Jena LIGHT

Photonics meets AI

September, 3rd - 6th 2024
Abbe Center of Photonics
Jena, Germany

FRIEDRICH-SCHILLER-
UNIVERSITÄT
JENA

WELCOME TO JENA

Being Europe's city of light, Jena has been pushing the frontiers of photonics for more than a century. Recently, the potential of photonic systems to create the fastest and most energy efficient artificial intelligence (AI) platforms has been recognized.

To truly push the capability of future neuromorphic photonic systems for facilitating AI, there is an immediate need for developing neural network architectures and machine learning algorithms that can best utilize the underlying physics of the photonic systems, especially their high dimensionality. In this regard, there is an urgent need to bring together the expertise of computer scientists active in the field of AI and machine learning with the research communities of neuromorphic photonics and quantum information.

The conference "Jena LIGHT – Photonics meets AI" is organized jointly by the university's LIGHT profile, the International Research Training Group Meta-Active (IRTG 2675), the Collaborative Research Center NOA (CRC 1375), and the CZS Nexus groups MetaNN and SINABSE. The conference particularly aims to bring together world-leading researchers in the field of neuromorphic photonic systems, quantum photonic technologies, nanooptics, and computer science, to explore and discuss the current challenges and future potentials in the field of neuromorphic photonics.

Yours sincerely,

Jena LIGHT
program committee

JENA LIGHT PROGRAM COMMITTEE

- **Alexander Breuer**
  Advanced Computing, University Jena
- **Dmitrii Pidgaiko**
  Photonic Nanomaterials, University Jena
- **Falk Eilenberger**
  Micro- and Nanostructured Optics, Fraunhofer Institute for Applied Optics and Precision Engineering Jena
- **Frank Setzpfandt**
  Quantum Optics, University Jena
- **Isabelle Staude**
  Photonic Nanomaterials, University Jena
- **Joachim Giesen**
  Algorithm Engineering for Machine Learning and AI, University Jena
- **Mario Chemnitz**
  Smart Photonics, Leibniz Institute of Photonic Technologies Jena
- **Martin Gärttner**
  Quantum Information, University Jena
- **Sina Saravi**
  Neuromorphic & Quantum Photonics, University Jena
- **Thomas Pertsch**
  Nano & Quantum Optics, University Jena
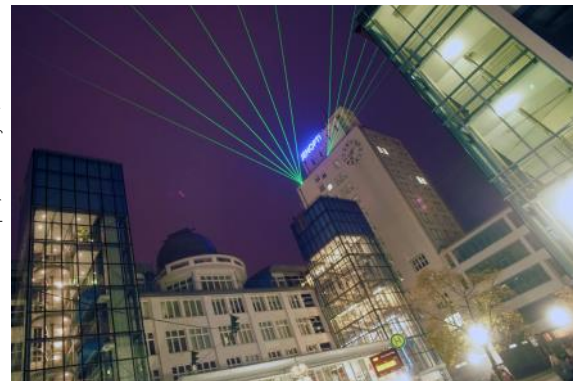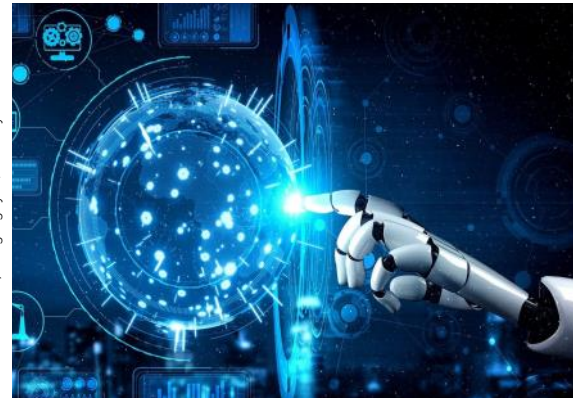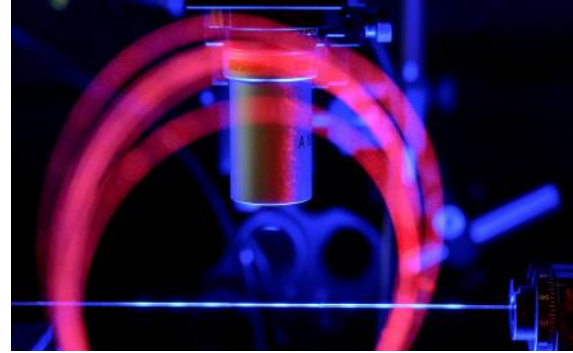
INVITED SPEAKERS

The following experts in the field of neuromorphic photonic systems, quantum photonic technologies, nanooptics, and computer science will speak about their latest research.

