February 2017

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EDITORIAL: HOW TO CONTRIBUTE TO THE NEWSLETTER

Dear Reader,

We are inviting contributions to the following rubrics:

- Research highlights (annotations) presenting the projects pursued by the members of the Consortium.
- Short regular papers.
- Proposals for collaborative research work.
- News from the participating institutions.
- Information about conferences, symposia, workshops, seminars.
- Programs and frameworks for an exchange of visits and mobility of researchers. Job opportunities (especially for young researchers, e.g. postdoctoral positions, specializations, internships).
- Annotations of books, conference proceedings, software and internet resources. Additions to the list of the recent scientific publications and conference reports at the website of the Consortium (http://fir.u-fukui.ac.jp/Website_Consortium/publist.html).
- Information and announcements about awards and nominations.
- Short presentations of laboratories and research groups belonging to the participating institutions.

Please submit your contributions to the Newsletter as well as requests for information to:

Professor Toshitaka Idehara
Supervisor of International Cooperation
and Facilitator of the International
Consortium
FIR UF
idehara@fir.u-fukui.ac.jp

Dr. Svilin Sabchevski
Editor of the website and the Newsletter
Institute of Electronics of the Bulgarian
Academy of Sciences (IE-BAS)
sabch@ie.bas.bg
Recently, a new International Research Group has been established at the Faculty of Advanced Researches and the Research Center for Development of Far-Infrared Region, University of Fukui (FIR UF Center). In the beginning of December 2016, Professor Svilen Petrov Sabchevski, a Head of the Laboratory Plasma Physics and Engineering at the Institute of Electronics of the Bulgarian Academy of Sciences (IE-BAS) joined the group as a Specially Appointed Professor. This group includes the following researchers (pictured):

- Professor Toshitaka Idehara – Supervisor of the international collaboration and facilitator of the International Consortium
- Professor Svilen Petrov Sabchevski – Specially Appointed Professor
- Visiting Professors at FIR UF:
  - Professor Olgierd Dumbrajs, University of Latvia (October – December 2016)
  - Professor Michail Glyavin, Institute of Applied Physics, Russian Academy of Sciences (January 2017)
  - Professor Alexei Kuleshov, O. Ya. Usikov Institute for Radiophysics and Electronics, National Academy of Sciences of Ukraine (February-March 2017)
  - Dr. Eduard Khutorian, O. Ya. Usikov Institute for Radiophysics and Electronics, National Academy of Sciences of Ukraine (until December 2017)
  - Dr. Ali Khumaeni.

**MISSION**

- Promote a broad and active international collaboration
- Strengthen the leading position of FIR UF as a managing organization and a facilitator of the International Consortium for Development of High-Power THz Science and Technology as well as in other current and prospective collaborations.

**GOALS AND OBJECTIVES**

- Development of novel advanced concepts and devices for high power science and technology.
- Accelerate the research leading to the development of novel high-performance radiation sources (sub-THz and THz gyrotrons) for novel applications.

**MEANS**

- Theoretical, experimental and numerical studies of sub-THz and THz gyrotrons
- Computer Aided Design (CAD) of radiation sources and quasi-optical systems
- Application of the developed gyrotrons to novel fields of the fundamental research and the technologies
Generalized Self-Consistent Non-Stationary Theory of the Gyrotron

Olgierd Dumbrajs

Institute of Solid State Physics, University of Latvia

For a long time, the gyrotron theory was developed assuming that the transit time of electrons through the interaction space $T_r = L/v_c$ is much shorter than the cavity fill time $\tau_d$. Correspondingly, it was assumed that during this transit time the amplitude of microwave oscillations remains constant. In such a case the standard self-consistent nonstationary theory of the gyrotron can be used [1]

$$\frac{dp}{d\zeta} + i\left(\Delta + |p|^2 - 1\right)p = ip(\zeta, \tau) \tag{1}$$

$$\frac{\partial^2 f}{\partial \zeta^2} - i \frac{\partial f}{\partial \tau} + \delta f = \frac{L}{2\pi} \int_0^{2\pi} p d\Theta. \tag{2}$$

First, for the given initial high frequency field distribution $f(\zeta,0)$ Eq. (1) is solved and the electron transverse momentum $p(\zeta,0)$ is calculated. Next, Eq. (2) is solved and $f(\zeta, h\tau)$ is found, which is then inserted into Eq. (1). This process is repeated until the solution no longer depends on time.

If the condition $T_r \ll \tau_d$ does not hold, Eq. (1) should be modified and the generalized self-consistent non-stationary theory of the gyrotron should be used [2]

$$\frac{\alpha^2}{4} \frac{dp}{\partial \tau} + \frac{dp}{\partial \zeta} + i\left(\Delta + |p|^2 - 1\right)p = ip(\zeta, \tau) \tag{3}$$

$$\frac{\partial^2 f}{\partial \zeta^2} - i \frac{\partial f}{\partial \tau} + \delta f = \frac{L}{2\pi} \int_0^{2\pi} p d\Theta. \tag{4}$$

Numerical implementation of solving the system (3) and (4) is significantly more complicated than solving the system (1) and (2) [3].

It has been found that the theory free from the assumption about the frozen wave amplitude during the electron transit time predicts some widening of the region of automodulation [4].

The topology of various regions (oscillations with constant amplitude, regular automodulation and chaos) shown in Fig. 1 is very similar to that presented in [5]. This could be expected because in the case of stationary oscillations with constant amplitude the addition term with the partial time derivative in Eq. (3) does not play any role. However, it plays a role in defining the boundary between the region of stationary oscillations and the region of automodulation.

