

INTERNATIONAL WORKSHOP 2018

Ettore Majorana Foundation and Center for Scientific Culture

INTERNATIONAL SCHOOL OF SOLID STATE PHYSICS



Organization - Chairs



FEDERICO CAPASSO
Harvard University, Boston
(USA)



MIRIAM SERENA VITIELLO
NEST, CNR-NANO and
Scuola Normale Superiore, Pisa, Italy



GAETANO SCAMARCIO
University of Bari and
CNR-IFN, Bari, Italy

Sponsors



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Location and Structures

The Ettore Majorana Foundation and Centre for Scientific Culture is named after an outstanding Italian physicist. Born in Sicily in 1906, Ettore Majorana's breadth of vision and exceptional contributions to theoretical physics moved Enrico Fermi to the following statement: «There are many categories of scientists, people of second and third rank, who do their best, but do not go very far. There are also people of first-class rank, who make great discoveries, fundamental to the development of science. But then there are the geniuses, like Galilei and Newton. Well, Ettore Majorana was one of them». Every year since 1963, authors of new discoveries and inventions come to Erice; 85 of them were awarded the Nobel Prize after their participation in the Ettore Majorana Schools and 49 were already Nobel laureates when they started to take part in the Centre activities. These scientific world leaders teach to students from all over the world who are eager to receive the latest knowledge directly from the mouth of its authors. Embracing 126 Schools, covering all branches of Science, the Centre is situated in the old pre-mediaeval city of Erice where four restored monasteries (one of which was the residence of the Viceroy of Sicily during the XIV and XV Centuries) provide an appropriate setting for high intellectual endeavour. These ancient buildings are now named after great scientists and strong supporters of the 'Ettore Majorana' Centre. The San Francesco Monastery (former Viceroy's residence) is now the Eugene P. Wigner Institute with the 'Enrico Fermi' Lecture Hall. The San Domenico Monastery is now the Patrick M.S. Blackett Institute with the 'Paul A.M. Dirac' Lecture Hall, 'Robert Hofstadter' Lecture Hall and 'John von Neumann' Lecture Hall. The San Rocco Monastery is now the Isidor I. Rabi Institute with the 'Richard P. Feynman' Lecture Hall, the Directorate and the main Secretariat of the Centre. The 'Ciclope' is now the Victor F. Weisskopf Institute with the 'John S. Bell' and 'Richard H. Dalitz' Lecture Halls. There are living quarters in all four Institutes for people attending the Courses at the Centre. The Polo Sismico, the first worldwide Network of Seismological Detectors (1981), is located in the I.I. Rabi Institute. The 'Paul A.M. Dirac' Museum is situated at the Patrick M.S. Blackett Institute.

Keynote Speakers

Dimitri Basov	- Columbia University, New York (USA)
Federico Capasso	- Harvard University (USA)
Andrea C. Ferrari	- Cambridge Graphene Center, Cambridge (UK)
Frank H. L. Koppens	- ICFO - Barcelona (Spain)
Ralph G. Nuzzo	- University of Illinois, Urbana-Champaign (USA)

Invited Speakers

Mikhail A. Belkin	- University of Texas, Austin (USA)
Tyler L. Cocker	- Michigan State University (USA)
Sukhdeep Dhillon	- Laboratoire Pierre Aigrain, Paris (France)
Frank A. Hegmann	- University of Alberta (Canada)
Manfred Helm	- HZDR, Dresden (Germany)
Andreas J. Huber	- neaspec GmbH (Germany)
Wojciech Knap	- University of Montpellier II and CNRS (France)
Alexey B. Kuzmenko	- University of Geneva (Switzerland)
Juliette Mangeney	- Laboratoire Pierre Aigrain, Paris (France)
Luis Martin-Moreno	- Inst. Ciencia de Materiales de Aragon-Zaragoza (Spain)
Oleg Mitrofanov	- University College of London (UK)
Alessandro Molle	- CNR-IMM, Agrate Brianza (Italy)
Róisín M. Owens	- University of Cambridge (UK)
Alberto Salleo	- Stanford University (USA)
Christoph Stampfer	- Aachen University (Germany)
Luisa Torsi	- University of Bari (Italy)
Karl Unterrainer	- Technical University of Wien (Austria)
Qi Jie Wang	- Nanyang Technological University (Singapore)
Nikolay I. Zheludev	- University of Southampton (UK) and NTU (Singapore)

Saturday July 14th

13:00 – 18:00: Arrival and Registration

20:00 - 22:00: Dinner

22:00: Sicilian cakes, marsala and piano music in the "Marsala Room Cave"

Sunday July 15th

9:00 – 9:30: **F. Capasso, G. Scamarcio, M. S. Vitiello, G. Benedek** *Opening remarks*

SESSION I

Chair: M.S. Vitiello (CNR – Nanoscience Institute, Italy)

09:30 – 10:30: **Federico Capasso** (Harvard University, USA) Keynote

"Flat Optics: from Metalenses to Structured Light"

