

International Quantum Cascade School and Workshop 2022

[ETH Zürich-Monte Verità, 23-28 August 2022](#)



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School ([ETH Zürich, Siemens Auditorium HIT ground floor](#))

Tuesday 23

14:30 Opening and remarks on logistics, organization, etc.

Chair: Giacomo Scalari

14:45 *Tutorial:* R. Teissier

From research to commercialization and applications of InAs-based long-wavelength QCLs

15:45 Coffee break

16:15 *Tutorial:* J.F. Lampin

Terahertz molecular lasers

17:15-19:30 **Welcome Reception** at [Bellavista](#)

Free evening

Wednesday 24

Chair: David Burghoff

9:00 *Tutorial:* B. Schwarz

Mid-infrared semiconductor laser frequency combs: From physics to devices

10:00 Coffee Break

Chair: Mattias Beck

10:30 *Tutorial:* Z. Wasilewski

MBE for terahertz—the quest for compact and powerful room temperature emitters

11:30 *Invited:* J-B. Rodriguez

Cascade lasers epitaxially grown on Silicon substrates

12:00 **Lunch break** (Lunch at [Chemistry Mensa ETH](#))

Chair: Jérôme Faist

13:30 *Keynote:* H. Altug

Mid-Infrared Metasurfaces for Biosensing and Imaging

14:15 *Tutorial:* L. Emmenegger

Mid-infrared laser spectroscopy for environmental trace-gas sensing

15:15 Coffee break

Chair: Lukas Emmenegger

- 15:45 M. David
Broadband mid-infrared spectroscopy employing quantum cascade optoelectronics and integrated plasmonic
- 16:00 B. Martin
QCL-based Frequency-modulated continuous-wave LiDAR at 4.6 μm
- 16:15 S. Zaminga
Chaos Synchronization in the Long Wave Infrared Thermal Atmospheric Window
- 16:30 D. Kavungal
Artificial intelligence aided plasmonic SEIRA as a tool for resolving complex biomolecular interactions
- 17:00 *Invited:* R.T. Chen (Remote)
Mid-IR Integrated Photonics for Sensing and Communications

17:40-19:00 Lab visit

Free evening

Transit to Monte Verità

Thursday 25

8:15 Bus departure to Monte Verità

12:30 Lunch at Monte Verità

14:15 Welcome Speech by Monte Verità team

Workshop (Monte Verità, Auditorium)

Chair: Charlie Unterrainer

14:30 *Tutorial:* F. Cappelli
Quantum cascade laser frequency combs: metrological properties and quantum optical investigation

Session I: Detectors and ISB devices

15:15 G. Marschick
High performance quantum cascade detectors for long-wave infrared detection, TU Wien

15:30 S. Barbieri
Frequency response of patch-array QWIP photodetectors up to 220 GHz via mid-infrared photomixing

15:45 P. Micheletti
Ultrafast Detection of Terahertz Radiation with Regenerative Terahertz Quantum Detector

16:00 Coffee Break

Chair: Qijie Wang

16:30 V. Trinité

Quantum cascade detectors operating in the strong light-matter coupling regime

16:45 T. Venanzi

Effect of doping and temperature on the THz intersubband absorption in parabolic SiGe quantum wells at high x

17:00 J-M. Manceau

Mid-Infrared Saturable Absorbers with Ultra-Low Saturation Intensities

17:30-19:00 Poster session I

Welcome Reception at Monte Verità

Free evening

Friday 26 (Monte Verità, Auditorium)

Chair: Alessandro Tredicucci

8:45 *Keynote:* C. Benea-Chelmus

On-chip non-linear THz emission and detection

Session II: THz lasers NATO workshop



9.30 *Invited:* K. Wang (Remote)

Terahertz quantum cascade lasers with orbital angular momentum

10.00 M. Salih

High Power Density Emission from Terahertz Quantum Cascade Lasers

10.15 K. Unterrainer

Silicon Integrated Terahertz Quantum Cascade Ring Laser Frequency Comb

10:30 Coffee break

Chair: Dan Botez

11:00 M. Mastrangelo

Optimization of patch-antenna metamaterial for the realization of quantum cascade laser arrays