- **Alexander Heinecke**
  Intel Labs, Santa Clara, USA

- **Alexander Breuer**
  Friedrich Schiller University Jena, Germany

- **Aydogan Ozcan**
  UCLA - University of California, Los Angeles, USA

- **Bhavin J. Shastri**
  Queen's University, Kingston, Canada

- **Birgit Stiller**
  MPL - Max Planck Institute for the Science of Light, Erlangen, Germany

- **Carlo Holly**
  ILT - Fraunhofer Institute for Laser Technology & RWTH - Aachen University, Aachen, Germany

- **Carsten Rockstuhl**
  KIT - Karlsruhe Institute of Technology, Germany

- **Clara Wanjura**
  MPL - Max Planck Institute for the Science of Light, Erlangen, Germany

- **Demetri Psaltis**
  EPFL - École Polytechnique Fédérale de Lausanne, Switzerland

- **Dragomir Neshev**
  ANU - The Australian National University, Canberra, Australia

- **Elena Goi**
  USST - University of Shanghai for Science and Technology, China

- **Humeyra Caglayan**
  Tampere University, Finland

- **Janik Wolters**
  Technische Universität Berlin & DLR - German Aerospace Center, Germany

- **Jean-Pierre Seifert**
  Technische Universität Berlin, Germany

- **Joachim Giesen**
  Friedrich Schiller University University Jena, Germany

- **Mario Chemnitz**
  IPHT - Leibniz Institute of Photonic Technologies, Jena, Germany

- **Mauro Paternostro**
  University Palermo, Italy and QUB - Queen's University Belfast, UK)

- **Peter Bienstman**
  Ghent University, Belgium

- **Sina Saravi**
  Friedrich Schiller University University Jena, Germany

- **Stefanie Kroker**
  Technische Universität Braunschweig, Germany

- **Tatsuhiro Onodera**
  Cornell University, Ithaca, USA

- **Wolfram Pernice**
  Heidelberg University, Germany

- **Yaron Bromberg**
  The Hebrew University of Jerusalem, Israel

PROGRAM OVERVIEW

Time	Tuesday, 03.09.2024	Wednesday, 04.09.2024	Thursday, 05.09.2024	Friday, 06.09.2024
08:30			**Demetri Psaltis (EPFL) KEYNOTE, ONLINE** Nonlinear Computation with Linear Optics	**Yaron Bromberg (Jerusalem) KEYNOTE** Quantum Communication and Computation with High-Dimensional Entangled Photons
09:00		**Timo Mappes (D.O.M. & FSU Jena)**		
09:30		Science Heritage Experience on Optics in Jena: Past - Present - Future We will take you on a walk through Jena's more than 100 years of optics history, from the early days of the founding fathers Abbe, Zeiss and Schott to the future in the new Zeiss campus.	**Clara Wanjura (MPL Erlangen)** Fully Nonlinear Neuromorphic Computing with Linear Wave Scattering	**Mauro Paternostro (Palermo & Belfast)** Quantum Enhanced Machine Learning: From Gate Synthesis to Photonic Reservoir Computing
10:00				
10:30			Coffee break & posters	Coffee break & posters
11:00	Registration & welcome coffee		**Joachim Giesen & Alexander Breuer (Uni Jena)** Einsum - A Formal Language for Tensor Expressions	**Elena Goi (USST Shanghai) ONLINE** Hybrid Nanoprinted Neural Networks
11:30		**Welcome Address** by VP Research FSU (at 11:45)		
12:00	**Visit of photonics research labs** Fraunhofer Institute for Applied Optics and Precision Engineering IOF (Albert-Einstein-Strasse 7, 07745 Jena)	**Sina Saravi (University Jena)** AI Photonics - Merging Disciplines	**Carlo Holly (Aachen)** The potential of AI in Photonics - From Advanced Beam Shaping to Self-Learning Laser Processes	**Peter Bienstman (Ghent)** Optical Computing with Silicon Photonic Reservoirs
12:30				
13:00		Lunch (Casino Beutenberg)	Lunch (Casino Beutenberg)	Lunch (Casino Beutenberg)
13:30	Lunch (Casino Beutenberg)			
14:00		**Wolfram Pernice (Heidelberg)** Photonic computing with incoherent light	**Alexander Heinecke (Intel)** From Tensor Processing Primitive towards Tensor Compilers using upstream MLIR	**Birgit Stiller (MPL Erlangen)** Photonic Computation Enabled by Sound Waves
	Conference Opening (at 14:15)			
14:30	**Carsten Rockstuhl (KIT)** Machine Learning Enhanced Design of Meta-Atoms and Metasurfaces			
15:00		**Martin Gärttner (University Jena)** Machine-Learning for Quantum Many-Body Physics	**Mario Chemnitz (Leibniz IPHT Jena)** Neuromorphic Computing with Nonlinear Dynamics in Single-mode Fibers	**Janik Wolters (TU Berlin & DLR)** Information Processing with Photons and Atoms
15:30	**Bhavin Shastri (Queen's CA) ONLINE** Neuromorphic Photonic Computing: Applications, Classical to Quantum			
16:00		Coffee break & posters	Coffee break	Farewell coffee & goodbye
16:30	Coffee break	**Tatsuhiro Onodera (Cornell) ONLINE** Deep Physical Neural Networks: A Case Study with a 2D Programmable Photonic Chip	**Visit of photonics research labs** Leibniz Institute of Photonic Technology IPHT (Albert-Einstein-Strasse 9, 07745 Jena)	
17:00	**Humeyra Caglayan (Tampere)** Imaging Applications through Learning-Enhanced Metasurface Optics			
17:30		**Aydogan Ozcan (UCLA) KEYNOTE, ONLINE** Programming Light Diffraction for Information Processing and Computational Imaging		
18:00	**Dragomir Neshev (ANU Canberra)** Analog Image Processing with Linear and Nonlinear Flat Optics			
18:30			**Pizza, Wine & Posters**	
19:00	**BBQ, Beer & Posters**		We will continue our discussions at the posters.	
19:30	We will enjoy a typical Thuringian barbeque while having a first look at the posters.	**Conference Dinner & Plants**		
...		Botanical Garden of University Jena (Fürstengraben 26, 07743 Jena)		
22:00				