The boundaries between the regions of oscillations with constant amplitude and automodulation determined with and without this additional term in Eq. (3) are shown in Fig. 2. Here, black, green and red lines show this boundary for the cases $\alpha=0$, $\alpha=1.0$ and $\alpha=1.5$, respectively. As the beam alpha increases, so does the region of automodulation, mostly, in the region of large values of negative detunings.
Fig. 1. Zones of different kinds of oscillations are separated by solid lines. The normalized interaction length $\mu=15$ allows realizing the maximum orbital efficiency. The contours of constant orbital efficiencies are shown by dashed lines. The point of the maximum orbital efficiency 0.7 is marked by the cross.

Fig. 2. Boundary between the regions of oscillations with constant amplitude and automodulation for three values of the beam alpha: $\alpha=0$ (black curve), $\alpha=1.0$ (green curve), and $\alpha=1.5$ (red curve). The first case ($\alpha=0$) represents results of the old theory in which the additional term in the equation for electron motion was neglected. Dashed lines show the frequency shift of oscillations with respect to the cutoff frequency, i.e. the frequency pulling.
The additional term in Eq. (3) may be important for the gyrotron development program at FIR UF Center (University of Fukui, Japan). Let us mention three examples.

1) **Competition between fundamental and higher harmonics.**
The electron transit time through the resonator is the same for all harmonics, but the cavity decay time is different. The condition $T_\tau \ll \tau_d$ holds better for higher harmonics than for the fundamental. To analyze properly the mode competition one should use the system of equations (3) and (4) generalized to multimode case.

2) **Higher axial indices.**
The condition $T_\tau \ll \tau_d$ holds better for lower axial indices. To analyze properly frequency tunability based on excitation of modes with different axial indices one should use the system of equations (3) and (4).

3) **Low-voltage gyrotrons (gyrotrino).**
In the case of low-voltage gyrotrons the electron transit time through the resonator is long and the condition $T_\tau \ll \tau_d$ may not hold.

**References**


The author of this short paper, Professor Olgierd Dumbrajs was a Visiting Professor at the University of Fukui and a member of the International Research Group at the Research Center for Development of Far-Infrared Region (FIR UF) from October to December 2016. On 13 December 2016 he delivered a talk “Generalized self-consistent non-stationary theory of the gyrotron” at the FIR UF seminar. The paper summarizes the main results presented and discussed there.
The University of Latvia’s Institute of Solid State Physics (ISSP) is a member of the International Consortium for Development of High-Power Terahertz Science and Technology and has active collaborations with many research partners worldwide. The main research topics of the Institute are:

**Functional materials for electronics and photonics.**

The R&D activities are focused on new materials for light emitters, sensors, materials for photonic applications in information and communications technologies, technology development for synthesis and growth of large single crystals. Special attention will be given to prototyping of photonic and microelectronic devices based on the developed materials in close cooperation with Latvian SMEs.

**Nanotechnology, nanocomposites and ceramics.**

This broad research field covers novel nanomaterials and nanostructures, nanoceramics and polymer nanocomposites, lead-free ferroelectric ceramic materials, materials for batteries, hydrogen production and storage, as well as for thermoelectric devices. In particular, the research includes investigations of different nanowire based applications, studies of glass ceramics for numerous photonic applications, development of lead-free multiferroic materials, new sodium ion batteries and new materials and innovative technologies for hydrogen energetics.

**Thin films and coating technologies.**

The main activities are directed towards R&D of the so-called Green Thin Film Nanotechnologies based on such vacuum technologies as physical and chemical vapour deposition (PVD & CVD) and pulsed laser deposition (PLD) as well as organic and inorganic spray wet technologies. Development of infrastructure, technological processes and a search for new applications in the field are also of high economical priority for Latvia, which has one of the largest vacuum technology industries among the Baltic countries.

**Theoretical and experimental studies of materials structure and properties.**

Development of existing and novel theoretical and experimental tools are of crucial importance for characterisation, testing and studying of (nano-)materials structural, electronic, magnetic and optical properties. These tools include high performance computing, x-ray absorption and optical spectroscopies, scanning/electron/optical microscopy and methods for characterisation of structure.

The Institute of Solid State Physics (ISSP) is the EUROfusion partner representing Latvia’s fusion research initiatives. The Latvian contribution to the European fusion programme began in 2000 in the form of cost-sharing actions and the Association EURATOM-University of Latvia was established in 2001. The ISSP is a member of the European Gyrotron Consortium (EGYC) (which consists of several European Fusion Laboratories, namely KIT - Germany, CRPP - Switzerland, HELLAS - Greece, CNR - Italy, and USTUTT - Germany), and and Thales Electron Devices (TED), France.

For more detail about Latvian R&D contribution to gyrotron development please visit: http://www.cfi.lu.lv/projekti/eurofusion/
The International Workshops on Far-Infrared Technologies (IW-FIRT) has been held five times in the past: 1999, 2002, 2010, 2012 and 2014. In these workshops, it was aimed to discuss the recent development and future directions of far-infrared and terahertz science and technologies with a special emphasis on high power radiation sources in this frequency region and their applications. On the other hand, the first International Symposium on Development of High Power Terahertz Science and Technology (DHP-TST 2013) was held in 2013 for discussion of the development of gyrotrons in sub-THz to THz band and their applications. This symposium was associated with the International Consortium "Promoting International Collaboration for Development and Application of Submillimeter Wave Gyrotrons," which consisted of six overseas institutions and three domestic institutions including FIR UF as the moderator institute. This International Consortium was reorganized and expanded in 2015 to the new International Consortium for "Development of High-Power Terahertz Science and Technology" (Visit: http://fir.u-fukui.ac.jp/Website_Consortium/), which consists of thirteen institutions from the world including FIR UF as the facilitator institute. We feel that it is the time to organize IW-FIRT and DHP-TST as a joint meeting to update our knowledge and understanding in this rapidly developing field. Therefore, we organize the Sixth International Workshop on Far-Infrared Technologies (IW-FIRT 2017) and The 2nd International Symposium on Development of High Power Terahertz Science and Technology (DHP-TST 2017) jointly, rather than organize them separately. An important aspect of this joint meeting is to discuss the present status and future prospect of application of high power terahertz technologies.

