



TeraNova Dissemination Activities

IST-511415

Period 2: 1st September 2005 – 31st August 2006

INVITED TALKS

Aurele Adam - TU Delft

'Apertureless Wide Band Terahertz Near-field Microscopy', NFO-9 (Ninth international conference on near-field optics, nanophotonics and related techniques), 10-15 September 2006, Lausanne Switzerland.

'Terahertz Near-field Optics and Microscopy', Materials Research Society Spring Meeting 2006, San Francisco, 17-21 April 2006.

S Barbieri - TeraView

'Terahertz Quantum Cascade Lasers'. S. Barbieri, J. Alton, C. Worrall, M. Houghton, O. Marshall, S. Dhillon, A. de Rossi, M. Calligaro, C. Sirtori, H. E. Beere, and D. Ritchie, The 8th International Conference on Intersubband Transitions in Quantum Wells, Cape Cod, MA, USA, September 11th – 16th, 2005.

'Progress on Terahertz Quantum Cascade Lasers'. S. Barbieri, J. Alton, C. Worrall, M. Houghton, O. Marshall, S. Dhillon, A. de Rossi, M. Calligaro, C. Sirtori, H. E. Beere, and D. Ritchie, 2006 Materials Research Society Spring Meeting, San Francisco, California, USA, April 17th – 21st, 2006.

S. Barbieri – Paris VII

'THz Generation and Frequency Mixing in Quantum Cascade Structures', Advanced Optical Material and Devices (AOMD-5), Vilnius, Lithuania, 2006.

'Terahertz Quantum Cascade Lasers', Nanosciences and Nanotechnologies – 3rd Russian-French Workshop, St. Petersburg, Russia, June 2006.

J.M. Chamberlain – Durham

'Novel Terahertz Sensing & Imaging Systems for Biotechnology, Healthcare, Security & Process Control'. SPIE Conference on Terahertz and Gigahertz Electronics and Photonics, Bruges, Belgium, September 2005.

'TeraNova and Other European Activities in THz Technology', HMGCC (Her Majesty's Government Communications Centre), Workshop on THz Sources and Systems for Security Use, Durham University, UK, 28-30th September 2005.

'Overview of European Terahertz Activities, Anglo-Japanese Meeting on Terahertz Science', British Embassy, Tokyo, November 2005.

'Advances in THz Functional Components, Applications & Basic Science in the TeraNova Programme'. Teratech 2005, Osaka, Japan, November 2005.

'Sensing, Imaging and Other Applications of Terahertz Radiation: Challenges, and (Some) Solutions, from the TeraNova Project'. EEE Lecture at University College, Dublin, Ireland, April 2006.

'TeraNova: Sensing, Imaging and Other Applications of Terahertz Radiation'. Essex University, UK, May 2006.



'Applied Terahertz Science: The Technology of the Future, and Always Will Be', NATO Advanced Study Institute on THz Systems for Sensing and Imaging, Spiez, Switzerland, July 2006.

J. Darmo – TU Wien

'THz Photonics', J. Darmo, J. Kroell, K. Unterrainer, International Laser Centre at Slovak University of Technology, Bratislava, January 12, 2006.

A.G. Davies - Leeds

'Spectroscopy of explosives and drugs-of-abuse', HMGCC (Her Majesty's Government Communications Centre), Workshop on THz Sources and Systems for Security Use, Durham University, UK, 28-30th September 2005.

'TeraNova: A European Integrated Project on 'Novel Terahertz Sensing and Imaging Systems'', Photonics West (January 2006).

'Molecular and Organic Interactions', NATO Advanced Research Workshop 'Terahertz Frequency Detection of Materials and Objects' (Switzerland, June 2006).

'Broadband Terahertz Sources'. 18th Annual Meeting of the IEEE Lasers and Electro-Optics Society (LEOS), Sydney, Australia, 23–27 October 2005.

'Solid State Terahertz Sources from an Optical Perspective'. Japanese European Seminar on Terahertz Technology. British Embassy, Tokyo, Japan, 21st November 2005.

'Broadband Pulsed Terahertz Sources'. Materials Research Society 2006 Spring Meeting, San Francisco, USA, 17–21 April 2006.

'Broadband THz Technology for Security Applications'. SPIE Europe Conference Optics/Photonics in Security and Defence, Stockholm, Sweden, 11–14 September 2006.

'Broadband THz Technology'. SPIE Optics East, Boston, MA, USA, 1–4 October 2006.

P. Haring Bolivar - Siegen

'Integrated Terahertz Sensing Arrays for Label-free Biomolecular Sensing', 230th ACS National Meeting, in Washington, DC, Aug 28-Sept 1, 2005.

'Terahertz Technology and Its Biosensing Potential', Life is Matter – Life Matter, 1st Annual Symposium *Conversations in Bionanotechnology*, Göteborg, Oct 25-27, 2005.

'THz Biomolecular Sensing', Forum for Terahertz Spectroscopy and Imaging, Kaiserslautern, Germany, March 1-2 2006.

P.U. Jepsen – DTU

'Quantitative Terahertz Time-domain Spectroscopy and Analysis in Chemistry and Biology', ACS Fall Meeting, Washington, USA, August 30th, 2005.

'New Light on the Metal-insulator Phase Transition in VO₂: A THz Perspective', TeraTech 2005, November 2005, Osaka, Japan, (invited).



'*Chemical and Biochemical Sensing with THz Radiation*', Japanese-European THz seminar on Terahertz Technology, November 21st 2005, Tokyo, Japan (invited).

'*Terahertz Time-domain Spectroscopy*', NATO Advanced Research Workshop, Spiez, Switzerland, 6-11 July 2006 (invited).

E.H. Linfield – Leeds

'*Quantum Cascade Laser*', HMGCC (Her Majesty's Government Communications Centre), Workshop on THz Sources and Systems for Security Use, Durham University, UK, 28-30th September 2005.

'*Solid-state Sources and Components for THz Applications*', 2nd Workshop on Terahertz Technology (Kaiserslautern, March 2006).

'*Terahertz Spectroscopy and Imaging*', Future Trends in Microelectronics workshop (Crete, June 2006).

'*Terahertz Quantum Cascade Lasers*', Seminar, University of Lancaster, UK (Lancaster, June 2006).

S. Dhillon – Paris VII

'*THz Generation and Non-linear Mixing in Quantum Cascade Lasers*', Mid-Infrared Coherent Sources (MICS), Barcelona, Spain, Nov 2005.

'*THz Generation and Non-linear Mixing in Quantum Cascade Lasers*', International Conference on Superlattices, Nanostructures and Nanodevices (ICSNN) 2006, Istanbul, Turkey, Aug 2006.

M. Kemp - TeraView

'*Explosives Detection Using Terahertz Technology*', by M. C. Kemp, Combating Terrorism Technology Support Office - Technical Support Working Group (TSWG) - Explosives Detection Conference, Miami, Florida, USA. June 12-16 2006.

P.C.M. Planken – TU Delft

'*Near-field THz Microscopy*', NATO Advanced Research Workshop, 7-11 July 2006, Spiez, Switzerland.

'*THz Microscopy*', HMGCC (Her Majesty's Government Communications Centre), Workshop on THz Sources and Systems for Security Use, Durham University, UK, 28-30th September 2005.

'*Terahertz Near-field Microscopy*', CLEO/QELS 2005 Baltimore USA, 22-27 May 2005.

'*Terahertz Imaging*', URSI 2005, Eindhoven, 27 April 2005.

'*Terahertz Near-field Optics and Microscopy*', 'Physics 2005, A Century after Einstein', Warwick UK, 10-14 April 2005.

C. Sirtori – Paris VII

'*THz Generation and Mixing in Quantum Cascade Lasers*', Photonics West 2006, San Jose, USA, Jan 2006.

'*Terahertz Generation and Frequency Mixing in Quantum Cascade Structures*', International Conference of the Physics of Semiconductors (ICPS) 2006, Vienna, Austria, Jul 2006.

'*Quantum Cascade Laser-Applications*', NATO Advanced Research Workshop: Terahertz Frequency Detection and Identification of Materials and Objects, Spiez, Switzerland, Jul 2006.



A. Tredicucci – SNS

'THz Photonics and Quantum Cascade Sources' (tutorial), POISE Summer School 2006, Cortona, Italy; June 25 – 30, 2006.

'Controlling the Emission of THz Quantum Cascade Lasers', NanItaly 2006 – 3rd National Conference on Nanoscience and Nanotechnology, Trieste, Italy; May 22 – 24, 2006.

'Surface Plasmon Photonic Structures for THz Quantum Cascade Lasers', WOCSDICE 2006 – 30th Workshop on Compound Semiconductor Devices and Integrated Circuits held in Europe, Fiskebäckskil, Sweden; May 14 – 17, 2006.

'Designing the Emission of THz Quantum Cascade Lasers with Surface Plasmon Photonic Structures', 21st General Conference of the EPS Condensed Matter Division, Dresden, Germany; March 27 – 31, 2006.

'Designing the Emission of THz Quantum Cascade Lasers with Surface Plasmon Photonic Structure', 2006 March meeting of the American Physical Society, Baltimore, USA; March 13 – 17, 2006.

'Controlling Surface Plasmon Modes in Terahertz Quantum Cascade Laser', 2005 Fall Meeting of the Materials Research Society (MRS), Boston, USA; November 28 – December 2, 2005.

'Manipulating Surface Plasmons in THz Quantum Cascade Lasers', Teratech '05 – International Workshop on Terahertz Technology, Osaka, Japan; November 16 – 18, 2005.

'THz Quantum Cascade Lasers: Developing New Operating Concepts and Advancing Application Technologies', XCI Congresso Nazionale della Società Italiana di Fisica, Catania, Italy; September 26 – October 1, 2005.

'Tailoring the Emission of THz QCL', NATO Advanced Research Workshop on THz frequency detection and identification of materials and objects, Spiez, Switzerland, July 2006.

'Terahertz Quantum Cascade Laser', Photonics West 2006, San Jose, US, January 2006.

K. Unterrainer – TU Wien

'THz Carrier Dynamics', K. Unterrainer, Int. Conf. on Superlattices, Nano-structures, and Nano-devices, ICSNN 2006, Istanbul, 31.7 - 4.8.2006.

'Generation and Application of THz Radiation in Semiconductor Nanostructures'. T. Müller, F. Schrey, G. Fasching, J. Darmo, J. Kröll, W. Parz, K. Unterrainer, M. Andrews, T. Roch, W. Schrenk, G. Strasser, E-MRS Spring Meeting, Nice, France, 29.5.- 2.6.2006.

'Ultra-broadband THz Generation and Nanostructure Spectroscopy', K. Unterrainer, International Workshop on Terahertz Technology (TeraTech 05), Osaka, Japan, 16.- 18. November 2005.

'Ultrawide Band THz Spectroscopy Applied to Semiconductor Nanostructures', T. Müller, F. Schrey, G. Fasching, J. Darmo, J. Kröll, W. Parz, M. Andrews, T. Roch, W. Schrenk, G. Strasser, K. Unterrainer, MICS 05, Nato Advanced Research Workshop "Mid-Infrared Coherent Sources", Barcelona, Spain, 6.-11. November 2005.



OTHER CONFERENCE PRESENTATIONS

'Sommerfeld Wires at Terahertz Frequencies', M. Wächter, M. Nagel, and H. Kurz, IEEE International Microwave Symposium (IMS), June 12 – 16, 2006, San Francisco, USA.

'LT-GaAs Based Photoconductive Antenna Arrays For Pulsed and CW Operation', M. Awad, M. Nagel and H. Kurz, IRMMW/THz2006, September 18 – 22, Shanghai, China.

'Low-Index Discontinuity THz Waveguides', M. Nagel, A. Marchewka, and H. Kurz, IRMMW/THz2006, September 18 – 22, Shanghai, China.

'Investigation of THz Sommerfeld Wires for Cavity Applications', M. Wächter, M. Nagel, and H. Kurz, IRMMW/THz2006, September 18 – 22, Shanghai, China.

'High Power Superlattice Quantum Cascade Laser Emitting at 2THz'. By C. Worrall, J. Alton, M. Houghton, O. Marshall, C. Sirtori, S. Barbieri, H. E. Beere, and D. Ritchie, Photonics West 2006, San Jose Convention Centre, San Jose, California, USA, 21st – 26th January 2006.

'Recent Developments in People Screening Using Terahertz Technology – Seeing the World Through Terahertz Eyes', M. C. Kemp, A. Glauser, and C. Baker, SPIE Defense and Security Symposium, Orlando, Florida USA, April 2006.

'Phase Matched Frequency Mixing Between Telecom Wavelengths and THz Radiation in A Quantum Cascade Laser', S. S. Dhillon, C. Sirtori, J. Alton, S. Barbieri, A. de Rossi, M. Calligaro, H. E. Beere, D. A. Ritchie, Photonics West 2006, San Jose, USA, Jan 2006.

'Phase Matched Frequency Mixing Between Telecom Wavelengths and THz Radiation in A Quantum Cascade Laser', S. S. Dhillon, C. Sirtori, J. Alton, S. Barbieri, A. de Rossi, M. Calligaro, H. E. Beere, D. A. Ritchie, 17th International Symposium on Space Terahertz Technology (ISSTT), Paris, France, May 2006.

'Continuous Wave THz Generation Based on a Dual-frequency Laser and a LTG - InGaAs Photomixer'. R. Czarny, M. Alouini, X. Marcadet, S. Bansropun, J. L. Doualan, R. Moncorgé, J.F. Lampin, M. Krakowski, D. Dolfi, IEEE International Conference on Microwave Photonics (MWP 06), Oct. 06, Grenoble.

'Optical Control in Active Terahertz Waveguide', J. Darmo, J. Kröll, K. Unterrainer, S. S. Dhillon, C. Sirtori, X. Marcadet and M. Calligaro, Joint 30th International Conference on Infrared and Millimeter Waves and 13th International Conference on Terahertz Electronics, Williamsburg, USA, September 19-23, 2005.

'Optical Processes in Terahertz Quantum-Cascade Laser Waveguides', J. Kröll, J. Darmo, K. Unterrainer, S. S. Dhillon, C. Sirtori 14th International Winterschool on New Developments in Solid State Physics, Mauterndorf, Austria, February 13-17, 2006.

'Quantum Cascade Laser Dynamics Probed by Broad-band Terahertz Pulses', J. Kröll, J. Darmo, K. Unterrainer, S. S. Dhillon, C. Sirtori, X. Marcadet and M. Calligaro Junior Scientist Conference 2006, Vienna, Austria, April 19-21, 2006.

'Terahertz Time-domain Spectroscopy of a Quantum Cascade Laser', J. Kröll, J. Darmo, K. Unterrainer, S. S. Dhillon, C. Sirtori, X. Marcadet and M. Calligaro, CLEO/QELS 2006 Conference, Long Beach, USA, May 21-26, 2006.

'Semiconductor Terahertz Lasers: Optical Assessments and Control', J. Kröll, J. Darmo, K. Unterrainer, S. S. Dhillon, C. Sirtori, X. Marcadet and M. Calligaro G. Fasching, W. Schrenk, T. Roch, M. Andrews, G. Strasser, IEEE/LEOS Semiconductor Laser Workshop 2006, Long Beach, USA, May 26, 2006.

'Optical Control of Terahertz Quantum Cascade Lasers', J. Kröll, J. Darmo, K. Unterrainer, S. S. Dhillon, C. Sirtori, X. Marcadet and M. Calligaro 11th International Workshop on Applied Physics of Condensed Matter, Mala Lucivna, Slovakia, June 21-23, 2006.



'Terahertz Quantum-Cascade Laser Dynamics in Time-domain', J. Kröll, J. Darmo, K. Unterrainer, S. S. Dhillon, C. Sirtori, X. Marcadet and M. Calligaro 28th International Conference on the Physics of Semiconductors, Vienna, Austria, July 24 – 28, 2006.

'Theoretical and Experimental Aspects o Time-domain Spectroscopy Applied to Semiconductor Terahertz Gain Medium', J. Darmo, J. Kröll, K. Unterrainer, S. S. Dhillon, C. Sirtori, X. Marcadet and M. Calligaro. 8th International Conference on the Physics of Semiconductors, Vienna, Austria, July 24 – 28, 2006.

'Advanced Device Architectures for THz QCLs' (Oral), A. Tredicucci, ICPS-28, Vienna, July 2006.

'New Device Structures for THz QCLs' (Oral), A. Tredicucci, POISE Summer School, Cortona, Italy, June 2006.

'Controlling Surface Plasmon Modes in Terahertz Quantum Cascade Lasers' (Oral), A. Tredicucci, Intersubband 'Transitions in Quantum Wells' (ITQW 2005), Cape Cod, US, September 2005.

'Towards Tunable THz QCLs' (Poster), A. Tredicucci, POISE Summer School, Cortona, Italy, June 2006.

'Analysis of Drugs-of-abuse and Explosives Using Terahertz Time-domain and Raman Spectroscopy', A Burnett, W Fan, J E Cunningham, P Upadhy, A G Davies, E Linfield, and R Miles, Photonics West (San Jose, January 2006).

'Ultra-broadband Coherent Terahertz Spectroscopy Using Asymmetric Excitation of Photoconductive Structures', P C Upadhy, W Fan, A Burnett, Y C Shen, A G Davies, E H Linfield, Infrared and millimetre wave conference (IRMMW) 2005, (Virginia, September 2005).

PUBLICATIONS

[1] *Frequency-dependent characterization of THz Sommerfeld wave propagation on single-wires*. M. Wächter, M. Nagel, and H. Kurz, *Opt. Expr.* **13** (26): 10815-10822 (2005).

[2] *THz biosensing devices: fundamentals and technology*. M. Nagel, M. Först and H. Kurz, *J. Phys.: Condens. Matter* **18**, 601–618 (2006).

[3] *Corrugated waveguide based genomic biochip for marker-free THz read-out*. M. Nagel and H. Kurz, *Int. J. Infrared Millimeter Waves*, **27**, 4, 517-529 (2006).

[4] *Low index discontinuity THz waveguides*. M. Nagel, A. Marchewka and H. Kurz, *Opt. Express*, **14**, 21 (2006).

[5] *Scattering in THz imaging*, J. R. Fletcher, G. P. Swift, De Chang Dai, D. Beggs, R. A. Abram, M. Kaliteevski, J. Levitt, A. Gallant, J. M. Chamberlain, *Proceedings of SPIE Volume: 5989*. Technologies for Optical Countermeasures II; Femtosecond Phenomena II; and Passive Millimetre-Wave and Terahertz Imaging II Editor(s): David H. Titterton, Sean M. Kirkpatrick, Razvan Stoian, Roger Appleby, J. Martyn Chamberlain, Keith A. Krapels/ Pages 320-325 [ISBN 0-8194-6011-7].

[6] *Terahertz scattering: comparison of a novel theoretical approach with experiment*, G. Peter Swift, DeChang Dai, John R. Fletcher, Andrew J. Gallant, James A. Levitt, Richard A. Abram, Daryl M. Beggs, Mikhail A. Kaliteevski, J. Martyn Chamberlain. *Proc. SPIE Vol. 6120*, p. 186-194, Terahertz and Gigahertz Electronics and Photonics V; R. Jennifer Hwu, Kurt J. Linden; Eds. {ISBN 0-8194-6162-8}.

[7] *Propagation of terahertz radiation through random structures: a novel theoretical approach and experimental validation*, J.R. Fletcher, G.P. Swift, De Chang Dai, J.A. Levitt and J.M. Chamberlain. *Journal of Applied Physics*. *Accepted for Publication*.

[8] *Doping in quantum cascade lasers. II. GaAs/Al_{0.15}Ga_{0.85}As terahertz devices*, L. Ajili, G. Scalari, M. Giovannini, N. Hoyler and J. Faist, *J. Appl. Phys.*, vol. **100**, pp. 043102–1–043102–3 (2006).



- [9] *Electrically switchable, two-color quantum cascade laser emitting at 1.39 and 2.3 THz*, G. Scalari, C. Walther, J. Faist, H. Beere and D. Ritchie, *Appl. Phys. Lett.*, vol. **88**, no. 14, pp. 141102–1–141102–3 (2006).
- [10] *Biomedical terahertz imaging with a quantum cascade laser*, S. Kim, F. Hatami, J. Harris, A. Kurian, J. Ford, D. King, G. Scalari, M. Giovannini, N. Hoyler, J. Faist and G. Harris, *Appl. Phys. Lett.*, vol. **88**, no. 15, pp. 153903–1–153903–2 (2006).
- [11] *Turn-key compact high temperature terahertz quantum cascade lasers: imaging and room temperature detection*, E. Brundermann, M. Havenith, G. Scalari, M. Giovannini, J. Faist, J. Kunsch, L. Me-chold and M. Abraham, *Optics Express*, vol. **14**, no. 05, pp. 1829–1841 (2006).
- [12] *Design, fabrication and optical characterization of quantum cascade lasers at terahertz frequencies using photonic crystal reflectors*, L.A. Dunbar, V. Moreau, R. Ferrini, R. Houdré, L. Sirigu, G. Scalari, M. Giovannini, N. Hoyler and J. Faist, *Optics Express*, vol. **13**, no. 22, pp. 8960–8968 (2005).
- [13] *In GaAsAlInAs/InP terahertz quantum cascade laser*, L. Ajili, G. Scalari, N. Hoyler, M. Giovannini and J. Faist, *Appl Phys. Lett.*, vol. **87**, pp. 141107–1–141107–3 (2005).
- [14] *MBE growth of terahertz quantum cascade lasers*, H. Beere, J. Fowler, J. Alton, E. Linfield, D. Ritchie, R. Kohler, A. Tredicucci, G. Scalari, L. Ajili, J. Faist and S. Barbieri, *J. Cryst. Growth*, vol. **278**, pp. 756–764 (2005).
- [15] *Terahertz bound-to-continuum quantum-cascade lasers based on optical-phonons scattering extraction*, G. Scalari, N. Hoyler, M. Giovannini and J. Faist, *Appl. Phys. Lett.*, vol. **86**, pp. 181101–1–181101–3 (2005).
- [16] *Imaging at 3.4 THz with a quantum-cascade laser*, D. Chamberlin, P. Robrish, W. Trutna, G. Scalari, M. Giovannini, L. Ajili and J. Faist, *Appl. Opt.*, vol. **44**, no. 1, pp. 121–125 (2005).
- [17] *Time-resolved broadband analysis of slow-light propagation and superluminal transmission of electromagnetic waves in three-dimensional photonic crystals*, J. Gómez Rivas, A. Farré Benet, J. Niehusmann, P. Haring Bolívar, and H. Kurz, *Phys. Rev. B* **71** (15), 155110 (2005).
- [18] *All-optical switching of the transmission of electromagnetic radiation through subwavelength apertures*, C. Janke, J. Gómez Rivas, P. Haring Bolívar and H. Kurz, *Opt. Lett.* **30** (18): 2357-2359 (2005).
- [19] *Terahertz science, engineering and systems—from space to earth applications*, Encyclopedia of RF and Microwave Engineering, P. de Maagt, P. Haring Bolivar and C. Mann, Ed. by K. Chang, pp. 5175-5194 (John Wiley & Sons, Inc., 2005) ISBN 0-471-27053-9.
- [20] *Terahertz time-domain spectroscopy of crystalline and aqueous systems*, P. Uhd Jepsen, H. Merbold, Z. Li, X. Xing, and S. Clark, NATO ARW Proceedings (submitted, Springer, 2006).
- [21] *Self-referenced reflection terahertz time-domain spectroscopy at arbitrary incidence angles and polarizations*, H. Merbold and P. Uhd Jepsen, in preparation for *Opt. Lett.* (August 2006).
- [22] *Contact-free determination of alcohol content with self-referenced terahertz time-domain spectroscopy*, H. Merbold and P. Uhd Jepsen, in preparation for *J. Opt. Soc. Am. B*, August 2006.
- [23] *High-resolution gas phase spectroscopy with a distributed feedback terahertz quantum cascade laser*, H.-W. Hübers, S. G. Pavlov, H. Richter, A. D. Semenov, L. Mahler, A. Tredicucci, H. E. Beere, and D. A. Ritchie, *Appl. Phys. Lett.* **89**, 061115 (2006).



- [24] *Heterodyne receiver at 2.5 THz with quantum cascade laser and hot electron bolometric mixer*, H.-W. Hübers, S. G. Pavlov, H. Richter, A. D. Semenov, L. Mahler, A. Tredicucci, H. E. Beere, and D. A. Ritchie, *Proceedings of SPIE -- Volume 6275 Millimeter and Submillimeter Detectors and Instrumentation for Astronomy III*, Jonas Zmuidzinas, Wayne S. Holland, Stafford Withington, William D. Duncan, Editors, 62750H (2006).
- [25] *Terahertz quantum cascade lasers*, A. Tredicucci and R. Köhler, *Intersubband Transitions in Quantum Structures* (McGraw-Hill, New York, 2006), p. 45-105.
- [26] *Electron-lattice coupling in bound-to-continuum THz quantum-cascade lasers*, M. S. Vitiello, G. Scamarcio, V. Spagnolo, T. Losco, R. P. Green, A. Tredicucci, H. E. Beere, and D. A. Ritchie, *Appl. Phys. Lett.* **88**, 241109 (2006).
- [27] *Surface plasmon photonic structures in terahertz quantum cascade lasers*, O. Demichel, L. Mahler, T. Losco, C. Mauro, R. Green, A. Tredicucci, J. Xu, F. Beltram, H. E. Beere, D. A. Ritchie, and V. Tamošinas, *Opt. Express* **14**, 5335 (2006).
- [28] *Quantum cascade lasers*, A. Tredicucci, *Encyclopedia of Condensed Matter Physics*, Q-1 (2005).
- [29] *High-performance operation of single-mode terahertz quantum cascade lasers with metallic gratings*, L. Mahler, A. Tredicucci, R. Köhler, F. Beltram, H. E. Beere, E. H. Linfield, and D. A. Ritchie, *Appl. Phys. Lett.* **87**, 181101 (2005).
- [30] *Continuous wave operation of a superlattice quantum cascade laser at 2 THz*, C. Worrall, J. Alton, M. Houghton, S. Barbieri, H. E. Beere, D. Ritchie and C. Sirtori, *Opt. Express* **14**, 171 (2006).
- [31] *Terahertz polarization imaging*. N. C. J. van der Valk. W. van der Marel, and P. C. M. Planken. *Opt. Lett.* **30**, 2802 (2005).
- [32] *Buried waveguides in terahertz quantum cascade lasers based on two-dimensional surface plasmon modes*, J. Alton, S. S. Dhillon, C. Sirtori, S. Barbieri, A. de Rossi, M. Calligaro, H. E. Beere, and D. A. Ritchie, *Appl. Phys. Lett.*, **86**, 071109 (2005).
- [33] *Buried heterostructure 2.9-THz quantum cascade lasers operating up to 77K in continuous wave*, J. Alton, S. S. Dhillon, C. Sirtori, S. Barbieri, A. de Rossi, M. Calligaro, H. E. Beere, and D. A. Ritchie, *Proc. SPIE Int. Soc. Opt. Eng.* **5738**, 159 (2005).
- [34] *Ultra-low threshold current quantum cascade lasers based on double-metal buried strip waveguides*, S. S. Dhillon, J. Alton, S. Barbieri, C. Sirtori, A. de Rossi, M. Calligaro, H. E. Beere, and D. A. Ritchie, *Appl. Phys. Lett.*, **87**, 071107 (2005).
- [35] *2.9 THz quantum cascade laser operating up to 70K in continuous wave*, S. Barbieri, J. Alton, H. E. Beere, J. Fowler, E. H. Linfield, and D. A. Ritchie, *Appl. Phys. Lett.* **85**, 1674 (2004).
- [36] *Recent developments in people screening using terahertz technology – seeing the world through terahertz eyes?* M. C. Kemp, A. Glauser, and C. Baker, *SPIE*, **6212**, 2006.
- [37] *Multi-spectral terahertz imaging using reflected and scattered radiation– seeing the world through terahertz eyes*, M. C. Kemp, Submitted to special issue of *International Journal of High Speed Electronics and Systems*, 2006.
- [38] *Characterization of Crystalline Phase-Transformations in Theophylline by Time-Domain Terahertz Spectroscopy*. Upadhy, P.; Nguyen, K.L.; Shen, Y.C.; Obradovic, J.; Fukushige, K.; Griffiths, R.; Gladden, L.; Davies, AG; Linfield, EH; *Spectroscopy Letters* **39**. Taylor & Francis. pp.215-224. 2006.
- [39] *On-chip photoconductive excitation and detection of pulsed terahertz radiation at cryogenic temperatures*. Wood, C.D.; Cunningham, J.; Upadhy, P.; Linfield, E.H.; Hunter, I.C.; Davies, A.G.; Missous, M. *Applied Physics Letters* **88** (14, Article 142103). pp.142103, 2006.



[40] *Analysis of drugs-of-abuse and explosives using terahertz time-domain and Raman spectroscopy*. A Burnett, W Fan, P Upadhyya, J Cunningham, E Linfield, G Davies, H Edwards, T Munshi, and A O'Neil. *Proceedings of SPIE* Vol. **6120**, 61200M (March 7, 2006).

[41] *Guided-wave THz devices for sensing the properties of overlaid dielectric films*. C Wood, J Cunningham, A G Davies, I C Hunter, P Tosch, and E H Linfield. *Proceedings of SPIE* Vol. **6120**, 61200P (March 7, 2006).

[42] *Complementary spectroscopic studies of materials of security interest*. A Burnett, W Fan, P Upadhyya, J Cunningham, H Edwards, T Munshi, M Hargreaves, E H Linfield, and A G Davies. *Proceedings of SPIE*, to be published.

PUBLIC RELATIONS

Lectures

'*Between Radio and the Light Bulb: Physics and Applications of Terahertz Frequency Waves*', British Physics Olympiad (lecture to High School Students), Royal Society, London, April 2006 (Martyn Chamberlain, Durham).

'*The Development and Applications of Terahertz Imaging and Spectroscopy Systems*', Student Open Day of the Institute of Physics CMMP Conference, Exeter, April 2006 (Edmund Linfield, Leeds).

Press Articles

'Terahertz Spectroscopie', *De Ingenieur*, p44-47, 10 February 2006, nr 2, Jaargang 118 (A clear story with colour photographs in which the applicant's work is covered, Paul Planken, Delft).

'Terahertzgolven maken doorzichtig', *NRC handelsblad*, 29-11 2005 (Paul Planken, Delft).

'Verkenningen in het duister: Terahertz Technologie opent de ogen', *Website of the Dutch Science programme Noorderlicht 2005*: <http://noorderlicht.vpro.nl/artikelen/20009058/> (Paul Planken, Delft).

Radio/TV Broadcasts

TV spot (5 Min) by Univ. Siegen on WDR3 (German TV) to inform the general public, 13th July 2006 (Peter Haring, Siegen).

Radio program WDR5 by Univ. Siegen, Frankfurt and Braunschweig to inform the general public on THz technology, 10th October 2006 (Peter Haring, Siegen).

September 21st 2006, TELEAC/NOT will record THz imaging activities in the Delft lab and interview the applicant for a "School TV" programme on imaging techniques (Paul Planken, Delft).



CONFERENCE/SUMMER SCHOOLS ORGANIZED

'Physics of Intersubband Semiconductor Emitter" (POISE) Summer School, Palazzone di Cortona, Italy, 25th–30th June 2006.

'Terahertz Frequency Detection and Identification of Materials and Objects', NATO Advanced Research Workshop, Spiez, Switzerland, July 7th - July 11th, 2006.

TRADE FAIRS & EXHIBITIONS

Photonics Korea 05, Korea, 5th-9th September 2005 (Femtolasers).

OSA, Tucson, USA, 16th-20th October 2005 (Femtolasers).

TeraTech 05, Osaka, Japan, 16th-18th November 2005 (Femtolasers).

BIOS/Photonics West, San Jose, USA, 19th-28th January 2006 (Femtolasers).

Laser 2006, Shanghai, China, 21st-23rd March 2006 (Femtolasers).

CLEO 2006, Long Beach, CA, USA, 22nd-25th May 2006 (Femtolasers).

SURA Terahertz Application Symposium, Washington DC, USA, 31st May – 6th June 2006 (Femtolasers).