David Theidel

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Laboratoire d'Optique Appliquée, Institut Polytechnique de Paris
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Education

PhD candidate October 2022 – Septermber 2025
Institut Polytechnique de Paris, École polytechnique, France
Title of thesis:
Investigation of Quantum Optical Effects in High-Harmonic Generation from Semiconductors

Master of Science October 2019 – May 2022
Faculty of Mathematics and Physics
Leibniz University Hanover, Germany
Title of Master thesis:
Design and Characterization of a Soft X-Ray Diffraction Imaging Setup

Bachelor of Science October 2015 – January 2020
Faculty of Mathematics and Physics
Leibniz University Hanover, Germany
Title of Bachelor thesis:
Establishment of a light-sheet microscope and novel algorithms for image enhancement

Abitur 2007 – 2015
Gymnasium Johaneum Lüneburg, Germany
Advanced courses: Physics, Mathematics, Computer Science

Research and academic experience

PhD Researcher at the Institut Polytechnique de Paris and École Polytechnique
October 2022 – September 2025

- Pioneering research in **Attosecond Quantum Optics**, focusing on photon statistics in semiconductor high-harmonic generation. Identified, developed, and implemented quantum metrology techniques to characterize nonclassical light from novel broadband sources.
- Performed **Glauber-correlation measurements** to demonstrate:
  - Non-classical photon statistics,
  - Multimode squeezing,
  - Non-classical correlations between harmonic modes.
- Conditional State Generation and Analysis based on Quantum Non-Gaussian Witnesses
- Established semiconductor HHG as a novel source of non-classical light with potential in quantum technologies.
- Co-supervised two M2 student research projects.

Research Assistant at the Institute of Quantum Optics **May 2022 – September 2022**

- Designed and implemented a **vacuum system** for a ptychographic microscope in the extreme ultraviolet (XUV) regime.
- Integrated multiple electronic systems, including:
  - Princeton Instruments camera (SOPHIA),
  - Piezo-electric stages,
  - Custom-built vacuum components.
- Co-mentored three undergraduate and graduate students.
- Led a physics internship for a group of 12 students.

Student Research Assistant at the Fraunhofer ITEM **August 2020 – August 2021**

- Project: *Bronchoconstriction from precision-cut lung slices*.
- Developed a **convolutional neural network** for microscope image segmentation.
- Researched pharmaceutical effects on bronchial constriction in lung tissue.

Tutor at the Leibniz University Hannover **April 2019 – August 2019**

- Tutored physics lab sessions for students of the Faculty of Mathematics and Physics (summer term).
- Supported introductory mathematics courses for first-year students (winter term).

Student Research Assistant at the Institute of Quantum Optics **August 2017 – October 2018**
August 2019 – April 2022

- *Relativistic Geodesy and Gravimetry with Quantum Sensors (geo-Q)* project:
  - **Developed electronics** for laser power supply stabilization used in a quantum gravimeter.
- *Biophotonics group*:
  - Developed software for **lightfield reconstruction** from fiber-based fluorescence images.

Private Tutoring **October 2017 – April 2019**

- Provided individual and group tutoring in **physics**, **mathematics**, **German**, and **English**.
- Tutored both privately and through tutoring studios across a wide range of grade levels.

Awards and Honors

- **Gold Medal with the Hanover Team at the iGEM Contest** **2020**
  The International Genetically Engineered Machine (iGEM) Contest is an international competition in the field of synthetic biology. Our team participated successfully with a novel idea for a cell-based sensor for biofilm-associated inflammation on implants.
- **Abitur prize for excellent accomplishments in physics** **2015**
- **Awards at Jugend Forscht** **2012 - 2015**
  National science contest for high school students. Main accomplishment, 1st prize at the regional and federal level and special prize by the *Wilhelm and Else Hereaus* foundation at the national level in 2014. 1st prize at the regional level and 3rd prize and special prize by the *Deutsches Museum München* at the federal level in 2015.

