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Monday, 12 May

8:45-9:00 **OPENING BY THE CHAIRS**

Petr Kužel, Institute of Physics, Academy of Sciences of the Czech Republic

Alessandro Tredicucci, CRN-NANO, Italy

9:00-10:00 **KEYNOTE TALK**

Terahertz Sources, Detectors and Sensors: Innovation by the Control of Plasma Dynamic 1

Hartmut Roskos, Goethe University, Germany

Charge carrier plasmas play an important role in many THz sources, detectors and sen sors. This presentation gives examples from diverse areas of THz research of how the control of plasma dynamics enables or enhances the performance of the respective proc-esses or devices.

10:00-11:15 TERAHERTZ DETECTORS

Chair: Michele Ortolani

10:00-10:15 **Physical Limits of Terahertz Plasma Field Effect Transistor Detectors** 3

Wojciech Knap, L2C & TERALAB, University Montpellier & CNRS, France

Two-dimensional electron plasma in nanometer size field effect transistors can oscillate in Terahertz (THz) frequencies, far beyond transistors fundamental cut-of frequencies. We propose an overview of some important and recent results concerning THz detection by nanometer field effect transistors. The subjects were selected in a way to show physics related limitations and advantages rather than purely technological/engineering im-provements of nanometer Field Effect transistors working as Terahertz detectors.

10:15-10:30 **High-performance THz nanodetectors with resonant antennas** 4

Leonardo Viti, NEST, Istituto Nanoscienze CNR and Scuola Normale Superiore, Italy

We report on the development of an innovative class of nanowire-based Terahertz (THz) detectors in which the metamaterial properties of an antenna have been imported in the detection scheme of an overdamped plasma-wave field-effect transistor making its response resonant to THz radiation. Responsivities of ~105 V/W at 0.3THz, with noise equivalent power levels ≈10E-9 W/√Hz are reached at room-temperature. The resonant nature of the detection scheme provided by the four-leaf-clover-shaped geo-metry and the possibility to extend this technology to large multi-pixel arrays opens the path to applications for ultra-sensitive metrology, spectroscopy and biomedicine.

10:30-10:45 **New pyroelectric THz detectors** 6

Andreas Steiger, Physikalisch-Technische Bundesanstalt (PTB), Germany

A joint R&D project is dedicated to develop new pyroelectric THz detectors. Due to a novel design their power responsivity is constant over a wide spectral range from below 100 GHz to at least 5 THz. The final goal is the first THz power measurement of a TDS system after a precise calibration of a new detector by PTB's FIR laser.

10:45-11:00 **Terahertz detector based on highly-aligned carbon nanotubes** 8
Naoki Fujimura, Department of Physical Electronics, Tokyo Institute of Technology, Japan

We have investigated the terahertz response of p-n junction films of highly aligned carbon nanotube. Photovoltages induced by terahertz irradiation at room temperature were observed through the photothermoelectric effect.

11:00-11:15 **High performance bilayer-graphene terahertz detector** 10
Davide Spirito, NEST, Istituto Nanoscienze CNR and Scuola Normale Superiore, Italy

We fabricated THz detector based on graphene-based field effect transistor. We achieved a responsivity ~1.2 V/W and a noise equivalent power ~4x10^{-9},W/Hz^{1/2}, with performance comparable with commercially available devices.

11:15-11:45 **Coffee break**

11:45-12:45 PLASMA WAVES

Chair: Wojciech Knap

11:45-12:15 **Plasmonic-enhanced optical-to-terahertz conversation efficiency** 12 **Invited talk**
Mona Jarrahi, University of California Los Angeles, United States of America

We present an overview of some recent developments in plasmonic photoconductive emitters, enabling significant enhancement in optical-to-terahertz conversion efficiency and terahertz radiation power.

12:15-12:30 ***Terahertz metasurfaces with two-dimensional electron plasma*** 14
Viacheslav Popov, Kotelnikov Institute of Radio Engineering Electronics, Russian Federation; Saratov State University, Russian Federation

It is shown that planar periodic nanostructures with two-dimensional electron plasma form resonant terahertz metasurfaces. Novel types of tunable modulators, near-field concentrators, amplifiers, and lasers operating in terahertz frequency range can be created with using such metasurfaces.

