

# Michał Parniak-Niedojadło

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## Assistant Professor, Group Leader

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## MAIN RESEARCH PROFILE AND INTERESTS

Quantum enhanced metrology, imaging and communication protocols using hybrid experimental platforms, including quantum optomechanics, cavity systems, cold and warm atomic ensembles and multimode photonic systems in the single-photon regime, also in the context of quantum imaging; hybrid discrete-variable/continuous-variable quantum information

## EMPLOYMENT

### Centre for Quantum Optical Technologies, University of Warsaw

Warsaw, Poland

Group Leader/Assistant Professor of the [Quantum Optical Devices Lab](#)

2020-

**Main Projects:** Spectroscopy with quantum light, quantum super-resolution imaging and spectroscopy, quantum communication using quantum memories, Rydberg atoms and quantum non-linear optics

### Niels Bohr Institute, University of Copenhagen

Copenhagen, Denmark

Postdoctoral Researcher in the [QUANTOP](#) laboratory led by prof. E. S. Polzik

2018-2023

**Main Projects:** Generation of mechanical Fock states of an ultracoherent membrane resonator and establishment of hybrid entanglement in a atomic-optomechanical system

### ICFO-The Institute of Photonic Sciences

Barcelona, Spain

Summer Research Fellow in the [group of prof. Morgan W. Mitchell](#), working on laser phase injection locking

2013

## EDUCATION

### University of Warsaw

Warsaw, Poland

Habilitation in physics, awarded with distinction by the Scientific Council for Physical Sciences at UW

2023

### Faculty of Physics, University of Warsaw

Warsaw, Poland

PhD in physics, awarded with distinction

2015 - 2019

**Thesis:** "Multimode Quantum Optics with Spin Waves and Photons" under supervision of [prof. W. Wasilewski](#) in the Quantum Memories

Laboratory, reviewed by [Prof. H. de Riedmatten](#) ([link to review](#)) and Prof. R. Ciuryło ([link to review - in polish](#))

**Main Projects:** Cold-atom multimode quantum memory, quantum control of spin waves, quantum-enhanced imaging, single-photon imaging devices

### Faculty of Physics, University of Warsaw

Warsaw, Poland

MSc in physics, working on wavelength-convertible four-wave mixing light-atom interface with warm atoms

2013 - 2015

### Faculty of Physics, University of Warsaw

Warsaw, Poland

BSc in physics, working on optical measurements of atomic diffusion for quantum memory applications

2010 - 2013

## SELECTED HONOURS AND AWARDS

### Ministry Scholarship for best young scientists

2023

Awarded for years 2023-2026

### W. Rubinowicz Prize from the Polish Physical Society (PTF)

2023

Awarded for developing techniques of controlling light-matter interactions at the quantum level

### Frank Wilczek prize awarded by the Kosciuszko Foundation and the Jagiellonian University

2022

Awarded for achievements in quantum optics and quantum information science

### National Centre for Quantum Information (KCIK - University of Gdańsk, Poland) PhD Thesis Award

2020

Awarded for the best thesis in the field of quantum information

### START Scholarship from the [Foundation for Polish Science](#) (FNP)

2019

Awarded with special distinction to top candidates with "exceptional scientific achievements"

### Ministry of Science and Higher Education (MNiSW) scholarship for best doctoral candidates

2017

Awarded yearly to 100 best doctoral students in all disciplines

### [Arkadiusz Piekara award](#) for the best Master Thesis from the [Polish Physical Society](#) (PTF)

2016

MSc Thesis: Four-photon nonlinear processes in warm rubidium vapours as a potential light-atom interface

