DEPARTMENT OF SOLID STATE PHYSICS

F-5

Our research programme focuses on the study of the structure and dynamics of disordered and partially ordered condensed matter at the atomic and molecular levels, with a special emphasis on phase transitions. The purpose of these investigations is to discover the basic laws of physics governing the behaviour of these systems, which represent the link between perfectly ordered crystals, on the one hand, and amorphous matter, soft condensed matter and living systems, on the other. Such knowledge provides the key to our understanding of the macroscopic properties of these systems and is an important condition for the discovery and development of new, multifunctional materials, nanomaterials and biomaterials for new applications. An important part of the research program is devoted to the development of new experimental methods and techniques in the field of magnetic resonance, magnetic resonance imaging, fluorescence microspectroscopy, scanning-tunnelling, electronic and atomic force microscopy, as well as dielectric relaxation spectroscopy and dynamic specific-heat measurements.

Head:
Prof. Igor Muševič

The experimental techniques used are:

- One (1D) and two (2D) dimensional nuclear magnetic resonance (NMR) and relaxation, as well as quadrupole (NQR) resonance and relaxation,
- Multi-frequency NMR in superconducting magnets of 2T, 6T and 9T, as well as the dispersion of the spin–lattice relaxation time t_1 via field cycling,
- Nuclear double resonance and quadrupole double resonance such as ^{17}O–H and ^{14}N-H,
- Fast field cycling NMR relaxometry,
- Frequency-dependent electron paramagnetic resonance (EPR) and 1D and 2D pulsed EPR and relaxation,
- MR imaging and micro-imaging,
- Measurement of the electronic transport properties,
- Magnetic measurements,
- Fluorescence confocal microscopy and microspectroscopy,
- Linear and non-linear dielectric spectroscopy in the range 10^{-2} Hz to 10^{9} Hz,
- Electron microscopy and scanning-tunnelling microscopy,
- Atomic force microscopy and force spectroscopy,
- Dynamic specific-heat measurements,
- Low-temperature scanning-tunnelling microscopy and single-atom manipulation,
- Atomic Force Microscopy,
- Manipulation of particles with laser tweezers,
- Super-resolution STED microscopy,
- Laser cooling and manipulation of Cs atoms.

The research program of the Department of Solid State Physics at the Jožef Stefan Institute is performed in close collaboration with Department of Physics at the Faculty of Mathematics and Physics of the University of Ljubljana, Institute of Mathematics, Physics and Mechanics and the Jožef Stefan International Postgraduate School. In 2018, the research was performed within three research programs:

- Magnetic resonance and dielectric spectroscopy of smart new materials
- Physics of Soft Matter, Surfaces and Nanostructures
- Experimental Biophysics of Complex Systems

I. Research program "Magnetic resonance and dielectric spectroscopy of smart new materials"

The research of the programme group *Magnetic Resonance and Dielectric Spectroscopy of Smart New Materials* was focused on the study of physical phenomena in condensed matter at the atomic and molecular levels. The purpose of these investigations was to discover the basic laws of physics governing the behaviour of the investigated systems. The acquired knowledge provides the key to the understanding of the microscopic and macroscopic properties of various types of solids and is an important condition for the discovery and development of new, multifunctional materials and nanomaterials for novel technological applications.

In our research we used the following experimental techniques:

- Nuclear magnetic resonance (NMR), electron paramagnetic resonance (EPR) and nuclear quadrupole resonance (NQR),
- Nuclear double resonance ^{17}O–H and ^{14}N–H,
- Fast field cycling NMR relaxometry,
- Linear and non-linear dielectric spectroscopy in the range 10^{-2} Hz to 10^{9} Hz,
- Frequency-dependent ac calorimetry,
- Measurement of electrical and thermal transport coefficients,
- Magnetic measurements,
- Methods of ultra-cold atoms.

The research programme was performed in close collaboration with the Department of Physics at the Faculty of Mathematics and Physics of the University of Ljubljana, Institute of Mathematics, Physics and Mechanics, and the Jožef Stefan International Postgraduate School.

In 2018, members of the programme group published 38 original scientific papers in international peer-reviewed scientific journals, two book chapters and obtained two US patents. Among these, one paper was published in Nature Physics (IF = 22.7), one in Adv. Mater. (IF = 22), one in Nano Letters (IF = 12.1), one in Sci. Adv. (IF = 11.5), one in J. Mater. Chem. (IF = 9.9), two in Phys. Rev. Lett. (IF = 8.8) and 15 papers in the journals with an IF between 3.0 and 5.0.

The investigations were focused to the following research fields:

1. Quantum magnetism

Andrej Zorko, Peter Jeglič, Matej Pregelj, and Denis Arčon, in collaboration with partners from Switzerland, Germany, and Russia, studied the magnetic properties of the layered compound CuNCN with several experimental techniques, including NMR, NQR, and mu-SR. The investigation revealed a magnetically frozen and disordered magnetic ground state. The authors showed that regions of magnetically frozen and paramagnetic phases coexist on a microscopic level in this compound below the freezing temperature in a broad temperature range. The results were published in the paper A. Zorko *et al.* "Magnetic inhomogeneity in the copper pseudochalcogenide CuNCN", *Phys. Rev. B* 97, 214432 (2018).

The research group has presented the first experimental proof of the existence of "anyone" particles (the particles that are simultaneously fermions and bozons) and discovered new quantum magnetic states in solid-state materials. It has found new multiferroic materials, revealed complex magnetism of high-entropy alloys, developed fully printed thin-film capacitors and determined the physical-mechanical properties of liquid crystals and liquid-crystalline elastomers.

Andrej Zorko and Denis Arčon, in collaboration with partners from the United Kingdom, Greece and Germany, employed a combination of complementary experimental techniques, including heat-capacity measurements, NMR and elastic and inelastic neutron scattering to investigate the structural and magnetic properties of the geometrically frustrated antiferromagnet β-$NaMnO_2$. The measurements disclosed the existence of novel structural degrees of freedom, which are incompatible with any commensurate order and are instead explained by an incommensurate compositionally modulated crystal structure. Such a structure leads to an incommensurate, that is, inhomogeneous, cooperative magnetism. The discovery was published in the paper F. Orlandi *et al.* "Incommensurate atomic and magnetic modulations in the spin-frustrated β-$NaMnO_2$ triangular lattice", *Phys. Rev. Materials* 2, 074407 (2018).

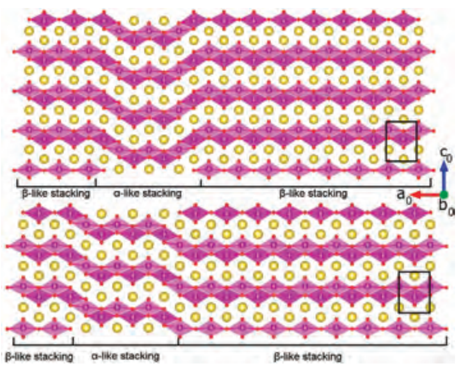

Figure 1: Incommensurate, compositionally modulated crystal structure of β-$NaMnO_2$

Andrej Zorko, in collaboration with partners from Croatia, France and the USA, discovered the first crystal structures of oxo-bridged [$Cr^{III}Ta^{V}$] dinuclear complexes. The new structure complies with theoretical predictions based on DFT calculations. The compound was also magnetically characterized by the use of bulk SQUID magnetometry and a local-probe ESR technique. Also, these experimental results agree well with DFT-based expectations. The discovery was published in the paper L. Androš Dubraja *et al.* "First crystal structures of oxo-bridged [$Cr^{III}Ta^{V}$] dinuclear complexes: spectroscopic, magnetic and theoretical investigations of the Cr–O–Ta core", *New J. Chem.* 42, 10912 (2018).

Matej Pregelj, Andrej Zorko and Denis Arčon, in collaboration with partners from Switzerland and Austria, discovered the coexistence of spinon and magnon excitations in the beta-$TeVO_4$ system. Their work is a rare demonstration of the coexistence of fractional and collective excitations in a system of weakly coupled, frustrated, zigzag spin chains. The team reproduced the experimental dispersion relations, derived from inelastic neutron scattering, using the linear-spin-wave-theory calculations and pre-calculated spinon dispersion. This allowed them to quantitatively determine the main exchange interactions and their anisotropies. The discovery was published in the paper M. Pregelj *et al*. "Coexisting spinons and magnons in the frustrated zigzag spin-1/2 chain compound β-$TeVO_4$", *Phys. Rev. B* 98, 094405 (2018).

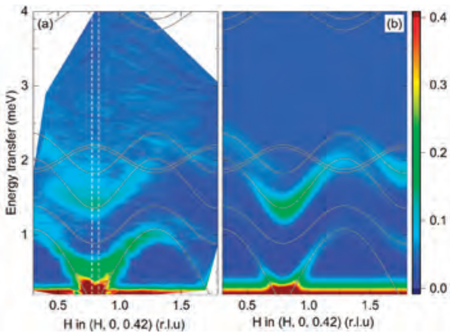

Figure 2: Results of inelastic neutron scattering: (a) measurement and (b) theoretical model.

Matej Pregelj, Nejc Janša and Denis Arčon, in collaboration with partners from Italy and Brazil, investigated spin fluctuations in a high-spin state of cobalt valence tautomer. A reversible transition from a low- to a high-spin state can be induced by temperature, pressure and light irradiation. The team investigated spin dynamics by nuclear-magnetic-resonance, muon-spin-relaxation and magnetization measurements. They found that at low temperatures (30 K) the high-spin state can be induced by light irradiation, which has a lifetime of several hours and occurs in the MHz frequency range. The discovery was published in the paper F. Caracciolo *et al*. "Spin fluctuations in the light-induced high-spin state of cobalt valence tautomers", *Phys. Rev. B* 98, 054416 (2018).

Nejc Janša, Andrej Zorko, Matjaž Gomilšek, Matej Pregelj and Martin Klanjšek, together with partners from Switzerland, experimentally demonstrated that a spin flip in the most promising Kitaev honeycomb magnet, in ruthenium trichloride, fractionalizes into a Majorana fermion and a pair of gauge fluxes, in line with the famous Kitaev prediction. Both types of fractional quasiparticles behave as neither pure fermions nor pure bosons, but rather as anyons. As they are both found to survive in a broad range of temperatures and magnetic fields, this discovery establishes ruthenium trichloride as a unique platform for future investigations of anyons. The work was published in the article N. Janša *et al.*, "Observation of two types of fractional excitation in the Kitaev honeycomb magnet", *Nature Physics* 14, 786 (2018).

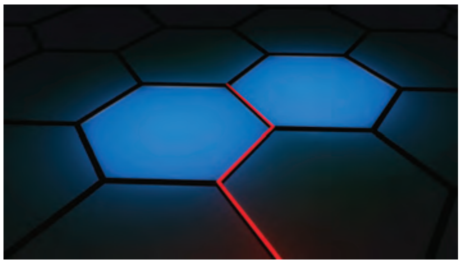
Figure 3: In a Kitaev honeycomb magnet, a spin flip fractionalizes into three fractional quasiparticles: a Majorana fermion (red trace) and two excited gauge fluxes (blue hexagons).

Denis Arčon, Peter Jeglič and Tilen Knaflič discovered a Verwey-type charge ordering and electron localization transition in a compound that is composed of negatively charged dioxygen molecules. One of the very first attempts to understand the charge dynamics in mixed-valence systems dates back to 1939 when Evert Verwey, a Dutch chemist, observed a sudden jump in resistivity near -150°C in magnetite. A research team of scientists from Germany and Slovenia reported a Verwey-type transition in a completely different class of mixed-valence compounds, which is composed of negatively charged dioxygen molecules. The compound Cs_4O_6 undergoes a phase transition from a state with indistinguishable molecular O_2^{x-} entities to a state with well-defined superoxide O_2^- and peroxide O_2^{2-} anions. The breakthrough of this study is the observation of such a charge ordering in a simple crystal structure where novel physical phenomena are expected to emerge from intertwining of the degrees of freedom pertinent to electronically active oxygen molecular units. The work was published in P. Adler *et al.*, "Verwey-type charge ordering transition in an open-shell p-electron compound", *Science advances* 4, eaap7581 (2018).

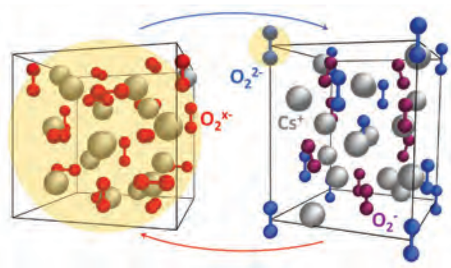

Figure 4: Charge ordering in Cs_4O_6 is temperature dependent and is responsible for the change in the crystal structure and the electrical conductivity.

2. Magnetism of CeGdTbDyHo high-entropy alloy

We have investigated the magnetism of the CeGdTbDyHo high-entropy alloy, composed of rare-earth elements that mix ideally in a solid solution. This high-entropy alloy forms an almost undistorted hexagonal crystal lattice (Figure 5), which possesses an enormous chemical disorder. The structure is stabilized entropically by the mixing entropy term $T\Delta S_{mix}$ in the Gibbs free energy.

By measuring the magnetic susceptibility, the magnetoresistance and the specific heat, we have determined the *(H, T)* magnetic phase diagram, which contains a helical antiferromagnetic state at elevated temperatures and a disordered ferromagnetic state at low temperatures (Figure 6).

Published in: S. Vrtnik, J. Lužnik, P. Koželj, A. Jelen, J. Luzar, Z. Jagličić, A. Meden, M. Feuerbacher, J. Dolinšek. Disordered ferromagnetic state in the Ce-Gd-Tb-Dy-Ho hexagonal high-entropy alloy. *Journal of Alloys and Compounds* 742 (2018), 877-886.

