

Davide Pierangeli

ERC Keywords:

PE2_12 Optics, non-linear optics and nano-optics

PE7_05 (Micro- and nano-) electronic, optoelectronic and photonic components

PE3_15 Statistical physics: phase transitions, condensed matter systems, models of complex systems, interdisciplinary applications

PERSONAL DETAILS

Family name, First name: **Pierangeli, Davide**

Date of birth, 29-04-1989

Researcher IDs: Scopus ID [5596862700](#) – Research ID [FUJ-4799-2022](#)

Websites: [Google Scholar](#)

Education and key qualifications

2022 Associate Professor Qualification in Experimental Physics of Matter and Applications – GSD 02/PHYS-03 – SSD PHYS/03-A

2017 PhD in Physics, *cum laude* – Sapienza University, Rome, Italy

2013 Master Degree in Physics, *cum laude* – Sapienza University, Rome, Italy

Current position

2025 – today Associate Professor
Department of Physics, Sapienza University of Rome

Previous positions

2023 – 2025 Senior researcher (“Primo ricercatore”)
Institute for Complex Systems, National Research Council, Rome, Italy

2021 – 2023 Tenured researcher (“Ricercatore III liv.”)
Institute for Complex Systems, National Research Council, Rome, Italy

2020 – 2021 BE-FOR-ERC Fellow – Department of Physics, Sapienza University, Rome, Italy
PI of the SPIM (Spatial Photonic Ising Machine) project

2018 – 2020 Researcher – Department of Physics, Sapienza University, Rome, Italy
Supervisor: Claudio Conti

2017 – 2018 Researcher – College of Optoelectronic Engineering, Shenzhen University, China

RESEARCH ACHIEVEMENTS

Legend: * corresponding author, ‡ co-first author,

Optical computing

1. **D. Pierangeli ***, G. Marcucci, and C. Conti,
[Large-Scale Photonic Ising Machine by Spatial Light
Modulation](#), *Physical Review Letters* 122, 213902 (2019).[‡]

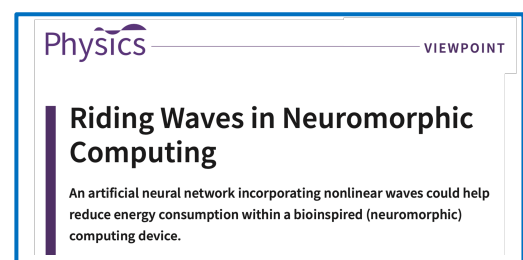
This seminal article reports the invention of Ising machines based on spatial light modulation. Featured in *Physics* “Photonic Ising Machines Go Big”, the result broke previous size records and has attracted worldwide attention (216 citations), with many research groups and high-tech companies (Microsoft, Huawei) now developing this scheme. The paradigm represents one of the most promising routes for photonic computing to date. I have been the PI of a fruitful project based on this finding (BE-FOR-ERC 2019). In LOOP, the distribution of the polarization spins in space is the key element to achieve parallelism and scalability.

2. **D. Pierangeli *** and C. Conti, [Single-shot polarimetry
of vector beams by supervised learning](#),
Nature Communications 14, 1831 (2023).[‡]

This recent finding solves the general problem of measuring the polarization of light in efficient way by enabling fast and compact polarization imaging. The method empowers the use of the polarization in the many contexts where conventional polarization detectors are useless. The result has already attracted attention for application in optical communication and microscopy, as shown by my invited talks. In my ERC StG Grant 2024 project LOOP I exploit it for ultrafast computing.



Highlight 1. The SPIM invention featured in *Physics*.



Highlight 2. Neuromorphic wave computing featured in *Physics*.

3. G. Marcucci, **D. Pierangeli**, and C. Conti, [Theory of neuromorphic computing by waves: machine learning by rogue waves, dispersive shocks, and solitons](#), *Physical Review Letters* 125, 093901 (2020).†

Influential article that has opened the route to machine learning by nonlinear waves. Featured in *Physics* “Riding waves in neuromorphic computing”, the work has stimulated immediately many neural networks based on optics, acoustic, etc. (115 citations). The concept, which I demonstrated experimentally in the following paper (D. Pierangeli et al., *Photonics Research* 9, 1446, 2021), is a paradigm in optical machine learning.

4. **D. Pierangeli** *, M. Rafayelyan, C. Conti, and S. Gigan, [Scalable Spin-Glass Optical Simulator](#), *Physical Review Applied* 15, 034087 (2021).†

The first optical simulator for spin glasses based on complex media. Realized together with S. Gigan at LKB (Paris) where I performed the experiments as a visiting researcher, the work underlines one of my active collaborations with leading groups in optical computing.

