

Laboratoire National des Champs Magnétiques Pulsés
CNRS, Université Paul Sabatier et INSA de Toulouse - UMR 5147



<p align="center">French- Russian THz Seminar</p> <p align="center">June 5-6, 2007</p>	
Title of the seminar	Sources and detectors of terahertz radiation based on semiconductor nanostructures
Funding agencies:	Russian Foundation for Basic Research Centre National de la Recherche Scientifique
date and venue	June, 5-6 , 2007 LNCMP laboratory and INSA facilities, Toulouse, France,
French applicant	KNAP Wojciech, (Groupe d'Etude des Semiconducteurs UMR 5650 CNRS & Université Montpellier II) GDR-Européen THZ
Russian applicant	GAVRILENKO Vladimir, Institute for Physics of Microstructures of Russian Academy of Sciences, Nizhny Novgorod
Organizers in Toulouse	GOIRAN Michel and LEOTIN Jean LNCMP-INSA-UPS goiran@lncmp.org ; leotin@lncmp.org

1. Objectives of the seminar :

Sources and detectors of terahertz radiation based on semiconductor nanostructures

One important nowadays challenge of solid state physics and technology is related to so called "Terahertz gap". In terms of the frequency of electromagnetic radiation this gap extends from 0.3 THz to 10 THz. This frequency region still lacks of convenient compact solid state devices that could emit or detect THz radiation in a selective and/or tunable way. Such sources are necessary for emerging applications such as THz medical imaging, chemical and biological sensing, wide-band telecommunications systems, etc.

The "Terahertz gap" can also be seen as a frontier between optics and electronics. The cut-off frequency of nanometer transistors was recently pushed up to a few hundreds GHz and the THz limit becomes realistic for electronic devices. From the high frequency (optics) side the semiconductor lasers (quantum cascade lasers) show possibility of the efficient operation not only in traditional 30 THz range but also in the frequency down to 2-4 THz range.

The main objective of the seminar is to intensify the scientific collaboration between French and Russian research groups in the field of terahertz response of semiconductor nanostructures. The seminar is conceived with the purpose to merge the competences of different scientific teams, to exchange ideas, to discuss the results of the experiments already carried out as well as to plan future joint studies with the exchange of experimental means between French and Russian teams and between adjacent sub-domains of THz research. It is focused on stimulating information exchange and collaborations including exchange research visits of scientists and PhD students.

2. Summary of organization and issues

The seminar is organized by French and Russian coordinators of the European Research Network (GDRE) "Semiconductor sources and detectors of THz frequencies" created in 2006 for the terms of four year. The consortium includes 4 French and 4 Russian laboratories as well as one Polish and one Lithuanian groups who has already established a closed collaboration in the field of THz response of semiconductors and semiconductor nanostructures. The seminar will precede the GDRE School-Meeting to be held in Bordeaux by May 29-31, 2007.

According to the Agreement to create GDRE the Russian Foundation for Basic Research will support the Russian member teams of the GDRE "once they are selected based on a call for proposals under the auspices of the current agreement between the RFBR and CNRS".

The main objective of the seminar is to intensify the scientific collaboration between French and Russian research groups in the field of terahertz response of semiconductor nanostructures. The seminar participants from French and Russian sides represent leading research teams both the involved in closed cooperation in the framework of GDRE and those intended to joint the GDRE in the nearest future.

The scientific program of the seminar includes experimental and theoretical problems of tuneable generation and detection of THz radiation in nanometer High Electron Mobility Transistors (HEMTs) with two-dimensional (2D) electron plasma, quantum cascade lasers operating in THz range, the population inversion and stimulated emission at optical transitions between shallow impurity levels in semiconductor nanostructures, semiconductor nanostructure characterization in high magnetic fields, technological challenges of semiconductor nanostructure growth and nanodevice fabrication, as well as novel approaches to study THz response of semiconductor nanostructures. The seminar also includes invited participants from FZD, Dresde, Germany (Stephan Winnerl) and ISSP Linz, Austria (Thomas Fromherz) on antennas and detectors topics.

All the Russian seminar visitors will participate in the "4e Journées Terahertz" and in the GDRE school-meeting to be held in Bombannes (May 29-June 2, 2007), or visit the French research centers involved in the field of THz response of semiconductor nanostructures.

As the outcome of the seminar, results of the carried out joint experiments will be discussed and interpreted and jointly presented in papers submitted to the international conferences and referred

journals for publication. New ideas on the generation and detection of THz radiation in semiconductor nanostructures as well as novel approaches to study their THz response will be proposed and discussed.

