CURRICULUM VITAE

NAME: Federico Capasso

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PERSONAL: Married; two children

CITIZENSHIP: Italian and U.S. (Naturalized; 09/23/1992)

EDUCATION:

1973	Doctor of Physics, Cum Laude University of Rome, Italy
1973-1974	Postdoctoral Fellow Fondazione Bordoni, Rome, Italy

ACADEMIC APPOINTMENTS

Jan. 2003- Present Robert Wallace Professor of Applied Physics
Vinton Hayes Senior Research Fellow in Electrical Engineering
School of Engineering and Applied Sciences, Harvard University, Cambridge,

PROFESSIONAL POSITIONS:

2000 – 2002	Vice President of Physical Research, Bell Laboratories Lucent Technologies, Murray Hill, NJ
1997- 2000	Department Head, Semiconductor Physics Research, Bell Laboratories Lucent Technologies, Murray Hill, NJ.
1987- 1997	Department Head, Quantum Phenomena and Device Research, Bell Laboratories Lucent Technologies (formerly AT&T Bell Labs, until 1996), Murray Hill, NJ
1984 – 1987	Distinguished Member of Technical Staff, Bell Laboratories, Murray Hill, NJ
1977 – 1984	Member of Technical Staff, Bell Laboratories, Murray Hill, NJ
1976 – 1977	Visiting Scientist, Bell Laboratories, Holmdel, NJ
1974 – 1976	Research Physicist, Fondazione Bordoni, Rome, Italy

Citations (Google Scholar)
Over 81000
H-index (G*oogl*e Scholar)
137

Publications
Over 500 hundred peer reviewed journals

Patents
69 US patents

KEY ACHIEVEMENTS

1. Bandstructure Engineering.and Quantum Cascade Lasers (QCLs)

Capasso and his team over a 20-year period pioneered *band-structure engineering,* a technique to design and implement artificially structured ("man-made") semiconductor ,materials and related phenomena/ devices, which revolutionized heterojunction devices. Quantum Cascade lasers represent the most important highlight of this research. Invented and demonstrated by Capasso and his group in 1994, QCLs are the first lasers in which the emission wavelength can be tailored over an extreme broad range using quantum design. They have revolutionized mid-infrared photonics, as they represent the first high performance and reliable semiconductor lasers for this technologically and scientifically important spectral region. They are finding widespread use in scientific and industrial applications: high-resolution spectroscopy, chemical sensing and trace gas analysis, atmospheric chemistry, combustion and medical diagnostics. Numerous companies are commercializing QC lasers and related sensors.
A tutorial account of Capasso's research on quantum cascade lasers has appeared in a book for a lay audience on materials research by Ivan Amato ("Stuff: the materials the world is made of", Basic Books, New York, NY, 1997) and in the article "Diminishing dimensions" in a special issue of Scientific American, the Solid-State Century, 1997-1998.
Other bandgap engineered devices invented by Capasso and his team are:

- A new class of low noise multiquantum well avalanche photodiodes and solid-state photomultipliers.
- Resonant tunneling bipolar transistors and circuits with reduced complexity. This work has been influential in stimulating new research in multiple valued logic and multilevel coding.
- New photoconductors based on effective mass filtering

2. Metasurfaces and Flat optics

- Generalized laws of reflection and refraction demonstrated and theoretically derived for a general class of designer metasurfaces.
- Flat optics based on metasurfaces such as aberration free flat lenses (metalenses), background free quarter wave plates, polarimeters etc. This work has led to a large effort worldwide since metalenses hold promise to replace refractive lenses because they are thinner, their aberrations are more easily corrected, they are much easier to align, and can be fabricated by lithographic methods. In addition, they don't suffer from many of the limitations of conventional diffractive optics (Fresnel lenses).

The polarization sensitive camera demonstrated with flat optics consists of a single metasurface and a sensor and performs as well as bulky state-of-the-art ones replacing the multiple phase plates, with the metasurface.

Capasso and his group have developed a new class of films which, due to the intentional introduction of optical losses, exhibit thin film interference though they are much thinner than the wavelength. This work has initiated a large effort with a wide range of potential applications: structured color, solar cells, detectors etc.

3. Plasmonics

This research has focused on designing in the near- and far-field of semiconductor lasers and on nanoparticle clusters as buiding blocks of new optical materials

- New surface plasmon coupling coupler (fishbone grating), allowing for the first-time polarization controlled directional coupling of surface plasmon polaritons.
- Plasmonic laser antennas with ultrahigh intensity nanoscale spots in the near field for optical storage applications
- Wavefront engineering of light sources including highly collimated mid-ir and far-ir semiconductor lasers; multibeam collimated lasers, etc.
- Core-shell nanoparticles clusters (trimers, quadrumers and heptamers) exhibiting magnetic activity in the near infrared and giant Fano resonances. They are building blocks of a new class of optical materials, such as liquid metamaterials

4. Casimir forces

This research has focused on basic studies of the Casimir effect, i.e. the attractive force between uncharged metals and dielectrics due to vacuum fluctuations, using MicroElectroMechanicalSystems (MEMS) and atomic force techniques. This line of research is ultimately aimed at engineering these quantum electrodynamical forces by designing quantum fluctuations through controlled changes (shapes and materials) of the boundary conditions of the electromagnetic fields. Applications include the quantum mechanical control of friction.