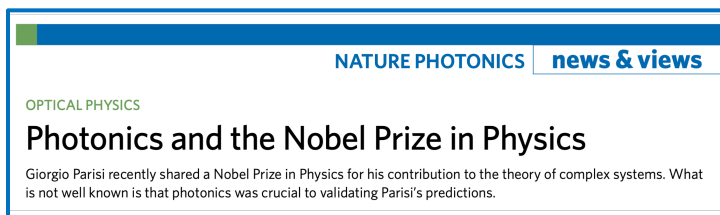
5. **D. Pierangeli** *, G. Marcucci, and C. Conti, [Adiabatic evolution on a spatial-photonic Ising machine](#), *Optica* 7, 1537 (2020).†

Important paper in the field of Ising machines that reports the first implementation of adiabatic computing and simulated annealing on a photonic platform. The work shows my expertise in heuristic algorithms for combinatorial optimization.

Nonlinear optics

6. **D. Pierangeli** *, A. Tavani, F. Di Mei, A.J. Agranat, C. Conti and E. DelRe, [Observation of replica symmetry breaking in disordered nonlinear wave propagation](#), *Nature Communications* 8, 1501 (2017).

First observation of a spin-glass phase for propagating light. The experiment has been significant for the **Nobel Prize in Physics 2021** awarded to Giorgio Parisi, as recognized in the scientific motivation released by the Nobel Committee that mentions and cites the article and in Parisi’s Nobel Lecture (*Rev. Mod. Phys.* 95 2023), and highlighted in the *Nature* Nobel Collection and *Nature Photonics* “Photonics and the Nobel prize in physics”. I was awarded the “Panizza and Galimberti” prize by the Italian Physical Society for this discovery. This landmark article contains the native idea that nonlinear optical propagation represents a spin system.



Highlight 3. *Nature Photonics* features the importance of our experimental findings for the Nobel Prize in Physics 2021 on complex systems.

7. **D. Pierangeli** *, M. Flammini, L. Zhang, G. Marcucci, A.J. Agranat, P.G. Grinevich, P.M. Santini, C. Conti and E. DelRe, [Observation of Fermi-Pasta-Ulam-Tsingou recurrence and its exact dynamics](#), *Physical Review X* 8, 041017 (2018).

First observation of the celebrated Fermi-Pasta-Ulam recurrence in nonlinear spatial optics. The paper solved a long-standing problem in nonlinear physics and opened a new testbed for nonlinear waves (98 citations). The achievement underlines my special expertise in nonlinear optical dynamics in crystals.

8. G. Marcucci ‡, **D. Pierangeli** ‡, A.J. Agranat, R.K. Lee, E. DelRe, and C. Conti, [Topological control of extreme waves](#), *Nature Communications* 10, 5090 (2019).

Experimental control of extreme waves in optical crystals that allows us to achieve the first observation of topological wave transitions. Highlighted in *Nature Physics* “Tamed by topology”, the paper is now an important reference for the nonlinear wave interdisciplinary community (49 citations).

9. **D. Pierangeli**, M. Ferraro, F. Di Mei, G. Di Domenico, C.E.M.de Oliveira, A.J. Agranat, and E. DelRe, [Super-crystals in composite ferroelectrics](#), *Nature Communications* 7, 10674 (2016).

Discovery of the super-crystal phase in ferroelectrics. The observation opened the route to important findings such as the observation of giant refraction in perovskites (*Nature Photonics* 12, 734 2018), which I co-authored, and 3D nonlinear photonic crystals. The article summarizes my achievements in nonlinear optics and electro-optics in crystals.



Highlight 4. Control of optical extreme waves featured in *Nature Physics*.

- 10. D. Pierangeli ***, G. Perini, V. Palmieri, I. Grecco, G. Friggeri, M. De Spirito, M. Papi, E. Del Re, and C. Conti, [Extreme transport of light in spheroids of tumor cells](#), *Nature Communications* 14, 4662 (2023).

Discovery of extreme optical transport in pancreas in-vitro tumors. The article reveals a novel nonlinear mechanism for optical propagation in biological tissues. I chose this recent finding to underline my attitude in starting and accomplishing new research on systems far from my background.

PEER RECOGNITION

Prizes, awards, and fellowships

■ ERC Starting Grant 2024

Proposal: Optical polarization for ultrafast computing - LOOP

Panel: PE7

■ Word's Top 2% Scientists

Rank in Optics: 1542 out of 78127

■ “Sergio Panizza e Gabriele Galimberti” prize 2022

Prize awarded by the Italian Physical Society (SIF) to an outstanding researcher in optoelectronics and photonics. The prize is the most prestigious Italian award in the field of optics.

Motivation: “For his important contributions to nonlinear optics through optical propagation experiments in photorefractive materials. Especially relevant is the first observation of the phenomenon of replica symmetry breaking in disordered photorefractive materials.”

■ BE-FOR-ERC fellowship 2019

Fellowship awarded by SAPIExcellence for “proposal of excellence made by PI with a scientific track record showing great promise”. Ranked first in panel PE.

