10th International Workshop

Strong Microwaves and Terahertz Waves: Sources and Applications

PROGRAM

Nizhny Novgorod – Moscow, Russia
July 17 – 22, 2017
Topical Symposia of the Workshop

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

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

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

- **Symposium T:**
  
  Extreme and nonlinear terahertz science

Workshop sponsored by Russian Foundation for Basic Research

(grants № 17-02-20320, № 17-02-20317, № 17-02-20314, № 17-02-20313).
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<td>P.1: J. Stober (&lt;em&gt;Max-Planck-Institut für Plasmaphysik, Germany&lt;/em&gt;, Overview of ECH experiments in Europe and their future prospects</td>
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<td>P.2: G. Denisov (&lt;em&gt;Institute of Applied Physics, Russia&lt;/em&gt;, New trends in gyrotron development)</td>
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<td>P.4: P. Bagryansky (&lt;em&gt;Budker Institute of Nuclear Physics, Russia&lt;/em&gt;, A new outlook on the magnetic mirror approach to fusion)</td>
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<td>P.5: O. Tarvainen (&lt;em&gt;University of Jyväskylä, Finland&lt;/em&gt;, Electron cyclotron resonance ion sources - physics, technology and future challenges)</td>
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<td>P.6: V. Skalyga (&lt;em&gt;Institute of Applied Physics, Russia&lt;/em&gt;, Powerful neutron generators based on high current ECR ion sources with gyrotron plasma heating)</td>
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<td>S1.2 (invited): S. Samsonov, Development of gyrotron traveling-wave tubes at IAP and GYCOM</td>
<td>A1.2: V. Ralchenko, Express in-situ measurement of single crystal diamond growth / etching rate in microwave plasma: how to perform multiparametric kinetics study in one working day</td>
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<td>S1.3: V. Zapevalov, Non-canonical gyrotrons</td>
<td>A1.3: Yu. Lebedev, Microwave discharge in liquid hydrocarbons</td>
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<td>S1.4: V. Manuilov, Development of advanced electron optical systems for novel gyrotrons</td>
<td>A1.4: S. Bogdanov, Influence of CVD diamond growth conditions and misorientation angle on nitrogen incorporation</td>
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<td>S1.5: C. Wu, Comparison between controlled nonadiabatic and ExB concepts for gyrotron multistage depressed collectors</td>
<td>A1.5: V. Kukushkin, Diamond Bragg superlattice grown in microwave gas discharge for obtaining photoluminescence of single diamond color centers comprising a dense 3D ensemble</td>
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<td>S1.6: I. Zotova, Generation of rogue waves in gyrotrons with high excess over the threshold</td>
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<td>S2.2: L. Popov, Super-high power gyrotrons for electron-cyclotron plasma heating</td>
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<td>S2.3: E. Di Palma, The CARM beam-wave interaction and cavity design</td>
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<td>S2.4: S. Ceccuzzi, Comparison of reflector concepts for a 250 GHz CARM cavity</td>
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<td>S2.5: G. Dattoli, From research and design work toward the realization of CARM source at ENEA</td>
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<td>T1.2: V. Bratman, Coherent spontaneous THz undulator radiation from dense electron bunches formed in laser-driven photo-injectors</td>
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<td>T1.3: N. Osintseva, Terahertz Bessel beams with orbital angular momentum: diffraction and interference</td>
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<td>T1.4: Yu. Choporova, THz ellipsometry as a sensitive tool for measuring of the complex refractive index of liquids and biological substances</td>
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<td>T1.5: I. Ilyakov, Terahertz time-domain measurements by electro-optic crystals with various symmetries</td>
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18:00 – 20:00