12:30-12:45 **Spectroscopic observation of terahertz plasmons in a two-dimensional electron gas** 16
Michele Ortolani, Sapienza University of Rome, Italy; CNR Istituto di Fotonica e Nanotecnologie, Italy

By measuring terahertz frequency mixing signals from a field effect transistor based on the AlGaAs/GaAs heterojunction at low temperatures, we have observed standing plasma waves of the ultra high-mobility two-dimensional electron gas.

12:45-14:30 **Lunch break**

Monday, 12 May

14:30-16:30 MICROSCOPY, METAMATERIALS

Chair: Alessandro Tredicucci

14:30-15:15 **THz/infrared near-field nanoscopy for mapping local conductivity, structure, and chemical composition** 18 **Masterclass**

Fritz Keilmann, Ludwig-Maximilians-Universität, Germany

By scattering focused radiation off an AFM tip the local THz/infrared response can be measured and mapped together with a sample's topography, at a spatial resolution down to 20 nm. This contribution will cover both monochromatic and broadband spectroscopic ("nano-FTIR" and "TD-THz") operation of scattering-type optical near- field microscopy (s-SNOM), and highlight applications including a material's conductance at THz frequencies.

15:15-15:30 **Ultrafast terahertz microscopy with sub-cycle temporal resolution** 19

Tyler Liam Cocker, University of Regensburg, Germany

We combine ultrafast terahertz spectroscopy with near-field microscopy to achieve field-resolved sub-wavelength spatial resolution (~15 nm) and sub-cycle temporal resolution (~9 fs). We apply our novel system to photoexcited InAs nanowires and measure femtosecond carrier dynamics – spatially, temporally and spectrally.

15:30-15:45 **Terahertz near-field imaging and spectroscopy with spatial resolution of 3 micron using sub-wavelength apertures** 21

Oleg Mitrofanov, University College London, United Kingdom; Center for Integrated Nanotechnologies, United States of America

We demonstrate sub-wavelength aperture near-field probes for THz time-domain spectroscopy and imaging capable of 3 micron spatial resolution. We discuss the probe design for achieving high sensitivity and resolution, and demonstrate THz imaging spectroscopy of single 20-30micron diameter TiO2 spheres, which exhibit Mie resonances at ~1THz

15:45-16:00 **Terahertz Near-field Imaging for Fractal Metallic Structures** 23

Koichiro Tanaka, Kyoto Uniiversity, Japan

Near-field electric field distribution in the Sielpinski metallic bow-tie antenna is determined by the terahertz microscope system. The resonance frequency clearly depends on the location, indicating site-selective local-field enhancement due to the self-similarity of the fractal structure.

16:00-16:15 **Bullseye with broken symmetry for coupling free space radiation to cylindrical substrate's mode** 25

Damien Armand, Japan science and technology agency, CREST, Japan; Hiroshima University, ADSM, Japan

We propose a modified bullseye device with broken symmetry to couple linear polarized free space radiation into a cylindrical focused substrate's mode. The device presents great advantages to reach a high conversion and enhancement of the electric component transverse to the substrate.

16:15-16:30 **Absolute Measurement of the Field Enhancement in Split Ring Resonators Featuring Nanometer-Sized Gaps** 27
Salvatore Bagiante, Paul Scherrer Institute, Switzerland; University of Bern, Switzerland

In this work we study the THz response of split-ring resonators with extended capacitive faces and nanometer-sized gaps. The resonant behavior of the split rings leads to a narrowband THz field enhancement with field enhancement factors as high as 14.000. Our experimental results demonstrate, by a direct correlation between simulations and near field measurements, the presence of extremely high field strength inside the nanogap.