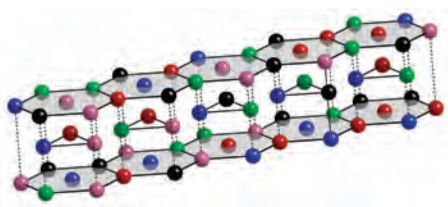
Figure 5: Schematic presentation of the crystal structure of a hexagonal high-entropy alloy, composed of five chemical elements that mix randomly on the lattice.

3. Study of nanostructured materials and materials with large caloric effects for solid-state cooling applications

Ferroelectric relaxors are an important class of materials that exhibit extraordinary ferroelectric, dielectric, piezoelectric, and electrocaloric properties. The physical reason behind these extraordinary properties of relaxors are the so-called polar nanoregions (PNRs). In this study we investigate the impact of PNRs on the polarization and electrocaloric properties by utilizing the dynamic pair distribution function (DPDF) technique. The DPDF indicates the distance between a specific atomic pair, while the peak height corresponds to the probability of finding such an

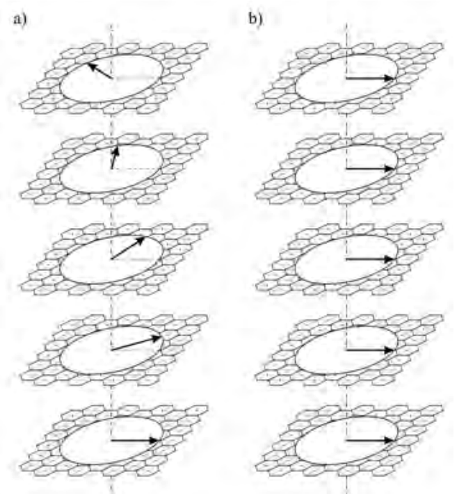

Figure 6: Schematic presentation of (a) helical antiferromagnetic structure and (b) ferromagnetic structure.

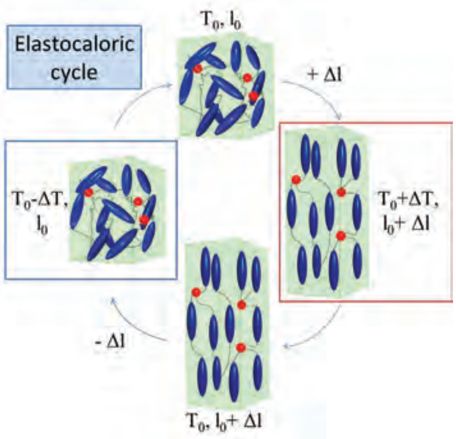

Figure 7: Elastocaloric cooling cycle.

atomic pair at this distance. Hence, we obtained direct information about the specific atomic off centring corresponding to polar vectors in real space, which was correlated with the dielectric, polarization and electrocaloric response of the lead-free relaxor system $Ba(Ti,Zr)O_3$. The study was published in Pramanick, A., Dmowski, W., Egami, T.I, Setiadi Budisuharto, A., Weyland, F., Novak, N., Christianson, A., Borreguero, J. M., Abernathy, D., J rgensen, M. R. V. Stabilization of Polar Nanoregions in Pb-free Ferroelectrics. *Physical Review Letters* **120** (2018), 207603.

We showed by direct measurements the existence of the large electrocaloric effect in novel bulk lead-free materials. In addition, we demonstrated that these materials can replace materials based on lead due to their large electrocaloric responsivity and large breakdown electric field. A patent application, which was bought by the company Gorenje d.d. in 2016, has been awarded a USA patent in 2018: patent Malič, B., Uršič, H., Kosec, M., Drnovšek, S., Cilenšek, J., Kutnjak, Z., Rožič, B., Flisar, U., Kitanovski, A., Ožbolt, M., Plaznik, U., Poredoš, A., Tomc, U., Tušek, J.. *Method for electrocaloric energy conversion: United States Patent US9915446 (B2), 2018-03-13*.

4. Enhanced electrical response in ferroelectric thin-film capacitors with inkjet-printed $LaNiO_3$ electrodes

We have developed an inkjet-printing process for lanthanum nickelate ($LaNiO_3$, LNO) top electrodes onto ferroelectric $Pb(Zr,Ti)O_3$ (PZT) thin films on platinized silicon substrates. The evolved ink formulation enabled the deposition of well-defined, smooth, and flat layers with minimal inter-diffusion at the LNO–PZT interface. The capacitors exhibit better polarization-switching characteristics, improved fatigue properties, and an about 40 % larger dielectric constant than those with sputtered gold top electrodes. The Rayleigh analysis of the dielectric response revealed the strongly enhanced mobility of the ferroelectric domain walls as the main contribution to improved characteristics of the LNO–PZT capacitors. Published in: A. Matavž, J. Kovač, M. Čekada, B. Malič, V. Bobnar, Applied Physics Letters 122, 214102 (2018).

5. Cellulose nanofibrils–reduced graphene oxide xerogels and cryogels for dielectric and electrochemical storage applications

Composites with reduced graphene oxide incorporated into the cellulose nanofibrils matrixes were fabricated as a dense film-like xerogel and well-aligned micro-to-nano porous cryogels and evaluated related to their dielectric properties and electrochemical storage capacity. An outstanding dielectric performance and high flexibility of the xerogel sample makes it a promising candidate as a highly-performing dielectric material for energy-storage applications in engineering and electronic fields. On the other hand, the high specific capacitance and electrochemical resistance indicate the suitability of porous cryogel as an electrode material in electrochemical storage devices. Published in: Y. Beeran, V. Bobnar, M. Finšgar, Y. Grohens, S. Thomas, V. Kokol, Polymer 147, 260 (2018).

6. Direct patterning of piezoelectric thin films by inkjet printing

We have developed a novel process for the patterning of lead zirconate titanate (PZT) films on pristine platinized silicon through the use of inkjet-printed alkanethiolate-based templates. The technique requires neither lithography nor etching, respectively, before and after PZT printing. The described process allows for feature sizes in the sub-100-μm range with control over the thickness of the final film. Inkjet-printed PZT displays the typical ferroelectric and piezoelectric properties of solution-derived thin films. Since substrate templating and functional material deposition are performed via additive manufacturing and using the same technology, we argue that our process could be an economically viable alternative to conventional deposition processes of patterned metal oxide films on high-surface-energy metal substrates. Published in: N. Godard, S. Glinšek, A. Matavž, V. Bobnar, E. Defay, Advanced Materials Technologies (2018), doi: 10.1002/admt.201800168.

7. Parameter optimizations for the synthesis of Al-doped ZnO nanodiscs by laser ablation in water

Al-doped ZnO crystalline colloidal nanodiscs were synthesized by the laser ablation of $ZnO:Al_2O_3$ in MilliQ water. Experiments were performed systematically by changing the number of applied laser pulses and laser output energy with the aim to affect the nanoparticle size, composition (Al/Zn ratio) and characteristics (band-gap, crystallinity). Distinctly, a set of nanoparticle syntheses was performed in deionized water for comparison. An SEM investigation of colloidal nanoparticles revealed that the formed nanoparticles are 30-nm-thick nanodiscs with average diameters ranging from 450 to 510 nm. It was found that craters in the target formed during the laser ablation influence the size of the synthesized colloidal nanoparticles. This is explained by the efficient nanoparticle growth through a diffusion process, which takes place in the spatially restricted volume of the target crater. When laser ablation takes place in deionized water, the synthesized nanoparticles have a mesh-like structure with a sparse concentration of disc-like nanoparticles. The Al/Zn ratio and band-gap energy of the nanoparticles are highly influenced by the number and output energy of applied laser pulses (N. Krstulović, K. Salamon, O. Budimilja, J. Kovač, J. Dasović, P. Umek, I. Capan: *Applied Surface Science* 440 (2018) 916–925).

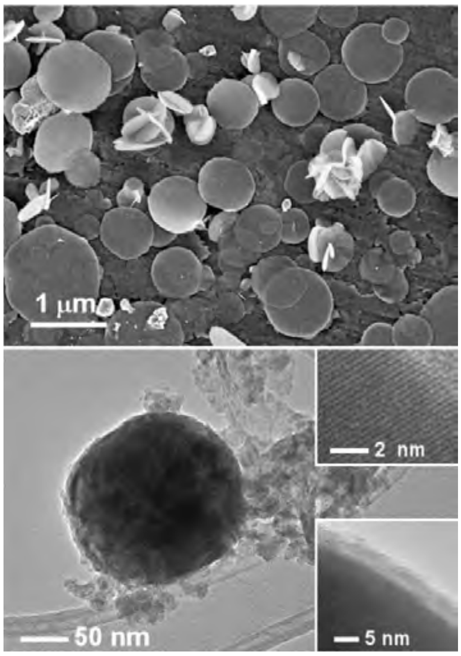

Figure 8: Representative SEM (a) and TEM (b) images of Al-doped ZnO nanodiscs. The particles were formed by irradiation of the ZnO:Al_2O_3 target with 10,000 laser pulses and 300 mJ of laser output energy (λ_{laser}=1064 nm).

8. Re-Orientational Motions and Ionic Conductivity in $(NH_4)_2B_{10}H_{10}$ and $(NH_4)_2B_{12}H_{12}$

Closo-boranes are promising materials for use in solid-electrolyte fuel cells due to their high ionic conductivity. We investigated two ammonium borane systems, containing 10 or 12 boron atoms in a boron cage (Figure 9). Molecular motions were studied by means of ^{1}H and ^{11}B NMR spectra and spin-lattice relaxation. We identified activation energies for rotations of the boron cages around different axes. These rotations assist the long-range diffusion of NH_4 units. Independent ionic conductivity measurements uncovered that these two systems are bad conductors and that the conductivity cannot be explained solely by the rotations of boron cages. Published in: Anton Gradišek, Mitja Krnel, Mark Paskevicius, Bjarne R. S. Hansen, Torben R. Jensen, Janez Dolinšek, *J. Phys. Chem. C*, 2018, **122**, 17073-17079.

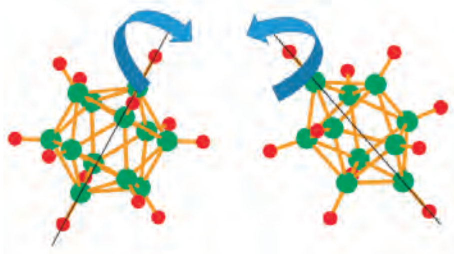

Figure 9: Structural details of $(NH_4)_2B_{10}H_{10}$ in $(NH_4)_2B_{12}H_{12}$, containing 10 or 12 boron atoms in a boron cage.

9. NMR investigations of liquid-crystalline elastomers

We investigated the orientational ordering of molecular building blocks in liquid single-crystal elastomers, using deuteron quadrupole perturbed nuclear magnetic resonance. By analysing the temperature dependencies of spin-spin and spin-lattice magnetization relaxation rates, we have resolved differences in the re-orientational dynamics of network-bound and free mesogen molecules, as well as of crosslinker molecules in selectively deuterated networks. We have found the dynamics of crosslinker to be substantially slower than the dynamics of mesogen, leading in the first case to strong homogeneous broadening of the resonance lines. This supports the scenario of substantial local disorder in the nematic director for real liquid single-crystal elastomer networks.

Research activities in the field of the physics of liquid crystal elastomers have been extended to binary systems, consisting of two mesogen species, typically of a nematogen and of a smectogen, with controlled composition. In such systems, the temperature profiles of elastic and thermomechanical response can be altered by changing the composition. We have shown that a relatively low external mechanical stress induces a transition from the smectic to the nematic state in the networks of composition close to 1:1, as observed through a decrease in the elastic constant by at least one order of magnitude (Figure 10).

Published in: Dynamic investigation of liquid crystalline elastomers and their constituentas by ^{2}H NMR spectroscopy, J. Milavec, A. Rešetič, A. Bubnov, B. Zalar, and V. Domenici, Liquid Crystals **45**, 2158-2173 (2018); Stress-strain and thermomechanical characterization of nematic to smectic A transition in a strongly-crosslinked bimesogenic liquid crystal elastomer, A. Rešetič, J. Milavec, V. Domenici, B. Zupančič, A. Bubnov, and B. Zalar, Polymer **158**, 96-102 (2018).

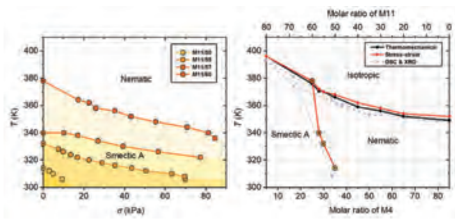

Figure 10: Temperature-composition-stress phase diagram of a binary smectic-nematic liquid-crystal elastomer.

II. Research programme "Physics of Soft Matter, Surfaces, and Nanostructures"

The investigations of the research program ***"Physics of Soft Matter, Surfaces, and Nanostructures"*** focus on novel complex soft-matter systems and surfaces with specific functional properties. The aim of the program is to understand the structural and dynamical properties of these systems, their interactions, their function at the molecular level, and self-assembly mechanisms in soft matter. The underlying idea is that it is possible to understand complex mechanisms, such as self-assembly, on a macroscopic level, using a simplified physical picture and models. In order to provide a comprehensive approach to the problem, the program combines both experimental and theoretical investigations, supported by modelling and simulations. Special emphasis is given to the possible electro-optic and medical applications.