11.15 *Invited:* Q. Wang

Electrically pumped topological quantum cascade lasers with topological protection and polarization control

11:45 N. North

Power-locking of a 3.5-THz quantum-cascade laser using an integrated photonic circuit

12:00 R. Mac
Effects of nonparabolicity and interband interaction on InAs/AlSb based QCL: using an 8x8 k·p method

12.15 S. Dhillon
Field-resolved high-order nonlinearities and ultrafast dynamics in a terahertz quantum cascade laser

12.30 Lunch at Monte Verità

Session II: THz laser session (continued)

Chair: Stefano Barbieri (TBC)

14:30 *Invited:* J-M. Manceau
Intersubband polariton-polariton stimulated scattering in a dispersive microcavity

15:00 M. Haider
A symbolic computation framework for Bosonic operators: Modeling quantum features in QCL frequency combs

15:15 B. Limbacher
Optically Controlled Quantum Cascade Random Lasers

15:30 A. Wacker
Optimising THz Quantum Cascade Lasers

15:45 L. Vicarelli
Vertical emitting terahertz microcavity quantum cascade lasers with high continuous wave efficiency

16:00 Coffee break

Session III: Integrated photonics

Chair: Mathieu Bertrand

16:30 *Invited:* G. Mashanovich
Silicon photonics integrated circuits for mid-infrared sensing

17:00 D. Ren
High-quality native germanium microresonators pumped by quantum cascade lasers

17:15 K. Zhang
Mid-infrared Microring Resonators and Wavelength Division Multiplexers on an InP Platform

17:30-19:00 Poster Session II

19:30 – 21:30 Dinner at Monte Verità

Saturday 27 (Monte Verità, Auditorium)

Chair: Benjamin Williams (TBC)

8:30 *Tutorial:* M. Vitiello

Quantum cascade resonators as powerful tools for near field quantum nanoscopy in the far infrared

Session IV: THz QCL combs

9:15 *Invited:* P. Micheletti

THz frequency combs from dispersion-compensated antenna-coupled ring quantum cascade lasers.

09:45 X. Qi

Optical Frequency Combs in Fabry-Perot Terahertz Quantum Cascade Lasers

10:00 U. Senica

Broadband active and passive photonics with planarized THz quantum cascade lasers

10:15 Coffee break

Chair: Miriam Vitiello (TBC)

10:45 *Invited:* B. Williams

RF-injection induced multimoding in THz QC-VECSELs

11:15 G. Scalari

Sub-comb formation in strongly RF driven broadband THz Quantum Cascade Lasers

Session V: Mid-IR QCL combs

11:30 *Invited:* D. Kazakov

Integrated active waveguides enable coherent control of ring quantum cascade laser frequency combs

12:00 F. Pilat

Measuring the spectrally resolved Linewidth Enhancement Factor of a Laser Frequency Comb

12:15 B. Schneider

RF-Injection Control of Quantum Cascade Lasers

12:30 Lunch @ Monte Verità and excursion to Brisago Island & botanical garden

19:00 – 22:00 Apéro & Conference dinner @ Monte Verità – Awards ceremony and animations

Sunday 28 (Monte Verità, Auditorium)

Chair: Benedikt Schwarz

9:00 *Keynote:* I. Kaminer

Quantum Optics with free electrons

Session V: Mid-IR QCL combs (continued)

9:45 *Invited:* P. Täschler

Short and ultrashort pulse generation from quantum cascade lasers

10:15 Coffee break

Chair: Roland Teissier (TBC)

10:45 *Tutorial:* M. Piccardo

Tutorial on cavity solitons

Session VI: Spectroscopy and applications

11:30 *Invited:* P. Jouy

High resolution quantum cascade laser dual-comb spectroscopy in step-sweep mode

12:00 S. Markmann

Rotational Fourier-Transform Infrared spectroscopy with QCL frequency comb

12:15 E. Giraud

High Performance Quantum Cascade Laser Frequency Combs at 6.0 and 5.3 μm

12:30 *Invited:* R. Weih,

Latest news and challenges in commercial ICLs/QCLs for real life application

13.00 Final remarks and conference ending

Posters (Poster sessions Thursday/Friday 17:30):