The joint workshop and symposium consist of invited talks, oral presentations, a panel discussion and a poster session with the following scope of topics:

1) Development of high power radiation sources in the far-infrared region,
2) Application of high power terahertz technologies especially to the following topics:
   2-1) Terahertz spectroscopy;
   2-2) Magnetic resonance phenomena in the far-infrared region;
   2-3) Material development with high-power FIR sources.
3) Other subjects related to the far-infrared region.

For information about the past workshops of IW-FIRT and DHP-TS please follow the links:

For more details please visit the official site of IW-FIRT 2017:
# The Program At-A-Glance (tentative)

7(Tue) - 9(Thu) March, 2017, at Conference Room on 13th floor of Science Tower I

## 7 Mar. (Tue)

<table>
<thead>
<tr>
<th>Start time</th>
<th>Session</th>
<th>No.</th>
<th>Time</th>
<th>Name (Affiliation)</th>
<th>Title</th>
<th>Chairperson</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:15</td>
<td>Opening remark</td>
<td>0:10</td>
<td>(Vice President for Research, Univ. of Fukui)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>9:25</td>
<td>Development and applications of gyrotrons</td>
<td>7a-1</td>
<td>0:30</td>
<td>Masahiko Tani (FIR UF)</td>
<td>Research activities on far-infrared technologies of FIR UF</td>
<td>T. Saito</td>
</tr>
<tr>
<td>9:55</td>
<td>Development and applications of gyrotrons</td>
<td>7a-2</td>
<td>0:30</td>
<td>Mikhail Yu. Glyavin (Inst. of Appl. Phys., RAS, Russia)</td>
<td>High frequency gyrotrons development and application at IAP RAS: Trends and results</td>
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<tr>
<td>10:25</td>
<td>Break</td>
<td>0:25</td>
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<tr>
<td>10:50</td>
<td>Development and applications of gyrotrons</td>
<td>7a-3</td>
<td>0:30</td>
<td>Gregory S. Nusinovich (Univ. of Maryland, USA)</td>
<td>Frequency tuning and pulling in gyrotrons</td>
<td>K. Sakamoto</td>
</tr>
<tr>
<td>11:20</td>
<td>Development and applications of gyrotrons</td>
<td>7a-4</td>
<td>0:30</td>
<td>Walter Kasparek (Univ. of Sututtgart, Germany)</td>
<td>Diplexers for high-power applications in millimeter and THz waves – an overview</td>
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<tr>
<td>11:50</td>
<td>Lunch</td>
<td>1:40</td>
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<td></td>
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</tr>
<tr>
<td>13:30</td>
<td>Development and applications of gyrotrons</td>
<td>7p-1</td>
<td>0:30</td>
<td>Yuusuke Yamaguchi (FIR UF)</td>
<td>Development of 303-GHz high power pulsed gyrotron</td>
<td>Y. Tatematsu</td>
</tr>
<tr>
<td>14:00</td>
<td>Development and applications of gyrotrons</td>
<td>7p-2</td>
<td>0:30</td>
<td>Keishi Sakamoto (National Inst. for Quantum and Radiological Sci. and Tech.)</td>
<td>Development of sub-terahertz gyrotron for DEMO</td>
<td></td>
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<tr>
<td>14:30</td>
<td>Development and applications of gyrotrons</td>
<td>7p-3</td>
<td>0:30</td>
<td>John Jelonek (Karlsruhe Inst. of Tech., Germany)</td>
<td>Towards 240 GHz high power fusion gyrotrons – KIT research status</td>
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<tr>
<td>15:00</td>
<td>Development and applications of gyrotrons</td>
<td>7p-4</td>
<td>0:20</td>
<td>†, Sebastian Ruest (Karlsruhe Inst. of Tech., Germany)</td>
<td>Key components development for the KIT 2-MW 170-GHz coaxial-cavity longer-pulse modular prototype gyrotron</td>
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<tr>
<td>15:20</td>
<td>Break</td>
<td>0:25</td>
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<tr>
<td>15:45</td>
<td>Development and applications of gyrotrons</td>
<td>7p-5</td>
<td>0:30</td>
<td>Michael A. Shapiro (Massachusetts Inst. of Tech., USA)</td>
<td>Recent results on sub-THz gyrotron devices for DNP NMR at MIT</td>
<td>S. Sabchevski</td>
</tr>
<tr>
<td>16:15</td>
<td>Development and applications of gyrotrons</td>
<td>7p-6</td>
<td>0:30</td>
<td>Monica Blank (Communications and Power Industries, USA)</td>
<td>Design and development of high-frequency CW gyrotrons for NMR/DNP applications</td>
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<tr>
<td>16:45</td>
<td>Development and applications of gyrotrons</td>
<td>7p-7</td>
<td>0:30</td>
<td>Yoh Matsuki (Osaka Univ.)</td>
<td>Advanced instrumentations for DNP-enhanced solid-state NMR</td>
<td></td>
</tr>
<tr>
<td>17:15</td>
<td>Development and applications of gyrotrons</td>
<td>7p-8</td>
<td>0:20</td>
<td># A. Kuleshov (Visiting prof. of FIR UF &amp; O. Ya. Usikov Inst. for Radiophys. and Electronics of NAS, Ukraine)</td>
<td>High-stable operation of CW clinotron and CW gyrotrons in THz range for DNP NMR spectroscopy and other applications</td>
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<tr>
<td>17:30</td>
<td>Break</td>
<td>0:25</td>
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<tr>
<td>18:00</td>
<td>Banquet</td>
<td>2:00</td>
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<td>at Academy Hall</td>
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</tbody>
</table>

**Note**

All invited talks are 30 minutes talks including the time for discussions (~5 min). Talks of contributed papers indicated by "#" are 20 minutes talks. "†" indicates awardee of the financial support for young researchers for IW-FIRT2017/DHP-TST2017.