16:30-17:00 **Coffee break**

17:00-18:45 TERAHERTZ SOURCES

Chair: Masayoshi Tonouchi

17:00-17:30 **Sub-THz photomixing components and applications** 29
Jean-Francois Lampin, Institute of Electronics, Microelectronics and Nanotechnology (IEMN), France

Invited talk

We have developed two kinds of photomixers for the sub-THz range: LTG-GaAs photoconductors and InGaAs/InP uni-travelling carrier photodiodes. Thanks to new designs and process we show that it is possible to generate powers in the milliwatt range and to use these photomixers in communication applications.

17:30-17:45 **Angular distribution of terahertz radiation emitted from semiconductor surfaces** 31
Raimund Mueckstein, Department of Electronic and Electrical Engineering, University College London, United Kingdom

Photo-current transients at semiconductor surfaces can give rise to terahertz (THz) frequency pulse generation, with the angular distribution of the THz emission allowing identification of the photo-current direction. We show that in-plane photo-currents can lead to much stronger THz pulses than photo-currents normal to the surface, with the resultant amplitude and directivity of the emitted radiation being controlled by the shape of the excitation beam.

17:45-18:00 **Narrowband THz generation through optical heterodyning of a dual wavelength heterogeneously integrated III-V/silicon DFB laser** 33
Matthias Vanwolleghem, Terahertz Photonics group, IEMN, Université Lille, France

We demonstrate a narrowband THz signal at a frequency of 357GHz generated by an uni-travelling carrier photodiode (UTC-PD) that is driven by a dual-wavelength III-V on silicon Distributed FeedBack (DFB) laser diode. THz linewidth, power and central frequency are analysed and proven to be very robust against DFB bias current variations.

18:00-18:15 **Multiple lateral photo-Dember emitters illuminated by a cylindrical micro-lens array** 35
Paul Gow, School of Physics and Astronomy, University of Southampton, United Kingdom

We demonstrate a terahertz multiple lateral photo-Dember emitter design illuminated with a cylindrical micro-lens array. The multiple emitter shows increased output power over a single lateral photo-Dember emitter and is capable of reaching bandwidth comparable to that of a single commercial photoconductive antenna.

18:15-18:30 **Phase-locked multi-THz fields control high-harmonic generation by dynamical Bloch oscillations in a bulk semiconductor** 37
Mathias Hohenleutner, Department of Physics, University of Regensburg, Germany

Dynamical Bloch oscillations and coherent interband polarization in bulk GaSe are controlled by ultra-intense and CEP-stable waveforms in the multi-THz range, resulting in the emission of an all-coherent high-harmonic frequency comb covering 12.7 optical octaves throughout the THz, infrared, and visible spectral regimes.

18:30-18:45 **Towards real-time THz measurements of electrical devices** 39
Stefan Weber, Department of Physics and Research Center OPTIMAS, University of Kaiserslautern, Germany; Department of Materials Characterization and Testing, Fraunhofer Institute for Physical Measurement Techniques IPM, Germany

We present a novel THz bandwidth network analyzer for characterizing low-noise amplifiers up to 3 THz as well as a resonator-based time-stretch system with variable magnification for real-time measuring of nonrepetitive high-frequency RF-signals up to 0.1 THz.

9:00-10:15 SPECTROSCOPY OF NANOSTRUCTURES

Chair: Manfred Helm

9:00-9:30 **THz spectroscopy of organolead trihalide Perovskites for high efficiency photovolatics** 41 **Invited talk**

Michael Johnston, Department of Physics, University of Oxford, United Kingdom

We have recently shown that solar cells based on vapour-deposited organolead trihalide Perovskite materials can achieve solar-to-electrical power conversion efficiencies of over 15 per cent. To help understand why these materials perform so well we have studied charge dynamics in them by utilizing terahertz spectroscopy. We show that the charge carrier mobility is ≥ 33 cm2V−1s−1, and the material has a remarkably low bimolecular electron-hole recombination.

