

Curriculum Vitae Morten Bache

Date and place of birth: 6 February 1974,
Copenhagen, Denmark
Citizenship: Danish

Civil status: Married, 2 children
Title: Ph.D. (physics), M.Sc.E.
(Applied Physics)



Current employment:

Associate professor, Ultrafast Nonlinear Optics team leader in the Ultrafast Infrared and Terahertz Science group, www.fotonik.dtu.dk/ultrafast

DTU Fotonik, Department of Photonics Engineering, Ørstedes Plads Bld. 343

Technical University of Denmark (DTU)

DK-2800 Lyngby (Denmark)

moba@fotonik.dtu.dk, [official homepage](#), [Researcher ID](#), [Google Scholar](#), [ORCiD](#), [ResearchGate](#)

Education:

- **14 October 2002:** Ph.D. (physics) Department of Informatics and Mathematical Modelling, DTU, and Department of Optics and Fluid Dynamics, Risø National Laboratory, Denmark.
- **April 1999:** Civil Engineering degree in Applied Physics obtained at DTU.

Employment:

- **August 2008-present:** Associate Professor (tenured since 2012), DTU Fotonik, DTU.
- **September 2007-July 2008:** Assistant Professor, DTU Fotonik, DTU.
- **June 2005-August 2007:** Postdoc, DTU Fotonik, DTU.
- **July 2002-May 2005:** Postdoc, Università degli Studi dell'Insubria, Como, Italy.
- **April 1999-June 2002:** Ph.D. student, Dept. of Informatics and Mathematical Modelling, DTU.

Publication summary: [Full list \(pdf\)](#)

- **ISI indexed publications: 2,400+ citations, h-index of 20, m-index of 1.1** ([Researcher ID](#))
 - h-index: h papers cited over h times. m-index: h-index/years of scientific activity
 - 100 ISI indexed publications: 61 journal papers, 34 conference papers, 5 errata
 - 6 papers with 100+ citations; 12 papers with 50+ citations; 41 papers with 10+ citations
- **Google Scholar: 3,400+ citations, h-index 23, i-10 index 45** ([Google scholar](#))
- **Conference contributions**
 - 36 conference contributions in proceedings
 - 67 oral conference contributions (9 invited), 31 posters
- **Other publications:** 2 book chapters, 1 patent

Key research topics and career summary:

Key topics: Ultra-fast lasers, ultra-short femtosecond laser pulses, nonlinear optics, nonlinear fiber optics, nonlinear nanophotonic devices, laser frequency conversion, spatial and temporal optical solitons, quantum optics

Important scientific contributions:

(The citations refer to *ISI-indexed peer-reviewed journal papers* in the [full publication list](#))

- First theoretical prediction of stationary space-periodic structures with equal diffusion coefficients in a chemical reaction-diffusion system [1]
- First experiment observing self-pulsing instability in cavity second-harmonic generation [5]
- First theoretical prediction of ghost imaging with classical thermal light [10,11] ([11] was ISI Highly Cited Paper in 2014)
- First experiment observing sub-shot noise quantum correlations with high gain [15]
- First experimental realization of ghost imaging with classical thermal light [17] (ISI Highly Cited Paper in 2014)
- First experiment with classical ghost imaging of a phase object [21]
- First theoretical explanation of the nonlocal nature of ultrafast cascaded nonlinearities [23]
- First theoretical prediction of optical Cherenkov radiation in ultra-fast cascaded second-harmonic generation [29]

- First experimental evidence of ultrafast and octave-spanning optical nonlinearities from strongly phase-mismatched cascaded interaction, first type 0 soliton compression experiment [33]
- First experimental observation of soliton-induced resonant radiation with a three-wave mixing nonlinearity (nonlocal resonances) [45]
- First experimental observation of octave-spanning supercontinuum generation in an unpoled quadratic nonlinear waveguide [46]
- First experimental observation of mid-IR resonant optical Cherenkov radiation with defocusing cascaded nonlinearities [47]
- First experimental observation of resonant radiation from non-degenerate four-wave mixing of a defocusing soliton and a probe [50]
- First observation and characterization of soliton-induced resonant radiation with three-wave mixing in the mid-IR [59]

Career summary: In his master's thesis, Morten Bache (MB) worked on pattern formation in complex nonlinear chemical systems. The basis of these results was a five month stay at the group of 1977 Nobel Laureate in Chemistry, Ilya Prigogine, Universite Libre de Bruxelles, Belgium. He co-authored a seminal paper in Physical Review E, predicting pattern formation from interaction of chemical species with equal diffusion coefficients. This was until then believed impossible.

During his Ph.D. he worked on theoretical nonlinear and quantum optics and modeling of complex spatial and temporal phenomena arising from laser light interacting with quadratic nonlinear materials. Of the 6 papers he co-authored in this period, the most important one remains an experimental and theoretical observation of a self-pulsing instability in cavity enhanced second-harmonic generation, which was predicted over 20 years before. During his Ph.D. he spent two months at University of Wisconsin, USA, and five months at Universitat de les Illes Balears, Spain.