Topological defects stabilized by fibres in a nematic liquid crystal

We demonstrate the stabilization of a large number of oppositely charged topological defects around helical colloids or grooved rods (*Soft Matter*, 14, (2018), 9819). In the case of straight fibres such defects are annihilated, but in this case the curved shape of the helical colloids or the grooved surface of a straight rod create energy barriers between neighbouring defects and prevent their annihilation. We also demonstrate a new type of topological loops

Using numerical modelling we have identified a novel coupling mechanism that is responsible for driven passive defects in active nematic. We succeeded in generating a large number of topological defects on spiral and ribbed colloids in the nematic liquid crystal and explain the mechanism of their stabilisation. We observed strong resonances in the photo-luminiscent spectra emitted by MoS_2 microtubes.

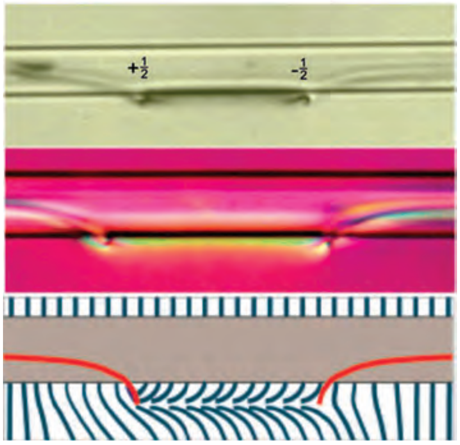

Figure 11: Topological soliton stabilized by fibre in a nematic liquid crystal.

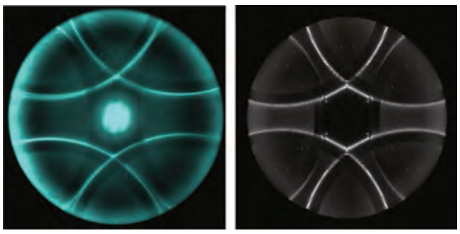
Figure 12: Experimental and numerically calculated Kosselov diagram of light reflected from a thin layer of a chiral liquid crystal forming a Skyrmion lattice.

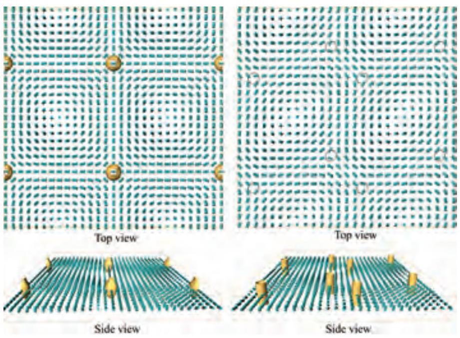

Figure 13: Periodically patterned molecular anchoring on confining surfaces stabilizes square lattices of half-Skyrmions and disclinations with winding number -1.

on a homeotropic fibre aligned perpendicular to the nematic director in a planar nematic cell. These stable loops can carry either positive or negative charge, or can be charge neutral and are always accompanied by two topological solitons, which emanate from the loop and propagate to the left- and right-hand sides of the fibre (*Liquid Crystals*, 45, (2018) 2294).

Observation of a Skyrmions lattice in an ultra-thin liquid-crystal layer

We identified the hexagonal lattice of half-Skyrmions in a thin film of a chiral liquid crystal by optical observation using the Kossel technique (*Scientific Reports*, 8, (2018) 17234). In the presented case Kossel lines appear as hexagonally arranged circular arcs and can be regarded as the manifestation of the dispersion eigenmodes of the medium. Our study demonstrates that the Kossel technique could be used to investigate the dispersion properties of thin systems that exhibit non-trivial band structures such as topologically protected exotic surface states in the optical regime.

Modelling thin layers of blue phases: stabilization of Skyrmion lattices and near-field optical microscopy

Solving Maxwell equations, we modelled optical images of Skyrmion lattices in thin layers of cholesteric blue phases that can be obtained by near-field optical microscopy. (Optics Express 26, (2018)1174). With Q-tensor-based phenomenological modelling we demonstrated how in thin layers of cholesteric blue phases of the second kind we can, with periodically patterned molecular anchoring on confining surfaces, stabilize square and trigonal lattices of half-Skyrmions (*Liquid Crystals,* 45, (2018) 2329–2340).

Topology of chiral nematic liquid crystals

Springer published the doctorate of Gregor Posnjak as a book in the Springer Theses series (Topological formations in chiral nematic droplets) in which they publish exceptional doctoral theses. The book presents a newly developed fluorescent confocal polarized microscopy method that enables an experimental determination of the director structures in liquid crystals. This method is used to study the complex structures of chiral nematic liquid crystals in droplets in detail. These structures range from highly symmetric layered structures and structures with line defects to newly observed point defects with topological charges -2 and -3, which enable the formation of complex topological molecules.

Localised opto-thermal response of nematic liquid crystal to laser light

We studied the non-equilibrium dynamics of the isotropic-to-nematic phase transition by observing the thermal response of a thin nematic liquid-crystal layer to a strong laser pulse, which is partially absorbed by the Indium Tin Oxide electrodes of the measuring LC cell. During the ultra-fast cooling the temperature profile of the heated region and the time response of the nematic layer birefringence were measured. (*Liquid Crystals, DOI: 10.1080/02678292.2018.1557270*).

Active nematic emulsions

Active nematic emulsions were demonstrated based on the encapsulation of an active liquid crystal, based on microtubules and kinesin molecular motors, into a thermotropic liquid crystal. These active nematic emulsions exhibit a variety of dynamic behaviours that arise from the cross-talk between the topological defects, separately residing in the active and passive components. Using numerical simulations, we show a feedback mechanism by which active flows continuously drive the passive defects. Such a hybrid active-passive system provides new perspectives for the dynamic self-assembly driven by an active material but regulated by the equilibrium properties of the passive component. The research was a combination of numerical modelling, performed at the Faculty of Mathematics and Physics at the University of Ljubljana and the Department of Condensed Matter Physics at the Jožef Stefan Institute, and experiments, which were performed at University of Barcelona. (Science Advances 4, (2018) eaao1470).

Read-on-demand microstructures in nematic cells

The generation of read-on-demand images and identification codes in a liquid-crystal (LC) device was demonstrated. Experimentally, these micrometre-sized polymer features are encoded directly into LC devices using direct laser writing, which locks in the local molecular orientation at the moment of fabrication. By reading the devices with the same voltage amplitude that is used to write the polymer structures, features can be made to disappear as the director profile becomes homogeneous with the surrounding regions, effectively cloaking the structure for both polarized and unpolarized light The potential use of this work is in authenticity and identification applications. Experiments were performed at the University of Oxford, whereas theory and numerical modelling were conducted at the Faculty of Mathematics and Physics at the University of Ljubljana and the Department of Condensed Matter Physics at the Jožef Stefan Institute (Advanced Optical Mater 6 (2018) 18005159). The work was also presented by the editors of Nature Photonics (Nat. Photon. **12**, (2018) 504).

Figure 14: A layered structure in a chiral nematic droplet with cylindrical symmetry and a single point defect.

Electro-caloric effect in nematics and its applications

Using Landau-type mesoscopic modelling, we demonstrated that the materials exhibiting continuous symmetry-breaking phase transitions could be efficiently exploited for thermal stabilisation and thermal transport. In particular, we developed a pioneering model describing the electrocaloric (EC) response in nematic liquid crystals. Using it we determined the conditions enabling anomalously strong EC responses (Energy 162, (2018) 554-563).

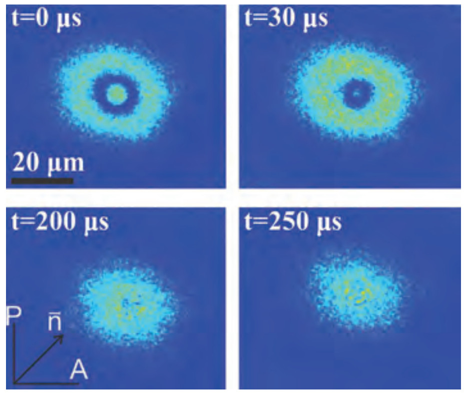

Figure 15: Ultra-fast cooling of the nematic liquid crystal.

Nematic droplets in water solutions of different electrolytes

We demonstrated experimentally and theoretically the strong impact of the electrostatic properties on structural transitions in nematic liquid-crystal (NLC) droplets dispersed in different aqueous environments. Among others we developed a phenomenological model of an electric double layer in the presence of different ionic impurities. The results reveal that one could sensitively control the NLC structural transitions by tuning the electrostatic properties (Soft Matter 14, (2018) 9619-9630).

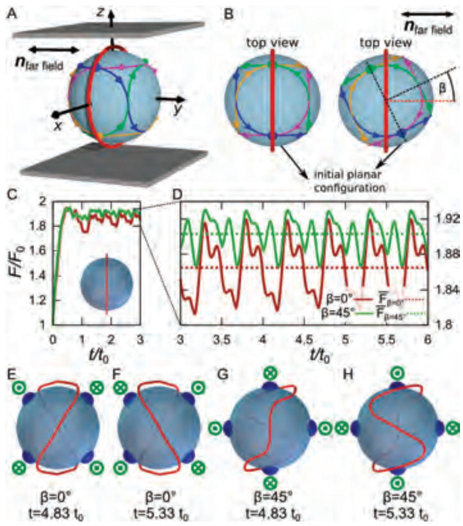

Figure 16: Coupling of the active defects to the passive nematic liquid crystal.

Nanosafety

We measured the release of nanoparticles during the burning of incenses, which are still in use as air fresheners, for insect repelling or for meditative purposes, although it is known that they significantly deteriorate the quality of indoor air (Air Quality, Atmosphere & Health **11**, (2018) 649-663). In the case of two types of incense, we found that the burning of a single incense causes a 30-fold increase in the number of nanoparticles in a room of 30 m^3 volume. The chemical analysis of the released nanoparticles showed the presence of $CaCo_3$, SiO_2, and traces of Mg, K, Al, Fe and Cl. At the end of the burning period, the nanoparticles are 60 to 100 nm in size, which puts them in a size group with a high health risk. The concentration exceeds 200,000 nanoparticles/cm^3. Their concentration only slowly decreases with time on account of the agglomeration into larger particles. In order to reduce the exposure to nanoparticles, we recommended shortening the burning time and ventilation of the room.

MoS_2 micro- and nanotubes

In collaboration with coworkers from Russia, USA and France, we studied the optical properties of MoS_2 micro- and nanotubes prepared by chemical transport reaction, which enables the growth of nanotubes with a very small concentration of structural defects. Strong peaks in the micro-photoluminescence (μ-PL) spectra were revealed, when detecting the light polarized along the nanotube axis. (*Appl.Phys. Lett.* **113**, (2018) 101106). A model describing the optical properties of the nanotubes acting as optical resonators was developed, which supports the quantization of whispering gallery modes inside the nanotube wall. Our findings open a way to use such nanotubes as the polarization-sensitive components of nanophotonic devices.

Self-assembly of organic corrosion inhibitors on metal surfaces

We studied (sub-)monolayers of the organic corrosion inhibitor 2-mercaptobenzimidazol on copper surfaces using scanning tunnelling microscopy and spectroscopy. By varying the substrate temperature during the deposition and using different heat treatments afterwards, we were able to study molecule-molecule and molecule-substrate interactions. The studied structures were compared and solved with the help of extensive DFT calculations. The results will help us to understand the reasons for the high effectiveness of these molecules as corrosion inhibitors.

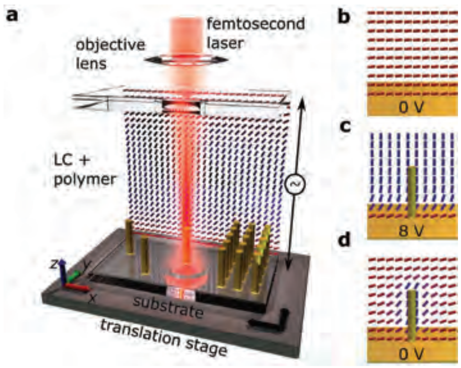

Figure 17: Direct laser writing of birefringent polymer objects that can be cloaked with birefringence.

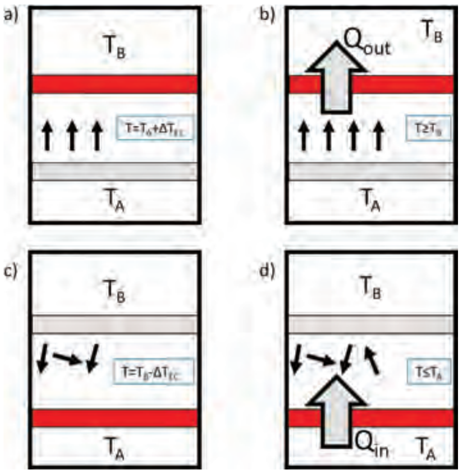

Figure 18: Key stages of the EC-based cooling cycle.

Structure of quasi one-dimensional charge density wave material

The basic and the charge density wave (CDW) structures of the monoclinic NbS_3-II polymorph were studied by synchrotron X-ray diffraction, ab-initio calculations, simulation of the electron diffraction patterns, and by atomic-resolution transmission electron and low-temperature scanning tunnelling microscopies. By solving the structure we were able to propose a mechanism for CDW sliding that is observed in this and some related materials (Physical Review B 98, (2018) 174113).

Atom laser and Bose fireworks

Two interesting phenomena in Bose-Einstein condensates have been observed. Firstly, if the dipole trap potential is slowly opened on the bottom, a coherent downwards flow of atoms appears – a continuous atom laser. Secondly, by periodically modulating the interatomic interaction the condensate inside a quasi-one-dimensional confinement emits jets of atoms. The simple one-dimensional geometry offers a new, simpler environment to study these so-called Bose fireworks that have previously only been observed in a two-dimensional geometry.