For oral presentations, you can connect your own PC to LCD projector via standard RGB cable (mini D-sub 15 pin connector). If you will bring your presentation file without your own PC, please let us know in advance.

For poster presentations, refer to the note in the list of poster presentations.
### 8 Mar. (Wed)

<table>
<thead>
<tr>
<th>Start time</th>
<th>Session</th>
<th>No.</th>
<th>Time</th>
<th>Name (Affiliation)</th>
<th>Title</th>
<th>Chairperson</th>
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</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Pulsed and CW ESR</td>
<td>8a-1</td>
<td>0:30</td>
<td>Masayuki Hagiwara (Osaka Univ.)</td>
<td>Terahertz ESR in quantum and frustrated spin systems</td>
<td>H. Ohta</td>
</tr>
<tr>
<td>9:30</td>
<td></td>
<td>8a-2</td>
<td>0:30</td>
<td>Mark Sherwin (Univ. of California, Santa Barbara, USA)</td>
<td>Pulsed electron paramagnetic resonance experiments with a quasi-cw free-electron laser</td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td></td>
<td>8a-3</td>
<td>0:20</td>
<td>#,‡ Daichi Yoshizawa (Osaka Univ.)</td>
<td>Multi-frequency ESR studies on quantum frustrated magnets with exotic anisotropy in pulsed high magnetic fields</td>
<td></td>
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<tr>
<td>10:20</td>
<td>Break</td>
<td></td>
<td>0:25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:45</td>
<td>THz spectroscopy and techniques</td>
<td>8a-4</td>
<td>0:30</td>
<td>Michael I. Bakunov (Univ. of Nizhny Novgorod, Russia)</td>
<td>Narrowband terahertz generation by an ultrashort laser pulse in bulk LiNbO₃</td>
<td>C.-L. Pan</td>
</tr>
<tr>
<td>11:15</td>
<td></td>
<td>8a-5</td>
<td>0:30</td>
<td>Koichiro Tanaka (Kyoto Univ.)</td>
<td>Nonlinear properties of semiconductors under high intensity THz radiation</td>
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<tr>
<td>11:45</td>
<td>Group photo</td>
<td></td>
<td>0:15</td>
<td></td>
<td>We shall take a photo with all participants just after the morning session.</td>
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</tr>
<tr>
<td>12:00</td>
<td>Lunch</td>
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<td>1:30</td>
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</tr>
<tr>
<td>13:30</td>
<td>Generation, application and simulation of electromagnetic wave</td>
<td>8p-1</td>
<td>0:30</td>
<td>Kimiya Komurasaki (The Univ. of Tokyo)</td>
<td>Rocket propulsion powered by a gyrotro</td>
<td>S. Mitsudo</td>
</tr>
<tr>
<td>14:00</td>
<td></td>
<td>8p-2</td>
<td>0:30</td>
<td>Keiichiro Kashimura (Chubu Univ.)</td>
<td>Iron making by electromagnetic heating at the frequency of 2.45 GHz</td>
<td></td>
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<tr>
<td>14:30</td>
<td></td>
<td>8p-3</td>
<td>0:20</td>
<td>#, Stefan Illy (Karlsruhe Inst. of Tech., Germany)</td>
<td>An overview of the simulation tools for design and optimization of high power / high frequency gyrotroon oscillators at KIT</td>
<td></td>
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<tr>
<td>14:50</td>
<td></td>
<td>8p-4</td>
<td>0:20</td>
<td>#,‡ Alexander Marek (Karlsruhe Inst. of Tech., Germany)</td>
<td>Development of a new vector analysis code for the simulation of electromagnetic fields in the quasi-optical system of gyrotroons</td>
<td></td>
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<tr>
<td>15:10</td>
<td></td>
<td>8p-5</td>
<td>0:20</td>
<td># Kazuo Ogura (Niigata Univ.)</td>
<td>Terahertz wave generation based on surface wave resonator</td>
<td></td>
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<tr>
<td>15:30</td>
<td>Break</td>
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<td>0:20</td>
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</tr>
<tr>
<td>15:50</td>
<td>Poster session</td>
<td></td>
<td>1:40</td>
<td>See List of Poster Presentations.</td>
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17:30 end