## FUNDING

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<b>SONATA grant from the National Science Centre (NCN)</b>	2022-2025
<i>Project: Bridging microwave and optical domains with nonlinear quantum optics enabled by Rydberg atoms</i>	<i>Funding amount: ~ 370k EUR</i>
<b>IRAP grant as one of group leaders, funded by FNP (Smart Growth, ERDF)</b>	2020-2023
<i>Project: Quantum Optical Technologies - QOT, PI: Prof. Konrad Banaszek</i>	<i>Total Funding amount (5 groups): ~ 7.5M EUR</i>
<b>PRELUDIUM grant for young researchers from the National Science Centre (NCN)</b>	2018-2020
<i>Project: Development of quantum imaging techniques in atomic and optical systems</i>	<i>Funding amount: ~ 35k EUR</i>
<b>Diamentowy Grant award from the Ministry of Science and Higher Education (MNiSW)</b>	2014-2018
<i>Project: Principles of quantum light-atom interface based on four-photon scattering in warm atomic vapors</i>	<i>Funding amount: ~ 50k EUR</i>

## INVITED CONFERENCE TALKS

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<b>Invited talk at ICTON conference</b>	2023
<i>Bucharest, Romania</i>	
<b>Invited talk at PSC 2022 conference</b>	2022
<i>Wojanów, Poland</i>	
<b>Invited talk at Quantum Optics X</b>	2021
<i>Torun, Poland</i>	
<b>Invited talks at SPIE Optics+Photonics</b>	2021, 2023
<i>San Diego, USA</i>	
<b>Invited talk at "Quantum Resources" symposium, hosted by Prof. R. Horodecki</b>	2018
<i>Sopot, Poland</i>	
<b>Invited talk at "Quantum Foundations and Beyond" symposium, hosted by Prof. P Horodecki</b>	2017
<i>Sopot, Poland</i>	
<b>Invited talk at "Photons Beyond Qubits" workshop, hosted by Prof. J. Fiurasek</b>	2017
<i>Olomouc, Czech Republic</i>	

## OTHER SCIENTIFIC ACTIVITIES

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### Teaching

*Physics Laboratory for Individual Students (part B) at Faculty of Physics, University of Warsaw - 2.5 semesters total* 2016-2018

### BSc theses as supervisor

<i>Marcin Jastrzębski</i>	2022
<i>Stanisław Kurzynia</i>	2022
<i>Bartosz Niewelt</i>	2023
<i>Pavel Halavach</i>	2023
<i>Jan Nowosielski</i>	2023
<i>Jan Ciepielewski</i>	2023

### MSc theses as supervisor

<i>Krzysztof Zdanowski</i>	2021
<i>Andrzej Ostasiuk</i>	2021
<i>Tomasz Szawelło</i>	2022
<i>Sebastian Borówka</i>	2022

### PhD students

*Mateusz Mazelanik - as co-supervisor* defended 2023, with distinction  
*Michał Lipka - as main supervisor* ongoing, since 2020

### Organization

*President of the Optics and Photonics Student Society (OSA and SPIE student chapters)* 2014-2016  
*Part of the Organizing and Steering Committees at Quantum Speedup 2021 and 2022 conferences* 2021-2022

### Refereeing

*Physical Review Letters, Physical Review A, Optica, Communications Physics, Optics Express, Optics Letters, ...* 2016-

## MAJOR PUBLICATIONS

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1. S. Borówka, U. Pylypenko, M. Mazelanik, **M. Parniak**, "Microwave-to-optical conversion using room-temperature atoms", *Nature Photonics* ([online - early access](#)) (2023)
2. B. Niewelt, M. Jastrzębski, S. Kurzyna, J. Nowosielski, W. Wasilewski, M. Mazelanik, **M. Parniak**, "Experimental implementation of the optical fractional Fourier transform in the time-frequency domain", *Physical Review Letters* **130**, 240801 (2023)
3. M. Mazelanik, A. Leszczyński, **M. Parniak**, "Optical-domain spectral super-resolution via a quantum-memory-based time-frequency processor", *Nature Communications* **13**, 691 (2022)
4. M. Lipka, **M. Parniak**, "Single-photon hologram of a zero-area pulse", *Physical Review Letters* **127** (16), 163601 (2021)
5. R. A. Thomas<sup>1</sup>, **M. Parniak**<sup>1</sup>, C. Østfeldt<sup>1</sup>, C. B. Møller<sup>1</sup>, C. Bærentsen, Y. Tsaturyan, A. Schliesser, J. Appel, E. Zeuthen, E. S. Polzik, "Entanglement between Distant Macroscopic Mechanical and Spin Systems", *Nature Physics* **17**, 228-233 (2021)
6. **M. Parniak**, M. Mazelanik, A. Leszczyński, M. Lipka, M. Dąbrowski, W. Wasilewski, "Quantum Optics of Spin Waves Through Ac-Stark Modulation", *Physical Review Letters* **122**, 063604 (2019), selected for [the cover of issue 6](#)
7. **M. Parniak**, M. Dąbrowski, M. Mazelanik, A. Leszczyński, M. Lipka, W. Wasilewski, "Wavevector-multiplexed quantum memory via spatially-resolved single-photon detection", *Nature Communications* **8**, 2140 (2017)
8. **M. Parniak**, S. Borówka, K. Boroszko, W. Wasilewski, K. Banaszek, R. Demkowicz-Dobrzański, "Beating the Rayleigh Limit Using Two-Photon Interference", *Physical Review Letters* **121**, 250503 (2018)

## ALL OTHER PUBLICATIONS

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1. M. Mazelanik, A. Leszczyński, T. Szaweńko **M. Parniak**, "Coherent optical two-photon resonance tomographic imaging in three dimensions", *Communications Physics* **4**, 165 (2023)
2. M. Han, H. Hao, X. Song, Z. Yin, **M. Parniak**, Z. Jia, Y. Peng, "Microwave electrometry with bichromatic electromagnetically induced transparency in Rydberg atoms", *EPJ Quantum Technology* **10**, 28 (2023)
3. Y. He, M. Han, Q. Li, Z. Jia, B. Chen, L. Wang, **M. Parniak**, Y. Peng, "Enhanced coherent microwave-to-optics conversion based on second-order nonlinearity", *Optics Communications* **545**, 129639 (2023)
4. S. Borówka, U. Pylypenko, M. Mazelanik, **M. Parniak**, "Sensitivity of a Rydberg-atom receiver to frequency and amplitude modulation of microwaves", *Applied Optics* **61**, 8806-8812 (2023)
5. F. Albrarelli, M. Mazelanik, M. Lipka, A. Streltsov, **M. Parniak**, R. Demkowicz-Dobrzański, "Quantum Asymmetry and Noisy Multimode Interferometry", *Phys. Rev. Lett.* **128**, 240504 (2022)
6. R. A. Thomas, C. Østfeldt, C. Bærentsen, **M. Parniak**, E. S. Polzik, "Calibration of Spin-Light Coupling by Coherently Induced Faraday Rotation", *Optics Express* **29** (15), 23637-2365 (2021)
7. M. Lipka, **M. Parniak**, "Fast imaging of multimode transverse-spectral correlations for twin photons", *Optics Letters* **46** (13), 3009-3012 (2021)
8. M. Mazelanik, M. Lipka, A. Leszczyński, W. Wasilewski, **M. Parniak**, "Real-time ghost imaging of Bell-nonlocal entanglement between a photon and a quantum memory", *Quantum* **5**, 493 (2021)
9. M. Lipka, M. Mazelanik, **M. Parniak**, "Entanglement distribution with wavevector-multiplexed quantum memory", *New Journal of Physics* **23** (5), 053012 (2021)
10. M. Lipka, M. Mazelanik, A. Leszczyński, W. Wasilewski, **M. Parniak**, "Massively-multiplexed generation of Bell-type entanglement using a quantum memory", *Communications Physics* **4**(1), 46 (2021)
11. **M. Parniak**<sup>1</sup>, I. Galinskiy<sup>1</sup>, T. Zwettler, E. S. Polzik, "High-frequency broadband laser phase noise cancellation using a delay line", *Optics Express* **29**(5), 6935-6946 (2021)
12. I. Galinskiy, Y. Tsaturyan, **M. Parniak**, E. S. Polzik, "Phonon counting thermometry of an ultracoherent membrane resonator near its motional ground state", *Optica* **7**(6), 718-725 (2020)
13. M. Mazelanik, A. Leszczyński, M. Lipka, **M. Parniak**, W. Wasilewski, "Temporal imaging for ultra-narrowband few-photon states of light", *Optica* **7**(3), 203-208 (2020)
14. M. Mazelanik, A. Leszczyński, M. Lipka, W. Wasilewski, **M. Parniak**, "Superradiant parametric conversion of spin waves", *Physical Review A* **100** (5), 053850 (2019)
15. Y. L. Len, C. Datta, **M. Parniak**, K. Banaszek, "Resolution limits of spatial mode demultiplexing with noisy detection", *International Journal of Quantum Information* **18** (01), 1941015 (2020)
16. M. Lipka, A. Leszczyński, M. Mazelanik, **M. Parniak**, W. Wasilewski, "Spatial spin-wave modulator for quantum memory assisted adaptive measurements", *Physical Review Applied* **11**, 034039 (2019)

17. M. Mazelanik<sup>1</sup>, **M. Parniak**<sup>1</sup>, A. Leszczyński, M. Lipka, W. Wasilewski, "Coherent spin-wave processor of stored optical pulses", *npj Quantum Information* **5**, 22 (2019)
18. M. Dąbrowski, M. Mazelanik, **M. Parniak**, A. Leszczyński, M. Lipka, W. Wasilewski, "Certification of high-dimensional entanglement and Einstein-Podolsky-Rosen steering with cold atomic quantum memory", *Physical Review A* **98**, 042126 (2018)
19. M. Lipka, **M. Parniak**, W. Wasilewski, "Microchannel plate cross-talk mitigation for spatial autocorrelation measurements", *Applied Physics Letters* **112**, 211105 (2018)
20. A. Leszczyński, M. Mazelanik, M. Lipka, **M. Parniak**, M. Dąbrowski, W. Wasilewski, "Spatially-resolved control of fictitious magnetic fields in a cold atomic ensemble", *Optics Letters* **43**, 1147 (2018)
21. M. Lipka, **M. Parniak**, W. Wasilewski, "Optical Frequency Locked Loop for long-term stabilization of broad-line DFB lasers frequency difference", *Applied Physics B* **123**, 238 (2017)
22. M. Dąbrowski, **M. Parniak**, W. Wasilewski, "Einstein-Podolsky-Rosen paradox in a hybrid bipartite system", *Optica* **4**, 272 (2017)
23. A. Leszczyński, **M. Parniak**, W. Wasilewski, "Phase matching alters spatial multiphoton processes in dense atomic ensembles", *Optics Express* **25**, 284 (2017)
24. **M. Parniak**, A. Leszczyński, W. Wasilewski, "Coupling of four-wave mixing and Raman scattering by ground-state atomic coherence", *Physical Review A* **93**, 053821 (2016)
25. **M. Parniak**, A. Leszczyński, W. Wasilewski, "Magneto-optical polarization rotation in a ladder-type atomic system for tunable offset locking", *Applied Physics Letters* **108**, 161103 (2016)
26. **M. Parniak**, D. Pęczak, W. Wasilewski, "Multimode Raman light-atom interface in warm atomic ensemble as multiple three-mode quantum operations", *Journal of Modern Optics* **63**, 2039 (2016)
27. **M. Parniak**, W. Wasilewski, "Interference and nonlinear properties of four-wave-mixing resonances in thermal vapor: Analytical results and experimental verification", *Physical Review A* **91**, 023418 (2015)
28. **M. Parniak**, W. Wasilewski, "Direct observation of atomic diffusion in warm rubidium ensembles", *Applied Physics B* **116**, 415 (2014)

## PREPRINTS

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1. M. Lipka, **M. Parniak**, "Ultrafast electro-optic Time-Frequency Fractional Fourier Imaging at the Single-Photon Level", [arXiv:2307.01141](https://arxiv.org/abs/2307.01141) (2023)
2. M. Jastrzębski, S. Kurzyna, B. Niewelt, M. Mazelanik, W. Wasilewski **M. Parniak**, "Spectrum-to-position mapping via programmable spatial dispersion implemented in an optical quantum memory", [arXiv:2308.01793](https://arxiv.org/abs/2308.01793) (2023)

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<sup>1</sup>Equal contributions