

Nanoscale Quantum Optics

COST Action MP1403 — www.cost-NQO.eu

Focus and Aims

- The investigation of quantum phenomena in nanophotonics systems may lead to new scales of quantum complexity and constitutes the starting point for developing photonic technologies that deliver quantumenhanced performances in real-world situations
- The aim of the COST Action Nanoscale Quantum Optics (NQO) has been to support and coordinate research activities in nanoscale quantum optics, explore innovative approaches by identifying, establishing and exploiting crosslinks between quantum science & technology, nanoscale optics & photonics and materials science, and facilitate the early-involvement of end-users



Facts and Figures

- Start 2.12.2014 End 30.4.2019
- 28 COST Countries
- 12 Inclusiveness Target Countries
- 3 COST Near-Neighbor Countries, 9 COST International Partner Countries, ESA
- 52 MC members, 16 Core Group members
- ~ 600 members organized in 4 Working Groups

- 18% female, 38% early-career investigators
- ~ 500 attendees to COST events
- ~ 600 000 EUR spent (~ 1000 EUR per person)
- Topical events (~ 30), publications & patents, shortterm scientific missions (~ 100), conference grants (~ 15), startups (~ 10), several invited speakers & lecturers from US, Canada and Australia

Core Group

- WG1 Leader: Christophe Couteau (FR) and Félix Bussières (CH)
- WG2 Leader: Walter Pfeiffer (DE)
- WG3 Leader: Thomas Durt (FR) and Branko Kolaric (BE)
- WG4 Leader: Peter Rabl (AT) and Dimitris Angelakis (GR)
- Industry Advisor: Félix Bussières (CH) and Valérian Giesz (FR)

- Gender Balance Advisor: Ruth Oulton (UK)
- ESR Advisor: Humeyra Caglayan (FI) and André Xuereb (MT)
- Education Advisor: Darrick Chang (ES) and Dario Gerace (IT)
- STSM Manager: Concita Sibilia (IT)
- Chair and Vice Chair: Irene D'Amico (UK) and Mario Agio (DE)

COST Action NQO - Scientific Focus

4 Working Groups

Generation, detection & storage of quantum states of light at the nanoscale

Nonlinearities & ultrafast processes in nanostructured media

Nanoscale quantum coherence

Cooperative effects, correlations and many-body physics tailored by strongly confined optical fields

Applications: ICT, sensing & metrology, energy efficiency

The NQO Roadmap

- Outlines research and innovation in NQO
- Shaped during Action's meetings and other networking events
- Structure of the NQO Roadmap:
 - Executive summary
 - Presentation of the COST Action NQO
 - 4 working-group scientific areas
 - Research topics
 - Technological outlook
- Available for download at: <u>www.cost-nqo.eu/support/documents/</u>

Research and Innovation in Nanoscale Quantum Optics



Technological Outlook

- Several companies have emerged or have expanded their activities in the field of NQO
- Quantum Photonic Devices and Systems:
 - Single-photon sources
 - Single-photon detectors
 - Photonic integration
 - Single-spin sensing
- Enabling technologies:
 - Software
 - Lasers
 - High-speed electronics
 - Cryogenics
- COST Action NQO industry partners at <u>www.cost-nqo.eu/industry</u>











Swabian instruments







The NanoPhotonics Foundry

Market Research Study in NQO

- Present the innovation potential of the field in a quantitative manner
- Short-term: **5 years** with insights for long-term market
- In cooperation with Tematys, a photonics market research company
- Cooperation between industry members of the COST Action NQO, other relevant industry in the value chain, stakeholders
- The MRS focuses on:
 - Quantum Sensing, Imaging and Measurement Systems
 - Quantum Communications
- The MRS will be an open access document for decision makers in the private and public sector, available at <u>www.cost-nqo.eu/support/documents/</u>

Focus Issue on NQO

New Journal of Physics

The open access journal at the forefront of physics

Focus on Nanoscale Quantum Optics

Darrick Chang ICFO Barcelona Christophe Couteau University of Technology of Troyes Thomas Durt Ecole Centrale Marseille Walter Pfeiffer University of Bielefeld Peter Rabl TU Wien Amir Savafi-Naeini Stanford University

Scope

The investigation of quantum phenomena in nanophotonics systems may lead to new scales of quantum complexity and constitutes the starting point for developing photonic technologies that deliver quantum-enhanced performances. This ambition demands new physical insight as well as cutting-edge engineering, with an interdisciplinary approach and a view towards how such ground-breaking

information & communication technology, sensing & metrology, and energy efficiency.

Horizon 2020 Framework Programme of the European Union.

Image: Nanoscale quantum optics in a nutshell. Controlling light-matter interaction at the quantum level by coupling a quantum system with the near field of an optical nanostructure. **Credit:** Mario Agio, University of Siegen. JOURNAL LINKS

Journal home

Scope and key information

IOP Institute of Physics

Editorial Board

Abstracted in

Author benefits

Article charge

Highlights of 2017

NJP 20th Anniversary 1998-2018

IOP reviewer awards 2017

Early Career Award

Fast track communications

'Focus on' series

Spotlights

Perspectives

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technologies may be implemented and commercialized. We aim at promoting and coordinating forefront research in nanoscale

The main focus is on quantum science & technology, nanoscale optics & photonics, and materials science. This issue will address

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fundamental challenges in NQO, contributing to the discovery of novel phenomena and define new routes for applications in

quantum optics (NQO), which will define new and unexplored pathways for deploying quantum technologies in nanophotonics devices.

Deutsche Physikalische Gesellschaft DPG

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International School of Physics "Enrico Fermi" Course 204 Nanoscale Quantum Optics

Nanoscale Quantum Optics 23 - 28 July 2018

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Gender Balance and Early-Stage Researchers in NQO

- The number of women in Nanoscale Quantum Optics is low (~18%) and there is substantial evidence that women face disadvantages in their scientific careers
- How much do scientists themselves know about these issues?
 - Ran a survey of attitudes towards gender equality in science
 - Ran discussion sessions with the whole COST NQO community at our meetings. Topics (usually thought-provoking and controversial) include: parenthood and academia, sexual harassment, affirmative action/positive discrimination...
 - Running a second survey at the end of the COST Action to monitor whether attitudes in our community have changed
- For ESRs the COST Action has supported workshops, STSMs, startups,...

Thanks to

- Ralph Stübner and Milena Stoyanova
- The Core Group and the Management Committee
- Members of the COST Action NQO, Colleagues and Stakeholders (Photonics21, ESA, SIF, ...)
- Sharon Marie Harvey
- Jacques Cochard and Thierry Robin
- Frank Gödicke and Heinz Ahlers

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