### 9 Mar. (Thu)

<table>
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<tr>
<th>Start time</th>
<th>Session</th>
<th>No.</th>
<th>Time</th>
<th>Name (Affiliation)</th>
<th>Title</th>
<th>Chairperson</th>
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</thead>
<tbody>
<tr>
<td>9:00</td>
<td>THz spectroscopy and techniques</td>
<td>9a-1</td>
<td>0:30</td>
<td>Joo-Hiu Kang (Univ. of Seoul, Korea)</td>
<td>Terahertz molecular fingerprints of cancer DNA</td>
<td>D. S. Bulgarevich</td>
</tr>
<tr>
<td>9:30</td>
<td></td>
<td>9a-2</td>
<td>0:30</td>
<td>Masayuki Nagai (Osaka Univ.)</td>
<td>Desorption of the organic solids by the intense picosecond THz-FEL pulses</td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td></td>
<td>9a-3</td>
<td>0:20</td>
<td># Hitoshi Ohta (Kobe Univ.)</td>
<td>Recent developments of multi-extreme THz ESR in Kobe</td>
<td></td>
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<tr>
<td>10:20</td>
<td>Break</td>
<td></td>
<td>0:25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:45</td>
<td>THz spectroscopy and techniques</td>
<td>9a-4</td>
<td>0:30</td>
<td>Ci-Ling Pan (National Tsing Hua Univ., Taiwan)</td>
<td>Dielectric properties of advanced PCBs in the MMW and sub-MMW frequency range</td>
<td>K. Tominaga</td>
</tr>
<tr>
<td>11:15</td>
<td></td>
<td>9a-5</td>
<td>0:30</td>
<td>Go Yumoto (The Univ. of Tokyo)</td>
<td>Nonlinear optical responses of non-equidistant Landau levels in graphene in terahertz frequency range</td>
<td></td>
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<tr>
<td>11:45</td>
<td></td>
<td>9a-6</td>
<td>0:20</td>
<td># Masahiko Tani (FIR UF)</td>
<td>Terahertz coherent Raman spectroscopy by using frequency-chirped picosecond optical pulses</td>
<td></td>
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<tr>
<td>12:05</td>
<td>Lunch</td>
<td></td>
<td>1:35</td>
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<td></td>
</tr>
<tr>
<td>13:40</td>
<td>DHP-TST special session</td>
<td>9p-1</td>
<td></td>
<td>Toshtaka Idehara (FIR UF)</td>
<td>Establishment of the international consortium and its renewal</td>
<td>M.Yu. Glyavin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9p-2</td>
<td></td>
<td>Svilen Sabchevski (FIR UF &amp; Institute of Electronics of BAS, Bulgaria)</td>
<td>Accelerating the collaboration between the members of the International Consortium for Development of High-Power Terahertz Science and Technology</td>
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<td>9p-3</td>
<td></td>
<td>Masahiko Tani (FIR UF)</td>
<td>Panel discussion</td>
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<td>P-1</td>
<td>Keisuke Tominaga (Kobe Univ.)</td>
<td>Development of Sub-Terahertz Time-Domain Spectroscopy and its Application to Molecular Science</td>
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<td>P-2</td>
<td>Fumiyoshi Kuwashima (Fukui Univ. of Tech.)</td>
<td>High Efficient THz-TDS System Using Laser Chaos and Super Focusing with Metal V-grooved Wave Guides</td>
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<tr>
<td>P-3</td>
<td>Kosaku Kato (Osaka Univ.)</td>
<td>Yellow luminescence of ZnO with the irradiation of sub-terahertz waves from a gyrotron</td>
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<td>P-4</td>
<td>Hikomitsu Kikuchi (Univ. of Fukui)</td>
<td>ESR study on quantum frustrated magnet KCu$_2$OC$_2$(SO$_4$_2)</td>
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<td>P-5</td>
<td>Mary Clare Escano (Univ. of Fukui)</td>
<td>Characteristics of band splitting in GaAs due to spin-orbit interaction from first-principles methods</td>
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<td>P-6</td>
<td>Dmitry S. Bulgarevich (National Inst. for Materials Sci.)</td>
<td>GHz-TDS Imaging for Materials NDT</td>
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<td>P-7</td>
<td>Kunizo Ohkubo (Visiting prof. of FIR UF)</td>
<td>Attenuation of Hybrid Modes in Corrugated Waveguides at Frequencies above the Bragg Frequency</td>
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<tr>
<td>P-8</td>
<td>Osamu Morikawa (Japan Coast Guard Academy)</td>
<td>Characterization of Focusing of Sub-THz Radiation Using Insulator Aperture</td>
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<tr>
<td>P-9</td>
<td>Takahiro Sakurai (Kobe Univ.)</td>
<td>Development of Ceramics for the Inner Parts of the Pressure Cell by Electromagnetic Wave Heating</td>
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<td>P-10</td>
<td>Akira Fukuda (Hyogo Coll. of Med.)</td>
<td>ESR Experiments of P Impurities in Si and Dynamic Nuclear Polarization Aimed at the Application for Qubits</td>
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<td>P-11</td>
<td>Takayasu Kawasaki (Tokyo Univ. of Sci.)</td>
<td>Analysis of dissociation mechanism of amyloid fibrils by using terahertz-time domain spectroscopy</td>
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<tr>
<td>P-12</td>
<td>Takayuki Yamazaki (The Univ. of Tokyo)</td>
<td>Search for Hidden Photon Dark Matter in the Millimeter Wave Region with a Dish Antenna</td>
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<td>P-14</td>
<td>V. N. Manuilov (Inst. of Appl. Phys., RAS, Russia)</td>
<td>Level of the ion compensation of the space charge in the gyrotron electron beams and its influence on the output tube parameters</td>
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<td>P-15</td>
<td>Moe Iizawa (FIR UF)</td>
<td>Frequency tunability in multi cavity modes in Gyrotroon FU CW AX</td>
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<td>P-16</td>
<td>M. Fukunari (FIR UF)</td>
<td>Millimeter Wave Discharge and Its Application to the Rocket Propulsion</td>
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<td>P-17</td>
<td>Takumi Hirobe (FIR UF)</td>
<td>Transmission Test of the 303-GHz Gyrotron Power by Corrugated Waveguides</td>
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<td>P-18</td>
<td>Ryosuke Ikeda (National Inst. for Quantum and Radiological Sci. and Tech.)</td>
<td>Development of ITER Gyrotron in QST</td>
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<td>P-19</td>
<td>Tokihiko Tokuwa (National Inst. for Fusion Sci.)</td>
<td>Study of THz pulse wave application for the plasma diagnostics</td>
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<td>P-20</td>
<td>Dazhi Li (Osaka Univ.)</td>
<td>Terahertz radiation from a grating structure with graphene</td>
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<td>P-21</td>
<td>M. Fujita (Univ. of Toyama)</td>
<td>Frequency measurement of rotational transitions of 15NH3 using Evenson-type tunable far-infrared spectrometer</td>
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<td>P-22</td>
<td>Ali Khumaeni (FIR UF)</td>
<td>Effect of pump pulse width in generating highly-intense terahertz pulses using tilted-pump-pulse-front (TPPF) scheme at 800 nm</td>
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<td>P-23</td>
<td>Dhonny Bacuyag (FIR UF)</td>
<td>Discriminating Surface Defects in GaAs(001)-6H(2x4) by First-Principles Method</td>
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<td>P-24</td>
<td>Hideaki Kitahara (FIR UF)</td>
<td>Electromagnetic-Wave Analysis of Tapered Parallel-Plate Wave-Guide by Finite-Difference Time-Domain Method</td>
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<td>P-25</td>
<td>Shun Nakae (FIR UF)</td>
<td>Terahertz Coherent Raman Spectroscopy Using Terahertz Radiation by Zinc Telluride Crystal</td>
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<td>P-26</td>
<td>Heishun Zen (Kyoto Univ.)</td>
<td>Development of Quasi-monochromatic THz Coherent Undulator Radiation Source at Institute of Advanced Energy, Kyoto University</td>
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<tr>
<td>P-27</td>
<td>Kiwamu Kusama (Univ. of Fukui)</td>
<td>Characteristics of THz plasmonic superfocusing in metallic V-groove tapered waveguides</td>
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<td>P-28</td>
<td>Yutaka Fuji (FIR UF)</td>
<td>Considerations on the Overhauser Effect from the Viewpoint of the Non-Equilibrium Phase Transition</td>
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<td>P-29</td>
<td>Susumu Okubo (Kobe Univ.)</td>
<td>Far-Infrared ESR Measurements of $S_1/2$ frustrated $J_1$-$J_2$ chain system NaCuMoO$_4$(OH)</td>
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<td>P-30</td>
<td>Yuya Ishikawa (Univ. of Fukui)</td>
<td>Development of millimeter-wave band Fabry-Perot type resonator for ESR/NMR double magnetic resonance measurements</td>
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<td>P-31</td>
<td>Yoshiaki Tsunawaki (Visiting prof. of FIR UF &amp; Osaka Sangyo Univ.)</td>
<td>Formation of Octacalcium Phosphate under the Microwave Irradiation</td>
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**Note**
A presenter should be in front of each poster board during the following time: Odd number: 15:50–16:40; even number: 16:40–17:30 on 8th March. Poster presentations are encouraged to be put up from 12:30 on 7th March until 17:30 on 8th March. (The boards for posters are available in the conference room from 9:00 on 7th March until 17:30 on 8 March.) The poster board size is 90 cm in width and 180 cm in height. Use detachable stick tape to put up your posters on the poster boards. **DO NOT** use pushpins. The detachable stick tape is available in the poster session room.
Scope:

This one-day symposium, a post-conference of IW-FIRT 2017/DHP-TST 2017 in the University of Fukui, will be held on March 10, 2017, at Kobe University to discuss the recent progresses of the spectroscopic applications of the THz region in molecular science. The THz region is an important frequency region to explore structures, interactions, and dynamics of various molecular systems in the fields of chemistry, biology, physics, and material science. The symposium provides an international forum for discussing advances at the forefront of THz research in informal atmosphere.

Discussion topics:

• THz ESR under strong magnetic field
• Applications of THz spectroscopy to various molecular systems such as polymers and biological systems
• Bioscience in magnetic resonance

Venue:

Takigawa Memorial Hall, Rokkodai 2nd campus, Kobe University

Invited speakers and tentative titles:

Mark Sherwin (UC Santa Barbara)
Joo-Hiuk Son (University of Seoul)
"Terahertz molecular spectroscopy and its applications in cancer diagnosis"
Masayuki Hagiwara (Osaka University)
Kohji Yamamoto (University of Fukui)
"Application of a metal parallel-plate waveguide to terahertz spectroscopy"
Keiichiro Shiraga (Kyoto University)
"Characterization of hydration state and hydrogen-bond network in the biomolecular solutions and the epithelial cells"
Yoshihiko Kanemitsu (Kyoto University)
"THz spectroscopy as a new characterization tool for solar-cell materials and devices"
Eiji Ohmichi (Kobe University)
"Development of mechanically detected terahertz electron spin resonance technique"
Toshiro Kohmoto (Kobe University)
"Observation of ultrafast spin dynamics in antiferromagnetic transition metal oxides by pump-probe and terahertz spectroscopies"
Harumi Sato (Kobe University)
"Higher-Order Structure of Biodegradable Polyesters Studied by Terahertz Spectroscopy"
Yasuhiro Kobori (Kobe University)
"Electron Spin Polarization Imaging of Photoinduced Charge-Separated States in Photosynthetic Proteins"

For more details, please visit: http://www.research.kobe-u.ac.jp/mprc/seminar/conference/RATHzMS/
This Workshop, organized by the Institute of Applied Physics of the Russian Academy in Sciences in Nizhny Novgorod, Russia, will be held from July 17 to July 22, 2017 on board of a river boat starting from Nizhny Novgorod, Russia.

The Workshop will consist of four strongly interrelated topical symposia:

**Symposium S:** High power microwave sources;

**Symposium H:** Current drive and plasma heating by microwaves in nuclear fusion devices;

**Symposium T:** Extreme and nonlinear terahertz science (metamaterials for strong THz generation and frequency conversion, nonlinear effects in THz frequencies, high power THz sources);

**Symposium A:** High power microwave and terahertz applications (including accelerators, radars, gas discharges, materials processing, biomedical applications etc.)

This workshop is a continuation of the “Strong Microwaves in Plasmas” workshops held every three years since 1990. The adjusted title reflects gradual changes in the workshop contents towards a broader range of frequencies and applications. The scope of the workshop covers a wide circle of research activities of both fundamental and applied importance. The workshop is highly interdisciplinary in nature; it opens ample opportunities for the interaction between the researchers working in high-power microwave electronics and plasma physics, with strong emphasis on the development of diverse applications. A three-year cycle chosen for the workshop provides the participants with the possibility of accumulating significant results of their research.

