

Curriculum Vitae Alessandro Tredicucci

Biographical details

- [REDACTED]

Languages

Italian mother language, fluent in English, French at scholastic level

Education

- "Laurea" degree (summa cum laude) in physics from the University of Pisa, Italy, in 1992, achieving at the same time the "Diploma" in physics of the Scuola Normale Superiore of Pisa (thesis: "Polaritons in semiconductor thin films and quantum wells" – Supervisor: Prof. [REDACTED])

- Ph.D. degree (summa cum laude) in physics from the Scuola Normale Superiore of Pisa in 1997 (thesis: "Optical properties of semiconductor microcavities" – Supervisor: Prof. [REDACTED])

Working Experience

1997-2000

Bell Laboratories, Lucent Technologies, Murray Hill, NJ - Research contractor (DARPA) in the Semiconductor Physics Research Department.

2000-2003

Scuola Normale Superiore of Pisa - Assistant professor of Semiconductor Physics

2003-2009

INFM (Istituto Nazionale per la Fisica della Materia, since 2005 part of CNR, the Italian National Research Council) – Senior Scientist, responsible for the "Advanced Photonics" unit of the NEST center in Pisa

2009-2014

Consiglio Nazionale delle Ricerche (CNR) – Research Director at the Nanoscience Institute - Pisa

2014-present

Università di Pisa – Full Professor of Condensed Matter Physics at the Physics Department

Research Activity

1991-1992

I worked on the optical properties of excitons in confined heterostructures of III-V semiconductors. In particular, I performed both theoretical (through real-space density-matrix approach) and experimental studies on polariton interference and exciton center-of-mass quantization in GaAs thin films.

1993-1996

My interests focused mainly on the investigation of light-matter interaction in semiconductor microcavities. In this field, beyond the development of a theoretical model for the study of the main optical properties, I gave fundamental contributions like the first observation of exciton Rabi splitting in bulk semiconductors [Phys. Rev. Lett. **75**, 3906 (1995)] and the achievement

of controlled spontaneous emission in porous silicon and GaAs microcavities. My research also encompassed non-linear optics and temporal dynamics of microcavity polaritons especially concerning all-optical switching possibilities.

I also dealt with large gap II-VI ZnCdSe/ZnSe heterostructures analyzing band discontinuities by measuring transport and excitonic optical properties

1997-2000

I worked on optical intersubband transitions in semiconductor heterostructures particularly in reference to the development of new photonic devices like lasers and detectors. My main activity was concentrated on quantum cascade lasers where I obtained several milestone achievements. Among them the most interesting are probably:

- the realization of the first semiconductor laser operating at the same time on multiple distinct transitions of the same active material (two-color lasers) [Nature **396**, 350 (1998)]
- the development of inter-miniband lasers for high power and high temperature operation
- the development of quantum cascade lasers operating at $\lambda > 17 \mu\text{m}$, at the time the longest wavelength existing III-V semiconductor lasers

2000-present

Currently my activity is mainly devoted to the realization of THz photonic devices (sources and detectors) based on intersubband transitions. After giving important contributions to the development of new geometries for laser waveguides and demonstrating high intensity THz emission from superlattice active region, I led my group at NEST to the realization of the first THz semiconductor heterostructure laser [Nature **417**, 156 (2002)], a milestone achievement in opto-electronics, promising to open the way for the development of wide-spread THz technology [the discovery received ample media coverage including a feature article and interview in *The Economist*, Aug. 8, 2002]. Our further developments have led to continuous wave emission, operation at higher temperatures and lower frequencies, and include also the fabrication of the first single-mode DFB THz lasers, of vertically emitting microdisk lasers [Nature Photon. **3**, 46 (2009)], of the first quasi-crystal injection lasers [Nature Photon. **4**, 165 (2010)], and of antenna-coupled THz microlasers [Light, Sci. & Appl. **6**, e17054 (2017)]. More recently, my group also demonstrated the first THz detectors in semiconductor nanowire [Nano Lett. **12**, 96 (2012)] and graphene [Nature Mater. **11**, 865 (2012)] field effect transistors. This last work also reports the first image ever realized with a graphene sensor.

2003-present

On the fundamental physics side, I started to develop studies on the modification and control of light interaction with intersubband transitions in structures with strong photon confinement, observing the formation of intersubband polaritons [Phys. Rev. Lett. **90**, 116401 (2003)], and demonstrating the electrical and optical manipulation of polaritonic coupling, even in the non-adiabatic limit up to the ultra-strong regime [Nature **458**, 178 (2009)]. In the last year my group realized the first experiment of coherent absorption control in a polariton system [Nature Phys. **10**, 830 (2014)].