PROGRAM - TUESDAY, SEPTEMBER 3, 2024

11:00   Registration & welcome coffee

12:00   Visit of photonics research labs
Fraunhofer Institute for Applied Optics and Precision Engineering IOF
Meeting point is the foyer of the Fraunhofer Institute (Albert-Einstein-Strasse 7, 07745 Jena, just opposite of the ACP)

13:30   Lunch (Casino Beutenberg)

14:15   Opening of the conference

Session chair: Isabelle Staude
14:30   Machine Learning Enhanced Design of Meta-Atoms and Metasurfaces
Carsten Rockstuhl (KIT - Karlsruhe Institute of Technology, Germany)

15:30   Neuromorphic Photonic Computing: Applications, Classical to Quantum -ONLINE
Bhavin Shastri (Queen's University, Kingston, Canada)

16:30   Coffee break

Session chair: Frank Setzpfandt
17:00   Imaging Applications through Learning-Enhanced Metasurface Optics
Humeyra Caglayan (Tampere University, Finland)

18:00   Analog Image Processing with Linear and Nonlinear Flat Optics
Dragomir Neshev (ANU - The Australian National University, Canberra, Australia)

19:00   Posters with BBQ & Beer
We will enjoy a typical Thuringian barbeque in the Foyer of the Abbe Center of Photonics, while having a first look at the posters.

PROGRAM - WEDNESDAY, SEPTEMBER 4, 2024

09:00   **Science Heritage Experience on Optics in Jena: Past - Present – Future**
Timo Mappes (Deutsches Optisches Museum and Friedrich Schiller University Jena, Germany)
Jena, being awarded the title "historic site" by the European Physical Society, is the cradle of modern optics. Timo Mappes, the founding director of the Deutsches Optisches Museum, will take you on a walk through Jena's more than 100 years of optics history, from the early days of the founding fathers Abbe, Zeiss and Schott to the future in the upcoming Zeiss campus.

