Urban Senica

Curriculum Vitae

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"I... a universe of atoms, an atom in the universe."
- Richard Feynman

Education

2018–2023 **Ph.D. in Physics**, *ETH Zurich*, Switzerland.
Department of Physics

2016–2017 **Visiting Exchange Student**, *Technical University of Munich*, Germany.
Department of Electrical and Computer Engineering

2015–2017 **M.Sc. in Electrical Engineering**, *University of Ljubljana*, Slovenia, GPA – 9.73/10.
Faculty of Electrical Engineering

2012–2015 **B.Sc. in Electrical Engineering**, *University of Ljubljana*, Slovenia, GPA – 9.82/10.
Faculty of Electrical Engineering

Experience

Research

2024–Present **Postdoctoral Researcher**, *ETH Zurich*, Switzerland.
Member of Prof. Faist's and Prof. Scalari's Quantum Optoelectronics Group.

2018–2023 **Ph.D. Student**, *ETH Zurich*, Switzerland.
Member of Prof. Jérôme Faist's and Prof. Giacomo Scalari's Quantum Optoelectronics Group. Focusing on THz Quantum Cascade Lasers and Frequency Combs. Work consists mainly of numerical simulations, cleanroom processing, and optical measurements.

2017 **Research Assistant**, *Walter Shottky Institut, Technical University of Munich*, Germany.
Member of Prof. Jonathan Finley's Chair for Semiconductor Nanostructures and Quantum Systems, working in the subgroup of Dr. Gregor Koblmueller. Focused on research on nanowire lasers, including numerical simulations and cleanroom processing.

2016 **Summer Student**, *CERN*, Geneva, Switzerland.
Member of the EP-DT-DD: Solid State Detectors Lab led by Dr. Michael Moll. Worked on further developing *TRACS*, a simulation program for induced transient currents in radiation-hard silicon particle detectors. Also participated in CERN Summer Student Lectures and Workshops.

2015 **Student Researcher**, *University of Ljubljana*, Slovenia.
Worked on numerical simulations of charge transport in crystalline silicon solar cells in the Laboratory of Photovoltaics and Optoelectronics, which is led by Prof. Marko Topič.

Industry

2013 & 2014 **Summer Student Intern**, *Sistemi IN ES*, Slovenia.
An internship over two consecutive summers where I developed a USB- and a Bluetooth-based communication system between an Android device and the main computer of a prototype electric car »Chebela«, which was partially developed at Sistemi IN ES.

Awards, Honors & Scholarships

2023 Monthly Editor's Pick Reviewer for the journal Light: Science & Applications

2022 Keynote Talk at the IRMMW-THz Conference

2018 The Award for excellent final grade upon the completion of studies (Master studies)

2017 The Award of the Dean for exemplary completion of study requirements in Year 2 of the Masters Programme

2016 Dr.-Ing. Otto und Karla Likar Stiftung Scholarship

2016 Erasmus+ Scholarship

2016 CERN Summer Studentship

2015 The Award for excellent final grade upon the completion of studies (Bachelor studies)

2014 The Award of the Dean for exemplary completion of study requirements in Year 2 of the university study programme

2013 The Award of the Dean for exemplary completion of study requirements in Year 1 of the university study programme

2012 Zlati Maturant – outstanding results at high school final exams (my results were in the top 3% in Slovenia)

2008–2017 Zois Scholarship – for outstanding high school and university students in Slovenia

Skills

Programming	C, C++, Python, VHDL, Java, Android, ROOT, Javascript, HTML, LaTeX
Simulations	COMSOL Multiphysics, CST Microwave Studio, Lumerical FDTD, SPICE, Matlab, Wolfram Mathematica, TRACS
Design	AutoCAD, Autodesk Inventor, KLayout, Altium Designer, Inkscape, Blender
Practical	cleanroom fabrication, optical measurements, semiconductor devices, cryogenics
Soft skills	participated in workshops on: teaching, team work, time management, project management, body language, creative ideation, group dynamics

Languages

Mothertongue	Slovenian
Fluent	English, German
Intermediate	Croatian, Serbian
Basic	French, Greek

Teaching & Mentoring

ETH Zurich **Teaching assistant**.
Courses: Physics I, Physics II, Physikpraktikum (10x)

ETH Zurich **Supervisor / Mentor**.
Semester Thesis (Tabea Buehler), Master Thesis (Sebastian Gloor), Junior PhD Student (Paolo Micheletti, Valerio Digiorgio)

Reviewer

Journal Articles: Applied Physics Letters, Light: Science & Applications, Optics Express, Photonics Research

Master Thesis

Title: *Unidirectional Coupling of Light from Nanowire Lasers into Silicon Waveguides*

Supervisors: Prof. Janez Krč & Prof. Markus Becherer

Description: This thesis focuses on numerical simulations of different nanowire and waveguide structures to achieve unidirectional coupling of light from a nanowire laser into a proximal waveguide via the spin-orbit interaction.

Journal Articles

1. T. Olariu, U. Senica, and J. Faist. "Single-Mode, Surface-Emitting Quantum Cascade Laser at 26 μm". *Applied Physics Letters*, **124**, 041109 (2024). DOI: 10.1063/5.0176281
2. U. Senica, S. Gloor, P. Micheletti, D. Stark, M. Beck, J. Faist, and G. Scalari. "Broadband surface-emitting THz laser frequency combs with inverse-designed integrated reflectors". *APL Photonics*, **8**, 9, p. 096101 (2023). DOI: 10.1063/5.0163337
3. U. Senica, A. Dikopoltsev, A. Forrer, S. Cibella, G. Torrioli, M. Beck, J. Faist, and G. Scalari. "Frequency-modulated combs via field-enhancing tapered waveguides". *Laser & Photonics Reviews*, **2023**, 2300472 (2023). DOI: 10.1002/lpor.202300472
4. P. Micheletti, U. Senica, A. Forrer, S. Cibella, G. Torrioli, M. Frankié, M. Beck, J. Faist, and G. Scalari. "Terahertz optical solitons from dispersion-compensated antenna-coupled planarized ring quantum cascade lasers". *Science Advances*, **9**, 24 (2023). DOI: 10.1126/sciadv.adf9426
5. E. Önder, D. O. Winge, M. Franckié, A. Forrer, U. Senica, G. Scalari, and A. Wacker. "Frequency modulations due to domain dynamics in terahertz quantum cascade lasers". *Journal of Applied Physics*, **133**, 12 (2023). DOI: 10.1063/5.0137716
6. G. Scalari, U. Senica, A. Forrer, P. Micheletti, T. Olariu, S. Cibella, G. Torrioli, M. Beck, and J. Faist. "THz frequency combs for integrated coherent photonics". *Swiss Physical Society Communications*, **70**, 98 (2023).
7. G. Torrioli, A. Forrer, M. Beck, P. Carelli, F. Chiarello, J. Faist, A. Gaggero, E. Giovine, F. Martini, U. Senica, R. Leoni, G. Scalari, and S. Cibella. "THz optical beat-note detection with a fast superconducting hot electron bolometer operating up to 31 GHz". *Optics Express*, **31**, 10 (2023). DOI: 10.1364/OE.481081
8. U. Senica, A. Forrer, T. Olariu, P. Micheletti, S. Cibella, G. Torrioli, M. Beck, J. Faist, and G.

Scalari. "Planarized THz quantum cascade lasers for broadband coherent photonics". *Light: Science & Applications*, **11**, 347 (2022). DOI: 10.1038/s41377-022-01058-2

9. P. Micheletti, J. Faist, T. Olariu, U. Senica, M. Beck, and G. Scalari. "Regenerative terahertz quantum detectors". *APL Photonics*, **6**, 10, p. 106102 (2021). DOI: 10.1063/5.0063141

10. U. Senica, E. Mavrona, T. Olariu, A. Forrer, M. Beck, J. Faist, and G. Scalari. "An antipodal Vivaldi antenna for improved far-field properties and polarization manipulation of broadband terahertz quantum cascade lasers". *Applied Physics Letters*, **116**, 161105 (2020). DOI: 10.1063/5.0004038

11. J. Calvo, P. de Castro, A. Díez González-Pardo, M. Fernández García, M. Moll, U. Senica, I. Vila. "TRACS: A multi-thread transient current simulator for micro strips and pad detectors". *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, **917**, 77-85, (2019). DOI: 10.1016/j.nima.2018.11.132

Conference Contributions (First Author)

1. U. Senica, S. Gloor, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Broadband Antenna-coupled THz Quantum Cascade Laser Frequency Combs With Inverse-designed Waveguide Facets", *48th International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz)*, September 17-22, 2023, **Talk** (presented by G. Scalari)

2. U. Senica, S. Gloor, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Broadband THz quantum cascade laser frequency combs with surface emission and inverse-designed facet reflectors", *EOS Annual Meeting (EOSAM)*, Dijon, France, September 11-15, 2023 **Talk** (presented by G. Scalari)

3. U. Senica, A. Forrer, T. Olariu, P. Micheletti, S. Gloor, S. Cibella, G. Torrioli, M. Beck, J. Faist, and G. Scalari. "High-performance Frequency Combs with Planarized THz Quantum Cascade Lasers", *Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference (CLEO/Europe-EQEC)*, Munich, Germany, June 26-30, 2023, **Talk**

4. U. Senica, S. Gloor, P. Micheletti, M. Beck, J. Faist, G. Scalari. "Surface-emitting planarized THz quantum cascade laser frequency combs with inverse-designed waveguide facets", *Photonics West*, San Francisco, CA, USA, January 28 - February 3, 2023, **Talk**

5. U. Senica, A. Forrer, T. Olariu, P. Micheletti, S. Gloor, S. Cibella, G. Torrioli, M. Beck, J. Faist, and G. Scalari. "Planarized THz Quantum Cascade Lasers for Coherent Broadband Photonics", *Workshop on parametric phenomena*, Zurich, Switzerland, January 11-13, 2023, **Poster**

6. U. Senica, S. Gloor, M. Beck, J. Faist, and G. Scalari. "Surface-emitting Broadband THz Quantum Cascade Laser with Inverse-designed Waveguide Facets", *28th International Semiconductor Laser Conference (ISLC)* (virtual), Matsue, Japan, October 16-19, 2022 **Poster**

7. U. Senica, A. Forrer, T. Olariu, P. Micheletti, S. Cibella, G. Torrioli, M. Beck, J. Faist, and G. Scalari. "Field-enhancing tapered planarized waveguides for THz quantum cascade laser frequency combs", *EOS Annual Meeting (EOSAM)*, Porto, Portugal, September 12-16, 2022, **Talk**

8. U. Senica, A. Forrer, T. Olariu, P. Micheletti, S. Cibella, G. Torrioli, M. Beck, J. Faist, and G. Scalari. "Planarized tapered waveguides for high-temperature THz quantum cascade laser frequency combs", *47th International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz)*, Delft, the Netherlands, August 27 - September 2, 2022, **Keynote Talk**

9. U. Senica, A. Forrer, T. Olariu, P. Micheletti, S. Gloor, S. Cibella, G. Torrioli, M. Beck, J. Faist, and G. Scalari. "Broadband active and passive photonics with planarized THz quantum cascade lasers", *International Quantum Cascade Laser School & Workshop (IQCLSW)*, Zurich and Monte Verità, Switzerland, August 23-28, 2022, **Talk**

10. U. Senica, S. Gloor, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Planarized THz quantum cascade laser frequency combs with inverse-designed waveguide facets and surface emission", *International Quantum Cascade Laser School & Workshop (IQCLSW)*, Zurich and Monte Verità, Switzerland, August 23-28, 2022, **Poster**

11. U. Senica, T. Olariu, A. Forrer, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Planarized THz quantum cascade lasers for active and passive broadband photonics", *10th International Workshop on Terahertz Technology and Applications*, Kaiserslautern, Germany, May 31 - June 1, 2022, **Talk**

12. U. Senica, T. Olariu, A. Forrer, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "THz Quantum Cascade Laser Frequency Combs based on Planarized Waveguides", *Conference on Lasers and Electro-Optics (CLEO)* (virtual), San Jose, CA, USA, May 15-20, 2022, **Talk**

13. U. Senica, T. Olariu, A. Forrer, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Planarized tapered waveguides for THz quantum cascade laser frequency combs", *SPIE Photonics Europe*, Strasbourg, France, April 3 - 7, 2022, **Talk**

14. U. Senica, T. Olariu, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Planarized waveguides for high-performance THz quantum cascade laser frequency combs", *Photonics West*, San Francisco, CA, USA, January 22 - 28, 2022, **Talk**

15. U. Senica, T. Olariu, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Frequency Comb Operation of a Y-Coupled Planarized THz Quantum Cascade Laser", *27th International Semiconductor Laser Conference (ISLC)*, Potsdam, Germany, October 10-14, 2021, **Poster**

16. U. Senica, T. Olariu, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Frequency comb operation and phase locking of a Y-coupled THz quantum cascade laser", *Joint Annual Meeting of ÖPG and SPS*, Innsbruck, Austria, August 30 - September 3, 2021, **Talk**