Scientific productivity

- I have co-authored 272 publications in ISI - Web of Science (Core Collection); my articles have collected 17599 citations (according to Google Scholar), h-index 60 (~ 2/year from the first publication).
- I have been designated as inventor in 16 international patents.
- I have authored chapters in 3 book volumes

International recognition

- I have given 106 invited talks at conferences (99 international and 7 national), of which 10 were plenary/keynote speeches and 8 tutorial lessons.
- I have been invited to write perspective articles by journals like Science, Nature Materials, Nature Photonics.
- I am cited in the list of the Top Italian Scientists by the VIA Academy (http://www.topitalianscientists.org/top_italian_scientists.aspx).
- I act as referee for the leading scientific journals, including Nature, Nature Physics, Nature Materials, Nature Photonics, Nature Communications, Science, Physical Review Letters.
- I have been the Chair of conferences from well established series like MSS-EP2DS (the second largest conference series on semiconductors, for the first time held in Italy with a record attendance of over 650 participants) and ITQW (the main conference series on intersubband physics and devices).

Professional assignments

- 2016-2019: member of the Scientific Council of the Department of Physical Sciences and Technologies of Matter of the Italian CNR
- 2019-present: Member of the Directive Council of LENS
- 2016-2020: President of the Physics Area Committee of Pisa University
- 2014: member of the review panel of the Paul Drude Institut in Berlino - Germany
- 2013-2019: member of the review board of the "Research Institute of Electrical Communication" of Tohoku University - Japan
- 2012: member of the advisory panel of the Italian Ministry of Education, University, and Research examining the creation of new Technological Districts according to the National Operative Program for Research and Competitiveness 2007-2013
- 2005-2014: Leader of the "Commessa Nanofotonica" of CNR (roughly 5 labs, 20-30 people)
- 2006-2009: member elect of the Institute Committee of the INFM
- 2006-2014: member elect of the Scientific Council of the Materials and Devices Department of the Italian CNR.
- 2009: member of the special committee for the reorganization of INFM designated by the President of CNR
- 2008: designated member of the DMD Working Group examining the situation of INFM within CNR
- 2011-2012: designated member of the evaluation committee for the calls to Directorship of the institutes CNR-INO and CNR-IFN
- 2010-2014: designated member of the Strategic Committee of the CNR - Fondazione Bruno Kessler cooperation

Conference organization

- Chair of the 2007 edition (13th) of the Modulated Semiconductor Structures conference (Genova, July 15-20, 2007), and member of the Program Committee of the 14th edition (Kobe, Japan, July 19-24, 2009) and 15th edition (Tallahassee, USA, July 25-29, 2011).
- Chair of "The International Conference on Intersubband Transitions in Quantum Wells (ITQW)" for the 11th edition (Sardinia, Italy, September 11-17, 2011).
- Chair of the 4th EOS Topical Meeting on Terahertz Science & Technology (Camogli, Italy, May 11-14, 2014) and Co-Chair of the 5th EOS Topical Meeting on Terahertz Science & Technology (Pecs, Hungary, May 8-11, 2016)
- Chair of the Condensed Matter section of the 100^o National Congress of the Italian Physical Society (Pisa, Italy, 22 - 26 September 2014)
- Chair of the school "Physics of intersubband semiconductor emitters" (Cortona, June 24-30, 2006) and co-chair of the second edition (Monte Verità, CH, September 14-19, 2008) jointly with "The 3rd International Workshop on Quantum Cascade Laser". Member of the Program

Committee of the 4th and 5th joint school and workshop. (Florence, August 30 - September 3, 2010 and Baden, Austria, September 2-6, 2012).

- Director of the “Nanowire-based One-Dimensional Electronics” summer school (Cortona, Italy, July 1-5, 2008).
- Director of the 35th workshop “Physics and technology of THz photonics” of the International School of Solid State Physics (Erice, July 20-26, 2005).
- Co-organizer of the School of Photonics 2013 (Cortona, May 20-23, 2013) and 2014 (Cortona, March 30 - April 3, 2014)
- Member of the International Program Committee of the International Conference on the Physics of Semiconductors (ICPS) for the 30th edition (July 20-25, 2010 Seoul), 31th edition (Zurich, July 29-August 3, 2012), and 34th edition (Montpellier, July 29-August 3, 2018).
- Member from 2006 to 2008 of the “THz technology and applications” Subcommittee for the “Conference on Lasers and Electro-optics (CLEO)” of the Optical Society of America
- Member for 2011 and 2012 of the Subcommittee “Optical Interactions with Condensed Matter and Ultrafast Phenomena” of the “Quantum Electronics and Laser Science Conference (QELS)” of the Optical Society of America.
- Member of the International Advisory Committee of “The joint 32nd International Conference on Infrared and Millimeter Waves and 14th International Conference on Terahertz Electronics” (Cardiff, September 2 - 7, 2007) and of “The joint 34th International Conference on Infrared and Millimeter Waves and 15th International Conference on Terahertz Electronics” (Busan, September 21 - 25, 2009). Member of the Program Committee of the 35th edition (Roma, September 5-10, 2010), 43rd edition (Nagoya, September 9-14, 2018), and 44th edition (Paris, September 1-6, 2019).
- Member of the “Terahertz Sources and Applications” Subcommittee of CLEO Europe (2013, 2015).