Invited talks

08-2025	SPIE Optics + Photonics 2025 (San Diego, California, US) Conference: Emerging Topics in Artificial Intelligence (ETAI) <i>Photonic Ising Machines: from spatial to polarization schemes</i>
05-2025	International Workshop on Ising Machines 2025 (Chicago, Illinois, US) <i>Ising Machine based on nonlinear polarization oscillators</i>
01-2025	SPIE Photonics West 2025 (San Francisco, California, US) <i>Single-shot polarization imaging by machine learning</i>
04-2024	SPIE Photonics Europe 2024 (Strasbourg, France) Conference: Machine Learning in Photonics <i>Spatial photonic machines for large-scale computing and polarization Imaging</i>
09-2023	Artificial Intelligence Photonics 2023 (San Sebastian, Spain) <i>Photonic machines for large-scale machine learning and light analysis</i>
09-2023	Dynamics Days Europe – DDE23 (Napoli, Italy) Symposium: Complex light as a dynamical system for novel applications <i>Spatially complex light for computing, communication and biophotonics</i>
08-2023	EXTREM23 - Max Planck Institute MIPPKS (Dresden, Germany) <i>Extreme waves in spatial optics</i>
07-2023	IEEE Summer Topical Meeting Series - SUM 2023 (Giardini Naxos, Italy) <i>Learning and control of polarization-structured light</i>
04-2023	Analog Optical Computing Workshop – MICROSOFT (Cambridge, UK) <i>Spatial photonic Ising machines</i>
10-2022	HPM 2022 - Hybrid Photonics and Materials (Hydra, Greece) <i>Polarization measurement by photonic machine learning</i>

Conference organization

2024 European Optical Society Annual Meeting (9-13/09 2024, Naples)
Topical meeting on Nonlinear and Quantum Optics

ADDITIONAL INFORMATION

Bibliometric data

I am co-author of **59 publications** in peer-reviewed journals, including 2 review articles and 1 book chapter.

First author	22
Corresponding author	24
Last author	2

Citations: 2646

h-index: 25

i10-index: 48

Nature Photonics	1
Nature Communications	5
Physical Review X	1
Physical Review Letters	16
Optica	1
Laser & Photonics Reviews	2
Invited articles	2

Source: *Google Scholar*

Date: 19/05/2026

Full publication list and statistics:

<https://scholar.google.com/DavidePierangeli>

Research grants

<i>Years</i>	<i>Role</i>	<i>Project</i>	<i>Funding</i>
2025 -2030	Principal Investigator	ERC Starting Grant 2024 LOOP – <i>Optical polarization for ultrafast computing</i>	Total: 1.5 M€
2024 -2025	Coordinator of ISC unit	NSQTI - National Quantum Science and Technology Institute - PE4 Spoke 7	ISC: 90 k€
2023 -2025	Coordinator of CNR unit	PRIN 2022 - MUR n. 2022N738SA MetaComputing - <i>Light-programmed two-dimensional meta-holograms for integrated neuromorphic computing</i>	Total: 240 k€ CNR: 140 k€
2020 -2021	Principal Investigator	BE-FOR-ERC 2020 Grant - SAPIExcellence SPIM - <i>Spatial Photonic Ising Machine</i>	Total: 50 k€
2018 - 2019	Principal Investigator	China Science Foundation (CPSF) n. 2018M630978 ctrlROGUE - <i>Control of rogue waves in spatial optics</i>	Total: 10 k€

Participation in project consortia

2024-2025	National Recovery and Resilience Plan - EU - NextGenerationEU NATIONAL QUANTUM SCIENCE AND TECHNOLOGY INSTITUTE (NQSTI) PE4 Spoke 7 – 49 partners from 10 institutes Role: Scientific coordinator for ISC-CNR
2023-2027	HORIZON-EIC-2022-PATHFINDERCHALLENGES HEISINGBERG – <i>Spatial Quantum Optical Annealer for Spin Hamiltonians</i> (International, 6 partners)
2019-2022	PRIN 2017 – MUR PELM - <i>Photonic Extreme Learning Machine</i> Role: Leading researcher of the Sapienza unit

2018-2021	QuantERA ERA-NET Cofund QUOMPLEX - <i>Quantum Information Processing with Complex Media</i> (International, 3 partners)
2018-2022	H2020 - FET Flagship Quantum Technologies PhoQus - <i>Photons for Quantum Simulation</i> (International, 8 partners)

Dissemination and outreach

2023	«Onde luminose estreme contro il cancro» [A46] on <i>Il Corriere della Sera</i>
2023	Interview to Davide Pierangeli on <i>ZeroUno</i> : “Arriva la camera di polarizzazione intelligente e promette cose mai viste” [A45]
2023	“Rivelare la terza dimensione della luce con l’intelligenza artificiale” on <i>Le Scienze</i>
2021	«Ecco il cervellone super-intelligente che non inquina» [A39] on <i>Il Messaggero</i>
2021	«Via i chip dal computer: ora basta la luce» [A39] on <i>Il Corriere della Sera</i>
2020	“Le onde luminose sono il vero aiuto per i calcoli veloci” [A31] on <i>Il Messaggero</i>
2020	“L’intelligenza delle onde” [A31] on <i>Le Scienze</i>
2019	“La macchina che risolve i problemi alla velocità della luce” [A22] on <i>La Repubblica</i>
2019	“Tecnologia Ising: la più grande macchina di calcolo basata sulla luce” on <i>La Stampa</i>

Rome, the 19th of May 2026
Davide Pierangeli

