



National Research Tomsk State University



St Petersburg
University

**UiT The Arctic University of Norway
Tomsk State University
St Petersburg University**



TOMSK, RUSSIA

NORWEGIAN-RUSSIAN WINTER SCHOOL 2020

Experimental advanced fluorescence spectroscopy
of organic molecules and biological systems

January 25-February 9, 2020

PROGRAM:

January 25, Saturday

09:00-15:00	<i>Meeting and accommodation of foreign participants Konov Ivan, tel. 89234111918</i>
Main building of Siberian Physical Technical Institute (SPhTI) Hall 222, Novosobornaya, 1	
15:00-15:45	School opening ceremony <i>President of TSU Georgy Mayer Vice rector of TSU Evgeniy Lukov Dean of Physics Faculty Sergey Filimonov Deputy Vice Rector for Research and Innovation Yurii Kistenev Head optic and spectroscopy department Victor Cherepanov PhD Rashid Valiev Professor Olga Tchaikovskaya Head of laboratory Valerii Svetlichnyi</i>
15:45-16:15	Coffee break
16:30-17:00	City walking tour: Novosobornaya sq. (the center of tomsk)
19:00-22:00	Jazz Café Underground 36, Lenina Ave Tatyana's Day Tatyana Stukalova (vocals)




January 26, Sunday

Off time

15:20-16:20	Extended walk along the sights of Tomsk (weather permitting): Sightseeing tour on walking routes of the center of Tomsk)
-------------	---


January 27, Monday




Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1

08:45-10:20 	Lecture 1 <i>Multiconfiguration self-consistent field (MCSCF). CASPT2, NEVPT2 and XMC-QDPT2</i> PhD Rashid Valiev Hall 222
10:35-12:10 	Lecture 1 <i>Hybrid theoretical approaches for calculation of optical spectra and excitation transfer between biological sequences and chromophore probes</i> PhD Vladimir Pomogaev Hall 222
12:10-13:00	Lunch
13:00-15:30 	Lecture 1 <i>Continuum solvation models in quantum chemistry</i> PhD Anna Pomogaeva Hall 222
15:30-16:00	Coffee break
16:00-19:00	Culture program The first museum of Slavonian mythology (Zagornaya street, 12) Master class on felting from wool (felt boots and souvenirs)





January 28, Tuesday

Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1



8:45-10:20 	Lecture 2 <i>The role of MCSCF methods in the calculation of triplet and singlet excited states. Examples</i> PhD Rashid Valiev Hall 222
---	---

10:35-12:10 	Lecture <i>Molecules at surfaces. Interplay of chemical bonding and dispersive forcers</i> Prof. Sergey Filimonov Hall 222
12:15-13:00	Lunch
13:00-14:15 	Lecture 1 <i>Interaction-induced electric properties of the van der Waals complexes</i> Prof. Victor Cherepanov Hall 222
14:20-16:00 	Lecture 2 <i>Hybrid theoretical approaches for calculation of optical spectra and excitation transfer between biological sequences and chromophore probes</i> PhD Vladimir Pomogaev Hall 211



January 29, Wednesday

Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1	
8:45-10:20 	Lecture 3 <i>The vibronic spectra of molecules. The Franck-Condon and Herzberg-Teller approximations. Models</i> PhD Rashid Valiev Hall 222
10:35-12:10 	Lecture 1 <i>Confocal microscopy with multiphoton excitation (comparison of multiphoton and single photon regimes). Determination of the two-photon absorption cross section using two-photon-excited luminescence by the two quantum standard method. Investigation of non-stationary absorption by the pump-probe spectroscopy.</i> PhD Valery Svetlichnyi, Ivan Lapin and Dmitry Ezhov Hall 211
12:10-13:10	Lunch
13:15-14:30 	Lecture 2 <i>Continuum solvation models in quantum chemistry</i> PhD Anna Pomogaeva Hall 211
14:45-16:00 	Lecture 2 <i>Interaction-induced electric properties of the van der Waals complexes</i> Prof. Victor Cherepanov Hall 222


January 30, Thursday

	Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1
08:45-12:00 	Lecture 4 <i>Photonics. Photophysical properties. The rate constants of radiative and radiationless electronic transitions</i> PhD Rashid Valiev Hall 222
10:35-12:10 	Lecture 3 <i>Interaction-induced electric properties of the van der Waals complexes</i> Prof. Victor Cherepanov Hall 222