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<td>M. Vilkov, Ultrasound pulse generation based on two coupled helical gyro-TWTs</td>
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<td>SP.16</td>
<td>A. Malkin, Amplification of short-wavelength radiation by relativistic electron beams moving near the impedance surfaces</td>
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<td>SP.17</td>
<td>M. Morozkin, Collector system of a gyrotron with magnetically shielded solenoid</td>
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<td>SP.18</td>
<td>I. Zotova, Modulation of microwave radiation in the process of resonant interaction with a counter-propagating rectilinear electron beam</td>
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<td>SP.19</td>
<td>V. Tarakanov, PIC-simulation of efficient Cherenkov X-band and V-band HPM sources with moderately relativistic electron beams</td>
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<td>SP.20</td>
<td>V. Tarakanov, Time-dependent numerical simulation of diffraction and absorption effects in diagnostics of short high-power microwave pulses using wide-aperture liquid calorimeters</td>
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<td>SP.21</td>
<td>A. Adilova, Modeling of a 0.4 THz second-harmonic frequency-tunable gyrotron with complex cavity</td>
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<td>TP1</td>
<td>A. Phelps, Pseudospark excited sub-THz frequency sources</td>
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<td>TP2</td>
<td>B. Shokri, Terahertz radiation of a metamaterial sphere excited by a relativistic revolving bunch</td>
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<td>TP3</td>
<td>A. Frolov, Generation of terahertz radiation in the interaction of a laser pulse with clusters</td>
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<td>TP4</td>
<td>A. Frolov, Excitation of THz surface waves in the conductor by a drag current generated by a focused femtosecond pulse</td>
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<td>TP5</td>
<td>A. Arzhannikov, Electrodynamic system for two-stage THz-generator on the base of two-channel planar FEM</td>
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<td>TP6</td>
<td>I. Osharin, Terahertz gyrotrons with quasi-regular cavities</td>
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<td>TP7</td>
<td>Yu. Oparina, Spontaneous coherent cyclotron THz super-radiation from a short dense photo-injector electron bunch</td>
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<td>P.13: T. Grotjohn* (Michigan State University, USA), Microwave plasma-assisted deposition of diamond for electronic applications</td>
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<td>P.14: A. Vikharev* (Institute of Applied Physics, Russia), CVD diamond with boron-doped delta-layers deposited by microwave plasma</td>
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<td>P.15: V. Luchinin* (St. Petersburg State Electrotechnical University &quot;LETI&quot;, Russia), The composition “diamond - silicon carbide” in extreme electronics</td>
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<td>T2.2: A. Arzhannikov*, Study of 0.3-0.8 THz flux generated by magnetized plasma column due to relaxation of high-current REB</td>
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<td>T2.3: V. Kubarev*, Instabilities, coherency, and spectra of the NovoFEL radiation</td>
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<td>T2.4: A. Savilov*, Super-radiative self-compression of photo-injector electron bunches and the use of this effect for realization of a THz source based on spontaneous coherent emission from a short dense electron bunch</td>
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<td>A3.3: M. Takahashi*, Numerical modeling for microwave breakdown on a beaming rocket supported by an external magnetic field</td>
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<td>A3.4: G. Sotnikov*, Excitation of wakefields by relativistic electron bunches in the dielectric waveguide filled with radially inhomogeneous plasma</td>
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<td>A3.5: V. Vdovin*, Data rates of SubTHz wireless telecommunication channels</td>
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<td>H2.1 (invited): A. Shalashov*, Electron-cyclotron waves in large-scale open traps: new questions highlighted by recent experiments</td>
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<td>H2.2: P. Bagryansky*, Stable plasma confinement with auxiliary ECR heating in a gas dynamic trap</td>
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<td>H2.3: E. Gospodchikov*, Plasma heating by microwaves in high-β devices</td>
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<td>H2.4: P. Aleynikov*, 3D full-wave modelling and mode conversion in realistic W7-X plasmas</td>
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<td>H2.5: A. Shalashov*, Quasi-optical approach for inhomogeneous dissipative media with high-order spatial dispersion</td>
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- **S3.1:** P. Strelkov, Plasma relativistic microwave amplifier
- **S3.2:** A. Kaminsky, Development of powerful Kaband FEM-amplifiers with broad frequency tuning
- **S3.3:** N. Peskov, Powerful narrow-band relativistic masers with Bragg resonators operating from mm to sub-mm wavelength band: resent results and prospects
- **S3.4:** A. Malkin, Surface-wave Bragg resonators for terahertz frequency range
- **S3.5:** M. Fuks, Magnetron on a lengthy virtual cathode with a magnetic mirror

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- **A4.2:** V. Yurov, Optical emission spectroscopy for diagnosis of diamond growth and etching processes in microwave plasma
- **A4.3:** M. Lobavev, Dependence of boron incorporation in delta layers on CVD diamond growth process and misorientation angle
- **A4.4:** M. Fukunari, Experiments on the millimeterwave discharge in atmosphere at 170 GHz and 28 GHz in the subcritical condition
- **A4.5:** K. Hamasaki, Numerical study of discharge physics induced by a subcritical microwave under air atmosphere