Between 2002 and 2005 MB held a postdoc position in the group of the highly acclaimed professor in Quantum Electronics Luigi Lugiato (winner of the 2002 Lamb Award, 2003 Quantum Electronics Prize of the EPS, and the 2007 Max Born Award), in Como, Italy. MB worked on modeling spatio-temporal quantum properties of short, intense pulses in quadratic nonlinear materials. He also worked on spatio-temporal properties of vertical-cavity surface-emitting lasers. He was co-author of several highly influential papers, including 4 Physical Review Letters: first, an experimental observation of nonclassical quantum spatial correlations from quadratic nonlinear materials where he was involved in developing the very complex numerical model that was used to guide the experiment. Secondly, a theoretical and numerical effort concerned quantum imaging, i.e. the retrieval of images with a precision beyond the classical limits by exploiting the quantum nature of noise from nonlinear processes. Finally, a series of theoretical, experimental papers concerned a highly controversial result concerning when classical correlations can replace quantum correlations in quantum imaging. This initiated a debate that reaches out to many other branches of quantum information, and has since generated a flurry of papers.

From June 2005-July 2008 he held a Steno postdoc grant from the Danish Natural Science Research Council at DTU Fotonik. He worked on quadratic nonlinear processes, focusing on the temporal aspects in the context of nonlinear fiber optics. He has been studying the potential of photonic crystal fibers (PCFs) for generating very short pulses at new wavelengths. Based on these results he has started a collaboration concerning cascaded quadratic nonlinear processes with the group of professor Frank Wise, Cornell University, USA, who is one of the leading experimental research groups in the world in this field. During this collaboration a new and very accurate theory has been developed to understand soliton-effect compression to ultra-short femtosecond pulses by using the cascaded quadratic nonlinearities. In particular, it was pointed out that the dispersion in the system gives rise to a temporal nonlocal effect, which is a very fundamental result that can help to understand the physics of the system. After his Steno grant he became an associate professor. In 2009 he received the DFF Young Elite Researchers Award, and in 2011 he became leader of the Ultrafast Nonlinear Optics team at DTU Fotonik.

Current research topics:

- Nonlinear optical pulses (solitons) generated in quadratic nonlinear crystals (bulk or with waveguides) using cascading (phase-mismatched) frequency conversion processes
- Novel frequency conversion methods for ultrashort pulses in the near- and mid-IR
- Novel compression methods for commercial laser systems (Yb-, Er-, and Cr-based laser systems, fiber or solid state) using cascaded nonlinearities
- Few-cycle pulse generation, octave-spanning supercontinuum generation, and optical Cherenkov wave formation using cascaded nonlinearities
- Ultrafast nonlinear interaction in gas-filled hollow-core optical fibers
- Nonlinear properties of metal nanoparticles and thin films, surface plasmons, waveguides for surface plasmons

Project management:

- *SUPUVIR: SUPERcontinuum broadband light sources covering UV to IR applications*, H2020 MCSA Innovative Training Networks, European Commission, (2016-2020), project coordinator.
- *Femto-midIR: Femtosecond few-cycle mid-infrared laser pulses*, Danish Council for Independent Research | Technology and Production Sciences (2012-2015), PI.
- *Cascaded optical pulse compressor*, FP7 (People), European Commission (2011-today), scientist in charge.
- *Femto-VINIR: Few-cycle femtosecond optical pulses in the visible and near-infrared*, Danish Research Council for Technology and Production Sciences, (2009-today), PI.
- *Optical transducer systems: Optical microphones, accelerometers and pressure transducers based on Fiber Bragg Grating technology and optical detectors*, The Danish National Advanced Technology Foundation, (2008-2009), project manager for DTU Fotonik.
- *Nanostructured polymer photonic crystal fibers for effective second-harmonic generation*, The Danish Natural Science Research Council (2005-2008), PI.
- *Quantum imaging*, The Carlsberg Foundation (2004-2005), PI.
- *Polarization properties and dynamics of microcavity semiconductor lasers*, The Danish Research Council for Technology and Production Sciences (2003-2004), PI.

Participation in international and national projects:

- *SUPUVIR: SUPERcontinuum broadband light sources covering UV to IR applications*, H2020 MCSA Innovative Training Networks, European Commission, (2016-2020).
- *Optical transducer systems: Optical microphones, accelerometers and pressure transducers based on Fiber Bragg Grating technology and optical detectors*, The Danish National Advanced Technology Foundation, 2008-2011.
- *Theoretical study of novel devices based on quantum entanglement*, project financed by The Italian Ministry of Education University and Research, 2003-2005.
- *Nonclassical light in quantum imaging and continuous variable quantum channels*, project financed by the European Community (INTAS-2001-02097), 2002-2005.
- *Quantum Images*, funded by the European Community (IST-2000-26019), 2001-2003.
- *VCSELs for Information Society Technology Applications*, funded by the European Union (HPRN-2000-00034), 2000-2004.