11:45   **Welcome address**
Georg Pohnert (Vice-President for Research of the Friedrich Schiller University Jena, Germany)

Session chair: Thomas Pertsch
12:00   **AI Photonics - Merging Disciplines**
Sina Saravi (Friedrich Schiller University Jena, Germany)

13:00   **Lunch (Casino Beutenberg)**

Session chair: Isabelle Staude
14:00   **Photonic Computing with Incoherent Light**
Wolfram Pernice (Heidelberg University, Germany)

15:00   **Semiconductors and Metasurfaces: From Neuromorphic Computing to Precision Experiments**
Stefanie Kroker (Technische Universität Braunschweig, Germany)

16:00   **Coffee break & posters**

Session chair: Falk Eilenberger
16:30   **Deep Physical Neural Networks: A Case Study with a Two-Dimensionally Programmable Photonic Chip**
Tatsuhiro Onodera (Cornell University, Ithaca, USA)

17:30   **Programming Light Diffraction for Information Processing and Computational Imaging - KEYNOTE, ONLINE**
Aydogan Ozcan (UCLA - University of California, Los Angeles, USA)

19:30   **Conference Dinner & Plants**
Botanical Garden of the Friedrich Schiller University Jena (Fürstengraben 26, 07743 Jena)

PROGRAM - THURSDAY, SEPTEMBER 5, 2024

Session chair: Alexander Breuer

08:30 Nonlinear Computation with Linear Optics - KEYNOTE, ONLINE
Demetri Psaltis (EPFL - École Polytechnique Fédérale de Lausanne, Switzerland)

09:30 Fully Nonlinear Neuromorphic Computing with Linear Wave Scattering
Clara Wanjura (MPL - Max Planck Institute for the Science of Light, Erlangen, Germany)

10:30 Coffee break & posters

Session chair: Mario Chemnitz

11:00 Einsum - A Formal Language for Tensor Expressions
Joachim Giesen and Alexander Breuer (Friedrich Schiller University Jena, Germany)

12:00 The Potential of AI in Photonics - From Advanced Beam Shaping to Self-Learning Laser Processes
Carlo Holly (Aachen)

13:00 Lunch (Casino Beutenberg)

Session chair: Joachim Giesen

14:00 From Tensor Processing Primitive towards Tensor Compilers using upstream MLIR
Alexander Heinecke (Intel Labs, Santa Clara, USA)

15:00 Neuromorphic Computing with Nonlinear Dynamics in Single-Mode Fibers
Mario Chemnitz (IPHT - Leibniz Institute for Photonic Technologies Jena, Germany)

16:00 Coffee break

16:30 Visit of photonics research labs
Leibniz Institute of Photonic Technology IPHT

18:30 Posters with Pizza & Wine

PROGRAM - FRIDAY, SEPTEMBER 6, 2024

Session chair: Martin Gärttner

08:30   Quantum Communication and Computation with High-Dimensional Entangled Photons - KEYNOTE
Yaron Bromberg (The Hebrew University of Jerusalem, Israel)

09:30   Quantum Enhanced Machine Learning: From Gate Synthesis to Photonic Reservoir Computing
Mauro Paternostro (University Palermo, Italy and QUB - Queen's University Belfast, UK)

10:30   Coffee break & posters

Session chair: Dmitrii Pidgaiko

11:00   Hybrid Nanoprinted Neural Networks - ONLINE
Elena Goi (USST - University of Shanghai for Science and Technology, China)

12:00   Optical Computing with Silicon Photonic Reservoirs
Peter Bienstman (Ghent University, Belgium)

13:00   Lunch (Casino Beutenberg)

Session chair: Sina Saravi

14:00   Photonic Computation Enabled by Sound Waves
Birgit Stiller (MPL - Max Planck Institute for the Science of Light, Erlangen, Germany)

15:00   Information Processing with Photons and Atoms
Janik Wolters (Technische Universität Berlin & DLR - German Aerospace Center, Germany)

16:00   Farewell coffee & goodbye

POSTERS

[P1]

Metasurfaces embedded in liquid crystals with spatially varying orientation

Maximilian Beddoe (Friedrich Schiller University Jena, Institute of Solid State Physics, Abbe Center of Photonics, Jena, Germany)

[P2]

Optimized photon pair generation in parametric down-conversion for high-dimensional maximally entangled states

Richard Bernecker (Helmholtz Institute Jena, Jena, Germany)

[P3]

High-efficiency tuneable metasurface for improved data encoding in optical neural networks.

