

UiT The Arctic University of Norway
Tomsk State University

III Winter school in Tomsk
"Advanced experimental optical spectroscopy"
January 25-February 9, 2020

PROGRAM:

January 25, Saturday

09:00-15:00	meeting and accommodation of foreign participants Konov Ivan, tel. 89234111918
Main building of Tomsk State University (TSU) Hall 209, Lenin Ave, 36	
15:00-16:00	school opening ceremony President of TSU Georgy Mayer Vice rector of UiT Kenneth Ruud Vice rector of TSU Victor Dyomin Dean of Physics Faculty Sergey Filimonov Senior Adviser, coordinator for Cooperation with Russia and CIS Tatiana Savinova 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 PhD Maarten Beerepoot
16:30-18:00	Dinner Café Minutka or Restaurant

January 26, Sunday

	Breakfast
	Off time
	Lunch



Физический факультет

1

15:20-16:20	City tour (weather permitting: Sightseeing tour on walking routes of the center of Tomsk) Lecture? Kenneth or Maarten?
19:00-21:00	CAFÉ UNDERGROUND Jazz

January 27, Monday

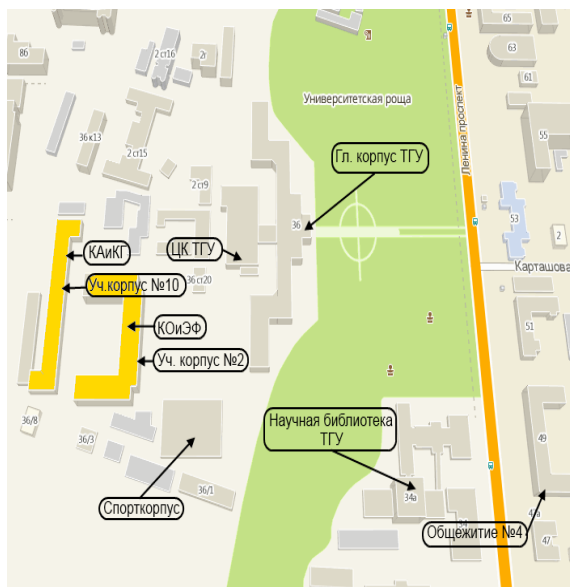
Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1	
08:45-10:20	Lecture 1 Multiconfiguration self-consistent field (MCSCF). CASPT2, NEVPT2 and XMC-QDPT2 PhD Rashid Valiev Hall 222
10:35-12:10	Lecture 1 Introduction. The electromagnetic radiation scale. The spectral region of photobiological processes. processes and reactions proceeding under the influence of light in molecule Prof. Olga Tchaikovskaya and Ivan Konov Hall 211a
12:10-13:00	Lunch
13:00-15:30	Lab 1 Introduction. The scheme of photochemical reactions: light absorption by molecules, electronically excited molecular states, primary photochemical reaction. The execution of Booger - Lambert - Bera Law Prof. Olga Tchaikovskaya Hall 211a
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	
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For notes





How to find us

There are two ways for you can get to Tomsk:

Moscow – Tomsk

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

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 forces</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	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

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 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. PhD Valery Svetlichnyi and Dmitry Ezhov Hall 225
12:10-13:10	Lunch

13:15-14:30	Lecture <i>Luminescence spectroscopy</i> PhD Yuliya Aksenova Hall 211a
14:45-16:00	Lecture 2 <i>Interaction-induced electric properties of the van der Waals complexes</i> Prof. Victor Cherepanov Hall 222
	Time off

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

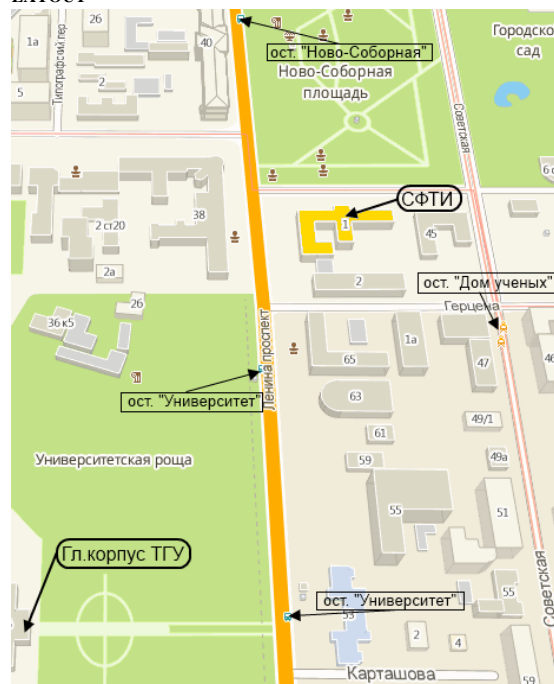
January 31, Friday

Main building of Siberian Physical Technical Institute (SPhTI)