9:30-9:45 **Effects of Depolarization Fields on Transient Terahertz Spectra of Nanostructured Materials** 43

Petr Kužel, Institute of Physics, Academy of Sciences of the Czech Republic, Czech Republic

We analyze the relationship between the microscopic conductivity, sample mor-phology (defined by percolation degree and pathways) and terahertz conductivity spectra. On this basis we retrieve microscopic properties of a variety of nanos-tructured materials from measurements by transient terahertz spectroscopy.

9:45-10:00 **THz Photoconductivity in Light-Emitting Silicon Nanocrystals** 45

Vit Zajac, Institute of Physics ASCR, Czech Republic; Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic

We measured optical pump-terahertz probe spectra of ensembles of light-emitting Si nanocrystals at pump intensities spanning over 2 orders of magnitude. The dependence of photoconductive response of the sample on photocarrier density allows us to determine volumes and characteristic sizes of nanocrystals.

10:00-10:15 **Bulk-like transversal electron mobility in heavily n-doped InP nanowires probed by terahertz spectroscopy** 47

Hyek Němec, *Institute of Physics, Academy of Sciences of the Czech Republic, Czech Republic*

Waveguiding of excitation beam and propagation of THz beam in a complex gradient environment were studied in an array of InP nanowires. Measurements by time-resolved THz spectroscopy accompanied by Monte-Carlo calculations of the response of localized charges enabled determination of transversal electron mobility.

10:15-10:45 **Coffee break**

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10:45-12:30 TOPOLOGICAL INSULATORS AND DIRAC FERMIONS

Chair: Tobias Kampfrath

10:45-11:15 **THz spectroscopy of organolead trihalide Perovskites for high efficiency photovolatics** 49 **Invited talk**

Frédéric Teppe, Université Montpellier II, France

We report on a Terahertz magnetospectroscopy study of topological transitions in HgCdTe-based heterostructures.

11:15-11:30 **Terahertz detection of injection and shift currents in Bi2Se3 films** 50

Alan Bristow, Department of Physics and Astronomy, West Virginia University, United States of America

We demonstrate all-optical injection of a ballistic current in thin films of Bi2Se3 using quantum interference control and terahertz detection. The phase-dependence of the terahertz signal indicates that the direct of the current is controlled and can be separated from a phase-independent shift current. The injection and shift currents are azimuthally isotropic and 6-fold symmetric respectively. Isolating the injection current allows for its film-thickness dependence to be extracted.

11:30-11:45 **THz and multi-THz photoluminescence from HgCdTe structures** 52

Sergey Morozov, Institute for Physics of Microstructures of Russian Academy of Sciences, Russia; Lobachevsky State University of Nizny Novgorod, Russia

Efficient interband PL is observed up 26 μm (for HgCdTe bulk films) and up to16 μm (for HgTe/CdHgTe QWs) from 18K to 280K. In bulk epitaxial HgCdTe waveguide structure a nar-rowing of bandgap PL line at wavelength 9 μm has been observed at T = 100 K with the in-crease in the excitation intensity that is attributed to the stimulated emission.

11:45-12:00 **Terahertz Plasmonic Excitations in Topological Insulators** 54

Stefano Lupi, INFN and Department of Physics, University of Rome La Sapienza, Italy

Dirac Plasmon excitations in the terahertz (THz) range have been discovered in Bi2Se3 topological insulator films patterned in form of different micro-structures: Ribbons, Disks and Rings. The plasmon line width is nearly constant for a temperature variation between 6 K and 300 K as expected when exciting topological carriers.

12:00-12:30 **Terahertz Radiation Induced Electric Currents in Dirac Fermions Systems** 56 **Invited talk**

Sergey Ganichev, Terahertz Center, University of Regensburg, Germany

The paper overviews experimental and theoretical studies of photocurrents induced in various Dirac fermions systems by polarized terahertz radiation.

12:30-12:45 **Preparation layer observation of Japanese historical wall paintings by THz imaging** 57

Kaori Fukunaga, National Institute of ICT, Japan

The Terahertz pulse-echo imaging technique was applied to observe the preparation layer of Japanese historical wall painting. First, a sample of preparation layer which has two layers part and one layer part was observed to clarify the interpretation of experi-

was too small to be detected by THz reflection spectroscopy, some lines are detected which are considered to be engraving style under-drawing lines. The lines are difficult to be observed in visible ray. The nondestructive cross-section image of the wall painting suggested that the preparation is only one layer, and has become porous.