For more detail visit the official website of the Workshop: [http://www.smp.sci-nnov.ru/](http://www.smp.sci-nnov.ru/)

Please address all correspondence to the Scientific Secretary of the Workshop, Dr. Sergey Mishakin

Institute of Applied Physics, RAS
46 Ulyanov St.,
Nizhny Novgorod 603950 Russia
Tel. +7 831 416 4621; Fax +7 831 416 0616
E-mail: smp@ipfran.ru
Overview

Terahertz (THz) science and technologies have rapidly advanced in recent years, attracting attention owing to its wide array of applications in THz spectroscopy of materials, THz sensing, and non-destructive evaluation of industrial products. The Molecular Photoscience Research Center, Kobe University and Research Center for Development of Far-Infrared Region, University of Fukui, have both dedicated to the development of THz science and technology for more than ten years as Centers of Excellence in this field. In the Philippine setting, pioneering THz-related research activities have commenced in the University of the Philippines (Diliman and Los Banos), mainly in collaboration with these Japanese institutes. These local THz research works have steadily grown and has expanded to active research work at the De La Salle University.

As such, it is high time to formally announce and showcase this active collaborative link between the two countries by holding the 1st Philippines-Japan THz Workshop (PJTW 2017) Structure of the workshop. This workshop aims to promote THz science and technology as a viable research area and to encourage young researchers and students to participate and present their works. The organizers hope that this small workshop will further strengthen the ties between the THz research communities of Japan and the Philippines.

Philippines-Japan THz Workshop 2017
De La Salle University Science and Technology Complex
Laguna Boulevard, LTI Spine Road, Barangays Biñan and Malamig, Biñan City, Laguna

Theme

- THz spectroscopy and sensing
- THz components (emitter, detector, waveguide, etc)
- THz material science (molecules, solid state materials, liquid meta-materials, nonlinear THz response, etc.)
- Theory and Modeling associated with THz science and technology
- Others, associated with THz science and technology

For more details please visit: http://www.dlsu.edu.ph/conferences/terahertz/2016/
LAPD18 Symposium is organized by Institute of Plasma Physics of the Czech Academy of Sciences. It will take place in Hotel DUO in Prague, Czech Republic from Sunday, 24 September 2017 (evening) to Thursday, 28 September 2017. The LAPD18 Symposium is the continuation of a biennial series that began at Kyushu University in 1983. It brings together physicists and chemists in diverse areas of laser-based plasma diagnostics including the physics of nuclear fusion, laser physics and low-temperature plasma chemistry and physics. The symposium aims to promote cross-pollination of these fields via fruitful discussion, and covers all diagnostics using electromagnetic waves (lasers and microwaves) applied to fusion plasmas, industrial process plasmas, environmental plasmas, plasmas for medical applications, atmospheric plasmas, plasmas in liquids and other plasma applications. Topics on hardware developments related to laser-aided plasma diagnostics are also welcome. Instrumentation developments related to laser-aided plasma diagnostics also received emphasis in the program.

For more information visit: http://indico.ipp.cas.cz/event/5/

**OTHER UPCOMING CONFERENCES**

42st International Conference on Infrared, Millimeter and Terahertz Waves, will be held from August 27-Sept. 1st in Cancun, Mexico.
http://www.irmmw-thz2017.org/

German THz Conference 2017
At the Ruhr University Bochum, Bochum, Germany from March 29 to 31, 2017.
http://www.thz2017.rub.de/

http://www.nemo-ieee.org/

http://www.imbioc-ieee.org/

International Conference on Microwaves for Intelligent Mobility (ICMIM 2017), 19-21 March, Nagoya, Aichi, Japan.
http://www.icmim-ieee.org/

Second International Conference on Terahertz Emission, Metamaterials and Nanophotonics (TeraMetaNano-2), May 28 – June 2, 2017, Palazzo Carnoldi, Venice, Italy

http://www.wptc2017.org/
https://www.waset.org/conference/2017/08/bangkok/ICMTT

https://www.waset.org/conference/2018/06/new-york/ICMTT

https://www.waset.org/conference/2017/07/london/ICMST

27th International Conference “Microwave and Communication Technology”, 10-17 Sept 2017, Ekaterinburg, Russia
http://agora.guru.ru/display.php?conf=CriMiCo_2016&page=conference&PHPSESSID=bdq7g5ikucaegokhc5vghuu6

Spring PIERS 2017 22-25 May 2017, St Petersburg, Russia.


http://www.ivec2017.org/

http://www.shu.edu/international-conference-plasma-science/index.cfm

http://ismot2017.org/

http://www.ampere2017.nl/

Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications IX, 30 Jan - 2 Feb 2016, San Francisco, California, USA.
http://spie.org/PWO/conferencedetails/thz-rf-mm-submm-wave-technology

http://www.veit.dir.bg/sozopol.htm

The 2017 IEEE International Conference on Antennas and Applications (IEEE CAMA 2017), 4-6 Dec 2017, Tsukuba, Ibaraki, Japan.
Bibliography and links to selected recent publications on topics related to the research field of the International Consortium

This is a cumulative list of selected publications in a chronological order as collected from various bibliographical and alert services and published after October 2016, i.e. after issuing the previous Newsletter #4

A. Publications by authors from the institutions participating in the International Consortium


http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4964238


http://scitation.aip.org/content/aip/journal/pop/23/10/10.1063/1.4964918


http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7676318&isnumber=4359079


http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4964228


http://link.springer.com/article/10.1134/S1063784216110104

http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4964236

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7750606&isnumber=4360151

https://www.jstage.jst.go.jp/article/tastj/14/ists30/14_Pb_99/_article


URL:http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7508412&isnumber=7533555

http://journals.ioffe.ru/articles/44187


B. Publications by other authors worldwide

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7590094&isnumber=4358746


http://scitation.aip.org/content/aip/journal/pop/23/10/10.1063/1.4964767

http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4964176

http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4964179

http://scitation.aip.org/content/aip/proceeding/aipcp/10.1063/1.4964155


http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=2575645

https://www.osapublishing.org/abstract.cfm?URI=isuptw-2016-IW2A.4


http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7723878&isnumber=6353170