International collaborations:

- [Frank W. Wise](#), professor, Cornell University, Ithaca (NY), USA
- [Wieslaw Krolikowski](#), professor, Australian National University, Canberra, Australia
- [Jeffrey Moses](#), assistant professor, Cornell University, Ithaca (NY), USA
- [Stefano Minardi](#), researcher, Friederich Schiller University, Jena, Germany
- [Luigi A. Lugiato](#), professor, University of Insubria, Como, Italy
- [Roland Schiek](#), professor, OTH Regensburg, Germany
- [Xianglong Zeng](#), associate professor, Shanghai University, Shanghai, China

Supervision of graduate and undergraduate students:

- Md. Selim Habib, PhD student, DTU Fotonik (2014-2017), main supervisor
- Oleg Lysenko, PhD student, DTU Fotonik (2013-2016), co-supervisor

- Xing Liu, PhD student, DTU Fotonik (2012-2015), main supervisor
- Hairun Guo, PhD student, DTU Fotonik (2011-2014), main supervisor
- Reza Kheradmand, PhD student, University of Insubria, Italy (2002-2004), co-supervisor
- Bo Krag Esbensen, Honors MSc Program in Physics and Nanotechnology, DTU (2009-2011)
- Qi Hu, bachelor student, bachelor thesis, DTU (2010)

Grants and funding:

- **Total funding:** 46 MDKK (6.2 M€) including overhead.
- **Total own funding:** 25 MDKK (3.3 M€) including overhead as project coordinator, PI or scientist in charge.
- **2016 SUPUVIR:** *SUPERcontinuum broadband light sources covering UV to IR applications*, H2020 MCSA Innovative Training Networks, European Commission, 4.018 M€ total (1.16 M€ own funding), project coordinator and supervisor of 3 Ph.D. projects.
- **2014 Novel ultrafast mid-IR laser source for spectroscopy**, International Network Programme, The Danish Agency for Science, Technology and Innovation, 164,707 DKK, PI
- **2014 Gas-filled hollow-core fibers for ultrafast nonlinear optics**, Carlsbergfondet, 250,000 DKK, PI
- **2014 Laserlab.dk**, infrastructure grant, Danish Ministry of Science, 23 million DKK (7 million DKK to DTU Fotonik), key scientist
- **2011 Femto-midIR: Femtosecond few-cycle mid-infrared laser pulses**, Danish Council for Independent Research | Technology and Production Sciences, 5,757,434 DKK, PI.
- **2009 Marie Curie Incoming International Fellowship (Xianglong Zeng, fellow)**, *Cascaded optical pulse compressor*, FP7 (People), European Commission, 303,598 € (2.26 mio. DKK), scientist in charge.
- **2008 Femto-VINIR: Few-cycle femtosecond optical pulses in the visible and near-infrared**, Danish Research Council for Technology and Production Sciences, 5,377,321 DKK, PI.
- **2005 Steno Postdoc grant Nanostructured polymer photonic crystal fibers for effective second-harmonic generation**, Danish Natural Science Research Council, 1,680,510 DKK, PI.
- **2004 Postdoc grant Quantum imaging**, The Carlsberg Foundation, 115,000 DKK, PI.
- **2003 Polarization properties and dynamics of microcavity semiconductor lasers**, Danish Research Council for Technology and Production Sciences, 51,600 DKK, PI.

Awards:

- **2009 DFF Young Elite Researchers Award**, The Danish Councils for Independent Research, [online](#), 270,000 DKK.
- **1997 Elite student award** from Sønderborg Statsskole, 10,000 DKK

Reviewer activities:

- Advisory Editor for Reviews in Physics (Elsevier)
- Scientific Committee for Photoptics 2014-2016 conferences
- Reviewer for over 90 manuscripts in
 - Nature Photonics, Nature Communications
 - Physical Review Letters, A, B, E and X
 - Optica, Optics Express, Optics Letters, Journal of the Optical Society of America: A and B
 - Applied Physics Letters
 - Nanophotonics
 - Optics Communications
 - IEEE Journal of Selected Topics in Quantum Electronics
 - European Physical Journal D
 - Journal of Physics B: Atomic Molecular and Optical Physics
 - Journal of Modern Optics
 - Springer
 - Applied Physics B – Lasers and Optics.

Committees:

2017-09-04

- Member of Advisory Group for Physics and Nanotechnology, DTU (2015-today).
- Member of Study Board, DTU Fotonik (2015-today)

Teaching:

- Education
 - UDTU Teaching & Learning, mentoring program, DTU (2011)
 - UDTU Teaching & Learning, Education in University Teaching, DTU (2009)
 - Course on PhD supervision, Learning Lab, DTU (2009)
 - Mentoring of Experts, course on supervision of postdocs, Learning Lab, DTU (2009)
- Teaching experience
 - *Physics project*, Physics and Nanotechnology Bachelor, DTU (2008-today)
 - *Optics and Photonics*, BSc course, DTU (2007-2010)
 - *Applied Mathematics for Engineers*, MSc course, DTU (2000, 2002, 2007)
 - *Non-linear Partial Differential Equations. Solitons. Biomathematics*, MSc course, DTU (2001)
 - *Mathematical Biology*, MSc course, DTU (2000)
 - *Statistics and probability theory*, BSc course, DTU (1998)