1. Enrico Talamas Simola, Michele Montanari, Tommaso Venanzi, Marina Cagnon Trouche, Leonetta Baldassarre, Luca Persichetti, Cedric Corley, Marvin Zöllner, Giovanni Capellini, Luciana Di Gaspare, Michele Virgilio, Michele Ortolani and Monica De Seta. *High-quality n-type Ge/SiGe QCL structures on Si and SOI substrates-*
2. David Stark, Filippos Kapsalidis, Zhixin Wang, Mathieu Bertrand, Ruijun Wang, Bo Meng, Emilio Gini, Mattias Beck and Jerome Faist. *Microcavity Quantum Cascade Surface Emitting Laser*
3. Marie C. Ertl, Michael Jaidl, Benedikt Limbacher, Dominik Theiner, Miriam Giparakis, Maximilian Beiser, Aaron M. Andrews, Gottfried Strasser, Juraj Darmo and Karl Unterrainer. *Episide down bonded terahertz quantum cascade wire laser*
4. Denizhan Ekin Önder, David Winge, Martin Franckie and Andreas Wacker. *The relation between light and electric field domain oscillations in THz quantum cascade lasers*

5. Andreas Windischhofer, Hedwig Knötig, Josephine Nauschütz, Nikola Opačak, Sven Höfling, Johannes Koeth, Robert Weih and Benedikt Schwarz. *Unveiling valence intersubband absorption mechanisms in interband cascade lasers in the 4-5 μm region*
6. Aleksandar Demic, Xizhe Wang, Zoran Ikonic and Dragan Indjin. *Simulation of resonant tunnelling diodes in non-polar m-lane ZnO/MgZnO*
7. Borislav Hinkov, Florian Pilat, Mauro David, Patricia L. Souza, Andreas Schwaighofer, Laurin Lux, Benedikt Schwarz, Daniela Ristanic, Hermann Detz, Aaron M. Andrews, Bernhard Lendl and Gottfried Strasser. *Lab-on-a-chip for real-time reaction monitoring of liquids*
8. Dominik Burghart, Gerhard Boehm and Mikhail A. Belkin. *Continuous-Wave Quantum Cascade Lasers on a Silicon Carbide substrate*
9. Nathalie Lander Gower, Silvia Piperno and Asaf Albo. *The impact of doping in Split Well Direct Phonon Terahertz Quantum Cascade Lasers*
10. Livia Del Balzo, Mohammadreza Saemian and Djamel Gacemi. *Ultra-sensitive room temperature coherent detection with unipolar quantum devices at 9 μm*
11. Nicola Opačak. *Parametric processes and nonlinear dynamics of quantum cascade laser frequency combs*
12. Xiaoqiong Qi, Hao Yang, Thomas Taimre, Aleksandar Demić, Dragan Indjin and Aleksandar Rakić. *Self-pulsations in multi-mode terahertz quantum cascade lasers under optical feedback*
13. Hua Li, Ziping Li, Xuhong Ma, Kang Zhou, Chenjie Wang, J. C. Cao, Min Li, Ming Yan and Heping Zeng. *Self-referenced terahertz quantum cascade laser dual-comb sources*
14. Aleksandar Demic, Alexander Valavanis, James Bailey, Andrey Akimov, Aniella Dunn, Paul Dean, Mohammed Salih, Lianhe Li, Giles Davies, Edmund Linfield, Paul Harrison, John Cunninghtam and Anthony Kent. *Acoustic phonons resonances in terahertz quantum cascade lasers*
15. Miguel Montesinos-Ballester, Ruijun Wang, Philipp Täschler, Zhixin Wang, Emilio Gini, Mattias Beck and Jerome Faist. *Monolithic integration of quantum cascade lasers in an InP platform*
16. Urban Senica, Sebastian Gloor, Paolo Micheletti, Mattias Beck, Jerome Faist and Giacomo Scalari. *Planarized THz quantum cascade laser frequency combs with inverse-designed waveguide facets and surface emission*
17. Elena Arigliani, Mauro David, Georg Marschick, Anna Lardschneider, Davide Disnan, Hanh Hoang, Dominik Wacht, Georg Ramer, Hermann Detz, Bernhard Lendl, Ulrich Schmid, Gottfried Strasser and Borislav Hinkov. *Polyethylene-loaded plasmonic waveguides for mid-infrared photonic integrated circuits*
18. Benoit Pezeshgi, Angela Vasanelli, Virginie Trinité, Thomas Bonazzi, Andrew Haky, Mohammadreza Saemian, Carlo Sirtori, Grégoire Beaudoin, Isabelle Sagnes, Gilles Patriarche and Konstantinos Pantzas. *Atomically resolved composition and strain mappings: applications to quantum cascade devices*