Hall 222 and 211a, Novosobornaya, 1

08:45-11:00	Lab 2 part 1 <i>Electronically excited states of molecules. Yablonsky scheme</i> Prof. Olga Tchaikovskaya Hall 211a
11:10-12:10	Siberian Botanical Garden
12:10-13:00	Lunch Café Minutka

HOUSING LAYOUT



Where can I have lunch on my own

Café, The 2nd academic building of TSU, The first floor

Café "Minutka", the main building of TSU

KFC, busstation "University"

Café "Baget-omlet", busstation "University"

Café "Conference", Science Library of TSU

Restaurant "Oborny Riyd", St. Gercen, 1a

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).

13:05-16:00	 Lab 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. PhD Valery Svetlichnyi and Dmitry Ezhov Hall 225
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 and 211a, Novosobornaya, 1	
8:45-10:20	 Lab 2 part 2 <i>Electronically excited states of molecules. Yablonsky scheme</i> Prof. Olga Tchaikovskaya Hall 211a
Time off	

February 2, Sunday	
Day off	
Culture program The first museum of Slavonian mythology (Zagornaya Street, 12) The master class on modeling from clay	

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	<i>The plenary discussion "Modern theory in practice"</i> Prof. Semen Lyakhovich and, PhD Dmitry Kaparulin Hall 222

12:10-13:00	Lunch
13:00-14:30	 Lab 2 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. PhD Valery Svetlichnyi and Dmitry Ezhov Hall 225
14:30-14:45	Time off
14:45-16:00	 Lab 2 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. PhD Valery Svetlichnyi and Dmitry Ezhov Hall 225

February 4, Tuesday	
Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1	
09:45-10:20	Transfer to Institute of Atmosphere Optic (Academic city)
10:20-11:00	Excursion in Institute of Atmosphere Optic
11:00-12:10	 Lecture <i>The water vapour self-continuum absorption in the infrared atmospheric windows: New laser measurements near 3.3 and 2.0 μm</i> PhD Alex Solodov and PhD Semen Vasilchenko
12:10-13:00	Lunch Café Dom Ucheny
13:00-15:30	 Lab <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> PhD Alex Solodov and PhD Semen Vasilchenko

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

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.

Non-centrosymmetric borates $K_7CaR_2(B_5O_{10})_3$ have been synthesized by solid state reaction and successfully grown by the top seeded solution growth method using $K_2O-B_2O_3-CaF_2$ flux. IR, Raman, absorption spectra as well as data on melting temperature for the crystals will obtain. Optical properties like UV absorption edge and SHG intensity will compare with KH_2PO_4 (KDP) and $K_7CaY_2(B_5O_{10})_3$.

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

	Time off
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February 7, Friday

	Main building of SPhTI 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 <i>Visualization of biological tissues, works on optical tomographs, mathematical image processing</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 225
12:10-13:00	LUNCH
13:00-14:30	Laboratory 3 <i>Visualization of biological tissues, works on optical tomographs, mathematical image processing</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 225
14:30-14:45	Café time
14:45-16:00	<i>Presentation of student scientific works or lecture</i> <i>PhD Vladimir Pomogaev “The layered modeling”</i> Time off

February 8, Saturday

	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 4 <i>Visualization of biological tissues, works on optical tomographs, mathematical image processing</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 225
12:10-13:00	Coffee break

15:30-16:30	Transfer to Tomsk
	Time off

February 5, Wednesday

	Main building of Siberian Physical Technical Institute (SPhTI) Hall 222 and 211a, Novosobornaya, 1
8:45-10:20	Lecture <i>Visualization of biological tissues, works on optical tomographs, mathematical image processing</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 225
10:35-13:00	Laboratory 1 <i>Visualization of biological tissues, works on optical tomographs, mathematical image processing</i> Prof. Yuriy Kistenev and Victor Nikolaev Hall 225
13:00-14:00	LUNCH
14:00-16:00	Laboratory 1 <i>Luminescence spectroscopy</i> Prof. Olga Tchaikovskaya and PhD Yuliya Aksenova Hall 211a
	Culture program

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 Hall 211a
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

14:00-16:00	Culture program Theater of living dolls (trans. Yuzhny, 29)
	Time off

February 9, Sunday

05:45-	Departure Airport transfer
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CONTACTS:

COORDINATOR OF PROGRAM:

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VOLONTERS:

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Lena 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.

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.