Member of the Program Committee of TERANANO V (5th International Symposium on Terahertz Nanoscience) - Martinique, 1 - 5 December 2014.

- Member of the Program Committee of Quantum Sensing and Nanophotonic Devices XII / Photonics West 2015 (San Francisco, USA, 7 - 12 February 2015).
- Member of the Program Committee of the 3rd EOS Topical Meeting on Terahertz Science & Technology (TST 2012), June 17-20, 2012 Prague
- Member of the Program Committee of “The International Conference on Intersubband Transitions in Quantum Wells (ITQW)” for the 8th edition (Cape Cod, September 11-16, 2005) and 9th edition (Ambleside, September 9-14, 2007).
- Co-organizer of the Symposium “Materials Research for THz Applications” of The Materials Research Society (MRS) Spring Meeting (San Francisco, April 17-21, 2006)

Editorial Activity

- 2010-2015: Associate Editor of the Journal of Infrared, Millimeter and THz Waves (Springer)
- 2015-present: Associate Editor of Applied Physics Letters

Awards

- 1999 Gilberto Bernardini award of the Italian Physical Society
- 2003 S. Panizza award for opto-electronics of the Italian Physical Society
- 2005 S. Campisano prize for condensed matter physics of the CNR
- 2007 Copernico prize for physics
- 2013 Nick Holonyak Jr. award of the Optical Society of America
- 2014 Fellow of the Optical Society of America
- 2014 Occhialini medal of the Institute of Physics

Research Project Management

- Coordinator of the NATO SPS project THESEUS (2020-2023).
- Coordinator of the PRIN – 2017 project MONSTRE-2D of the Italian MIUR (2019-2022).
- Coordinator of the ERC advanced grant "SoulMan" of the European Commission (2013-2018).
- PI of the Pisa University unit in the FET-OPEN MIR-BOSE of the European Commission (2017-2021).
- Coordinator of the Terafluid project of the Italian Ministry for Economic Development (2012-2014).
- Scientific Responsible of the People-IOF project NEMO of the European Commission (2012-2014).
- Scientific coordinator of the Terasuper project of the Italian Ministry of Defense (2011-2014).
- Thematic coordinator of the Integrated Project Teranova of the European Commission and scientific responsible of the Scuola Normale participation (2004-2008). Also coordinated the MIST demonstrator development (2006-2009).
- Scientific coordinator of the Scuola Normale group in the Integrated Project NODE of the European Commission (2005-2009).
- Scientific coordinator of the Scuola Normale group in the PASR project Terasec of the European Commission (2005-2006).
- Scientific coordinator of the Scuola Normale group in the Marie Curie RTN POISE of the European Commission (2004-2008).
- Project manager of the advanced project "ICONS" of section E of the INFN (2002-2003).
- Project manager of the "Teralight" project of the Fondazione Cassa di Risparmio di Pisa (2002-2004).
- Scientific person in charge of the INFN-Pisa unit in the Future and Emerging Technologies project "WANTED" of the European Commission (2000-2003).

Project Monitoring and Refereeing

- Registered as expert at the European Commission - reviewed many INTAS and IST-FET projects as well as ERC Advanced, Starting and Consolidator Grants.
- Project monitor of the IR-ON project of the Austrian Science Fund (2005-2009)
- Panel Member of the Swiss National Science Foundation Consolidator Grants 2014 and international referee member of Division II of the SNF Research Council (2018-present).
- Project reviewer on behalf of the EPSRC (UK), Royal Society (UK), NWO (NL), Science Foundation Ireland, Agence Nationale de Recherche (FR), Swiss National Science Foundation, Estonian Science Foundation, Austrian Science Fund, MacArthur Foundation

Teaching Activity

- 2017- present: "Fundamentals of light matter interaction" course at the University of Pisa
- 2015 - present: "States of Matter" course at the University of Pisa
- 2009 – present: "Physics of Photonic Devices" course at the University of Pisa
- 2006 – 2009: "Physics of Photonic Devices II" course at the University of Pisa
- 2001 – 2009: "Introduction to semiconductor physics" course at the Scuola Normale Superiore
- 2000 – 2001: "Solid state physics" course at the Scuola Normale Superiore