The seminar will enable to formulate the priority directions of scientific research in the field of THz response of semiconductor nanostructures and give impetus to the further French-Russian scientific collaboration in this field.

French-Russian Seminar.

Sources and detectors of terahertz radiation based on semiconductor nanostructures.

5th and 6th June 2007.

Laboratoire des Champs Magnétiques Pulsés, Toulouse.

5th June 2007

9H15 **Opening**

THz Detection

- 9H30 Plasmon enhanced electron drag and terahertz photoconductance in a grating-gated field-effect transistor with two-dimensional electron channel.
G. R. Aizin,¹ **V. V. Popov**,² O. V. Polischuk²
(¹Kingsborough College University of New York, ²Saratov Division of IRE RAS)
- 9H50 Hot electron bolometer mixers and ultrafast detectors for terahertz frequency range.
Gregory Gol'tsman (MPSU, Moscow)
- 10H10 The frequency and power investigations of terahertz radiation with help of nonstationary Josephson effect in high-T_c superconductors.
L.N. Zherikhina, A.M.Tskhovrebov, V.N.Murzin (Lebedev Institute, Moscow)
- 10H30 THz detection by nanotransistors.
Frederic Teppe (GES, Montpellier)
- 10H50 **Pause**
- 11H30 Coherent detection of terahertz radiation with non-resonant antennas.
S. Winnerl, F. Peter, S. Nitsche A. Dreyhaupt, O. Drachenko, H. Schneider, and M. Helm, K. Köhl, (FZD, Dresden),
- 11H50 Integration of quantum wells structures into a p- type silicon BIB structure for THz detection.
Thomas Fromherz, (ISSP, Linz)
- 12H10 THz Blocked Impurity Band Detectors.
Jean Léotin, (LNCMP, Toulouse)
- 12H30 **Lunch**

THz Emission

- 15H00 THz generation by Quantum Cascade Lasers.
Carlo Sirtori, (Thales, Université D. Diderot)
- 15H20 Picosecond's kinetics of photocarriers in GaAs with aluminum nanoclusters
V.Ya.Aleshkin, **Z.F.Krasil'nik**, D.I.Kuritsyn (IPM RAS, Nizhny Novgorod)

- 15H40 THz response of GaAsN and GaAs/AlGaAs nanostructures.
D.A.Firsov, (Saint Petersburg State Polytechnic University).
- 16H00 Molecular beam epitaxial growth of the Sb-and As-based III-V nanoheterostructures for applications in the terahertz and mid-IR spectral ranges
A.N. Semenov, V.A. Solov'ev, B.Ya. Meltser, O.G. Lyublinskaya, Ya.V. Terent'ev, S.V. Ivanov (Ioffe Physico-Technical Institute, St. Petersburg)
- 16H20 **Pause**
- 16H50 THz emission from nanotransistors.
Wojciech Knap, (GES, Montpellier)
- 17H10 Terahertz emission in resonant-tunneling superlattices under vertical electric fields
S.A.Savinov, N.V. Dyakonova+, O.A.Klimenko, W.Knap+, Yu.A.Mityagin, V.N. Murzin,(P.N.Lebedev Institute, Moscow,+ GES Montpellier)
- 17H30 THz activity at IRE Russian Academy of Sciences
M. Kagan (Institute of Radio Engineering and Electronics-Laboratory of non-equilibrium electronic processes in Semiconductors, Moscow, Russia)

6th June 2007

THz Spectroscopy

- 9H30 Resonant tunneling in weakly coupled superlattices in transverse magnetic fields.
V.N. Murzin, Yu.A. Mityagin (Lebedev Institute, Moscow).
- 9H50 Cyclotron resonance of 2D electrons and holes in high magnetic fields.
Vladimir Gavrilenko (IPM RAS, Nizhny Novgorod).
- 10H10 THz spectroscopy of the electron subbands in AIP QWs under high pulsed magnetic fields.
Michel Goiran, (LNCMP, Toulouse).
- 10H30 The impact of a donor and/or acceptor strength of the pi-electron molecular systems on the THz range transitions efficiency and nonlinear-optical response..
Alexander Shkurinov (Lomonosov MSU, Moscow).
- 10H50 **Pause**
- 11H30 **Visit of the LNCMP facility.**
- 12H15 **Lunch**
- 14H30 **Round table and closing session**