12:45-14:30 **Lunch Break**

14:30-16:00 2DEGS, MAGNETOSPECTROSCOPY

Chair: Alexey Kuzmenko

14:30-15:15 **Coherent Terahertz Cyclotron Resonance Spectroscopy** 59
Junichiro Kono, Department of Electrical and Computer Engineering, *Rice University, United States of America*

Masterclass

We demonstrate coherent detection and control of cyclotron resonance in various semi-conductors. Decoherence of many-electron superposition states is studied, and a se- quence of coherent terahertz pulses are used to control the amplitude of cyclotron resonance oscillations in an arbitrary fashion via phase-dependent interactions.

15:15-15:30 **Terahertz-induced electron localization in a quantum Hall system** 61
Takashi Arikawa, Department of Physics, Kyoto University, Japan

We performed time-resolved longitudinal voltage measurements in a GaAs quantum Hall system after sub-picosecond terahertz pulse excitation. A fast decrease of the longitudinal voltage in the quantum Hall plateau region is observed, which suggests electron localization induced by terahertz pulse excitation.

15:30-15:45 **Ultrastrong light-matter interaction with superconducting THz split ring resonators** 63
Curdin Maissen, Institute for Quantum Electronics, ETH Zürich, Switzerland

The resonances of superconducting split ring resonators(SRRs) are strongly modified when tuning the material across the superconductor phase transition. This tuning possibility is a promising control knob for ultrastrong coupling experiments. We demonstrate a normalized vacuum Rabi frequency of W/w_LC = 0.87

15:45-16:00 **Time-resolved spectroscopy on Landau-quantized graphene revealing strong Auger scattering** 65
Stephan Winnerl, Helmholtz-Zentrum Dresden-Rossendorf, Germany

The carrier dynamics within the system of Landau levels of index n = -1 to n = 0 and n = 1 in graphene is investigated by pump-probe experiments using circularly polarized terahertz radiation. The study, complemented by microscopic modelling, reveals a pronounced carrier redistribution caused by strong Auger scattering.

16:00-16:30 **Coffee break**

Tuesday, 13 May

16:30-17:30 GRAPHENE

Chair: Junichiro Kono

16:30-17:00 **Terahertz and infrared magneto-optical properties of graphene** 67 **Invited talk**
Alexey Kuzmenko, University of Geneva, Switzerland

Graphene attracts much attention as a tunable electromagnetic material, where optical absorption, polarization rotation are highly sensitive to external electric and magnetic fields. Due to the two-dimensionality, its electromagnetic properties are also strongly affected by intrinsic defects and the substrate via plasmonic effects. In this talk, I'll present our recent THz and infrared studies of epitaxial graphene on SiC, which combine broadband magneto-optical spectroscopy and scanning near-field microscopy (s-SNOM) . We find that excitation and reflection of plasmons on steps between atomically flat substrate terraces and other nanoscale defects affect dramatically the terahertz absorption and Faraday rotation. In addition, we show that the giant terahertz Faraday rotation can be enhanced further by using the Fabry-Perot effect in the substrate. Our near-field measurements suggest that generation and propagation of graphene plasmons might be tailored using extremely compact nanostructures, such as nanometer-wide graphene gaps.

17:00-17:15 **THz saturable absorption in graphene** 68
Federica Bianco, NEST, Istituto Nanoscienze CNR and Scuola Normale Superiore, Italy

Combining the unique optical properties and the fast carrier dynamics, graphene proved to be a good ultrafast broadband saturable absorber in the infrared. In this work we show experimental results on the saturable absorption property of graphene in THz regime. This paves to possible novel graphene-based THz lasing devices.

17:15-17:30 **Monitoring of molecular adsorption and desorption dynamics on graphene using terahertz emission** 70
Iwao Kawayama, Institute of Lser Engineering, Osaka University, Japan

We demonstrate a new approach to visualize the distribution of molecular adsorbates on graphene using terahertz time-domain spectroscopy and imaging. We found that the waveforms of terahertz radiation from graphene-coated InP sensitively changed with the type of the atmospheric gas, the laser illumination time.

17:30-19:30
POSTER SESSION (SEE THE LIST OF POSTERS ON THE NEXT PAGE)

20:30
CONFERENCE DINNER

17:30-19:30 POSTERS

POSTERS ARE LABELED ACCORDING TO THE SUBMISSION NUMBER

Tuesday, 13 May

9:00-10:45 QCLS

Chair: Miriam Serena Vitiello

9:00-9:30 **Terahertz quartz enhanced photo-acoustic gas sensor employing a quantum cascade laser source** 120 **Invited talk**

Vincenzo Spagnolo, Dipartimento Interateneo di Fisica, Universida e Politecnico di Bari, Italy

An innovative quartz enhanced photoacoustic (QEPAS) gas sensing system operating in the THz spectral range and employing a custom quartz tuning fork (QTF) will be described. The QTF dimensions are 3.3 cm x 0.4 cm x 0.8 cm, with the two prongs spaced by ~ 800 μm. To test our sensor we used a quantum cascade laser as light source and selected a methanol rotational absorption line at 131.054 cm^{−1} (~3.93 THz), with line-strength S = 4.28•10^{-21} cm/mol. The sensor was operated at 10 Torr pressure on the first flexion QTF resonance frequency of 4245 Hz. The corresponding Q factor was 74760. Stepwise concentration measurements were performed to verify the linearity of the QEPAS signal as a function of the methanol concentration. The achieved sensitivity of the system is 7 parts per million in 4 seconds, corresponding to a QEPAS normalized noise-equivalent absorption of 2•10^{-10} W•cm^{-1}•Hz^{-1/2}, comparable with the best result of mid-IR QEPAS systems.

9:30-9:45 **Broadband extractors for THz quantum cascade lasers** 121

Markus Rösch, Institute for Quantum Electronics, ETH Zurich, Switzerland

We present a monolithic extractor for broadband THz quantum cascade lasers (THz QCL) with metal-metal waveguides. An increase of more than 10% in power density is observed. In addition the farfield is confined to a 20° x 20° area.

9:45-10:00 **Single mode operation of coupled-cavity terahertz quantum cascade laser with integrated quantum well absorber.** 123

Hua Li, University of Paris Diderot end CNRS, France

We present the operation of a coupled-cavity terahertz quantum-cascade laser (QCL) integrating a quantum well absorber section. By tuning the bias across the well, the fundamental intersubband transition can be brought in and out of resonance with the laser frequency (2.6THz), producing a ~35% modulation of the total losses. In addition the absorber section behaves as a low finesse etalon modulating the losses of the Fabry-Perot modes of the QCL section. This mechanism allows stable, single longitudinal mode operation with typical side mode suppressions in the 30 to 40 dB range. We employ a transfer matrix method to model the mode selection mechanisms in the coupled-cavity laser. The calculated results show good agreement with the measurements.

10:00-10:15 **Integrated planar antennas for quantum cascade lasers operating at 4.7 THz** 125

Christopher Bonzon, Institute for Quantum Electronics, ETH Zurich, Switzerland

This work shows the integration of a patch array and a slot array antennas on as facet condition for a quantum cascade laser operating around 4.7~THz. The antenna devices show an increase of the slope efficiency by up to a factor 4 and output power up to a a factor 2. Additionally the effect of the antenna is retrieved in the far-field and the spectrum of the laser, the devices were operating up to 70K in continuous wave.

Wednesday, 14 May

10:15-10:45 **From Growth Asymmetries towards Watt-Level Output Powers in Terahertz Quantum Cascade Lasers** 127

Invited talk

Christoph Deutsch, Photonics Institute, Vienna University of Technology, Austria

Terahertz quantum cascade lasers with high output powers approaching the watt- level are presented. Understanding the growth asymmetries in the active region core, the development of a direct waferbonding fabrication, and InGaAs-based material systems are the key to this improved device performance.