Smeared d-wave anisotropy in a monolayer organic superconductor

The smeared anisotropy of low-lying quasiparticles in a single-layer d-wave organic superconductor is observed when the anti-nodal states are inextricably mixed. The weak momentum dependence is only manifested for low-lying states, while higher-energy states preserve their momentum anisotropy (Advanced Electronic Materials, DOI: 10.1002/aelm.201800247)

III. Research program "Experimental biophysics of complex systems and imaging in biomedicine"

The programme group "Experimental biophysics of complex systems and imaging in biomedicine" combines research of the processes and structures of biological systems by developing new, advanced experimental techniques of super-resolution microscopies, micro-spectroscopies and nano-scopies as well as new imaging techniques. Our research is mainly focused on the response of molecular and supramolecular structures to interactions between materials and living cells as well as between light and living cells. We are interested in molecular events and the physical mechanisms with which these events are causally connected, time scales, conditions and the applied value of the investigated mechanisms, especially for use in medicine and in the field of health care in general. With the development of new, coupled super-resolution and spectroscopic techniques we want to open up new possibilities to investigate biological systems and from there onwards to open up new possibilities for designing medical materials and devices, for diagnostics, therapy and tissue regeneration, representing key challenges due to the aging population. The investment into the new super-resolution STED system opened a variety of fluorescence microscopy approaches: STED microscopy and two-photon (2PE) microscopy, multichannel spectrally resolved fluorescence lifetime imaging (spFLIM), fluorescence micro-spectroscopy (FMS). These, coupled with optical tweezers, can be used to examine interactions between materials, nanomaterials and cell lines and the phenomena involved such as lipid wrapping, membrane disintegration, and cellular membrane translocation, bypassing conventional signalling pathways. We also introduced a method that enables the monitoring of the electric field in tumours in the treatment of cancer with electroporation, and further developed a method of multiparametric magnetic resonance imaging for the characterization of food and medicines and various industrial processes. High-resolution magnetic resonance imaging can monitor the effectiveness of surface treatments, the formation and dissolution of gels as well as measure diffusion in confined geometries with the use of modulated gradients.

A new molecular event has been described in our article in Nano letters, which is triggered by lipid wrapping that can drive the relocation of membranes and membrane proteins across the living pulmonary epithelium.

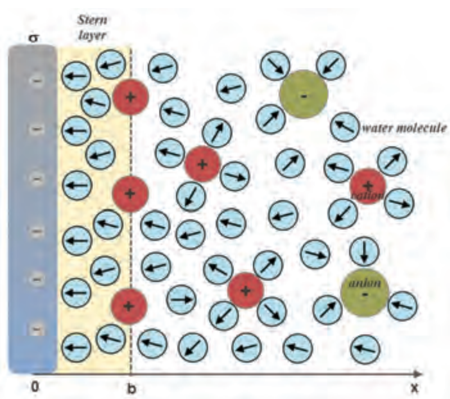

Figure 19: Schematic figure on an electric double layer near a negatively charged surface.

Because of the introduction of nonlinear super-resolution live microscopy in 2017 to monitor the changes in supramolecular structures in living systems and deep involvement in the H2020 SmartNanoTox project, in 2018 the team of the Laboratory of Biophysics successfully published its first high-impact paper after many years. In this publication (Nano Lett., 2018, 18 (8), pp 5294–5305) we directly observed the molecular event of lipid wrapping in the lung epithelium by STED microscopy, which we could previously observe only indirectly, using many other methods. This observation has triggered many other studies, including proteomics analysis, which has been done within the SmartNanoTox consortia, in particular with David Gomez's group at UCD (Dublin, Ireland) and which indicated many possible interferences between various proteins, their relocation and the known signalling cascades. The paper published in Nano letters has discussed one of those interferences, the one that potentially leads to coagulation. However, the proteomics results led us to lysosome disruption, mitochondrial network changes, and cytoskeleton degradation as well, which have been studied by live STED microscopy in 2018. Several interesting phenomena have been observed, driven by the physical affinity between the surface of the nanomaterials and the supramolecular structures, such as fibrous structures of actin and tubulin and membranes of mitochondria, endosomes and lysosomes. The team members have a focus on the dynamics, the driving forces and correlation by the known processes such as endocytosis, linear transportation within the cell and uptake into lysosomes, where the cell would try to degrade the nanoparticles, of course unsuccessfully. As a result of such physical interactions, new structures have been observed, making the complex of remnants of cell organelles and nanomaterial. More evidences are collected to prove that these structures are growing within the cells, before the cells go into the apoptotic phase.

To understand the first contact between nanomaterials and the lung's epithelial surface, the Laboratory of Biophysics team has started the development of a living copy of a lung together with a system that mimics the breathing, including the nanomaterial exposure. Here, the problem addressed in our laboratory is the rupture of the surfactant layers that separate the air in the lung and the epithelial cell layer. The nebulization of nanomaterials has been implemented on a special incubator that allows monitoring of the cell layer by STED super-resolved microscopy live during exposure. Since nanomaterial exists as individual particles as well as various aggregates, high dynamic range vertical-section microscopy has to be applied free of PSF contamination. For that purpose, the other modality of new equipment two-photon STED microscopy has been applied (at the time of purchase this was the only commercial machine of its kind in the world) and allow us to see "nano rain" in the vertical cross-section. To colocalize with surfactant proteins SP-B and SP-C the team contacted the group of Jesus Perez Gil from Univ. Madrid (Spain), which will provide us with specific labelling of the aforementioned proteins.

To track the nanoparticles in a living organism, the NPs must have a fluorescence signal. In the past year the Laboratory of Biophysics team has designed and optimized a NP labelling protocol that is suitable for metal oxides, in general, exemplified on TiO_2 NPs. This protocol contains an important step, for which the basic knowhow has been transferred into our laboratory from the group of Christian Eggeling from the University of Oxford (UK). This step relies on Fluorescence Correlation Spectroscopy (FCS), which can be performed also on our STED microscope. FCS is used to validate the labelling efficiency and the desorption of the probe after labelling. In addition to the labelling protocol, our team has discovered that (at least some of) the TiO_2 nanostructures can be imaged without labelling by gated microscopy. The trick originates in the fact that some of the TiO_2 structures weakly fluoresce. Usually, this fluorescence is so fast that normal detectors do not acquire enough light. In our case, the APD detectors are fast enough, providing an opportunity to catch those photons and distinguish them from other fluorescence such as autofluorescence or the one from specific labelling. This result has been recognized by the European Commission and the SmartNanoTox project officer at the SmartNanoTox midterm evaluation in September 2018 as one of the most important results in nanotoxicology-related EU projects, since it allows the tracking of TiO_2 nanomaterials in vitro, in vivo and ex vivo without labelling.

For efficient labelling we have designed, synthesized and tested a series of new STEDable fluorophores where we specifically aim at molecules that rearrange slowly from plasma to internal cell membranes. Two candidates have been selected for further improvements based on the stability/possible resolution and slow rate of relocation in the lipid phase. In addition, we designed new par-fluorophores for nano-temperature mapping, which aim at detecting the temperature profiles within cells, in particular within mitochondria, where higher temperatures are expected based on the evolution adaptation of mitochondria-located enzymes.

In collaboration with the Biological Physics Group at Carnegie Mellon University, Pennsylvania, USA, we have studied the phase behaviour and structure of lipid sphingomyelin (SM) model membranes using X-ray diffraction. Despite the biological significance of SMs, there is far less structural information available for SMs compared to glycerophospholipids. We have observed clear evidence of a ripple phase for egg SM as well as palmitoyl SM for a relatively

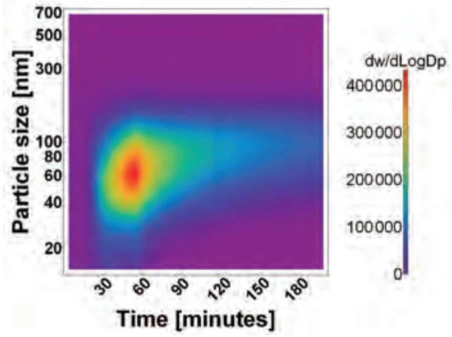

Figure 20: Number concentration of nanoparticles that are released during the burning of a single incense.

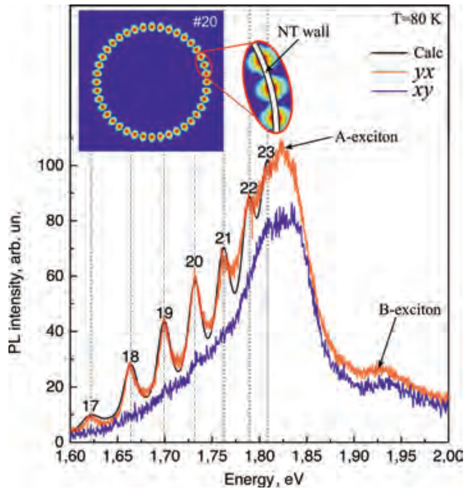

Figure 21: Micro-photoluminescence spectra (μ-PL) taken at 80 K with detecting laser light polarized along (red line) and perpendicular (blue line) to the MoS_2 nanotube axis. The calculated spectrum for PL is shown by the black line.

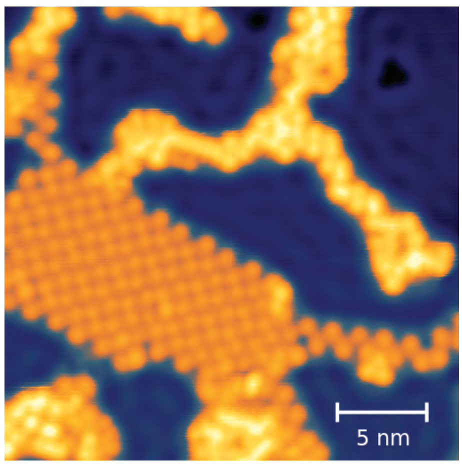

Figure 22: Ordered structures of 2-mercaptobenzimidazol molecules on a copper surface.

Figure 23: Charge density wave and atomic structure of NbS_3-II polymorph.

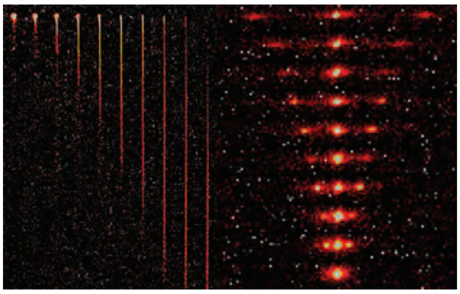

Figure 24: (Left) Atom laser from Bose-Einstein condensate of caesium atoms. (Right) Bose fireworks in a quasi-one-dimensional geometry.

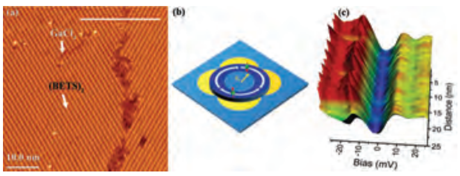

Figure 25: (a) Topographic STM image of mixed molecular orientation in a monolayer island of $(BETS)_2GaCl_4$ on a Ag(111) surface. (b) Schematic representation of convoluted symmetry of superconducting gap. (c) Tunnelling spectroscopy across the line in (a) showing flat low-lying quasi particles.

broad temperature range below the main phase transition temperature. This contradicts the usual assumption that SM membranes are in the gel phase below the main phase transition. Therefore, these findings suggest the necessity to re-evaluate the interpretations of structural results obtained on physiologically relevant model lipid rafts, which contain SM as one of the lipid components. In addition, the obtained electron density profiles in the fluid phase will allow the development of improved force fields for molecular dynamics simulations.

In collaboration with the University of Oxford (UK) we showed that the activation of T cells during microscopy can only be prevented by suspending them in a hydrogel. The findings of the study involving super-resolution STED microscopy were published in Nature Immunology. Using super-resolution fluorescence correlation spectroscopy (STED-FCS) we showed that the slow diffusion of proteins in the lipid envelopes of proteins is mainly due to their composition, and not their curvature.

Use of magnetic resonance in wood science

Magnetic resonance imaging is a very efficient method for water detection in biological systems, including wood. Water has a major influence on wood properties, especially dynamics moisture cycles, which affect wood in outdoor applications. It is therefore important to understand the penetration and distribution of water in the wood. In collaboration with colleagues from the Department of Biotechnical Faculty, University of Ljubljana, we conducted a study in which rainfall events were simulated to correspond to water-immersion periods of one hour. For the study the most important wood species in Central Europe with different water-repellent properties were used. After the immersion, the samples were imaged by MRI. Measurements were used to determine the water distribution in the wood and to elucidate the changes during the drying of the specimens. From these measurements a scientific article was published: Mojca Žlahtič Zupanc, Urša Mikac, Igor Serša, Maks Merela, Miha Humar. Water distribution in wood after short term wetting. Cellulose, ISSN 0969-0239, First Online 09 November 2018, https://doi.org/10.1007/s10570-018-2102-y.

Use of magnetic resonance in battery research

Due to the increasing number of mobile devices, the development of more powerful batteries is necessary. Magnetic resonance imaging (MRI) can be used to monitor the growth of dendrites in batteries, and by using a special MRI technique, CD-MRI, also to monitor the electric current during battery operation. However, batteries contain metal parts (electrodes) that cause distortion of the MR image. Therefore, the influence of metal electrodes on the MRI signal in different orientations with respect to static and radio-frequency magnetic fields was tested on a model battery, and the optimal orientation of the electrodes in which the distortions are practically negligible was determined. The results were published in the article: Igor Igor, Mikac Urka. A study of MR signal reception from a model for a battery cell. Journal of magnetic resonance, ISSN 1090-7807, 2018, 294, p. 7-15.