Highlights of this work are:

- First measurement of the repulsive Casimir-Lifshitz force.
- Demonstration of actuators and nonlinearoscillators using the Casimir force, the observation of the effect of the skin depth on the Casimir force;
- Observation of the Casimir effect in a fluid

Entrepeneurship

2010 Cofounded *EOS Photonics* to market Quantum Cascade Laser based sensors of gases for atmospheric science and security; standoff detection of hazardous vapors and condensed phase materials; molecular spectroscopy and power scaling. It merged in 2015 with Pendar Medical to form *Pendar Technologies* (http://www.pendartechnologies.com/) which is focused on bringing breakthrough portable analysis and monitoring systems to market.

2016 Cofounded *Metalenz* (http://metalenz.com) which is focused on bringing to market metalenses for a wide range of applications. Metalenses can be fabricated with the same technology of integrated circuits. *Metalenz* has received substantial VC support and backing from major industries

Honors

Awards:

2019 Matteucci Medal, Accademia Nazionale delle Scienze, detta dei XL
2019 Guglelmo Marconi Science Award, UNICO
2018 Fermi Prize of the Italian Physical Society
2017 Kenneth Button Prize, International Society of Infrared, Millimeter and Terahertz Waves and Institute of Physics (UK)
2016 Balzan Prize for Applied Photonics, Balzan Foundation
2015 Rumford Prize, American Academy of Arts and Science
2013 Gold Medal of SPIE
2013 European Physical Society Quantum Electronics and Optics Award
2013 Humboldt Research Award
2011 Jan Czochralski Award of the European Materials Research Society
2011 Galileo Galilei Medal of the Italian Society for Optics and Photonics
2010 Julius Springer Prize in Applied Physics
2010 Berthold Leibinger Zukunft Prize (Future prize)
2005 King Faisal International Prize for Science
2005 Gold Medal of the President of Italy for meritorious achievement in science
2004 Edison Medal, Institute of Electrical and Electronic Engineers (IEEE)
2004 Arhur Schawlow Prize in Laser Science, American Physical Society
2004 Tommasoni & Chisesi Prize for Outstanding Achievements in Physics
2003 Goff Smith Prize and Lecture, University of Michigan
2002 Duddell Medal and Prize of the Institute of Physics (London, UK)
2001 Robert Wood Prize of the Optical Society of America
2000 Willis E. Lamb Medal for Laser Physics and Quantum Optics
2000 NASA Group Achievement Award
1998 IEEE/Laser & Electrooptics Society W. Streifer Award for Scientific Achievement
1998 Rank Prize in Optoelectronics (UK)
1998 Capitolium Prize of the Mayor of Rome, Italy
1997 Wetherill Medal of the Franklin Institute
1997 Bell Laboratories Fellow Award
1995 Materials Research Society Medal
1995 Moet Hennessy&Louis Vuitton "Leonardo da Vinci" Award of Excellence
1995 Newcomb Cleveland Prize of the American Association for the Advancement of Science (AAAS) for best paper published in Science
1995 Electronics Letters Prize of the Institute of Electrical Engineers (London, UK)
1994 Heinrich Welker Memorial Medal (Germany) & International Compound Semiconductors Symposium Award
1993 The New York Academy of Sciences Award
1991 IEEE David Sarnoff Award in Electronics
1984 Bell Laboratories Distinguished Member of Technical Staff Award

Memberships/Fellowships

2019 Fellow, National Academy of Inventors
2015 Member, Academia Europaea
2012 Foreign Member, Accademia dei Lincei
1995 Member, National Academy of Sciences
1996 Member, National Academy of Engineering
1998 Fellow, American Academy of Arts and Sciences
1999 Fellow, Institute of Physics (UK)

1997- Honorary Member, of the Franklin Institute
1992 Fellow, American Association for the Advancement of Science
1991 Fellow, International Society for Optical Engineering (SPIE)
1989 Fellow, Optical Society of America
1987 Fellow, Institute of Electrical and Electronic Engineers
1986 Fellow, American Physical Society

Honorary Doctorates and Other Honors

2019 Honorary issue of *Nanophotonics* (Volume 7, Issue 6, Jun 2018) for Federico Capasso on "Metamaterials & Metasurfaces"
2011 Honorary Doctorate University Paris Diderot, France
2011 Honorary Doctor of Technology, Lund University, Sweden
2011 Honorary Doctorate in Materials Science, University of Roma III, Italy
2003 Honorary Doctorate in Electrical Engineering, University of Bologna, Italy
2004 Commendatore of the Italian Republic