10:45-11:15 **Coffee Break**

11:15-12:30 HIGH FIELD

Chair: Hartmut Roskos

11:15-11:30 **Nonlinear distortion of intense THz beams** 129

József A. Fülöp, MTA-PTE High-Field Terahertz Research Group, Pécs, Hungary; ELI-ALPS, Szeged, Hungary

Profiles of energetic THz beams generated by optical rectification of femtosecond laser pulses with tilted pulse front were measured. Strong variation of the divergence angle with pump intensity was found, indicating that nonlinearities induced by the optical pump and THz are important for the design of high-energy THz sources.

11:30-11:45 **A High-field THz source operating at few 100 kHz repetition rates** 131

Michael Gensch, HZDR, Germany

First results from a new super-radiant THz facility are presented. The facility is based on sub-ps electron bunches generated and accelerated in a unique superconducting radio-frequency (SRF) linear accelerator that allows quasi-cw operation. It aims at providing transient electric fields in the GV/m regime at flexible repetition rates of up to 500 kHz.

11:45-12:00 **THz-pulse-driven particle accelerators** 133

Janos Hebling, Institute of Physics, University of Pecs, Hungary; MTA-PTE, High-Field Terahertz Research Group, Hungary

Because of their suitable wavelength and temporal period, THz pulses with extremely high field strength are ideal for driving miniature particle accelerators. However, this fact is not yet well recognized. Here we give an overview of the possibilities and challenges of THz-pulse-driven electron and proton/ion accelerators.

12:00-12:15 **Highest-energy THz pulses by optical rectification** 135

József A. Fülöp, MTA-PTE High-Field Terahertz Research Group, Pécs, Hungary; ELI-ALPS, Szeged, Hungary

THz pulses with more than 0.4 mJ energy were generated with 0.77% efficiency by optical rectification of 785-fs laser pulses in LiNbO3 using tilted-pulse-front pumping. The spectral peak is at about 0.2 THz, suitable for charged-particle manipulation.

12:15-12:30 **The High Intensity THz Radiation Source at SPARC_LAB** 137
Flavio Giorgianni, University of Rome La Sapienza, Italy

The linac-based THz source at SPARC_LAB at the INFN laboratory of Frascati, Italy can deliver broadband terahertz (THz) pulses with a femtosecond shaping. Beyond beam diagnostic applications, the possibility to store energy up to 50 μJ in a single THz pulse renders this source very competitive for research investigations.

12:30-14:30 **Lunch Break**

14:30-16:30 CHEMICAL SPECTROSCOPY, MEDICAL APPLICATIONS, IMAGING

Chair: René Beigang

14:30-15:00 **Fuel Cell Analysis using THz technology** 139 **Invited talk**
Toshiko Kiwa, Graduate School of Natural Science and Technology, Okayama University, Japan

Terahertz chemical microscopy was carried out to visualize diverse types of chemical reactions using laser-terahertz technology. Here, the mapping of the chemical reactions in the solutions and the catalytic reactions of the hydrogen gas were demonstrated.

15:00-15:15 **Characterizing the Hydrogen Bond Network of Water in Aqueous Saccharide Solution** 141
Keiichiro Shiraga, Graduate School of Agriculture, Kyoto University, Japan

Based on the complex dielectric constant in the THz region that is selectively sensitive to picosecond and sub-picosecond dynamics, it was pointed out that glucose has the "destructuring effect" on the native hydrogen bond (HB) network of water, and thus, water molecules are partly released from the HB network

15:15-15:30 **Discerning the conformation of G-quadruplex forming DNA** 143
John Roberts, School of Systems Engineering, University of Reading, United Kingdom

Terahertz power transmission spectroscopy (TPTS) measurements have been carried out to detect a difference between the hydration shells of G-quadruplex forming DNA sequences in strand and quadruplex configuration. Evidence of a change in hydration shell was observed.

