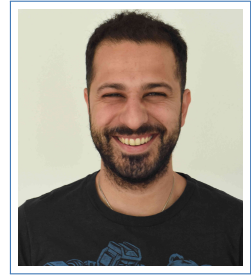


Sahand Mahmoodian

Curriculum Vitae

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Summary and Career Goals

I'm a theoretical physicist interested in quantum optics and many-body physics in systems where light-matter interaction can be tailored. My research in this area focuses on engineering light-matter interaction to generate new quantum states of light and matter. Such states can find application in quantum simulation, quantum metrology, and quantum computing.

My career goal is to perform outstanding research and teaching in an environment that fosters excellent physics research and education. In the short term as part of my ARC Future Fellowship, I will explore emergent quantum many-body phenomena in engineered quantum optical systems and use this to develop novel quantum states of light and matter.

Employment

- 2021-present **Senior Lecturer and ARC Future Fellow**, *School of Physics, The University of Sydney, NSW, Australia.*
Future Fellowship title: Emergent many-body phenomena in engineered quantum optical systems
- 2017-2021 **Postdoctoral Researcher**, *Institute for Theoretical Physics, and The Institute for Gravitational Physics (Albert Einstein Institute), Hannover, Germany.*
Principal Investigator: Prof. Klemens Hammerer
Area of Study: Generating few- and many-body states of light in one-dimensional systems.
- 2013-2016 **Postdoctoral Researcher**, *Niels Bohr Institute, University of Copenhagen, Denmark.*
Principal Investigators: Profs. Anders Sørensen and Peter Lodahl
Area of Study: Theoretical and numerical investigation of light-matter interaction in photonic nanostructures. Quantum nanophotonic systems for quantum information processing.
Funding: Danish Council for Independent Research (FNU) Individual Postdoctoral Grant

Education

- 2008-2013 **Ph.D. in physics**, *The University of Sydney.*
Date of Award: 14 June 2013
Thesis Title: Perturbative Methods for Localised States in Photonic Crystals.
Advisors: Prof. C. Martijn de Sterke and Prof. Ross C. McPhedran
Area of Study: Developed and applied semi-analytic methods for examining photonic crystal waveguide and cavity modes.
External Stay: University of Toronto with Prof. John Sipe
- 2004-2007 **Bachelor of Science (Advanced) Honours I**, *The University of Sydney.*
First class honours with majors in physics and mathematics

Publications

I have published 27 journal papers and preprints. I have over 3100 citations and my h-index is 16 (Google Scholar). I currently have four papers with more than 400 citations, one of which has more than 900 citations. My best publications include:

- [1] S. Mahmoodian, G. Calajó, D. Chang, K. Hammerer, and A. Sørensen. Dynamics of Many-Body Photon Bound States in Chiral Waveguide QED. *Phys. Rev. X* **10**, 031011, 2020.
- [2] S. Mahmoodian. Chiral light-matter interaction beyond the rotating-wave approximation. *Phys. Rev. Lett.* **123**, 133603, 2019.
- [3] S. Mahmoodian, M. Čepulkovskis, S. Das, P. Lodahl, K. Hammerer, and A.S. Sørensen. Strongly Correlated Photon Transport in Waveguide Quantum Electrodynamics with Weakly Coupled Emitters. *Phys. Rev. Lett.* **121**, 143601, 2018.
- [4] I. Söllner, S. Mahmoodian, S. Lindskov Hansen, L. Midolo, A. Javadi, G. Kiršanskė T. Pregolato, H. El-Ella, E.H. Lee, J.D. Song, S. Stobbe, and P. Lodahl. Deterministic photon-emitter coupling in chiral photonic circuits. *Nat. Nanotechnol.* **10**, 775–778, 2015.
- [5] S. Mahmoodian, P. Lodahl, and A.S. Sørensen. Quantum networks with chiral-light-matter interaction in waveguides. *Phys. Rev. Lett.*, **117**, 240501, 2016.
- [6] Peter Lodahl, Sahand Mahmoodian, Søren Stobbe, Arno Rauschenbeutel, Philipp Schneeweiss, Jürgen Volz, Hannes Pichler, Peter Zoller. Chiral quantum optics, *Nature* **541**, 473, 2017.
- [7] P. Lodahl, S. Mahmoodian, and S. Stobbe. Interfacing single photons and single quantum dots with photonic nanostructures, *Reviews of Modern Physics* **87**, 347, 2015.
- [8] Adarsh S Prasad, Jakob Hinney, Sahand Mahmoodian, Klemens Hammerer, Samuel Rind, Philipp Schneeweiss, Anders Sørensen, Jürgen Volz, and Arno Rauschenbeutel. Correlating photons using the collective nonlinear response of atoms weakly coupled to an optical mode, *Nature Photonics* **14**, 719, 2020.

