experienced in the field. The tasks of this team include: reinvestment of royalties from patents in other tech transfer-related activities, dissemination of tech transfer best practices and information towards INO scientists, promotion and commercialization of INO Patents, consultancy for spin off activities, interaction with the central CNR Tech Transfer Office (UVR) in Rome. In the period 2010-2019, 36 patents were filed by INO. INO has hosted a spin-off company, founded by INO researchers, from 2012 to 2015 in the Lecce Unit.

The International Committee appointed for the CNR internal Evaluation (performed in 2015 and evaluating the 2011-2014 period, when PDN was the director) has written for INO what follows:

*"...In terms of patents, the Institute did very well in 2013 and less well in 2014, but I am less concerned about the number of patents as such rather than how they were used. In this respect, the translation of research appears to be improving, which is good to see; there are some very nice examples of technology transfer. ..."*

During the two years term as President of CNR Research Area in Sesto Fiorentino (Firenze), PDN started a Technology Transfer Center, named CENTRATEC, to enhance and reorganize interaction of multidisciplinary activities of CNR Institutes with Companies.

## Foundation of start-up Companies

### 2016-ppqSense Srl

Following this intense Tech-Transfer activity, with the aim to train a generation of scientists in the field, PDN co-founded a CNR **spin-off company** on April, 29<sup>th</sup> 2016, following formal approval by CNR and MIUR in February 2016. This company, named **ppqSense Srl**, was conceived and based on the unique scientific results achieved with the groundbreaking invention of a new laser spectroscopy technique, named *SCAR-Saturated absorption Cavity-Ringdown* first published in 2010 (*Saturated-absorption cavity ring-down spectroscopy* Physical Review Letters **104**, 110801 (2010)) which already showed a record sensitivity for <sup>14</sup>CO<sub>2</sub> (radiocarbon dioxide) detection in 2011 (*Molecular gas sensing below parts per trillion: radiocarbon-dioxide optical detection* Physical Review Letters **107**, 270802 (2011)), increasing of orders of magnitude a few years later (*Spectroscopic detection of radiocarbon dioxide at parts-per-quadrillion sensitivity* Optica **3**, 385-388 (2016): this ultimate sensitivity level gave also the acronym to the Company-ppq (i.e. 10<sup>-15</sup>)) and very recently unfolding its potential to solve key problems in the area of Energy&Environment (*Biogenic Fraction Determination in Fuel Blends by Laser-Based <sup>14</sup>CO<sub>2</sub> Detection* Advanced Photonics Research **2**, 2000069 (2021) and *Precise radiocarbon determination in radioactive waste by a laser-based spectroscopic technique* Proceedings of the National Academy of Sciences-PNAS **119**, e2122122119 (2022)).

Other key areas of application of the commercially developed SCAR spectrometer are: portable/on-site laser dating of archeological remains; leakage detection around underground reservoirs of sequestered carbon dioxide for greenhouse effect mitigation; metabolic curve measurement for novel <sup>14</sup>C-marked pharmaceuticals under test; precise assessment of fossil-fuels burning by local dilution measurement of radiocarbon dioxide, in view of mitigation of climate change.

Another key discovery that took to the realization of the control electronics of the Quantum Cascade Lasers-QCLs used in SCAR spectrometers, was the strong dependence of QCLs linewidth from the driving current noise (*Observing the intrinsic linewidth of a quantum-cascade laser: beyond the Schawlow-Townes limit* Physical Review Letters **104**, 083904 (2010)).

At present, two different lines of products are commercialized by ppqSense Srl: the SCAR spectrometer and a wide range of control electronics for semiconductor lasers (see also the company website: [www.ppqsense.com](http://www.ppqsense.com)). **Three patents**, extended in several Countries worldwide, cover these technologies. Since April 2022, CNR had to sell to the other stakeholders its 25% of shares, the spin-off phase being finished, at a price almost 10 times higher than the original value at the foundation.

In the last few years, ppqSense Srl has been partner in key EU projects, including two in the framework of the FET-Flagship on Quantum Technologies: QOMBS (on Quantum Simulation) just completed on July, 31<sup>st</sup> 2022 and, very recently, MUQUABIS (on Quantum Sensing), started on July, 1<sup>st</sup> 2022.