17. U. Senica, T. Olariu, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Y-coupled planarized waveguide THz quantum cascade laser frequency comb", *46th International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz)* (virtual), August 29 - September 3, 2021, **Talk**

18. U. Senica, T. Olariu, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "THz Quantum Cascade Laser Frequency Comb based on a Y-coupled Planarized Waveguide", *Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference (CLEO /Europe-EQEC)* (virtual), June 21-25, 2021, **Talk**

19. U. Senica, M. Beck, J. Fast and G. Scalari. "A Broadband Suspended Hollow Vivaldi Antenna for THz Quantum Cascade Lasers", *Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference (CLEO/Europe-EQEC)* (virtual), June 21-25, 2021, **Poster**

20. U. Senica, T. Olariu, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Y-coupled THz Quantum Cascade Laser Frequency Comb", *Conference on Lasers and Electro-Optics (CLEO)* (virtual), May 9-14, 2021, **Talk**

21. U. Senica, P. Micheletti, M. Beck, J. Faist, and G. Scalari. "Coupled waveguide arrays for terahertz quantum cascade laser frequency combs", *Photonics West 2021* (virtual), March 6-11, 2021, **Talk**

22. U. Senica, P. Micheletti, M. Beck, J. Fast and G. Scalari. "Terahertz Quantum Cascade Laser Frequency Comb Operation of a Coupled Waveguide Array", *45th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz)* (virtual), November 8-13, 2020, **Talk**

23. U. Senica, P. Micheletti, M. Beck, J. Fast and G. Scalari. "Frequency comb operation of a coupled array of THz QCLs", *International Quantum Cascade Lasers School & Workshop (IQCLSW)* (virtual), September 7-10, 2020, **Poster**

24. U. Senica, E. Mavrona, T. Olariu, A. Forrer, M. Beck, J. Faist, and G. Scalari. "A broadband polarization-rotating antipodal Vivaldi antenna for improved far-field properties of terahertz quantum cascade lasers", *44th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz)*, Paris, France, September 1-6, 2019, **Talk**

25. U. Senica, E. Mavrona, T. Olariu, A. Forrer, M. Beck, J. Faist, and G. Scalari. "A polarization-rotating Vivaldi antenna for narrow beam far-field patterns of broadband terahertz quantum cascade lasers", *Joint Annual Meeting of SPS and ÖPG*, Zurich, August 26 - 30, 2019, **Poster**

26. U. Senica, E. Mavrona, T. Olariu, A. Forrer, M. Beck, J. Faist, and G. Scalari. "A Broadband Polarization-Rotating Vivaldi Antenna for Beam Focusing of Terahertz Quantum Cascade Lasers", *Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference (CLEO/Europe-EQEC)*, Munich, Germany, June 23-27, 2019, **Talk**

27. U. Senica, E. Mavrona, T. Olariu, A. Forrer, M. Beck, J. Faist, and G. Scalari. "A Broadband Vivaldi Antenna for Improving the Far-field of Terahertz Quantum Cascade Lasers", *French-German Terahertz Conference*, Kaiserslautern, Germany, April 2-5, 2019, **Poster**

28. U. Senica, J. Faist, and G. Scalari. "Coupled waveguides for dispersion compensation in THz QCLs", *International Quantum Cascade Lasers School & Workshop (IQCLSW)*, Cassis, France, September 2-7, 2018, **Poster**

29. U. Senica, J. Faist, and G. Scalari. "Coupled waveguides for dispersion compensation in THz frequency combs based on quantum cascade lasers", *QSIT Junior Meeting*, Chur, Switzerland, June 4-6, 2018, **Talk**

30. U. Senica and M. Fernández García. "Calculation of effective space charge of irradiated Si detectors: comparing simulations with measurements", *CERN Summer Student Poster Session*, Geneva, Switzerland, August 2016, **Poster**

31. U. Senica and M. Filipič. "Simulation of crystalline silicon solar cell top contact using ASPIN3 and COMSOL Multiphysics simulators", *51st International Conference on Microelectronics, Devices and Materials and the Workshop on Terahertz and Microwave Systems*, Bled, Slovenia, September 23-25, 2015, **Talk**

32. U. Senica, B. Prah, and U. Rupnik. "A security system for bicycles", *24th International Electrotechnical and Computer Science Conference ERK*, Portorož, Slovenia, September 21-23, 2015, **Talk**