19. Johannes Popp, Lukas Seitner, Michael Schreiber, Michael Haider and Christian Jirauschek. *Modeling of THz Difference-Frequency Comb Generation in Mid-Infrared Quantum Cascade Lasers*
20. Suraj Suri, Huilong Gao, Thomas Grange, Benjamin Knipfer, Jeremy Kirch, Luke Mawst, Robert Marsland and Dan Botez. *Effect of Graded Interfaces on the Performance and Design of High-Power 8.3 micron-Emitting QCLs*
21. Takuma Sato, Stefan Birner, Christian Jirauschek and Thomas Grange. *Towards NEGF Simulation of Interband Cascade Lasers using an 8-band k.p Model*
22. Alessio Cargioli, Mathieu Bertrand and Jerome Faist. *Characterization of QCL Frequency Combs under Strong Injection Locking*
23. Ina Heckelmann, Mathieu Bertrand and Andres Forrer. *Measurement of sub-poissonian shot noise in a Quantum Cascade Detector*
24. Lukas Seitner, Johannes Popp, Michael Haider, Martin Frankié, Jérôme Faist and Christian Jirauschek. *Towards Self-Consistent Simulation of Mid-Infrared Kerr Solitons in Ring-Cavity Quantum Cascade Lasers*
25. Thomas Grange, Samik Mukherjee and Giovanni Capellini. *Generalized theory of interface roughness scattering and application to the prediction of QCL performances*
26. Jonas Krakofsky, Simon Stich, Nikita Nefed Kin, Sander Mann, Ahmed Mekawy, Anna Könnigner, Gerhard Boehm, Andrea Alù and Mikhail Belkin. *Overcoming intensity saturation in second harmonic nonlinear intersubband metasurfaces using two-level systems*
27. Ziping Li, Kang Zhou, Xuhong Ma, Chenjie Wang, J.C. Cao and Hua Li. *High-frequency modulation response of terahertz quantum cascade lasers employing a heterodyne beating configuration*
28. Kang Zhou, Xiaoyu Liao, Ziping Li, Wen Guan, Yiran Zhao, Chenjie Wang, Wenjian Wan, Sijia Yang, Zhenzhen Zhang, Chang Wang, J. C. Cao, Heping Zeng and Hua Li. *Broadband terahertz quantum cascade laser dual-comb sources with off-resonant microwave injection*
29. Pavel Abajyan, Daniel Andrés Díaz-Thomas, Mohammadreza Saemian, Baptiste Chomet, Juliette Mangeney, Jerome Tignon, Alexei N. Baranov, Konstantin Pantzas, Isabelle Sagnes Sagnes, Carlo Sirtori, Laurent Cerutti and Sukhdeep Dhillon. *Frequency comb generation in Interband Cascade Lasers*
30. Xiang Lü, Benjamin Röben, Klaus Biermann, Jente Wubs, Uwe Macherius, Klaus-Dieter Weltmann, Jean-Pierre van Helden, Lutz Schrottke and Holger Grahn. *Quantum-cascade lasers for terahertz high-resolution spectroscopy*
31. Mauro Pereira. *Controllable Giant GHz-THz Nonlinearities in Superlattices with Applications to Metabolomics*
32. Tudor Olariu. *Towards Continuous Wave, Single Mode, Surface-Emitting Lasers at 24 μ m and 28 μ m*