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7735641&isnumber=7734201

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7735692&isnumber=7734201


http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7735756&isnumber=7734201

http://scitation.aip.org/content/aip/journal/rsi/87/11/10.1063/1.4966681


http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7561770&isnumber=7561752


http://scitation.aip.org/content/aip/journal/pop/23/11/10.1063/1.4967867

http://link.springer.com/article/10.1134%2FS1064226916110048


http://iopscience.iop.org/article/10.1088/1402-4896/92/2/024001/meta


http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7802640&isnumber=5741778


http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7802565&isnumber=4358746


http://www.tstnetwork.org/December2016/tst-v9n4-141Study.pdf
http://www.tstnetwork.org/December2016/tst-v9n4-149Theoretical.pdf

http://www.tstnetwork.org/December2016/tst-v9n4-166Continuously.pdf

http://www.tstnetwork.org/December2016/tst-v9n4-177Development.pdf

http://tinyurl.com/zjp89r


http://strathprints.strath.ac.uk/56705/1.pdf

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7807275&isnumber=7828063


http://www.nature.com/articles/srep41116


https://www.researchgate.net/publication/313161100

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7847447&isnumber=4360151

https://www.osapublishing.org/oe/abstract.cfm?uri=oe-25-3-2960

C. PATENTS

Method and apparatus for exchanging communication signals

US 9461706 B1
Inventors: Robert Bennett, Paul Shala Henry, Farhad Barzegar, Irwin Gerszberg, Donald J Barnickel, Thomas M. Willis
Publication date: Oct 4, 2016
https://www.google.com/patents/US9461706

Electron beam gun with kinematic coupling for high power RF vacuum devices

US 9502203 B1
Inventors: Philipp Borchard
Publication date: Nov 22, 2016
http://www.google.com/patents/US9502203

Large-Scale Space-Based Solar Power Station: Power Transmission Using Steerable Beams

United States Patent Application 20160380486
Inventors: Hajimiri S.A, Atwater H.A., Pellegrino S., Abiri B., Bohn F.
Publication date: Dec 29, 2016.

High power terahertz photoconductive antenna array

US 20160377803 A1
Inventors: Dong Ho Wu, Benjamin Graber
Publication date: Dec 29 2016

Method for the Chemical Strengthening of Glass

US 9505654
Inventors: Vladislav Sklyarevich, Mykhaylo Shevelev
Publication date: Nov 29, 2016
https://www.google.com/patents/US9505654
NOVEL SOURCES OF COHERENT RADIATION USING METAMATERIALS AND INTENSE ELECTRON BEAMS

Recently, Professor Richard Temkin and his colleagues at MIT have presented experimental results [1] that demonstrate the generation of reversed Cherenkov radiation when an intense electron beam is passing through a waveguide loaded by a metamaterial. They have observed power levels up to 5 MW at a frequency of 2.40 GHz using a one microsecond electron beam of 490 keV in a magnetic field with an intensity of 400 G. The authors comment that contrary to the expectations the output power is not generated in the Cherenkov mode but is due to a Cherenkov-cyclotron (or anomalous Doppler) instability induced by the presence of the magnetic field, which is used for guiding the electron beam trough, the structure. The resonance frequency is equal to the Cherenkov frequency minus the cyclotron frequency. The potential applications of this first experimental demonstration of coherent microwave generation from a continuous electron beam interacting with a metamaterial structure are discussed in [2]. This work is a continuation of the research of novel sources of coherent radiation that utilize metamaterial structures and intense electron beams [3-4].


The 2017 terahertz science and technology roadmap

Recently a large panel of researchers (from 32 institutions worldwide) has published a roadmap for a further development of the terahertz science and technology (see the link below). Its aim is to present the current State-of-the-Art in this broad field of research and to provide an opinion on the challenges and opportunities that the future holds. This topical review consists of 18 sections that cover most of the key areas of THz science and technology. This paper and the references therein is a useful resource that provides a wide-ranging introduction to the capabilities of THz radiation and surveys the most important well established as well as novel and prospective applications.

The resonant heating of heavy water solutions under the terahertz pulse irradiation

In a recent paper by Yang, et al. significant differences between the properties of heavy and usual water irradiated by terahertz pulses have been observed. The main highlights of this study are: (i) A resonant heating of heavy water solution under terahertz pulse irradiation is observed; (ii) The resonant frequencies exhibit a large difference between heavy water and normal water; (iii) Several rotational collective modes are addressed as the mechanisms of the resonant phenomena; (iv) The specific location of the resonant peak is dependent on the intensity of the terahertz pulse; (v) The shifting of peak location stems from different efficiency of each resonant mode under different pulse intensities.

For more detail see the paper:

Record 34Gbit/second Wi-Fi data transmission at a 500 GHz range

Japanese researchers from Tokyo Institute of Technology have succeeded to boost the speed of Wi-Fi data transmissions to 34 Gbps (Gigabits per second) by harnessing the 500 GHz frequency band of the electromagnetic spectrum, which falls within the Terahertz range. Such high frequencies are attractive because they have ultra-wide bandwidth (several tens of GHz) and offer short-range speeds of more than 100 Gbps. For more detail, please visit:
and the original paper:
http://digital-library.theiet.org/content/journals/10.1049/el.2016.3120

First metal-free metamaterial that can absorb electromagnetic energy without heating

Electrical engineers at Duke University have created an electromagnetic metamaterial made without metal. It has the ability to absorb electromagnetic energy without heating. Such material could find numerous applications in imaging, sensing, lighting and other advanced technologies. The concept of an all-dielectric metasurface absorber offers a new route for control of the emission and absorption of electromagnetic radiation from surfaces with potential applications in energy harvesting, imaging, and sensing..
https://pratt.duke.edu/about/news/dielectric-metamaterial
See the original paper at:

Terahertz radiation could speed up computer memory by 1000 times!

A team of Russian scientists from the Moscow Institute of Physics and Technology in a collaboration with their colleagues from the Netherlands and Germany have developed a method for speeding up the computer memory using terahertz waves. For more detail, please see the original paper: