PLANCKS student visit

L1 Laboratory for femtosecond laser spectroscopy

Research in the Laboratory for femtosecond laser spectroscopy is focused on investigation of photochemical processes using ultrafast spectroscopy methods and laser microstructuring.

Photochemistry is one of the most influential research fields that expand our knowledge of some important processes such as: ultrafast chemical reactions, efficient energy conversion (photosynthesis), photodegradation, photopolymerization etc. In photochemical reactions, processes initiated by exciting a molecular ensemble can result in formation of new molecules. Careful selection of excitation energy and temporal or spectral pulse shaping can be used for controlling chemical reactions.

Miniaturization of the different components of devices and microstructuring of various materials is indispensable in modern technology. As an alternative to machine or chemical processing, direct laser writing of different structures is used more and more. Sufficient intensity of laser field is obtained by tight focusing of ultrashort laser pulses. The short duration of laser pulses reduces thermal effects and provides high precision of inscribed micron and sub-micron structures. This technique is particularly useful in applications such as fabrication of 3D photonic crystals, waveguides, microfluidic devices etc.

During your visit to the lab we will present you our research on monitoring of different ultrafast photoinduced processes as well as microstructuring (drilling) of human teeth.

L2 Laboratory for magnetic anisotropy

Most of the magnetic materials that physicists study today are not magnetic in the conventional sense: you would not be able to stick them to the fridge or at least collect them with a magnet like you can collect a piece of iron. To the naked eye these materials do not seem magnetic. However, they exhibit much more exciting magnetic states which, in some cases, can also be harvested for new technologies. Important class of materials are so called low-dimensional magnets in which quantum effects play important role in formation of exotic ground states.
In our laboratory we study magnetic anisotropy of new low-dimensional magnetic materials. Our experimental techniques allow us to observe magnetic phase transitions, symmetry breaking and different types of spin reorientations in antiferromagnets.

L3 2D materials

2D materials (2DMs), such as single-layer graphene, hexagonal boron nitride and molybdenum disulfide, are promising candidates for significant advancements in technology due to their novel and exciting properties. In this tour, two laboratories devoted to the investigation of 2DMs will be visited. In one of them (2D synthesis lab), techniques for the synthesis of 2DMs will be presented and important parameters of their growth will be discussed. In another laboratory (Lab for surface science and nanostructures), two surface-sensitive, vacuum-based techniques will be addressed (STM and ARPES) that are commonly used for characterization of the morphology and electronic structure of 2DMs.

More info @ http://cems.irb.hr/en/research-units/the- science-of- graphene-and- related-2d-structures/teme-istrazivanja/

L4 Laboratory for magnetic research by inductive techniques

We cover the measurements of following quantities:
- initial and differential ac susceptibility (including the higher harmonics)
- simple and butterfly hysteresis
- Magnetic after effect (time relaxation of ac susceptibility) in the range of 1.5 - 900 K, up to 1 kOe and up to kHz range of frequency of driving magnetic field.

Recent research on new generation of steels for nuclear and future fusion reactors will be presented.

L5 Laboratory for laser microscopy

The main focus of our research is based on investigation of exceptional optical properties of 2D materials due to the light-matter interaction. This interaction does not only reveal the electronic structure of the material, but can also be an excellent tool for exploring 2D crystal structural features. Optical setup based on confocal microscope in backscattered configuration serves for absorption (contrast reflectivity), photoluminescence and Raman spectra measurements. Equipped with xy-translator stages, confocal setup provides both a sequential sample movement and spectrum data acquisition from the defined sample area with sub-micron resolution. In this way spatial maps of the sample are created. With such infrastructure we are able to investigate and understand optical and electronic properties of atomically thin 2D materials and related van der Waals (vdW) heterostructures and use this knowledge to form structures and devices with desired optical response. The intrinsic semiconducting character of transition metal dichalcogenides (TMD) hold the potential for applications in electronics and valley physics. TMDs are often combined with other 2D materials like graphene andhexagonal boron nitride to make heterostructures. These heterostructures need to be optimized to be possibly used as building blocks for developing optoelectronic applications, including photodetectors, photodiodes, light-emitting devices, and photovoltaic cells etc., with promising impact on our technology.

L6 Laboratory for dielectric spectroscopy and magnetotransport

New electronic and spintronic materials have been allowing us to build faster, smaller and smarter devices. Microscopically, most high-tech compounds rely on electrons organizing themselves cooperatively, and the responsible electronic interactions may under certain circumstances give rise to exotic phases and effects, such as colossal magnetoresistance, unconventional superconductivity, charge ordering, density waves of spin etc. To better understand how these novel electronic orderings relate to each other and tailor them to our needs, in our laboratory we probe for their subtle signatures in electric capacitance and conductivity when the material under examination is cooled to low temperatures and placed in magnetic fields.

L7 Cold Atoms @ Institute of Physics

We investigate cold rubidium atoms, cooled and trapped in magneto-optical trap by laser cooling techniques. We use that atoms to explore novel phenomena that arise when atoms are excited by a specific kind of the femtosecond laser called frequency comb. We explore novel directions in laser cooling which could contribute to the improvement of the precision of optical frequency standards, enable measurements of fundamental constants with unprecedented accuracy, and open up the possibility to reach quantum degeneracy with atoms that have optical transitions unreachable by continuous wave lasers such as hydrogen, deuterium and antihydrogen.

In our laboratory you will have the opportunity to see the coolest object in Croatia - glowing ball of rubidium atoms at temperatures around 50 microK. Colder even than universe.

For details visit http://cold.ifs.hr/

L8 Plasma Lab

In Plasma Lab we study few types of plasmas ranging from hot to cold and from low pressure to atmospheric pressure plasmas. We use plasmas as a souce of light for elemental analysis, source of particles for new molecules synthesis and as a source of atoms and ions in liquids for colloidal nanoparticles solution synthesis. Various plasma sources and their combinations are applied for material treatments in order to make new materials with added values. Atmospheric pressure plasma jets are recently used for plasma agriculture, plasma medicine and plasma material processing applications.

A grupa - vodič: Mateo Forjan
10:30 - 10:50 L1 Laboratory for femtosecond laser spectroscopy
10:50 - 11:10 L2 Laboratory for magnetic anisotropy
11:10 - 11:30 L3 2D materials

B grupa - vodič: Ivana Levatić
10:30 - 10:50 L2 Laboratory for magnetic anisotropy
10:50 - 11:10 L3 2D materials
11:10 - 11:30 L4 Laboratory for magnetic research by inductive techniques

C grupa - vodič: Borna Radatović
10:30 - 10:50 L3 2D materials
10:50 - 11:10 L4 Laboratory for magnetic research by inductive techniques
11:10 - 11:30 L5 Laboratory for laser microscopy

D grupa - vodič: Damir Dominko
10:30 - 10:50 L4 Laboratory for magnetic research by inductive techniques
10:50 - 11:10 L5 Laboratory for laser microscopy
11:10 - 11:30 L6 Laboratory for dielectric spectroscopy and magnetotransport

E grupa - vodič: Valentino Jadriško
10:30 - 10:50 L5 Laboratory for laser microscopy
10:50 - 11:10 L6 Laboratory for dielectric spectroscopy and magnetotransport
11:10 - 11:30 L7 Cold Atoms @ Institute of Physics

F grupa- vodič: David Rivas
10:30 - 10:50 L6 Laboratory for dielectric spectroscopy and magnetotransport
10:50 - 11:10 L7 Cold Atoms @ Institute of Physics
11:10 - 11:30 L8 Plasma Lab

G grupa- vodič: Danijel Buhin
10:30 - 10:50 L7 Cold Atoms @ Institute of Physics
10:50 - 11:10 L8 Plasma Lab
10:10 - 11:30 L1 Laboratory for femtosecond laser spectroscopy

H grupa- vodič: Damjan Blažeka
10:30 - 10:50 L8 Plasma Lab
10:50 - 11:10 L1 Laboratory for femtosecond laser spectroscopy
11:10 - 11:30 L2 Laboratory for magnetic anisotropy

PROGRAM TOUR:

10:00 **10:30**	WELCOME SPEECH by director Dr. Marko Kralj (All groups together)							
Group:	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
10:30 **10:50**	L1	L2	L3	L4	L5	L6	L7	L8
10:50 **11:10**	L2	L3	L4	L5	L6	L7	L8	L1
11:10 **11:30**	L3	L4	L5	L6	L7	L8	L1	L2
Group photo at the end of the visit in front of the Institute								