Patents

My research has led to significant innovation. I am listed as a co inventor on four patents for on-chip quantum photonics and single photon sources. Some of these patents have been licensed by my colleagues' startup Sparrow Quantum and are being developed further.

- [P1] Sahand Mahmoodian, Immo Söllner, Søren Stobbe and Peter Lodahl, *Efficient spin-photon interface using glide-plane symmetric waveguide*. US10261250B2, EP3154899A1. Priority date 16-06-2014.
- [P2] Sahand Mahmoodian, Immo Söllner, Søren Stobbe, and Peter Lodahl, *Optical Devices having an Efficient Light-Matter Interface for Quantum Simulation*. US20170160474A1. Priority date 14-07-2014.
- [P3] Søren Stobbe, Sahand Mahmoodian, David Garcia and Peter Lodahl, *A slow-light generating optical device and a method of producing slow light with low losses*. US20180217331A1. Priority date 20-04-2015.
- [P4] Philipp Schneeweiss, Jürgen Volz, Arno Rauschenbeutel, Sahand Mahmoodian, and Anders S. Sørensen, *Device for generating single photons* European patent: PCT/EP2019/075386. Date of receipt 20-09-2019

Prizes, Awards, and Grants

Australian Research Council (ARC) Future Fellowship 2020 (to start in June 2021)
Danish Council for Independent Research (FNU) Individual Postdoctoral Grant (2013-2015)

First place - Best Poster Award - CEWQO Brussels (2014)
Third place - Best student presentation - PECS-X Santa Fe (2012)
First place - Best student research poster - CUDOS workshop (2010)
First place - Student competition (MC Udos) - CUDOS workshop (2010)
Australian Postgraduate Award Scholarship (2008-2011)
Third place - Student competition (Single Photon Sauce) - CUDOS workshop (2012)
School of Physics Science Foundation Scholarship No. III (2007)

Teaching and Supervision

2017-present **Project supervision.**

I am currently cosupervising a PhD. student at Leibniz University Hannover working on many-body quantum optics.

2017-2021 **Assistant Lecturer, Leibniz University, Hannover.**

I prepared lecture material and gave lectures in quantum optics and advanced quantum mechanics when Prof. Hammerer was on leave. I also led computational physics modules in Introductory Quantum Mechanics and Analytical Mechanics. This involved coming up with and implementing new computational exercise problems.

2013-2016 **Supervised master and bachelor students, Niels Bohr Institute, University of Copenhagen.**

I supervised two bachelor projects on numerical modelling of nanophotonic systems. I supervised a master project on realizing a robust CZ gate in waveguide QED and a second master project on analyzing Green's tensor for photonic waveguides.

2013-2016 **Assistant Lecturer, Niels Bohr Institute, University of Copenhagen.**

I prepared coursework for quantum nanophotonics with Prof. Lodahl. This included developing a module on computational electromagnetism. I was also responsible for the problem sets.

2009-2011 **Supervised bachelor and honours research projects, The University of Sydney.**

The projects focused on modelling photonic crystal waveguide arrays.

2007-2012 **Teaching Assistant, The University of Sydney.**

Throughout my PhD I supervised first-year problem workshops.

Professional Services

Referee.

I appreciate a robust peer-review process, and as such I try to excel as a referee. I regularly review manuscripts for *Physical Review Letters* and *Physical Review A*. Additionally, I have reviewed manuscripts for *Nature Communications*, *Optica*, *Optics Letters*, and *Optics Express*.

Languages, Interests and Hobbies

English (native), Farsi (fluent), Danish (intermediate), Russian (beginner), German (beginner)

Manual photography, Olympic weightlifting, body-weight-based resistance training, and current affairs.

References

Klemens Hammerer, Professor, Leibniz University, Hannover, Germany.

email: klemens.hammerer@itp.uni-hannover.de phone: +49 511 762 17072

I work as a postdoc with Klemens at the Institute for Theoretical Physics, Leibniz University, Hannover.

Anders Sørensen, Professor, the Niels Bohr Institute, Copenhagen, Denmark.

email: anders.sorensen@nbi.ku.dk phone: +45 3532 5240

I worked as a postdoc with Anders at the Niels Bohr Institute.

Peter Lodahl, Professor, The Niels Bohr Institute, Copenhagen, Denmark.

email: lodahl@nbi.ku.dk phone: +45 3532 5306

I worked as a postdoc with Peter at The Niels Bohr Institute.