Deformation tensor imaging by magnetic resonance

Magnetic resonance imaging enables the precise detection of phase changes. This, among other effects, also enables the measurement of very small displacements in the direction of the applied magnetic field gradient. In the magnetic resonance imaging laboratory we have shown that by the use of the spin-echo imaging method with a superimposed bipolar gradient pair (the PGSE method) displacements can be measured with accuracy of up to 0.7 μm. With experiments of the test sample, we showed that this method also enables imaging of the deformation tensor. These results were published in the article Serša Igor. Magnetic resonance imaging of strain in elastic gels. Journal of Applied Physics, ISSN 0021-8979, 2019, 125(8), p. 0825211–082521-9.

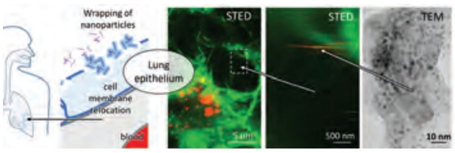

Figure 26: Causal connection has been identified between the inhalation of nanoparticles (red), lipid (green) wrapping and triggering of the coagulation signal cascade in lung epithelium, where the key experiments have been done using a super-resolution STED microscope and with TEM microscopy (IJS, Ljubljana, Slovenia) and new proteomics techniques at UCD (Dublin, Ireland). The work was published in Nano Letters.

Simulations of translational dynamics of chain-like particles through mucosal scaffolds

Mucus scaffolds represent one of the most common barriers in targeted drug delivery and can remarkably reduce the outcome of pharmacological therapies. Understanding the transport mechanism is particularly important for the treatment of disorders such as cystic fibrosis. In the study, we employed the bond fluctuation model (BFM) to analyse the effect of steric interactions on slowing the translational dynamics of compound chain-like particles, traversing through scaffolds of different configurations. The developed mathematical model accounted for the geometry-imposed steric interactions as well as for the intra-chain steric interactions between the chain subunits. The presented model is generic and could also be applied for studying the translational dynamics of other particles with more complex architecture, such as dendrites or chain-decorated nanoparticles. The results of the study were published in Bajd Franci, Serša Igor. A bond-fluctuation model of translational dynamics of chain-like particles through mucosal scaffolds. *Biophysical journal*, ISSN 0006-3495, 2018, 114(11), p. 2732-2742.

The research at our department has been supported by a number of international projects financed by the European Union. It was also supported within the bilateral Slovenian–USA, Slovenian–German and Slovenian–Greek and other scientific cooperations. In 2018, the department had cooperations with 108 partners from Slovenia and abroad. Among them:

- The high magnetic field centres in Grenoble, France, and Nijmegen, The Netherlands
- The high magnetic field centre at the University Florida, Tallahassee, Florida, USA
- The ETH, Zürich, Switzerland
- The Ioffe Institute in St. Petersburg, Russia
- The University of Duisburg, the University of Mainz and the University of Saarbrucken in Germany
- The University of California, the University of Utah and the Liquid Crystal Institute, Kent, Ohio, USA
- National Institute for Research in Inorganic Materials, Tsukuba, Japan
- NCSR Demokritos, Greece
- Institut für Biophysik und Nanosystemforschung OAW, Graz, Austria
- Bioénergétique et Ingénierie des Protéines, CNRS Marseille, France
- Architecture et Fonction des Macromolécules Biologiques, CNRS Marseille, France
- The Max Delbruck Center for Molecular Medicine in Berlin
- The Dartmouth Medical School, Hanover, NH, USA
- The Mayo Clinic, Rochester, USA
- Kyung Hee University, Suwon, Korea
- Technische Universität Ilmenau, Ilmenau, Germany
- Elettra Sincrotrone Trieste, Trieste, Italy
- University of North Carolina at Chapel Hill
- Max-Delbrück-Centrum für Molekulare Medizin (MDC)

made the above studies possible.

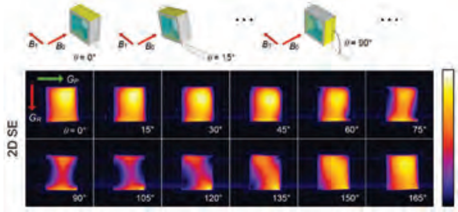

Figure 27: Effect of the model battery orientation with respect to the B_0 and B_1 fields on the signal suppression. As shown by the inset above the MR images, the model sample was rotated in steps on 15° around the axis parallel to the B_0 field from θ = 0° to θ = 165°. In the initial orientation (θ = 0°) the electrodes are parallel to the B_1 field so that there is no RF-induced eddy currents. As θ is increased RF-induced eddy currents start to appear. These lead to a more extensive signal suppression that is the strongest at θ = 90° (the B_1 field perpendicular to the electrodes) and diminishes again when θ approaches 180°.

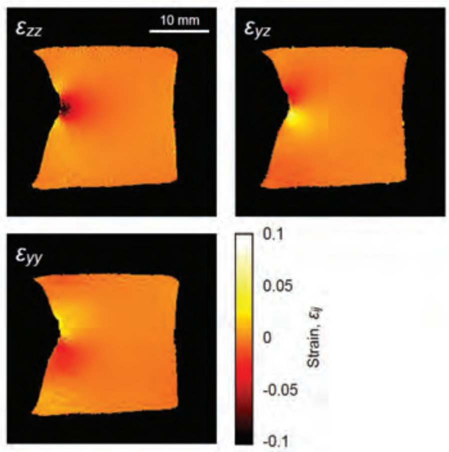

Figure 28: Maps of the three components of the strain tensor, ε_{yy}, ε_{zz}, and ε_{yz}. The strain tensor components were calculated from maps of displacements u_z and u_y, which were obtained from images of the signal phase change induced by the sample displacements.

Some outstanding publications in 2018

1. N. Janša, A. Zorko, M. Gomilšek, M. Pregelj, K.W. Krämer, D. Biner, A. Biffin, C. Rüegg, M. Klanjšek. Observation of two types of fractional excitation in the Kitaev honeycomb magnet. *Nature Physics* 14, (2018), 786-790.
2. P. Adler, P. Jeglič, T. Knaflič, M. Komelj, D. Arčon, et al. Verwey-type charge ordering transition in an open-shell p-electron compound. *Science Advances* 4, (2018), eaap7581.
3. S. Gao, S. Vrtnik, J. Luzar, et al. Dipolar spin ice states with a fast monopole hopping rate in $CdEr_2X_4$ (X=Se, S). *Physical Review Letters* **120** (2018), 137201.
4. Yu.O. Zagorodniy, B. Zalar et al. Chemical disorder and ^{207}Pb hyperfine fields in the magnetoelectric multiferroic $Pb(Fe_{1/2}Sb_{1/2})O_3$ and its solid solution with $Pb(Fe_{1/2}Nb_{1/2})O_3$. *Physical Review Materials* **2** (2018), 014401.
5. J. Dolinšek. Electronic transport properties of complex intermetallics. *Crystal growth of intermetallics*, Eds. P. Gille, Yu. Grin (Berlin: De Gruyter, 2018), 260-278.
6. Pramanick, A., Dmowski, W., Egami, T.I, Setiadi Budisuharto, A., Weyland, F., Novak, N., Christianson, A., Borreguero, J. M., Abernathy, D., Jørgensen, M. R. V.. Stabilization of Polar Nanoregions in Pb-free Ferroelectrics. *Physical Review Letters* **120** (2018), 207603.
7. Guillamat, Pau, Kos, Žiga, Hardoüin, Jérôme, Ignés-Mullol, Jordi, Ravnik, Miha, Sagués, Francesc. Active nematic emulsions. *Science Advances* 4 (2018), 2375-2548.
8. Urbančič, Iztok, Garvas, Maja, Kokot, Boštjan, Majaron, Hana, Umek, Polona, Škarabot, Miha, Arsov, Zoran, Koklič, Tilen, Čeh, Miran, Muševič, Igor, Štrancar, Janez, et al. Nanoparticles can wrap epithelial cell membranes and relocate them across the epithelial cell laye. *Nano Letters* **18** (2018), 5294-5305.
9. Aničić, Nemanja, Vukomanović, Marija, Koklič, Tilen, Suvorov, Danilo. Fewer defects in the surface slows the hydrolysis rate, decreases the ROS generation potential, and improves the Non-ROS antimicrobial activity of MgO. *Small* **14** (2018), 1800205.

10. Santos, Ana Mafalda, Urbančič, Iztok, et al. Capturing resting T cells: the perils of PLL. *Nature Immunology* 19 (2018), 203-205.

Some outstanding publications in 2017

1. M. Klanjšek, A. Zorko, R. Žitko, J. Mravlje, Z. Jagličić, P.K. Biswas, P. Prelovšek, D. Mihailović, D. Arčon. A high-temperature quantum spin liquid with polaron spins. *Nature Physics* 13 (2017), 1130–1134.
2. Y. Takabayashi, M. Menelaou, H. Tamura, N. Takemori, T. Koretsune, A. Štefančič, G. Klupp, A.J.C. Buurma, Y. Nomura, R. Arita, D. Arčon, M.J. Rosseinsky, K. Prassides. ϖ-electron $S = 1/2$ quantum spin-liquid state in an ionic polyaromatic hydrocarbon. *Nature Chemistry* 9 (2017), 635–643.
3. B. Rožič, J. Fresnais, C. Molinaro, J. Calixte, S. Umadevi, S. Lau-Truong, N. Felidj, T. Kraus, F. Charra, V. Dupuis, T. Hegmann, C. Fiorini-Debuisschert, B. Gallas, E. Lacaze. Oriented gold nanorods and gold nanorod chains within smectic liquid crystal topological defects. *ACS Nano* 11 (2017), 6728–6738.
4. A. Zorko, M. Herak, M. Gomilšek, J. van Tol, M. Velázquez, P. Khuntia, F. Bert, P. Mendels. Symmetry reduction in the quantum Kagome antiferromagnet Herbertsmithite. *Physical Review Letter* 118 (2017), 017202.
5. M. Gomilšek, M. Klanjšek, R. Žitko, M. Pregelj, F. Bert, P. Mendels, Y. Li, Q. M. Zhang, A. Zorko. Field-induced instability of a gapless spin liquid with a spinon Fermi surface. *Physical Review Letter* 119 (2017), 137205.
6. L. Giomi, Ž. Kos, M. Ravnik, and A. Sengupta. Cross-talk between topological defects in different fields revealed by nematic microfluidics. *Proceedings of the National Academy of Sciences of the United States of America* 114 (2017), E5771-E5777.
7. S. M. Hasheimi, U. Jagodič, M. R. Mozaffari, M. R. Ejtehadi, I. Muševič, and M. Ravnik, Fractal nematic colloids. *Nature Communications* 8 (2017), 12106.
8. G. Posnjak, S. Čopar and I. Muševič. Hidden topological constellations and polyvalent charges in chiral nematic droplets. *Nature Communications* 8 (2017), 14594.
9. A. Nych, Jun-ichi Fukuda, U. Ognysta, S. Žumer, I. Muševič. Spontaneous formation and dynamics of half-skyrmions in a chiral liquid-crystal film. *Nature Physics* 13 (2017), 1215.
10. E. Sezgin, F. Schneider, V. Zilles, I. Urbančič, E. Garcia, D. Waithe, A.S. Klymchenko, C. Eggeling. Polarity-Sensitive Probes for Superresolution Stimulated Emission Depletion Microscopy. *Biophysical Journal* 113 (2017), 1321-1330.
11. M. Kranjc, S. Kranjc,F. Bajd, G. Serša, I. Serša, D. Miklavčič. Predicting irreversible electroporation-induced tissue damage by means of magnetic resonance electrical impedance tomography. *Scientific Reports* 7 (2017*)*, 1-10.

Some outstanding publications in 2016

1. A. Rešetič, J. Milavec, B. Zupančič, V. Domenici, B. Zalar. Polymer-dispersed liquid crystal elastomers. *Nature Communications* 7 (2016), 13140.
2. M. Jeong, M. Klanjšek et al. Dichotomy between attractive and repulsive tomonaga-luttinger liquids in spin ladders. *Physical Review Letters* 117 (2016), 106402.
3. F. E. Annanouch, P. Umek et al. Aerosol-assisted CVD-grown PdO nanoparticle-decorated tungsten oxide nanoneedles extremely sensitive and selective to hydrogen. *ACS Applied Materials & Interfaces* 8 (2016), 10413.
4. H. Uršič, V. Bobnar, B. Malič, C. Filipič, M. Vrabelj, S. Drnovšek, Jo Younghun, M. Wencka, Z. Kutnjak. A multicaloric material as a link between electrocaloric and magnetocaloric refrigeration. *Scientific Reports* 6 (2016), 26629.
5. M. Igarashi, P. Jeglič, A. Kranjc, R. Žitko, T. Nakano, Y. Nozue, D. Arčon. Metal-to-insulator crossover in alkali doped zeolite. *Scientific Reports* 6 (2016), 18682.
6. G. Posnjak, S. Čopar, I. Muševič. Points, skyrmions and torons in chiral nematic droplets. *Scientific Reports* 6 (2016), 26361.
7. L. E. Aguirre, A. de Oliveira, D. Seč, S. Čopar, P. L. Almeida, M. Ravnik, M. H. Godinho, S. Žumer. Sensing surface morphology of biofibers by decorating spider silk and cellulosic filaments with nematic microdroplets. *Proceedings of the National Academy of Sciences of the United States of America* 113 (2016), 1174.
8. S. Nizamoglu, M. Humar et al. Bioabsorbable polymer optical waveguides for deep-tissue photomedicine. *Nature Communications* 7 (2016), 10374.
9. S. Cho, M. Humar, N. Martino, S. H. Yun. Laser Particle Stimulated Emission Microscopy. *Physical Review Letter* 117 (2016), 193902.
10. B. Nitzsche, E. Dudek, L. Hajdo, A. A. Kasprzak, A. Vilfan, S. Diez. Working stroke of the kinesin-14, ncd, comprises two substeps of different direction. *Proceedings of the National Academy of Sciences of the United States of America* 113 (2016), E6582.

Awards and appointments

1. Bizjak Jani, Gradišek Anton, Gams Matjaž: the award for the best innovation for a public research organization, Ljubljana, The 11th International Technology Transfer Conference, The ultimate European assistant for the elderly

Organization of conferences, congresses and meetings

1. The 8th Regional Biophysics Conference 2018, Zreče, 16–20 May 2018
2. 11th conference on fundamental physical research, Terme Dobrna, 23 November 2018
3. Expert meeting F-5, Orehov gaj, 10 December 2018

Patents granted

1. Andraž Rešetič, Jerneja Milavec, Blaž Zupančič, Boštjan Zalar, Polymer dispersed liquid crystal elastomers (PDLCE), US9969847 (B2), US Patent and Trademark Office, 15. 05. 2018.
2. Barbara Malič, Hana Uršič, Marija Kosec, Silvo Drnovšek, Jena Cilenšek, Zdravko Kutnjak, Brigita Rožič, Uroš Flisar, Andrej Kitanovski, Marko Ožbolt, Uroš Plaznik, Alojz Poredoš, Urban Tomc, Jaka Tušek, Method for electrocaloric energy conversion, US9915446 (B2), US Patent and Trademark Office, 13. 03. 2018.

INTERNATIONAL PROJECTS

1. MERCK - AFM Investigations
Prof. Miha Škarabot
Merck Kgaa
2. Kimberly-Clark - Development of LCD Shutter in the Year 2018
Prof. Igor Muševič
Kimberly-clark
3. 7FP - SIMDALEE2; Sources, Interaction with Matter Detection and Analysis of Low Energy Electrons 2
Prof. Maja Remškar
European Commission
4. 7 FP; ERA CHAIR ISO-FOOD - Era Chairs for Isotope Techniques in Food Quality, Safety and Traceability
Prof. Maja Remškar
European Commission
5. COST MP1308; Towards Oxide Based Electronics (TO-BE)
Aleksander Matavž
Cost Office
6. COST CA15107; Multi-Functional Nano-Carbon Composite Materials Network
Dr. Polona Umek
Cost Office
7. COST CA15209; European Network on NMR Relaxometry
Prof. Tomaž Apih
Institut Jožef Stefan
8. COST CA16109; Chemical On-Line Composition and Source Apportionment of Fine Aerosol
Asst. Prof. Griša Močnik
Cost Office
9. COST CA16218; Nanoscale Coherent Hybrid Devices for Superconducting Quantum Technologies
Dr. Abdelrahim Ibrahim Hassanien
Cost Office
10. COST CA16221; Quantum Technologies with Ultra-Cold Atoms
Dr. Peter Jeglič
Cost Association Aisbl
11. Training School on Black and Brown Carbon - Organisation of the Workshop of Project COST - COLOSSAL, COST CA16109, Ljubljana, Slovenia, 15.01.-17.01.2018
Asst. Prof. Griša Močnik
Cost Office
12. COST CA17121; Correlated Multimodal Imaging in Life Sciences
Prof. Janez Štrancar
Cost Association Aisbl
13. COST CA17139; European Topology Interdisciplinary Action
Prof. Slobodan Žumer
Cost Association Aisbl
14. COST CA16202; International Network to Encourage the Use of Monitoring and Forecasting Dust Products
Asst. Prof. Griša Močnik
Cost Association Aisbl
15. H2020 - SmartNanoTox; Smart Tools for Gauging Nano Hazards
Prof. Janez Štrancar
European Commission
16. H2020 - ENGIMA; Engineering of Nanostructures with Giant Magneto-Piezoelectric and Multicaloric Functionalities
Prof. Zdravko Kutnjak
European Commission
17. Crystal and Electronic Structure of NbS3 Phases
Dr. Erik Zupanič
Slovenian Research Agency
18. Lead-Free (Ba0.8Ca0.2)1-xLa2x/3TiO3 Based Electrocaloric Materials for New Dielectric Cooling Technologies
Prof. Zdravko Kutnjak
Slovenian Research Agency
19. Stabilisation of Networks of Topological Defects
Prof. Samo Kralj
Slovenian Research Agency
20. Superconductivity and Magnetism: Two Faces of Electron Correlations in Carbon- and Fe-Based Superconductors
Prof. Denis Arčon
Slovenian Research Agency
21. Transport and Field Emission Properties of Low-Dimensional Molybdenum and Tungsten Based Nanomaterials
Prof. Maja Remškar
Slovenian Research Agency
22. Testing Biocompatibility of Molybdenum and Tungsten based Nanoparticles: Measuring Cytotoxicity and Inflammatory Response in Human Cell Lines
Prof. Maja Remškar
Slovenian Research Agency
23. The Lipid-Peroxidation Inhibition Governed by Interactions between Nanocarried Flavonoids and Model Lipid Membranes
Prof. Janez Štrancar
Slovenian Research Agency
24. Dynamic Hysteresis in the Study of Magnetic Nanoparticle Efficacy for Hyperthermia Therapy
Prof. Janez Dolinšek
Slovenian Research Agency
25. Conservation of Cultural Heritage Indoors - The Case of Leonardo da Vinci's „Last Supper"
Asst. Prof. Griša Močnik
Slovenian Research Agency
26. Lipid Wrapped Nanoparticles and Activity of Factor Xa
Dr. Tilen Koklič
Slovenian Research Agency
27. Studies of Nanoporous Materials for Hydrogen Storage
Prof. Janez Dolinšek
Slovenian Research Agency
28. Magnetoresonance Study of Spin-Liquid Candidates
Asst. Prof. Andrej Zorko
Slovenian Research Agency
29. Advanced Organic and Inorganic Thin-Film Composites with Enhanced Dielectric and Electromechanical Response
Prof. Zdravko Kutnjak
Slovenian Research Agency

RESEARCH PROGRAMS

1. Magnetic resonance and dielectric spectroscopy of „smart“ new materials
   Prof. Janez Dolinšek
2. Physics of Soft Matter, Surfaces and Nanostructures
   Prof. Slobodan Žumer
3. Experimental Biophysics of Complex Systems
   Prof. Janez Štrancar

R & D GRANTS AND CONTRACTS

1. High-Entropy Alloys
   Dr. Stanislav Vrtnik
2. Metamaterials from liquid crystal colloids
   Prof. Miha Ravnik
3. Sensor technologies in diagnostics and monitoring of cultural heritage buildings
   Prof. Janez Dolinšek
4. Electroporation-based treatments with new high-frequency electroporation pulses
   Prof. Igor Serša
5. Multifunctional materials for actuator and cooling devices
   Prof. Zdravko Kutnjak
6. Correlated electrons in cnofined molecular systems
   Prof. Denis Arčon
7. High-resolution optical magnetometry with cold cesium atoms
   Dr. Peter Jeglič
8. Integrated multi-channel artificial nose for vapor trace detection
   Prof. Igor Muševič
9. Photonic devices made entirely out of edible materials
   Asst. Prof. Matjaž Humar
10. Probing spin states near the surface of quantum spin materials
    Prof. Denis Arčon
11. Advanced soft nematocaloric materials
    Dr. Brigita Rožič
12. Multicaloric cooling
    Prof. Zdravko Kutnjak
13. Optimization of MRI techniques for assessment of thrombolytic treatment outcome
    Prof. Igor Serša
14. Performance of wood and lignocelolosic composites in outdoor applications
    Prof. Igor Serša
15. Advanced electrocaloric energij conversion
    Prof. Zdravko Kutnjak
16. Biopharmaceuticals: sensor for aggregation of protein particles based on liquid crystals
    Prof. Miha Ravnik
17. Spatial and temporal shaping of laser light for minimally invasive ophthalmic procedures
    Prof. Janez Štrancar
18. Microspectroscopy-based optimization of the effects of laser pulses on the retina
    Prof. Janez Štrancar
19. Domain engineered ferroelectric ceramic layer elements for efficient energy harvesting and energy conversion applications
    Prof. Zdravko Kutnjak
20. Building blocks, tools and systems for the Factories of the Future – GOSTOP
    Prof. Janez Štrancar
    Ministry of Education, Science and Sport
21. Irradiation and Analysis of Nano SiC Samples in the Year 2017
    Prof. Vid Bobnar
    National Nuclear Research Center
22. Inkjet Printing of PZT Test Structures and Piezoelectric Characterization of Thin Films Double-Beam Laser Interferometer Measurement
    Prof. Vid Bobnar
    Epcos Ohg

NEW CONTRACTS

1. Instrumentation for measurement of aerosol light absoption
   Prof. Igor Muševič
   Ames d. o. o.
2. Detecion of Non-Anthropogenic Air Pollution project (DNAAP)
   Asst. Prof. Griša Močnik
   Aerosol d. o. o.

VISITORS FROM ABROAD

1. Dr Hashemi Masoomeh, Sharif University of Technology, Tehran, Iran, 1 November 2017 to 31 January 2018, 4 February to 30 March 2018 and 1–28 April 2018
2. Patrycja Boguslawa Zawilska, Faculty of Biotechnology, University of Wroclaw, Wroclaw, Poland, 7–28 January 2018 and 16 April to 16 June 2018
3. Prof. Katsumi Tanigaki, Materials Physics and Nano Solid-State Physics, Tohoku University, Sendai, Japan, 28–30 January 2018
4. Dr Nych Andriy, Institute of Physics, Kiev, Ukraine, 22 January to 2 February 2018
5. Takuma Ogasawara, Materials Physics and Nano Solid-State Physics, Tohoku University, Sendai, Japan, 28 January to 23 February 2018
6. Prof. Stoeger Tobias and Dr Mendes Carola, Helmholtz Center Munich, Institute of Lung Biology and Disease, Munich, Germany, 18–22 March 2018
7. Prof. Makan Wallin, National Institute of Occupational Health, Oslo, Norway, 18–23 March 2018
8. Dr Mendels Philippe, Laboratoire de Physique des Solides, Universite Paris-Sud, Orsay, France, 28–29 March 2018
9. Prof. Dr Hoet Peter, KU Leuven, Department of Public Health and Primary Care, Centre Environment and Health, Leuven, Belgium, 9–10 April 2018
10. Prof. Dr Guo Sheng, Chalmers University of Technology, Gothenburg, Sweden, 15–18 April 2018
11. Dr Šegota Suzana and Dr Baranović Goran, Ruđer Bošković Institute, Zagreb, Croatia, 28 May to 1 June 2018
12. Prof. Dr Smalyukh Ivan, University of Colorado, Boulder, Colorado, USA, 1 June 2018
13. Dr Kimouche Amina, School of Science, Aalto University, Helsinki, Finland, 14–21 June 2018
14. Dr Dhara Surajit, School of Physics, University of Hyderabad, Hyderabad, India, 16 June to 7 July 2018
15. Dr Ryzhkova V. Anna, ASML, Eindhoven, the Netherlands, 9–15 July 2018 and 21 October to 10 November 2018
16. Prof. Dr Kotur Bogdan, Ivan Franko National University of Lviv, Lviv, Ukraine, 14– 17 July 2018
17. Dr Ositi Agnese, Faculty of Chemistry, University of Latvia, Riga, Latvia, 2–7 July 2018
18. Dr Majhen Dragomira and Nestić Davor, Ruđer Bošković Institute, Zagreb, Croatia, 13 July 2018
19. Dmitry Richter, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany, 15 July–15 August 2018 and 8 September to 31 October 2018
20. Dr Asbani Bouchra, Université de Picardie Jules Verne, Laboratoire de Physique de la Matière Condensée, Amiens, France, 29 July to 7 August 2018
21. Hajar Zaitouni, University Cadi Ayyad, Marrakesh, Morocco, 29 July to 4 September 2018
22. Dr Abdelhadi Alimousa, University Cadi Ayyad, Marrakesh, Morocco 3–18 August 2018
23. Prof. Mezzane Daoud, University Cadi Ayyad, Marrakesh, Morocco, 13–31 August 2018
24. Prof. Schreiner Rupert, Lawrowski Robert, Assist. Prof. Huettel Andreas and Reinhardt Simon, Institute for Experimental and Applied Physics, Regensburg, Germany, 15–18 August 2018
25. Dr Wencka Magdalena, Institute of Molecular Physics, Polish Academy of Sciences, Poznań, Poland, 19–31 August 2018
26. Dr Savić Aleksandar, Institute for Multidisciplinary Research, Beograd, Serbia, 20–31 August 2018
27. Igarashi Mutsuo, Gunma National College of Technology, Maebashi, Japan, 29 August to 7 September 2018 and 29 October to 8 November 2018
28. Dr Čadež Vida in Dr Šegota Suzana, Ruđer Bošković Institute, Zagreb, Croatia, 1–8 September 2018
29. Dr Kimouche Amina, Catalan Institute of Nanoscience and Nanotechnology, Barcelona, Spain, 24 September to 6 October 2018
30. Dr Ghosh Sharmistha, DST-INSPIRE, University of Calcutta, Calcutta, India, 9 September to 10 November 2018
31. Dr Kasahara Yuichi, Department of Physics, Kyoto University, Kyoto, Japan, 16–18 September 2018
32. Dr Umerova Saide and Kovalenko Olga, Nanotechcenter Llc. Kiev, Ukraine, 28 September to 21 December 2018
33. Dr Yoshiko Kitahata (Takenaka), Research Institute for Sustainable Chemistry, Ibaraki, Japan, 1 October 2018 to 30 September 2019
34. Matteo Polello, Stelar, Pavia, Italia, 2–4 October 2018
35. Prof. Dr Xiangwei Zhao, State Key University of Bioelectronics, Southeast University, Nanjing, China, 5 October 2018
36. Prof. Dr Jiang Liyong, Nanjing University of Science and Technology, Nanjing, China, 5 October 2018
37. Dr Majhen Dragomira, Dekanić Ana and Nestić Davor, Ruđer Bošković Institute, Zagreb, Croatia, 26 October 2018
38. Coutinho T. Joana, Center for Nuclear Sciences and Technologies, Instituto Superior Técnico, Lisbon, Portugal, 21 October to 18 November 2018
39. Dr Anastasios Stergiou, Theoretical and Physical Chemistry Institute, Athens, Greece, 29 October to 10 November 2018
40. Berndt Dominik M.Sc., Lawrowski Robert and Langer Christoph, Ostbayerische Technische Hochschule Regensburg, Regensburg, Germany, 19–21 November 2018
41. Dr Bittencourt Carla, University of Mons, Mons, Belgium, 20 November to 2 December 2018
42. Dr Barudžija Tanja and Bošković Marko, Institute of Nuclear Sciences, Beograd, Serbia, 26 November to 1 December 2018
43. Dr Thoen Jan, KU Leuven, Leuven, Belgium, 9–12 December 2018
44. Dr Gagou Yaovi, Université de Picardie Jules Verne, Amiens, France, 11–14 December 2018
45. Said Ben Moumen, Université de Picardie Jules Verne, Amiens, France, 13–24 December 2018
46. Dr Deliss Jean-Luc, Université de Picardie Jules Verne, Amiens, France, 19–27 December 2018

STAFF

Researchers
1. Prof. Tomaž Apih
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21. Prof. Miha Ravnik*
22. Prof. Maja Remškar
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24. Prof. Miha Škarabot
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29. Asst. Prof. Andrej Vilfan
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31. Prof. Boštjan Zalar
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34. Dr. Erik Zupanič
35. Prof. Slobodan Žumer

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38. Dr. Nikola Novak
39. Dr. Rok Podlipec
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41. Dr. Andraž Rešetič
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43. Dr. Anna Ryzhkova
44. *Dr. Melita Sluban, left 01.06.18*
45. Dr. Maja Trček*
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47. Dr. Jernej Vidmar*
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Postgraduates
49. Dejvid Črešnar, B. Sc.
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52. *Dr. Matjaž Gomilšek, left 14.04.18*
53. Urška Gradišar Centa, B. Sc.
54. Saša Harkai, B. Sc.
55. Asst. Prof. Matjaž Humar
56. Uroš Jagodič, B. Sc.
57. Nejc Janša, B. Sc.
58. Tilen Knaflič, B. Sc.
59. Dr. Marta Lavrič
60. Dr. Janez Lužnik
61. Hana Majaron, B. Sc.
62. Bojan Marin*, M. Sc.
63. Matevž Marinčič, B. Sc.
64. Aleksander Matavž, B. Sc.
65. Tadej Mežnaršič, B. Sc.
66. Maruša Mur, B. Sc.
67. Luka Pirker, B. Sc.
68. Gregor Pirnat, B. Sc.
69. Jaka Pišljar, B. Sc.
70. *Muhammad Saqib, B. Sc., left 08.05.18*
71. Aleksandar Sebastijanović, B. Sc.
72. Marion Antonia Van Midden, B. Sc.

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73. Dr. Luka Drinovec*
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75. Dr. Andreja Jelen
76. Boštjan Kokot, B. Sc.
77. Ivan Kvasić, B. Sc.
78. Jaka Močivnik, B. Sc.

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79. Sabina Gruden, B. Sc.
80. Dražen Ivanov
81. Janez Jelenc, B. Sc.
82. Maša Kavčič, B. Sc.
83. Davorin Kotnik
84. Jože Luzar, B. Sc.
85. Silvano Mendizza
86. Janja Milivojević
87. Ana Sepe, B. Sc.
88. Marjetka Tršinar
89. Patrycja Boguslawa Zawilska, B. Sc.

Note:
* part-time JSI member

BIBLIOGRAPHY

Original Article

1. Janez Grad, Anton Gradišek, "Bumblebee brood temperature and colony development: a field study", *Acta entomologica slovenica*, 2018, **26**, 2, 219-232.
2. Peter Keil, Maximilian Trapp, Nikola Novak, Till Frömling, Hans-Joachim Kleebe, Jürgen Rödel, "Piezotronic tuning of potential barriers in ZnO bicrystals", *Advanced materials*, 2018, **30**, 10, 1705573.
3. Chloe C. Tartan, John J. Sandford O'Neill, Patrick S. Salter, Jure Aplinc, Martin J. Booth, Miha Ravnik, Stephen Morris, Steve Elston, "Read on demand images in laser-written polymerizable liquid crystal devices", *Advanced optical materials*, 2018, **6**, 1800515.
4. Bojana Višić, Eva Kranjc, Luka Pirker, Urška Bačnik, Gašper Tavčar, Srečo D. Škapin, Maja Remškar, "Incense powder and particle emission characteristics during and after burning incense in an unventilated room setting", *Air quality, atmosphere & health*, 2018, **11**, 6, 649-663.
5. Aleksander Matavž, Janez Kovač, Miha Čekada, Barbara Malič, Vid Bobnar, "Enhanced electrical response in ferroelectric thin film capacitors with inkjet-printed $LaNiO_3$ electrodes", *Applied physics letters*, 2018, **113**, 1, 012904.
6. D. R. Kazanov *et al.* (12 authors), "Multiwall MoS_2 tubes as optical resonators", *Applied physics letters*, 2018, **113**, 10, 101106.
7. Nikša Krstulović, Krešimir Salamon, Ognjen Budimlija, Janez Kovač, Jasna Dasović, Polona Umek, Ivana Capan, "Parameters optimization for synthesis of Al-doped ZnO nanoparticles by laser ablation in water", *Applied Surface Science*, 2018, **440**, 916-925.
8. Borut Jereb, Tanja Batkovič, Luka Herman, Gregor Šipek, Špela Kovše, Asta Gregorič, Griša Močnik, "Exposure to black carbon during bicycle commuting - alternative route selection", *Atmosphere*, 2018, **9**, 1, 21.
9. Samuel Weber, Gaëlle Uzu, Aude Calas, Florie Chevrier, Jean-Luc Besombes Besombes, Aurélie Charron, Dalia Salameh, Irena Ježek, Griša Močnik, Jean-Luc Jaffrezo, "An apportionment method for the oxidative potential of atmospheric particulate matter sources: application to a one-year study in Chamonix, France", *Atmospheric chemistry and physics*, 2018, **18**, 13, 9617-9629.

10. Nivedita K. Kumar *et al.* (13 authors), "Production of particulate brown carbon during atmospheric aging of residential wood-burning emissions", *Atmospheric chemistry and physics*, 2018, **24**, 17843-17861.
11. Irena Ježek, Nadège Blond, Grzegorz Skupinski, Griša Močnik, "The traffic emission-dispersion model for a Central-European city agrees with measured black carbon apportioned to traffic", *Atmospheric environment*, 2018, **184**, 177-190.
12. Pavlo Kurioz, Marko Kralj, Bryce S. Murray, Charles Rosenblatt, Samo Kralj, "Nematic topological defects positionally controlled by geometry and external fields", *Beilstein journal of nanotechnology*, 2018, **9**, 109-118.
13. Franci Bajd, Igor Serša, "A bond-fluctuation model of translational dynamics of chain-like particles through mucosal scaffolds", *Biophysical journal*, 2018, **114**, 11, 2732-2742.
14. Rita R. Ferreira, Guillaume Pakula, Lhéanna Klaeyle, Hajime Fukui, Andrej Vilfan, Willy Supatto, Julien Vermot, "Chiral cilia orientation in the left-right organizer", *Cell reports*, 2018, **25**, 8, 2008-2016.e4.
15. Zoran Arsov, Emilio J. González-Ramírez, Felix M. Goñi, S. Tristram-Nagle, John F. Nagle, "Phase behavior of palmitoyl and egg sphingomyelin", *Chemistry and physics of lipids*, 2018, **213**, 102-110.
16. Satyanarayan Patel, Florian Weyland, Xiaoli Tan, Nikola Novak, "Tunable pyroelectricity around the ferroelectric/antiferroelectric transition", *Energy technology*, 2018, **6**, 5, 865-871.
17. Satyanarayan Patel, Aditya Chauhan, Virginia Rojas, Nikola Novak, Florian Weyland, Jürgen Rödel, Rahul Vaish, "Thermomechanical energy conversion potential of lead-free $0.50Ba(Zr_{0.2}Ti_{0.8})O_3-0.50(Ba_{0.7}Ca_{0.3})TiO_3$ bulk ceramics", *Energy technology*, 2018, **6**, 5, 872-882.
18. Florian Weyland, Richard Perez-Moyet, George A. Rossetti, Nikola Novak, "Material measures of electrocaloric cooling power in perovskite ferroelectrics", *Energy technology*, 2018, **6**, 8, 1512-1518.
19. Florian Weyland, Andraž Bradeško, Yang-Bin Ma, Jurij Koruza, Bai-Xiang Xu, Karsten Albe, Tadej Rojac, Nikola Novak, "Impact of polarization dynamics and charged defects on the electrocaloric response of ferroelectric $Pb(Zr,Ti)O_3$ ceramics", *Energy technology*, 2018, **6**, 8, 1519-1525.
20. Marjan Krašna, Eva Klemenčič, Zdravko Kutnjak, Samo Kralj, "Phase-changing materials for thermal stabilization and thermal transport", *Energy*, 2018, **162**, 554-563.
21. Luca Ferrero, Griša Močnik, Sergio Cogliati, Asta Gregorič, Roberto Colombo, Enzio Bolzacchini, "Heating rate of light absorbing aerosols: resolved measurements, the role of clouds and source-identification", *Environmental science & technology*, 2018, **52**, 6, 3546-3555.
22. Eva Kranjc, Darja Mazej, Marjana Regvar, Damjana Drobne, Maja Remškar, "Foliar surface free energy affects platinum nanoparticle adhesion, uptake, and translocation from leaves to roots in arugula and escarole", *Environmental science. Nano*, 2018, **5**, 2, 520-532.
23. Žiga Kos, Miha Ravnik, "Elementary flow field profiles of micro-swimmers in weakly anisotropic nematic fluids: stokeslet, stresslet, rotlet and source flows", *Fluids*, 2018, **3**, 15.
24. Alen Ajanović, Andrej Ulčar, Ana Marija Peterlin, Karolina Počivavšek, Gašper Fele-Žorž, Anton Gradišek, Matjaž Gams, Mojca Matičič, "Application for viral hepatitis infection risk assessment - HEPY", *Informatica: an international journal of computing and informatics*, 2018, **42**, 2, 279-281.
25. Stanislav Vrtnik, S. Guo, S. Sheikh, Andreja Jelen, Primož Koželj, Jože Luzar, Andraž Kocjan, Zvonko Jagličić, Anton Meden, Hwanuk Guim, Hee-Joung Kim, Janez Dolinšek, "Magnetism of $CoCrFeNiZr_x$ eutectic high-entropy alloys", *Intermetallics*, 2018, **93**, 122-133.
26. Mitja Pohlen, Luka Pirker, Matevž Luštrik, Rok Dreu, "A redispersible dry emulsion system with simvastatin prepared via fluid bed layering as a means of dissolution enhancement of a lipophilic drug", *International journal of pharmaceutics*, 2018, **549**, 1-2, 325-334.
27. Ela Şule Erten, Melek Kiristi, Ana Varlec, Ferhat Bozduman, Maja Remškar, Lutfi Oksuz, Aysegul Uygun Oksuz, "Platinum-free counter electrodes of plasma-modified hybrid nanomaterials for dye-sensitised solar cells", *International journal of sustainable energy*, 2018, **37**, 7, 640-653.
28. Bouchra Asbani, Y. Gagou, Maja Trček, J.-L. Dellis, M. Amjoud, A. Lahmar, D. Mezzane, Zdravko Kutnjak, Mimoun El Marssi, "Dielectric permittivity enhancement and large electrocaloric effect in the lead free $(Ba_{0.8}Ca_{0.2})_{1-x}La_{2x/3}TiO_3$ ferroelectric ceramics", *Journal of alloys and compounds*, 2018, **730**, 501-508.
29. Stanislav Vrtnik, Janez Lužnik, Primož Koželj, Andreja Jelen, Jože Luzar, Zvonko Jagličić, Anton Meden, Michael Feuerbacher, Janez Dolinšek, "Disordered ferromagnetic state in the Ce-Gd-Tb-Dy-Ho hexagonal high-entropy alloy", *Journal of alloys and compounds*, 2018, **742**, 877-886.
30. Magdalena Wencka, Janez Kovač, Venkata D. B. C. Dasireddy, Blaž Likozar, Andreja Jelen, Stanislav Vrtnik, Peter Gille, Hae Jin Kim, Janez Dolinšek, "The effect of surface oxidation on the catalytic properties of Ga_3Ni_2 intermetallic compound for carbon dioxide reduction", *Journal of analytical science & technology*, 2018, **9**, 12.
31. Gerard Masdeu, Slavko Kralj, Stane Pajk, Josep López-Santín, Darko Makovec, G. Álvaro Gregorio, "Hybrid chloroperoxidase-magnetic nanoparticle clusters: effect of functionalization on biocatalyst performance", *Journal of chemical technology and biotechnology*, 2018, **93**, 1, 233-245.
32. J. C. Corbin *et al.* (15 authors), "Brown and black carbon emitted by a marine engine operated on heavy fuel oil and distillate fuels: optical properties, size distributions, and emission factors", *Journal of geophysical research. Atmospheres*, 2018, **123**, 11, 6175-6195.
33. Igor Serša, Urška Mikac, "A study of MR signal reception from a model for a battery cell", *Journal of magnetic resonance*, 2018, **294**, 7-15.
34. Andraž Šuligoj, Iztok Arčon, Matjaž Mazaj, Goran Dražić, Denis Arčon, Pegie Cool, Urška Lavrenčič Štangar, Nataša Novak Tušar, "Surface modified titanium dioxide using transition metals: nickel as a winning transition metal for solar light photocatalysis", *Journal of materials chemistry. A, Materials for energy and sustainability*, 2018, **6**, 21, 9882-9892.
35. Florian Weyland, Matias Acosta, Malte Vögler, Yoshitaka Ehara, Jürgen Rödel, Nikola Novak, "Electric field-temperature phase diagram of sodium bismuth titanate-based relaxor ferroelectrics", *Journal of Materials Science*, 2018, **53**, 13, 9393-9400.
36. Fedor V. Podgornov, Anna V. Ryzhkova, Wolfang Haase, "Dynamics of nonlinear electrophoretic motion of dielectric microparticles in nematic liquid crystal", *Journal of molecular liquids*, 2018, **267**, 345-352.
37. Miha Škarabot, Anna V. Ryzhkova, Igor Muševič, "Interactions of single nanoparticles in nematic liquid crystal", *Journal of molecular liquids*, 2018, **267**, 384-389.
38. Luka Kelhar, Jana Bezjak, Marjeta Maček, Janez Zavašnik, Sašo Šturm, Primož Koželj, Spomenka Kobe, Jean-Marie Dubois, "The role of Fe and Cu additions on the structural, thermal and magnetic properties of amorphous Al-Ce-Fe-Cu alloys", *Journal of non-crystalline solids*, 2018, **483**, 70-78.
39. Andreja Lang, Maja Ovsenik, Ivan Verdenik, Maja Remškar, Čedomir Oblak, "Nanoparticle concentrations and composition in a dental office and dental laboratory: a pilot study on the influence of working procedures", *Journal of occupational and environmental hygiene*, 2018, **15**, 5, 441-447.
40. Priyadarshi Ranjan *et al.* (11 authors), "Decoration of inorganic nanostructures by metallic nanoparticles to induce fluorescence, enhance solubility, and tune band gap", *The journal of physical chemistry. C, Nanomaterials and interfaces*, 2018, **122**, 12, 6748-6759.
41. Anton Gradišek, Mitja Krnel, Mark Paskevicius, Bjarne R. S. Hansen, Torben Rene Jensen, Janez Dolinšek, "Reorientational motions and ionic conductivity in $(NH_4)_2B_{10}H_{10}$ and $(NH_4)_2B_{12}H_{12}$", *The journal of physical chemistry. C, Nanomaterials and interfaces*, 2018, **122**, 30, 17073-17079.
42. Florian Weyland, Thorsten Eisele, Sebastian Steiner, Till Frömling, George A. Rossetti, Jürgen Rödel, Nikola Novak, "Long term stability of electrocaloric response in barium zirconate titanate", *Journal of the European ceramic society*, 2018, **38**, 2, 551-556.
43. Jerneja Milavec, Andraž Rešetič, Alexej Bubnov, Boštjan Zalar, Valentina Domenici, "Dynamic investigations of liquid crystalline elastomers and their constituents by ^2H NMR spectroscopy", *Liquid crystals*, 2018, **45**, 13-15, 2158-2173.
44. Alexander Dubtsov, Sergey V. Pasechnik, Dina V. Shmeliova, D. Semerenko, Aleš Iglič, Samo Kralj, "Influence of polar dopant on internal configuration of azoxybenzene nematic-in-water droplets", *Liquid crystals*, 2018, **45**, 3, 388-400.
45. Shun Wang, Miha Ravnik, Slobodan Žumer, "Surface-patterning generated half-skyrmion lattices in cholesteric blue phase thin films", *Liquid crystals*, 2018, **45**, 13/15, 2329-2340.
46. Iztok Urbančič *et al.* (16 authors), "Nanoparticles can wrap epithelial cell membranes and relocate them across the epithelial cell layer", *Nano letters*, 2918, **18**, 8, 5294-5305.
47. Nina Kostevšek, Irena Abramović, Samo Hudoklin, Mateja Erdani-Kreft, Igor Serša, Ana Sepe, Janja Vidmar, Sašo Šturm, Janez Ščančar, Matjaž Spreitzer, Spomenka Kobe, Kristina Žužek Rožman, "Hybrid FePt/SiO_2/Au nanoparticles as theranostic tool: in vitro photo-thermal treatment and MRI imaging", *Nanoscale*, 2018, **10**, 3, 1308-1321.