January 31, Friday

	Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1
8:45-10:20 	Lecture 1 <i>Calculating molecular properties: From real-time method to (quasi)-energy derivatives</i> Prof. Kenneth Ruud Hall 222 or 211
10:20-10:45	Coffee break
12:10-13:00	Lunch Café Minutka
	Main building of Siberian Physical Technical Institute (SPhTI) Institute of biology and biophysics
13:05-16:00 	Laboratory 1 <i><u>The first group*</u>: Confocal microscopy with multiphoton excitation (comparison of multiphoton and single photon regimes). <u>The second group**</u>: Determination of the two-photon absorption cross section using two-photon-excited luminescence by the two-quantum standard method. <u>The third group***</u>: Investigation of non-stationary absorption by the pump-probe spectroscopy.</i> PhD Valery Svetlichnyi, Ivan Lapin and Dmitry Ezhov * The first group - at Institute of biology and biophysics (in the University Grove) hall 27 ** The second group – SPhTI Hall 225 ***The third group SPhTI Hall 027
16:00-16:30	Coffee break
16:30-19:00	Culture program Tomsk History Museum (3 Bakunin St.)


February 1, Saturday



	Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 or 211, Novosobornaya, 1
8:45-10:20 	Lecture 2 <i>Calculating molecular properties: From real-time method to (quasi)-energy derivatives</i> Prof. Kenneth Ruud Hall 222 or 211
10:35-12:10	<u><i>Part 2</i></u> Practice 1. Case study <i>A quantum-mechanical model of the energy states of atoms and molecules</i> Prof. Olga Tchaikovskaya and Ivan Konov Hall 211a
13:00-14:00	Siberian Botanical Garden
	Time off

February 2, Sunday



	Day off
15:20-16:20	Culture program The first museum of Slavonian mythology (Zagornaya Street, 12) The master class on modeling from clay
17:20-17:50	City walking tour: Novosobornaya Sq. (the center of Tomsk)
18:00-22:00	Jazz Café Underground 36, Lenina Ave Music group NEMOI (instrumental experimental jazz)

February 3, Monday

	Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1
08:45-10:20 	Lecture 5 <i>Examples of photophysical calculations</i> PhD Rashid Valiev Hall 222
10:35-12:10	The plenary discussion <i>Modern theory in practice</i> Prof. Semen Lyakhovich and, PhD Dmitry Kaparulin Hall 222
12:10-13:00	Lunch
	Main building of Siberian Physical Technical Institute (SPhTI) Institute of biology and biophysics

<p>13:00-14:30</p> 	<p style="text-align: center;">Laboratory 2</p> <p style="text-align: center;"><u>The third group*</u>: Confocal microscopy with multiphoton excitation (comparison of multiphoton and single photon regimes). <u>The first group**</u>: Determination of the two-photon absorption cross section using two-photon-excited luminescence by the two-quantum standard method. <u>The second group***</u>: Investigation of non-stationary absorption by the pump-probe spectroscopy.</p> <p style="text-align: center;">PhD Valery Svetlichnyi, Ivan Lapin and Dmitry Ezhov</p> <p style="text-align: center;">*Institute of biology and biophysics (in the University Grove) hall 27 **SPhTI Hall 225 *** SPhTI Hall 027</p>
<p>14:30-14:45</p>	<p style="text-align: center;">Time off</p>
<p>14:45-16:00</p> 	<p style="text-align: center;"><u>The second group*</u>: Confocal microscopy with multiphoton excitation (comparison of multiphoton and single photon regimes). <u>The third group**</u>: Determination of the two-photon absorption cross section using two-photon-excited luminescence by the two-quantum standard method. <u>The first group***</u>: Investigation of non-stationary absorption by the pump-probe spectroscopy.</p> <p style="text-align: center;">PhD Valery Svetlichnyi, Ivan Lapin and Dmitry Ezhov</p> <p style="text-align: center;">*Institute of biology and biophysics (in the University Grove) hall 27 **SPhTI Hall 225 ***SPhTI Hall 027</p>

February 4, Tuesday

	<p style="text-align: center;">Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1</p>
<p>09:45-10:20</p>	<p style="text-align: center;">Transfer to Institute of Atmosphere Optic (Academic city)</p>
<p>10:20-11:00</p>	<p style="text-align: center;">Excursion in Institute of Atmosphere Optic</p>
<p>11:00-12:10</p> 	<p style="text-align: center;">Lecture</p> <p style="text-align: center;"><i>The water vapour self-continuum absorption in the infrared atmospheric windows: New laser measurements near 3.3 and 2.0 μm</i></p> <p style="text-align: center;">PhD Alex Solodov and PhD Semen Vasilchenko</p>
<p>12:10-13:00</p>	<p style="text-align: center;">Lunch Café Dom Ucheny</p>
<p>13:00-15:30</p> 	<p style="text-align: center;">Lab</p> <p style="text-align: center;"><i>Measurement and Modeling of Air-Broadened Methane Absorption in the MERLIN Spectral Region at Low Temperatures</i> <i>FTIR spectroscopy of some gases confined in nanoporous silica aerogel</i></p> <p style="text-align: center;">PhD Alex Solodov and PhD Semen Vasilchenko</p>
<p>15:30-16:30</p>	<p style="text-align: center;">Transfer to Tomsk</p>

February 5, Wednesday






	Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1
8:45- 10:20	Lecture <i>Multiphoton microscopy. Visualization of biological tissues</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 211
10:35- 13:00	Laboratory 1 The first group <i>Multiphoton microscopy. Visualization of biological tissues</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 225
10:35- 13:00	Laboratory 1 <i>Luminescence spectroscopy</i> Prof. Olga Tchaikovskaya and PhD Yuliya Aksenova The second group HALL 203-204 The third group HALL 211a
13:00- 14:00	Lunch
14:00- 16:00	Laboratory 1 The first group <i>Luminescence spectroscopy</i> Prof. Olga Tchaikovskaya and PhD Yuliya Aksenova Hall 211a
14:00- 16:00	Laboratory 1 The second group <i>Multiphoton microscopy. Visualization of biological tissues</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 225
	Culture program Museum of the History of the NKVD or the Museum of Wooden Architecture

February 6, Thursday



	Main building of Siberian Physical Technical Institute (SPhTI) Novosobornaya, 1, Hall 222 and 211a
08:45- 10:20	Laboratory 2 <i>Luminescence spectroscopy</i> Prof. Olga Tchaikovskaya and PhD Yuliya Aksenova The first group HALL 203-204 The second group Hall 211a
08:45- 10:20	Laboratory 1 The third group <i>Multiphoton microscopy. Visualization of biological tissues</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 225
10:45- 12:10	<i>Student research presentation</i> Hall 211a
	Lunch

14:45-16:20	Lecture 3 <i>Interaction-induced electric properties of the van der Waals complexes</i> Prof. Victor Cherepanov Hall 222
Time off	

February 7, Friday

Main building of SPbTI Novosobornaya, 1, Hall 222	
8:45-10:20 	Lecture 4 <i>Interaction-induced electric properties of the van der Waals complexes</i> Prof. Victor Cherepanov Hall 222
10:35-12:10 	Laboratory 2 The second group <i>Visualization of biological tissues, works on optical tomographs, mathematical image processing</i> Prof. Yuriy Kistenev and Victor Nikolaev Research Institute of Applied Mathematics and Mechanics TSU
10:35-12:10	Laboratory 1 <i>Luminescence spectroscopy</i> prof. Olga Tchaikovskaya and PhD Yuliya Aksenova the third group HALL 203-204 the first group HALL 211a
12:10-13:00	Lunch
13:00-14:30 	Laboratory 2 The first group <i>Visualization of biological tissues, works on optical tomographs, mathematical image processing</i> Prof. Yuriy Kistenev and Victor Nikolaev Research Institute of Applied Mathematics and Mechanics TSU
13:00-14:30 	Laboratory 1 <i>Luminescence spectroscopy</i> prof. Olga Tchaikovskaya and PhD Yuliya Aksenova the third group HALL 203-204 the second group HALL 211a
14:30-14:45	Café time
14:45-16:00	<i>Presentation of student scientific works</i>
14:45-16:00 	Laboratory 2 The third group <i>Visualization of biological tissues, works on optical tomographs, mathematical image processing</i> Prof. Yuriy Kistenev and Victor Nikolaev Research Institute of Applied Mathematics and Mechanics TSU

February 8, Saturday

08:45-12:10	Main building of SPhTI Novosobornaya, 1, Hall 222
08:45-10:20 	Lecture 5 <i>Interaction-induced electric properties of the van der Waals complexes</i> Prof. Victor Cherepanov Hall 222
10:35-12:10 	Laboratory 3, processing measurements and summarizing the work All groups <i>Multiphoton microscopy. Visualization of biological tissues</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 211
12:10-13:00	Coffee break
14:00-16:00	Culture program Theater of living dolls (trans. Yuzhny, 29)
	Time off

February 9, Sunday

05:45-	Departure Airport transfer
--------	---------------------------------------

CONTACTS:

COORDINATOR OF PROGRAM:

Olga Tchaikovskaya, mob. +79059923299

VOLONTERS:

Tatyana Nevzorova, mob. +799996203275, +79627770899

Elena Bocharnikova, mob. +79528800844

Overview Programme

Lectures, Instrumentation for laboratories “Absorbance and Fluorescence spectra” and “Intermolecular interactions” (Prof. Olga *Tchaikovskaya, Ivan Konov*)

This module gives a basic introduction to the physical principles of understanding the interaction of electromagnetic radiation with matter. We tried to avoid quantum representations, and some complex questions are presented in a simplified non-mathematical form. The module acquaints students with the variety of modern physical methods and with the features of the experiment. Fluorescence techniques are being used and applied increasingly in academics and industry. The Principles of Fluorescence Techniques course will outline the basic concepts of fluorescence techniques and the successful utilization of the currently available commercial instrumentation. The course is designed for students who utilize fluorescence techniques and instrumentation and for researchers and industrial scientists who wish to deepen their knowledge of fluorescence applications. Participants are recommended to have at least a bachelor's degree in the life sciences, physical sciences or engineering before attending. Interactions between participants and lecturers will be fostered. Students will have ample opportunity to personally explain their research programs and ask questions about the applicability of specific fluorescence techniques to their course lecturers.

In our discussion of instrumentation factors, we will stress their effects on absorbance, excitation and emission spectra of organic molecules. Additionally, the optical properties of the biological samples, such as density and turbidity, can also affect the spectra.

We wish to record spectra with using UV-VIS spectrophotometer (for absorption of light), IR spectrophotometer (for absorption of IR light) and spectrofluorometer (for excitation and emission of light), for example: *Carry Eclipse*, CM2203 (SOLAR, Belarus), *Evolution 600 (THERMO ELECTRON)* or *NIKOLET-380* firms.

Laboratory work will best be carried out in a room equipped with a fume hood, chemical glassware, analytical balance, quartz cuvette (path length 1 cm) and dispensers. We will determine the concentration of organic

molecules (what is the true optical density of the solution? What is the apparent optical density measured by our spectrophotometer?); oscillator strength of the electronic transition, Stokes shift, S_1 state lifetime, Lippert curve, etc.

In laboratory classes, students will get acquainted with specific examples of establishing the structure of compounds, learn how to obtain spectra and identify a substance. The module is a less week consisting of lecture a 2 hours and a 2 labs a 4-6 hours. The students will in addition solve physical problem as well as implement computer algorithms relevant to the lecture guided by tutors.

Lectures, Instrumentation for laboratories
“Multiphoton fluorescence excitation: new spectral windows for biological nonlinear microscopy” (*PhD Valery Svetlichnyi, Dmitry Ezhov*)

The module consists of the following topics: 1. Confocal microscopy with multiphoton excitation (comparison of multiphoton and single photon regimes). 2. Determination of the two-photon absorption cross section using two-photon-excited luminescence by the two quantum standard method. 3. Investigation of non-stationary absorption by the pump-probe spectroscopy.

This module gives a basic introduction to the physical principles of understanding the interaction of electromagnetic radiation with matter under the action of laser radiation. In laboratory classes, students will get acquainted with fast-flowing photo processes.

The module is a less week consisting of lecture a 2 hours and a 2 labs a 6 hours.

Lecture “Interaction-induced electric properties of the van der Waals complexes” (*Prof. Victor Cherepanov*)

The electrical properties of molecules and molecular complexes are the subject of a close attention up today. While the multipole electric moments have studied good enough, any information about the polarizabilities, especially higher polarizabilities, is quite scarce. At the same time, these interaction-induced properties play often the key role to understand many physical and chemical properties of interacting

molecules or atoms. The knowledge of such interactions is important for lot of applications in science and engineering. This small book summarizes mainly the researches carried out last decade by group of Tomsk State University and devoted to interaction-induced electrical properties (multipole moments, (higher)polarizabilities) of van der Waals complexes. We hope that this short survey gives useful contribution to the theory of molecular interactions to be applied for modeling of different physical chemical properties of interacting species, for describing the long-range potential energy surfaces and the surfaces of some electrical properties of van der Waals complexes.