Side Projects

- **Student representative (2018–2020)** – Council of the QUEST Leibniz Research School
- **iGEM Team Hanover 2020 leader** – Managing finances and leading software development for a team of 16 interdisciplinary students. `igem.org/Team:Hannover`
- **Author and developer** – Published Python package **BiofilmSimulation** on PyPI in October 2020. Developed an open-source molecular dynamics tool that simulates the growth of biofilms on surfaces, featuring user-defined bacterial parameters and built-in visualization tools. `pypi.org/project/BiofilmSimulation`
- **Co-organizer** – **Quantum PhDay 2024** at ENS Paris-Saclay, attended by 50 PhD students from the Quantum-Saclay network.
  Helped to organize the event and chaired one session to facilitate research exchange.
  `quantum-phday24.sciencesconf.org`
- **Co-organizer** – **Quantum PhDay 2025** at ENS Paris-Saclay.
  `quantum-phday25.sciencesconf.org`
- **Participation – DESY's FLASH beamline 2022** Contributed to experimental vacuum setup, developed code for data processing and analysis.
- **Invited participant and poster presenter** at the **Quantum Connections Summer School 2024 and 2025**, hosted by Nobel Laureate Frank Wilczek.
  Attended courses on cutting-edge topics in quantum matter, information, and fundamental particle physics. Presentation of a poster. `indico.fysik.su.se/event/8573/`
- **Participant – LOQCathon 2023** Interdisciplinary Quantum Hackathon on Linear Optical Quantum Computation using the Perceval software platform.

Publications

1. Cotte Viviane Heinzel Philip Griguer Houssna Weis Mateusz Sondenheimer René Theidel, David and Hamed Merdji. Observation of a displaced squeezed state in high-harmonic generation (accepted). *Phys. Rev. Res.*, Jul 2025

    - Reports the experimental observation of multipartite entanglement and displaced squeezing in solid-state high-harmonic generation, establishing a foundational step toward scalable attosecond quantum optics and its integration into quantum photonic technologies.

2. David Theidel, Viviane Cotte, René Sondenheimer, Viktoriia Shiriaeva, Marie Froidevaux, Vladislav Severin, Adam Merdji-Larue, Philip Mosel, Sven Fröhlich, Kim-Alessandro Weber, et al. Evidence of the quantum optical nature of high-harmonic generation. *PRX Quantum*, 5(4):040319, 2024

    - First direct observation that high-harmonic generation exhibits genuine quantum optical features, including nonclassical correlations between spectral modes.

3. Christian Steinmeyer, Susann Dehmel, David Theidel, Armin Braun, and Lena Wiese. Automating bronchoconstriction analysis based on u-net. In *EDBT/ICDT Workshops*, 2021

4. Julia Bahlmann, Nodir Madrahimov, Fiene Daniel, David Theidel, Daphne E DeTemple, Manuela Buettner, André Bleich, Axel Haverich, Alexander Heisterkamp, and Stefan Kalies. Establishment of a guided, in vivo, multi-channel, abdominal, tissue imaging approach. *Scientific Reports*, 10(1):1–9, 2020

5. David Theidel. Goldener Quantentsprung. *Junge Wissenschaft*, 109(1):50–55, 2016

Talks & Posters

1. David Theidel et al. Quantum light from solid-state high-harmonic generation, 11 2024. Poster presentation at the European Quantum Technologies Conference (EQTC) in Lisbon

2. David Theidel et al. Modal analysis of a multimode displaced squeezed state from high-harmonic generation, 10 2024. Poster presentation at the 2nd Colloquium GDR TeQ Quantum Technologies at Sorbonne University, Paris

3. David Theidel et al. Squeezed states of light generated by high-harmonic generation, 07 2024. Accepted post-deadline talk at the 23rd Ultrafast Phenomena conference in Barcelona

4. David Theidel et al. Experimental verification of the non-classicality of high-harmonic generation, 07 2024. Poster presentation at the 23rd Ultrafast Phenomena conference in Barcelona

5. David Theidel et al. Experimental evidences of quantum properties in a high-harmonic-based bipartite system, 04 2024. Accepted talk at the SPIE Photonics 2024 in Strasbourg

6. David Theidel. Non-classical signatures in a bipartite, high-harmonic based system, 04 2024. Invited talk at the Extreme Quantum Optics Workshop organized by Jens Biegert at ICFO, Barcelona

7. David Theidel. Optical quantum phenomena: Non-classical light, applications and high-harmonic generation, 02 2024. Invited talk at the colloquium of the Institute of Quantum Optics, Ultrafast Laser Laboratory, LUH, Hanover

8. David Theidel. Unraveling the quantum nature of high-harmonic generation, 11 2023. Invited talk at the colloquium of the Laboratory of Advanced Quantum Architecture, EPFL, Laussane

9. David Theidel, Philip Mosel, Elisa Appi, Pranitha Sankar, Uwe Morgner, and Milutin Kovacev. Table-top nanoscale imaging with xuv and soft x-ray radiation, 03 2022. Talk at the summer assembly 2022 of the german physics society DPG