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- **T3.1 (invited):** A. Shkurinov, Introduction into nonlinear THz photonics: basis and their potential applications
- **T3.2 (invited):** A. Stepanov, Strong terahertz fields: interaction with condensed matter and electron acceleration
- **T3.3:** Y. Li, Bursts of terahertz radiation from relativistic laser-plasma interactions
- **T3.4:** A. Ushakov, 3D terahertz beam profiling from two color laser induced plasma with different focusing
- **T3.5:** D. Sitnikov, Generation of high power terahertz pulses and applications

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<td>P.16: J. Li (Institute of Plasma Physics, China), ECRH on CFETR - physics and technology needed</td>
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<td>P.17: E. Gusakov (Ioffe Institute, Russia), Anomalous absorption in ECRH experiments due to parametric excitation of localized UH waves</td>
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<td>P.18: A. Krasilnikov (Institution &quot;Project Center ITER&quot;, Russia), Status of ITER program</td>
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<td>P.19: W. Kasparek (Institute of Interfacial Process Engineering and Plasma Technology, Germany), Optics for electron cyclotron resonance heating and collective Thomson scattering at the stellarator W7-X</td>
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<td>P.20: M. Yalandin (Institute of Electrophysics, Russia), Relativistic microwave oscillators with high power flux in a free space and interaction zone</td>
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<td>S4.1 (invited): <strong>M. Thumm</strong>, The gyrotron – a natural source of high-power orbital angular momentum millimeter-wave beam</td>
<td>H3.1 (invited): <strong>A. Melnikov</strong>, ECRH effect on the electric potential in toroidal plasmas (overview of recent T-10 tokamak and TJ-II stellarator results)</td>
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<td>S4.2: <strong>S. Ruess</strong>, Design and manufacturing process for the KIT 2-MW 170-GHz coaxial-cavity longer-pulse gyrotron</td>
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<td>S4.3: <strong>A. Marek</strong>, Simulation of electromagnetic fields scattered from arbitrary shaped electric conductors</td>
<td>H3.3: <strong>K. Brunner</strong>, Continuous high power microwave heating at the W7-X stellarator</td>
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<td>S4.4: <strong>M. Petelin</strong>, Grating-based millimeter-wave quasi-optical components</td>
<td>H3.4: <strong>S. Lashkul</strong>, Isotopic effect in experiments on lower hybrid current drive in the FT-2 tokamak</td>
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<td>S4.5: <strong>D. Sobolev</strong>, Polarization-dependent TE_{11} to TE_{11}/TE_{01} waveguide mode converter for transmission line mode switching</td>
<td>H3.5: <strong>L. Simonchik</strong>, Decay of the X-mode into two upper-hybrid plasmons in the plasma filament. Experimental modeling and theoretical description</td>
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<td>AP.2: S. Prasanna, Effect of methane on stability of plasma in a MW-assisted hydrogen-methane plasma</td>
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<td>AP.3: M. Dukhnovsky, Simulation of thermal fields in the output window of electrons from polycrystalline diamond for electron gun</td>
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<td>AP.4: Yu. Fedorov, Diamond window for electron gun</td>
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<td>AP.5: N. Kharchev, Use of microwave pulse train for plasma-chemical experiments on high-pressure discharges</td>
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<td>AP.6: A. Sorokin, Microstructure of the microwave fast-sintered MgAl₂O₄ ceramics</td>
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<td>AP.7: A. Vodopyanov, High rate production of nanopowders by the evaporation-condensation method using gyrotron radiation</td>
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<td>AP.8: T. Krapivnitskaia, High-temperature microwave pyrolysis of peat as a method to obtaining liquid and gaseous fuels</td>
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<td>AP.9: I. Abramov, Theory of resonant stationary discharge with multiply charged ions in plasma flow propagating in mirror magnetic trap</td>
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<td>AP.10: I. Izotov, Study of plasma parameters in a continuous ECR discharge sustained by 24 GHz/5 kW gyrotron radiation in a quasi-gasdynamic mode</td>
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<td>AP.11: R. Lapin, First experiments on applying the gasdynamic ECR ion source for negative hydrogen ion production</td>
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<td>AP.12: S. Golubev, New approach for a “point-like” neutron source creation based on sharp focusing of a high quality deuteron beam produced by high-current gasdynamic ECR ion source</td>
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<td>AP.13: A. Tsvetkov, Reaching high sensitivity of radio-acoustic spectroscopy using «strong microwaves»</td>
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<td>AP.14: A. Vikharev, Study of grown single crystal diamond by optical and X-ray spectroscopy</td>
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<td>AP.15: V. Zapevalov, High-power microwaves against locusts and other harmful animals</td>
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<td>AP.16: S. Razin, Gas breakdown by a focused beam of THz waves</td>
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<td>AP.17: S. Razin, Light emission properties of a discharge induced in a gas flow by terahertz waves in the vacuum and extreme ultraviolet range</td>
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<td>AP.18: M. Glyavin, A possibility of remote detection of air breakdown in a focal spot of microwave beam using reflected signal</td>
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<td>AP.19: M. Glyavin, Theory of initial stage of the breakdown in non-uniform gas flow</td>
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<td>HP.1: S. Hansen, Parametric decay instability near the upper hybrid resonance and anomalous mm-wave scattering in tokamak and stellarator plasmas</td>
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<td>HP.2: I. Roy, Status and design of ECRH/CD system of the upgrade of the tokamak T-15</td>
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<td>HP.3: E. Gospodchikov, Quasi-optical approach to reconstruction of plasma fluctuations using amplitude distribution of transmitted microwave beam</td>
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<td>HP.4: E. Gospodchikov, Electron cyclotron heating and diagnostics of plasma at the second harmonic in the GDT device</td>
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<tr>
<td>19:15 – 22:00</td>
<td><strong>CONFERENCE DINNER</strong></td>
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<tr>
<td>8:00 – 9:00</td>
<td><strong>BREAKFAST</strong></td>
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<tr>
<td>9:00 – 12:00</td>
<td><strong>EXCURSION TO TVER</strong></td>
</tr>
<tr>
<td>12:00 – 12:30</td>
<td><strong>COFFEE BREAK</strong></td>
</tr>
</tbody>
</table>

**FRIDAY, July 21**
### PLENARY SESSION (Hall A)

**P.21:** T. Ozaki *(INRS-EMT, Canada)* Advances in nonlinear THz optics at the Canadian Advanced Laser Light Source – from bleaching to harmonic generation

**P.22:** N. Matlis *(Deutsches Elektronen-Synchrotron DESY, Germany)* Acceleration of electrons in THz driven structures

**P.23:** N. Ginzburg, *(Institute of Applied Physics, Russia)* Generation of single and periodically repeated powerful ultrashort microwave pulses

### ORAL SESSIONS

#### Session S-5 (Hall A)

- **S5.1** (invited): **G. Nusinovich**, Review of the gyrotron theory
- **S5.2**: **S. Copplestone**, Simulation of gyrotrons using the high-order particle-in-cell code PICLas
- **S5.3**: **P. Ortwein**, Benchmarking a high-order particle-in-cell code for the simulation of a gyrotron traveling wave tube
- **S5.4**: **Yu. Novozhilova**, Influence of mode competition and external wave frequency modulation on gyrotron frequency locking
- **S5.5**: **A. Fokin**, High precision frequency stabilization of a 263 GHz continuous wave gyrotron

#### Session A-5 (Hall B)

- **A5.1** (invited): **A. Galdetskiy**, Cooperation and competition of solid state and vacuum microwave devices in radar applications
- **A5.2**: **N. Skvortsova**, Synthesis of micro- and nanostructures with controllable composition in the chain plasma-chemical reactions initiated by the radiation of a powerful gyrotron in the mixtures of metal/dielectric powders
- **A5.3**: **S. Sedykh**, Influence of intense coherent electromagnetic radiation on several types of radioactive decay
- **A5.4**: **L. Simonchik**, Microwave pulse delay at propagation through the 1D electromagnetic crystals

#### Session H-4 (Hall C)

- **H4.1** (invited): **D. Mansfeld**, Kinetic instabilities in nonequilibrium plasma: a review of observations
- **H4.2**: **A. Phelps**, Laboratory experiments simulating electron cyclotron masers in space
- **H4.3**: **M. Viktorov**, Observation of multiple chirping events in electron cyclotron emission of nonequilibrium mirror-confined plasma
- **H4.4**: **A. Bruschi**, Fast events detection with the CTS diagnostic on FTU and plans for improvement