10:30 – 11:15: **Mikhail A. Belkin** (University of Texas, Austin, USA) *invited*

"Nonlinear Intersubband Polaritonic Metasurfaces"

11:15 – 11:45: *Coffee Break*

SESSION II

Chair: L. Martin-Moreno (Inst. Ciencia de Materiales de Aragon-Zaragoza, Spain)

11:45 – 12:30: **Karl Unterrainer** (TU Wien, Austria) *invited*

"Dynamics and non-linear effects of passive and active THz metamaterials"

12:30 – 12:45: Michele Tamagnone (Harvard University, USA)

"Mid-Infrared Sub-Wavelength Resonant Hexagonal Boron Nitride Polaritonic Nanoantennas"

13:00 – 16:00: Lunch Break and Discussion Time

SESSION III

Chair: K. Unterrainer (TU Wien, Austria)

16:00 – 16:45: **Qi Jie Wang** (Nanyang Technological University, Singapore) *invited*

"Mid-infrared Optoelectronics in 2D Materials"

16:45 – 17:15: **Alexei B. Kuzmenko** (University of Geneva, Switzerland) *invited*

"Infrared and terahertz magneto-absorption and Faraday rotation in hBN/graphene/hBN heterostructures"

17:15 – 17:30: Benedikt Limbacher (TU Wien, Austria)

"Strong Light-Matter Interaction in Triple-Barrier Resonant Tunneling Diodes"

17:30 – 17:45: Juan Sebastian Totero Gongora (University of Sussex, UK)

"Photo-induced dynamic metasurfaces: route to all-optical control of THz emission from Black Silicon"

17:45 – 18:00: Marina Giordano (CNR-NANO, Pisa, Italy)

"Phase-resolved terahertz near-field nanoscopy"

20:00 - 22:00: Dinner

22:00: Sicilian cakes, marsala and piano music in the "Marsala Room Cave"

Monday July 16th

SESSION IV

Chair: F. Capasso (Harvard University, USA)

9:30 – 10:30: **Dimitri N. Basov** (Columbia University, USA) Keynote

"Quantum Materials: Insight from Infrared Nano Optics"

10:30 – 11:15: **Luis Martin-Moreno** (Inst. Ciencia de Materiales de Aragon-Zaragoza, Spain) *invited*

"Graphene plasmons: magneto-optical effects and scattering properties"

11:15 – 11:45: *Coffee Break*

SESSION V

Chair: F. Koppens (ICFO Barcelona, Spain)

11:45 – 12:30: **Oleg Mitrofanov** (University College of London, UK) *invited*

"Near-field probing of highly confined resonant THz fields"

12:30 – 12:45: Fritz Keilmann (Ludwig-Maximilians-Universität, Munich, Germany)

"All-electronic THz Nanoscopy"

13:00 – 16:00: Lunch Break and Discussion Time

SESSION VI

Chair: G. Scamarcio (University of Bari, Italy)

16:00 – 16:45: **Tyler L. Cocker** (Michigan State University, USA) *invited*

"Ultrafast photo-switching of interface polaritons in black phosphorus heterostructures"

16:45 – 17:15: **Juliette Mangeney** (Laboratoire Pierre Aigrain, Paris, France) *invited*

"Mid-infrared photoresponse in hBN-encapsulated graphene"

17:15 – 17:30: Pierluigi Rubino (University of Leeds, UK)

"Coherent THz apertureless near-field microscopy based on self-mixing in QCLs"

17:30 – 17:45: Leonardo Viti (CNR-NANO, Pisa, Italy)

"Phase-sensitive terahertz imaging with room-temperature near-field nanodetectors"

17:45 – 18:00: Guy Matmon (University College of London, UK)

"2D-3D crossover in a dense electron liquid in silicon"

20:00 - 22:00: Dinner

22:00: Sicilian cakes, marsala and piano music in the "Marsala Room Cave"

Tuesday July 17th

SESSION VII

Chair: A. Salleo (Stanford University, USA)

9:30 – 10:30: **Ralph G. Nuzzo** (University of Illinois at Urbana-Champaign, USA) Keynote

"2D Nanomembrane Materials with Exemplary Applications in Quantitative Chemical Imaging and High Efficiency Photovoltaic Energy Conversion"

10:30 – 11:15: **Luisa Torsi** (University of Bari, Italy) *invited*

"Ultra-Low Detection Limits and Selectivity with Organic Bio-Electronic Sensors"

11:15 – 11:45: *Coffee Break*

SESSION VIII

Chair: L. Torsi (University of Bari, Italy)

11:45 – 12:30: **Róisín M. Owens** (University of Cambridge, UK) *invited*

"Bioelectronics in vitro: 3D, Biomimetic Devices and Cell Models"

12:30 – 12:45: Antonio Giorgini (CNR-INO, Italy)

"Surface Plasmon chemical sensors based on optical resonators: innovative methods for interrogation and readout"