Samuel Blair (University of York, York, United Kingdom)

[P4]

Second harmonic generation in all-optical diffractive neural networks

<u>**Marie Braasch**</u>, Thomas Pertsch, and Sina Saravi (Friedrich Schiller University Jena, Institute of Applied Physics, Abbe Center of Photonics, Jena, Germany)

[P5]

Nonlinear interference and electron dynamics: probing photoelectron momentum distributions in strong-field ionization

Danish Furekh Dar (Helmholtz Institute Jena, Jena, Germany)

[P6]

Neuromorphic photonic processing based on a Kerr laser cavity

Luigi Di Lauro (Institut national de la recherche scientifique, Montreal, Canada)

[P7]

Machine learning for the free-form inverse design in nanophotonics

Timo Gahlmann (AMOLF, Amsterdam, Netherlands)

[P8]

Time-domain topology optimization of dispersive dielectric and plasmonic nanostructures for broadband performance

<u>**Johannes Gedeon**</u>, Izzatjon Allayarov, Antonio Calà Lesina, and Emadeldeen Hassan (Leibniz Universität Hannover, Hannover, Germany)

[P9]

AI-driven discovery in quantum optics using graph representations

Xumei Gu (Max Planck Institute for the Science of Light, Erlangen, Germany)

POSTERS

[P18]
Inverse design for integrated polymer 3D optical circuits
Abhishek Nanda (Leibniz University Hannover, Cluster of Excellence PhoenixD, Hannover, Germany)

[P19]
End to end design of RGB Metahologram
<u>Jaebum Noh</u> and Junsuk Rho (POSTECH - Pohang University of Science and Technology, Pohang, South Korea)

[P20]
Nano and quantum information
Malika Boubaker Ourabia (University USTHB, El alia babezzouar, Algiers, Algeria)

[P21]
Photonic neuromorphic computing with integrated phase change material equipped with nanographene-microheater
<u>Anna P. Ovvyan</u> and Wolfram H. Pernice (Heidelberg University, Physics Institute, Heidelberg, Germany)

[P22]
AI-Powered education: Transformative insights from design thinking lecture projects
Reinhold Pabst (Fraunhofer IOF, Jena, Germany)

[P23]
Interaction of vector light with atoms exposed to time dependent magnetic field
Shreyas Ramakrishna (Helmholtz Institute Jena, Jena, Germany)

[P24]
Prospects of hybrid atomic-photonic neural networks for neuromorphic computing
Elizabeth Robertson (Deutsches Zentrum für Luft- und Raumfahrt, Berlin, Germany)

[P25]
Machine learning-enhanced optical microresonator sensor for chip-independent multiplexed biosensing
Anton Saetchnikov (Ruhr-University Bochum, Applied Laser Technologies, Germany)

THE VENUE

The conference is hosted by the Abbe Center of Photonics at the Friedrich Schiller University Jena, Germany.

The Abbe Center of Photonics (ACP) is the academic center of scientific activities in the fields of optics and photonics at the Friedrich Schiller University Jena, Germany. In the last years, ACP has become one of the leading European centers for research and education in optics and photonics as well as in the development and transfer of optical and quantum-photonic technologies. ACP is strongly engaged in young-career scientists' education via its integrated Abbe School of Photonics.

ACP fosters and sustains strong links with local industry partners as well as with the international scientific community. Research is conducted in joint cooperation with the Fraunhofer Institute Jena, the Helmholtz Institute Jena, the Leibniz Institute of Photonic Technology, and the Deutsches Optisches Museum.

Photo: Jan-Peter Kasper / Friedrich Schiller University Jena

PRACTICAL INFORMATION

Address of the venue
Abbe Center of Photonics
Albert Einstein Strasse 6
07745 Jena
Germany

Mobile internet access
The worldwide WLAN "eduroam" is available in all rooms of the conference venue. If you would like to use our alternative Guest Wi-Fi, please see the notices in the foyer of the conference venue.

Lunch
Lunch can be ordered in the Casino at the Abbe-Zentrum Beutenberg (Hans-Knöll-Str. 1, 07745 Jena; 2-minutes-walk from the conference venue).

Public Transportation
The venue can be reached easily by public transportation from the city center of Jena (Bus station "Stadtzentrum Teichgraben"). Just take the bus line 10,11 or 12 and get off at the stop "Beutenberg Campus", from here it is a 5-minutes-walk to the Abbe Center of Photonics.
Tickets can be purchased in every bus or tram or via the FAIRTIQ-App (App Store or Google Play Store).

Further questions
If you have any further questions, you will find us in the foyer at the registration desk.

Photos: Janina Kalisch, Jan-Peter Kasper/ Friedrich Schiller University Jena

MANY THANKS TO ALL SUPPORTERS OF THE CONFERENCE!

CONTACT

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