### COFFEE BREAK

- **16:30 – 17:00**

#### ORAL SESSIONS

**17:00 – 18:30**
<table>
<thead>
<tr>
<th>Session S-6 (Hall A)</th>
<th>Session T-5 (Hall B)</th>
<th>Session H-5 (Hall C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S6.1 (invited): A. Phelps, Progress in microwave to sub-THz sources at Strathclyde</td>
<td>T5.1: W. Fu, Harmonic terahertz gyrotron with quasioptical confocal cavity</td>
<td>H5.1: Y. Zhao, The design and verification of ECRH polarization control system on EAST</td>
</tr>
<tr>
<td>S6.2: I. Chelis, Development of a self-consistent simulation code for the electron cyclotron interaction in dielectric-loaded gyrotron beam tunnels</td>
<td>T5.2: X. Yuan, A 0.22 THz gyrotron based on carbon nanotube cold cathode</td>
<td>H5.2: D. Malakhov, Filters for diagnostic of Doppler reflectometry on the L-2M stellarator for operation under conditions of high ECR heating power</td>
</tr>
<tr>
<td>S6.3: V. Tarakanov, Code KARAT in simulations of power microwave sources including Cherenkov plasma devices, vircators, orotron, E-field sensor, calorimeter etc.</td>
<td>T5.3: V. Bulgakova, Sub-wavelength plane gratings for terahertz plasmonic sensing of liquids</td>
<td>H5.3: N. Kharchev, ECR system for plasma heating at stellarator L-2M</td>
</tr>
<tr>
<td>S6.4: V. Zaslavsky, Simulations of powerful microwave oscillators with oversized electrodynamics systems</td>
<td></td>
<td>H5.4: J. Xie, Interferometer system for Keda Torus eXperiment using terahertz solid-state diode sources</td>
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<tr>
<td>S6.5: A. Leontyev, W-band 5 MW pulse relativistic gyrotron. Development and experimental implementation</td>
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<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>19:00 – 19:30</td>
<td>CLOSING SESSION (Hall A)</td>
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<tr>
<td>20:00 – 21:00</td>
<td>DINNER</td>
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<tr>
<td>21:00 – 22:00</td>
<td>CONCERT</td>
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SATURDAY, July 22

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<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>8:00 – 9:00</td>
<td>BREAKFAST</td>
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<td>9:00</td>
<td>ARRIVAL IN MOSCOW</td>
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</table>
# Workshop Timetable

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday, July 17</th>
<th>Tuesday, July 18</th>
<th>Wednesday, July 19</th>
<th>Thursday, July 20</th>
<th>Friday, July 21</th>
<th>Saturday, July 22</th>
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<tbody>
<tr>
<td>07:30</td>
<td>0:00 – 9:00 Registration</td>
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<td>Breakfast</td>
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<td>08:00</td>
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<td>10:00</td>
<td>Opening session</td>
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<tr>
<td>11:00</td>
<td>Plenary session P1, P2, P3</td>
<td>Stop in Plyos (10:00 – 11:30)</td>
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<tr>
<td>12:00</td>
<td>Coffee break</td>
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<tr>
<td>13:00</td>
<td>Plenary session P4, P5, P6</td>
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<td>14:00</td>
<td>Lunch</td>
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<tr>
<td>15:00</td>
<td>Oral sessions S-1: Hall A</td>
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<td>Oral sessions T-2: Hall A</td>
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<td>15:30</td>
<td>A-1: Hall B</td>
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<td>16:00</td>
<td>H-1: Hall C</td>
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<td>16:30</td>
<td>Oral sessions S-2: Hall A</td>
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<td>Oral sessions S-4: Hall A</td>
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<td>17:00</td>
<td>A-2: Hall B</td>
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<td>A-5: Hall B</td>
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<tr>
<td>17:30</td>
<td>T-1: Hall C</td>
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<td>H-3: Hall B</td>
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<td>18:00</td>
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<td>T-4: Hall C</td>
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<td>Welcome party</td>
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"NIZHNY NOVGOROD" SHIP SCHEME