13:00 – 16:00: Lunch Break and Discussion Time

SESSION IX

Chair: R.G. Nuzzo (University of Illinois, Urbana-Champaign, USA)

16:00 – 16:45: **Alberto Salleo** (Stanford University, USA) *invited*

"Plastic Electrochemical Devices from Biosensors to Artificial Synapses"

16:45 – 17:15: **Wojciech Knap** (University of Montpellier II & CNRS, France) *invited*

"New GaN FETs and Silicon Junctionless Field Effect Transistors as Terahertz Detectors"

17:15 – 17:30: Rosaria A. Picca (University of Bari, Italy)

"Investigation of the Stability of Organic Field Effect Transistors for Biosensing Applications"

17:30 – 17:45: Maria Josè Lo Faro (CNR-IMM, Italy)

"Enhanced Optical Properties of 2D Fractal Arrays of Silicon Nanowires"

17:45 – 18:00: R. Thomas Weitz (Ludwig-Maximilians-Universität, Munich, Germany)

"Non-Reversible Transition from Rhombohedral to Bernal Stacking in Multilayer Graphene promoted by Contact Patterning"

20:00 - 22:00 Dinner

22:00: Sicilian cakes, marsala and piano music in the "Marsala Room Cave"

Wednesday July 18th

SESSION X

Chair: D. Basov (Columbia University, New York, USA)

9:30 – 10:30: **Frank H. L. Koppens** (ICFO - Barcelona, Spain) *Keynote*

"Probing quantum plasmonics and the ultimate limits of light compression with Van der Waals heterostructures"

10:30 – 11:15: **Nikolay I. Zheludev** (University of Southampton, UK) *invited*

"Classical and Quantum Photonics in 2D Matter in Standing Waves"

11:15 – 11:45: *Coffee Break*

SESSION XI

Chair: C. Stampfer (RWTH Aachen University, Germany)

11:45 – 12:30: **Alessandro Molle** (CNR-IMM, Agrate Brianza, Italy) *invited*

"Materials design the 2D level: from Xenon to anisotropic MoS₂ nanosheets"

12:30 – 12:45: Kundan Chaudhary (Harvard University, USA)

"Enhanced In-plane Optical Anisotropy of Black Phosphorus by Phonon Polaritons in Hexagonal Boron Nitride"

14:00 – 20:00: Excursion

Visit to the archeological site of Selinunte (Selinus), an ancient Greek city in front of the Mediterranean sea, followed by a swimming and dinner at the nearby beach of Marinella.

20:00 – 22:00: Dinner

22:00: Sicilian cakes, marsala and piano music in the “Marsala Room Cave”

Thursday July 19st

SESSION XII

Chair: F.A. Hegmann (University of Alberta, Canada)

9:30 – 10:30: **Andrea C. Ferrari** (Cambridge Graphene Center, Cambridge, UK) Keynote

“Light Scattering and Emission from Hetero-structures”

10:30 – 11:15: **Christoph Stampfer** (Aachen University, Germany) *invited*

“Spin states in bilayer graphene quantum point contacts and quantum dots”

11:00 – 11:30: *Coffee Break*

SESSION XIII

Chair: O. Mitrofanov (University College of London, UK)

11:45 – 12:30: **Manfred Helm** (HZDR, Dresden, Germany) *invited*

“Nonlinear THz Spectroscopy of Two-Dimensional Systems”

12:30 – 13:00: **Sukhdeep Dhillon** (Laboratoire Pierre Aigrain, Paris, France) *invited*

“How to generate short THz pulses from Quantum Cascade Lasers”

13:00 – 16:00: Lunch Break and Discussion Time

SESSION XIV

Chair: A.C. Ferrari (Cambridge Graphene Center, University of Cambridge, UK)

16:00 – 16:45: **Frank A. Hegmann** (University of Alberta, Canada) *invited*

“Ultrafast Terahertz Scanning Tunneling Microscopy with Atomic Resolution”

16:45 – 17:15: **Andreas J. Huber** (neaspec GmbH, Germany) *invited*

“Near-field correlation nanoscopy for organic and inorganic material analysis”

17:15 – 17:30: Shun Okano (Chemnitz University of Technology, Germany)

“The Influence of Field Effect Doping on the Optical and Electrical Properties of a Graphene Monolayer”

17:30 – 17:45: Andrea Ottomaniello (University of Pisa, Italy)

“Symmetry enhanced non-reciprocal polarization rotation in a THz metal-graphene metasurface”

17:45 – 18:00: Stefan Schlauderer (University of Regensburg, Germany)

“Lightwave valleytronics in monolayers of transition metal dichalcogenides”

20:00 - 22:30: Conference Banquet

Poster Session

1. Maciej Sakowicz (Institute of Electron Technology – Warsaw, Poland)
"Mid-Infrared Quantum Cascade Lasers With Nonuniformly Tapered Waveguides"
2. Michele Tamagnone (Ecole Polytechnique Fédérale de Lausanne, Switzerland and Harvard University, USA)
"Beam Steering Graphene Terahertz Metasurface"