### 2020-QTI Srl

More recently, and following the launch of the FET- Flagship 10-years long program on Quantum Technologies, PDN has cofounded a start-up named QTI Srl in 2020, to commercialize Quantum Communication systems ([www.qticompany.com](http://www.qticompany.com)). In particular, reconfigurable quantum key distribution architectures are developed, from the design phase to the building of the final system. On July, 14<sup>th</sup> 2021, a Commercial Agreement with the TIM telecommunication group, was signed. This was a strategic step for QTI, allowing to speed up the commercialization of Quantum Key Distribution systems in combination with existing Networks: this is the only case, until now, of a big

telecommunication company, in Europe, that develops quantum communication systems within the group. **Two patents** have been filed to protect QTI technologies. The technologies under development rely on a long and impactful scientific history of the founders, in the fields of quantum science and photonics. Moreover, public demonstration of these technologies has been done at national and even trans-national level (see e.g.: *Deploying an inter-European quantum network* Advanced Quantum Technologies (2023)).

#### RESPONSIBILITY OF RESEARCH PROJECTS (SELECTION OF THE MAIN PROJECTS)

- 2022-present **PNRR-Research Infrastructures: I-PHOQS** Scientific Coordinator. Funded by MUR (50 M€ over 3 years), Network including 4 Infrastructures, 9 sites throughout Italy, 2 Legal entities (CNR, PoliMI)
- 2020-2022 **PASCQUA Infrastructural Project** Coordination. Funded by MUR through CNR (3.5 M€ I-year+1M€ II-year)
- 2015 **EU-FET (Future Emerging Technologies): UltraQCL**. Responsible for INO-CNR (for INO-CNR: 133 k€)
- 2011 - present **ELI Extreme Light Infrastructure**. Responsible for INO-CNR. Belonging to the EU ESFRI roadmap and MIUR (total amount till now: about 4.5 M€).
- 2014 - 2015 **Progetto Premiale MIUR**: Synchronization of distributed laboratories by time&frequency standards using an optical fiber. Responsible for CNR (131 k€)
- 2011 - 2014 **Energia da Fonti Rinnovabili (Renewable energy)-EFOR**, funded by MIUR/MEF. Responsible for INO-CNR (for INO-CNR: 187 k€)
- 2010 - 2012 **CTOTUS** – Integrated Project for the development of Space Science&Technology in Tuscany. Funded by Toscana Region (for INO-CNR: 750 k€)
- 2004 - 2006 **Photonic circuits for optical communications and sensing for the study of innovative optical devices and sensors**. Funded by MIUR (562.5 k€)
- 2002 - 2007 Coordinator **FIRB-negoziale** (Basic Research Funding from the Italian Ministry of Univ. and Research-MIUR) for the development of techniques and photonic devices in lithium niobate. (Total amount: 3 M€)
- 2003 - 2005 Coordinator international research project: **Development of an integrated spectroscopic system for remote and continuous detection of volcanic gases**. Funded by INGV and GNV. Partners: Cambridge Univ., UK; Rice University Houston, TX, USA; II Univ. Naples. (Total amount: 465 k€)
- 2002 - 2006 **PON Integrated Environmental Monitoring System-SIMONA**. Funded by EU and MIUR (1.033 M€ + Training 697 k€)
- 2002 - 2006 **POR** project-(Funded by EU through Campania Region) on Analysis and monitoring of environmental risk for the realization of optical innovative sensors based on coherent sources and fiber optical technologies. (for INOA: 559 k€)

#### EVALUATION OF PROJECTS

PDN regularly serves as evaluator of projects for several Agencies funding Research (including EU, Belgium, the Netherlands, France, Austria, Switzerland)

#### PUBLICATIONS, CITATIONS, H-INDEX

PDN main fields of interest are mostly related to experimental Atomic, Molecular and Optical (AMO) Physics and applications and, more specifically, are: Environmental applications of photonic instrumentation, nonlinear optics, laser physics, atomic and molecular high precision spectroscopy, frequency metrology, development of high performance photonic sensors, quantum technologies with application to communication and simulation. PDN is editor of 8 scientific books/special volumes and co-author of the book on *Laser-Based Measurements for Time and Frequency Domain Applications – A Handbook* (CRC Press –Taylor & Francis Group).

## PATENTS

According to the EU Patent Office

( [https://worldwide.espacenet.com/searchResults?submitted=true&locale=en\\_EP&DB=EPODOC&ST=advanced&TI=&AB=&PN=&AP=&PR=&PD=&PA=&IN=De+Natale+Paolo&CPC=&IC=&Submit=Search](https://worldwide.espacenet.com/searchResults?submitted=true&locale=en_EP&DB=EPODOC&ST=advanced&TI=&AB=&PN=&AP=&PR=&PD=&PA=&IN=De+Natale+Paolo&CPC=&IC=&Submit=Search)): 14 Patents