Prof. Yuri Kistenev and Victor Nikolaev (lectures, practical classes - Study of the spatial structure of collagen using the methods of multiphoton microscopy and machine learning, Diagnosis of oral lichen, Broadband tunable source) planus from analysis of saliva samples using terahertz time-domain spectroscopy and chemometrics)

Luminescence spectroscopy (lecture and practices/laboratory works, 6 hours). Coordinators: Ph.D. Yuliya Aksenova, Prof. Dr. Olga Tchaikovskaya

Outline of the module

This module gives a basic introduction to the physicochemical basis of luminescence. It does not require special knowledge of classical physics or quantum chemistry. The module gives an overview at the beginner level. Basic knowledge in the field of molecular structure and photoprocesses occurring in molecular systems is sufficient to attend the module. Additional important concepts will be taught in the beginning: spectroscopic parameters and laws, characteristics of electronic transitions in complex molecules - luminophores. The main classes of luminophores and the processes of absorption and emission of light occurring in them will be considered. Applications of luminescence spectroscopy will also be discussed. So, luminescent methods are successfully applied to measure kinetics and establish the mechanism of chemical reaction; for analytical purposes to detection and identification of low concentrations of substances, determination the purity of compounds. They are also used in biology for the study of protein structure by fluorescent probes and labels.

The module covers the following topics:

- What is luminescence?
- What types of luminescence exist? What characteristics can be determined?
- What photoprocesses occur in polyatomic organic molecules - luminophores?
- What are the main applications of luminescence spectroscopy?

The plenary discussion "Modern theory in practice"

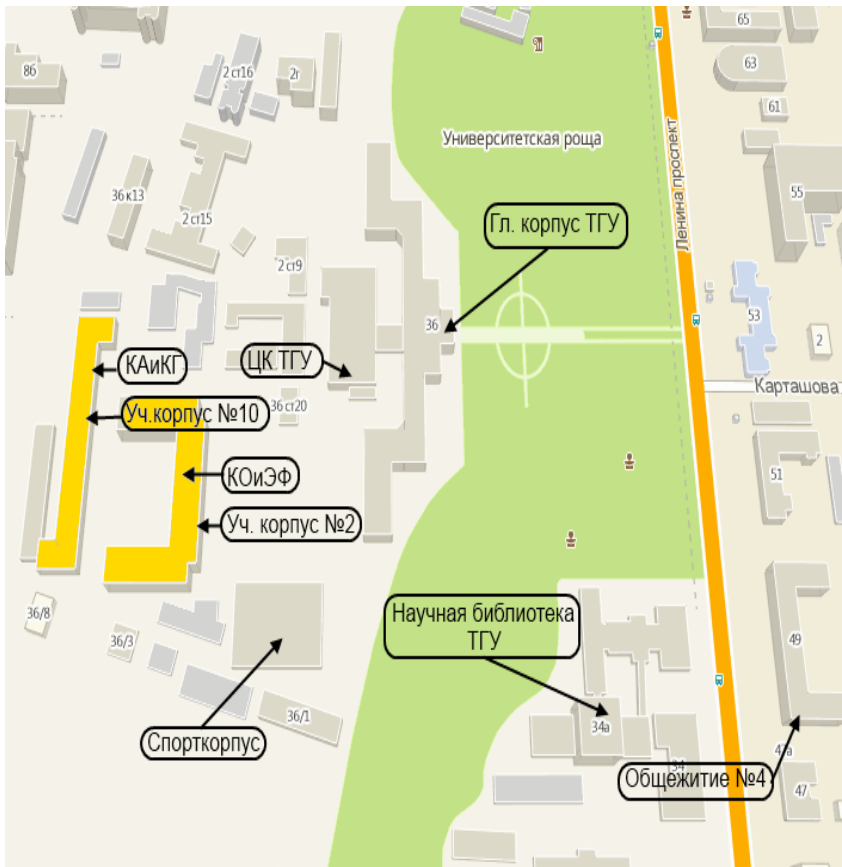
(Prof. Semen Lyakhovich, PhD Dmitry Kaparulin)

The discussion of modern theoretical fantasies in promoting experimental research.

Student research presentation

Students report no more than 10 minutes in free scientific form about their achievements in the field of quantum chemistry and spectroscopy.

The school was supported by the joint Norwegian-Russian scientific and educational project Optical Probe Sensors at Biological Environments (OPS @ BE) (2018-2020).



How to find us

There are two ways for you can get to Tomsk:

Moscow – Tomsk

by plane – approximately 4 hours (aircompany: SU, S7, Ural)

by train – approximately 56 hours (train 037/038 Tomich)

Novosibirsk – Tomsk

by plane – approximately 40 minutes

by train – approximately 5 hours

by bus or car – approximately 4 hours (300 km)

Both Moscow and Novosibirsk have regular international airline connections with a number of cities all over the world.

TSU International Division:

Tel./Fax: +7 (3822) 529 558

e-mail: int.admissions@mail.tsu.ru

For notes