15:30-15:45 **Terahertz Bio-Sensing based on Extraordinary Optical Transmission Devices** 145
Fausto D'Apuzzo, Dipartimento di Fisica, Universida di Roma La Sapienza, Italy; Istituto Italiano di Technologia, Genova, Italy

The excitation of Surface Plasmon Polaritons (SPP) at a metal-dielectric interface is studied in metal plasmonic devices tuning SPP at THz frequencies. These devices can be used as Refractive Index sensors at wavelengths resonant with collective modes of macromolecules. Moreover, we compare electromagnetic and sensing response of THz devices with those of equivalent sensors working in the Mid-Infrared range.

Wednesday, 14 May

15:45-16:00 **High-sensitivity THz spectroscopy for biological systems** 147
Ben Felix Spencer, The Photon Science Institute and the School of Physics and Astronomy, The University of Manchester, United Kingdom

A high sensitivity time-resolved terahertz spectrometer, utilizing a double-modulation lock-in detection scheme, has been developed and used to study the photoexcited dynamics of the light-harvesting complex 2 from Rhodopsedomonas Acidophilia. The spectrometer is sensitive to photoexcited absorption changes of 1 in 35,000.

16:00-16:30 **Terahertz applications in medicine** 149
Joo-Hiuk Son, Department of Physics, University of Seoul, Republic of Korea

Invited talk

Various medical applications using terahertz technology are presented. Examples include the dynamic imaging of skin drug absorption, the diagnostic imaging of cancers such as brain tumors and oral melanoma, and the analysis of fatty livers. Measurement depth enhancement techniques are also discussed.

16:30-17:00 **Coffee Break**

17:00-18:30 SOLID STATE SPECTROSCOPY AND ULTRAFAST TECHNIQUES
Chair: Petr Kužel

17:00-17:30 **Probing and controlling spin dynamics using terahertz pulses** 151
Tobias Kampfrath, Fritz Haber Institute of the Max Planck Society, Germany

Invited talk

Terahertz (THz) spectroscopy is routinely used to study electronic and ionic motion in many physical systems. Here, we present two examples to show that THz radiation is also an excellent tool to probe and control the precession and transport of electron spins in magnetically ordered solids.

17:30-17:45 **Terahertz dielectric properties of KTaO3 crystal: electric-field tunability, comparison with SrTiO3** 153
Volodymyr Skoromets, Institute of Physics, Academy of Sciences of Czech Republic, Czech Republic

We used time-domain THz spectroscopy to study the dielectric properties of a KTaO3 crystal upon applied electric field at temperatures from 40 to 250 K. Tunable ferroelectrics are promising for the control of THz radiation and their study enables deeper understanding of structural instabilities close to phase transition.

17:45-18:00 **A further insight into the tunability of strontium titanate thin films in the THz range** 155
Christelle Kadlec, Institute of Physics, Academy of Sciences of the Czech Republic, Czech Republic

Several SrTiO3/DyScO3 strained epitaxial bilayers were investigated by time-domain THz spectroscopy as a function of electric field and temperature. A model accounting for the coupling of the soft mode to a central mode is shown to explain the high electric-field tunability of these structures.

18:00-18:15 **Distortion-free enhancement of THz signals measured by electro-optic sampling** 157
Fabian D.J. Brunner, Institute of Applied Physics, University of Bern, Switzerland

We present a technique for the distortion-free enhancement of THz signals measured by electro-optic sampling based on the subtraction of data collected at opposite optical biases near the zero transmission point in a crossed polarizer detection geometry and demonstrate enhancement factors of one order of magnitude.

18:15-18:30 **High-resolution broadband terahertz spectroscopy with electronic detection of photonically generated terahertz frequency comb** 159
Anton Skryl, University of Nizhny Novgorod, Russian Federation

We report a new approach to the terahertz frequency comb spectroscopy (TFCS) based on electronic heterodyne detection of a photonically generated comb. While simpler than the standard TFCS with complex dual laser systems, our approach retains the advantages of TFCS – high spectral resolution and broadbandness.