48. Manel Rodríguez Ripoll, Agnieszka Tomala, Christoph Gabler, Goran Dražić, Luka Pirker, Maja Remškar, "In-situ tribochemical sulfurization of molybdenum oxide nanotubes", *Nanoscale*, 2018, **10**, 7, 3281-3290.
49. Ana Mafalda Santos *et al.* (19 authors), "Capturing resting T cells: the perils of PLL", *Nature immunology*, 2018, **19**, 3, 203-205.
50. Nejc Janša, Andrej Zorko, Matjaž Gomilšek, Matej Pregelj, Karl W. Krämer, Daniel Biner, Alun Biffin, Christian Rüegg, Martin Klanjšek, "Observation of two types of fractional excitation in the Kitaev honeycomb magnet", *Nature physics*, 2018, **14**, 786-790.
51. Lidija Androš-Dubraja, Marijana Jurić, William Lafargue-Dit-Hauret, Damir Pajić, Andrej Zorko, Andrzej Ozarowski, Xavier Rocquefelte, "First crystal structures of oxo-bridged [$Cr^{III}Ta^{V}$] dinuclear complexes espectroscopic, magnetic and theoretical investigations of the Cr-O-Ta core", *New journal of chemistry*, 2018, **42**, 13, 10912-10921.
52. Yunjiang Zhang, Olivier Favez, Francesco Canonaco, Dantong Liu, Griša Močnik, Tanguy Amodeo, Jean Sciare, Andre S. H. Prevot, Valérie Gros, Alexandre Albinet, "Evidence of major secondary organic aerosol contribution to lensing effect black carbon absorption enhancement", *npj climate and atmospheric science*, 2018, **8**, 47.
53. Jun-ichi Fukuda, Slobodan Žumer, "Reflection spectra and near-field images of a liquid crystalline half-Skyrmion lattice", *Optics express*, 2018, **26**, 2, 1174-1184.
54. Gregor Pirnat, Matjaž Humar, Igor Muševič, "Remote and autonomous temperature measurement based on 3D liquid crystal microlasers", *Optics express*, 2018, **26**, 18, 22615-22625.
55. Anja Bregar, Mitja Štimulak, Miha Ravnik, "Photonic properties of heliconical liquid crystals", *Optics express*, 2018, **26**, 18, 23265-23277.
56. Jaka Pišljar, Miha Ravnik, "Lensing and waveguiding in birefringent double-twist cylinders demonstrated using FDTD simulations", *Optics express*, 2018, **26**, 20, 26327-26338.
57. Rita Rosentsveig *et al.* (11 authors), "Doping of fullerene-like MoS_2 nanoparticles with minute amounts of niobium", *Particle & particle systems characterization*, 2018, **35**, 3, 1700165.
58. Lena Yadgarov *et al.* (13 authors), "Strong light-matter interaction in tungsten disulfide nanotubes", *PCCP. Physical chemistry chemical physics: a journal of European chemical societies*, 2018, **20**, 32, 20812-20820.
59. Florian Weyland, Haibo Zhang, Nikola Novak, "Enhancement of energy storage performance by criticality in lead-free relaxor ferroelectrics", *Physica status solidi. Rapid research letters.*, 2018, **12**, 7, 1800165.
60. A. Pramanick, W. Dmowski, Takeshi Egami, A. Setiadi Budisuharto, Florian Weyland, Nikola Novak, A. Christianson, J. M. Borreguero, D. Abernathy, M. R. V. Jørgensen, "Stabilization of Polar Nanoregions in Pb-free Ferroelectrics", *Physical review letters*, 2018, **120**, 20, 207603.
61. Shang Gao *et al.* (22 authors), "Dipolar spin ice states with a fast monopole hopping rate in $CdEr_2X_4$ (X=Se, S)", *Physical review letters*, 2018, **120**, 13, 137201.
62. Yu. O. Zagorodniy *et al.* (13 authors), "Chemical disorder and ^{207}Pb hyperfine fields in the magnetoelectric multiferroic $Pb(Fe_{1/2}Sb_{1/2})O_3$ and its solid solution with $Pb(Fe_{1/2}Nb_{1/2})O_3$", *Physical review materials*, 2018, **2**, 1, 014401.
63. Fabio Orlandi *et al.* (12 authors), "Incommensurate atomic and magnetic modulations in the spin-frustrated $\beta - NaMnO_2$ triangular lattice", *Physical review materials*, 2018, **2**, no 7, 074407.
64. Nikola Novak, Florian Weyland, Satyanarayan Patel, Haibo Guo, Xiaoli Tan, Jürgen Rödel, Jurij Koruza, "Interplay of conventional with inverse electrocaloric response in $(Pb, Nb)(Zr, Sn, Ti)O_3$ antiferroelectric materials", *Physical review. B*, 2018, **97**, 9, 094113.
65. Andrej Zorko, Peter Jeglič, Matej Pregelj, Denis Arčon, Hubertus Luetkens, Andrei L. Tchougréeff, Richard Dronskowski, "Magnetic inhomogeneity in the copper pseudochalcogenide CuNCN", *Physical review. B*, 2018, **97**, 21, 214432.
66. F Caracciolo, M. Mannini, G. Poneti Poneti, Matej Pregelj, Nejc Janša, Denis Arčon, Pietro Carretta, "Spin fluctuations in the light-induced high-spin state of cobalt valence tautomers", *Physical review. B*, 2018, **98**, 5, 054416.
67. Matej Pregelj, Oksana Zaharko, U. Stuhr, Andrej Zorko, H. Berger, A. Prokofiev, Denis Arčon, "Coexisting spinons and magnons in the frustrated zigzag spin-1/2 chain compound $\beta - TeVO_4$", *Physical review. B*, 2018, **98**, 9, 094405.
68. Erik Zupanič, Herman J. P. van Midden, Marion Van Miden, Sašo Šturm, Elena Tchernychova, Vadim Ya Pokrovskii, Sergey G. Zybtsev, Venera Nasretdinova, S. V. Zaitsev-Zotov, W. T. Chen, Woei Wu Pai, J. Craig Bennett, Albert Prodan, "Basic and charge density wave modulated structures of NbS_3-II", *Physical review. B*, 2018, **98**, 17, 174113.
69. C. Kyrou, Samo Kralj, M. Panagopoulou, Y. Raptis, George Nounesis, Ioannis Lelidis, "Impact of spherical nanoparticles on nematic order parameters", *Physical review. E*, 2018, **97**, 4, 042701.
70. Tilen Koklič, Štefan Pintarič, Irena Zdovc, Majda Golob, Polona Umek, Alma Mehle, Martin Dobeic, Janez Štrancar, "Photocatalytic disinfection of surfaces with copper doped $Ti0_2$ nanotube coatings illuminated by ceiling mounted fluorescent light", *PloS one*, 2018, **13**, 5, e0197308.
71. Tilen Koklič, Iztok Urbančič, Irena Zdovc, Majda Golob, Polona Umek, Zoran Arsov, Goran Dražić, Štefan Pintarič, Martin Dobeic, Janez Štrancar, "Surface deposited one-dimensional copper-doped $Ti0_2$ nanomaterials for prevention of health care acquired infections", *PloS one*, 2018, **13**, 7, e0201490.
72. Pottathara Yasir Beeran, Vid Bobnar, Matjaž Finšgar, Yves Grohens, Sabu Thomas, Vanja Kokol, "Cellulose nanofibrils-reduced graphene oxide xerogels and cryogels for dielectric and electrochemical storage applications", *Polymer*, 2018, **147**, 260-270.
73. Andraž Rešetič, Jerneja Milavec, Valentina Domenici, Blaž Zupančič, Alexej Bubnov, Boštjan Zalar, "Stress-strain and thermomechanical characterization of nematic to smectic A transition in a strongly-crosslinked bimesogenic liquid crystal elastomer", *Polymer*, 2018, **158**, 96-102.
74. Igor Kocijančič, Jernej Vidmar, Marko Kastelic, "Dynamics of CT visible pleural effusion in patients with pulmonary infarction", *Radiology and oncology*, 2018, **52**, 3, 245-249.
75. Nina Kostevšek, Samo Hudoklin, Mateja Erdani-Kreft, Igor Serša, Ana Sepe, Zvonko Jagličić, Jerneja Vidmar, Janez Ščančar, Sašo Šturm, Spomenka Kobe, Kristina Žužek Rožman, "Magnetic interactions and in vitro study of biocompatible hydrocaffeic acid-stabilized Fe-Pt clusters as MRI contrast agents", *RSC advances*, 2018, **8**, 26, 14694-14704.
76. Pau Guillamat, Žiga Kos, Jérôme Hardoüin, Jordi Ignés-Mullol, Miha Ravnik, Francesc Sagués, "Active nematic emulsions", *Science advances*, 2018, **4**, eaao1470.
77. Dae Seok Kim, Simon Čopar, Uroš Tkalec, Dong Ki Yoon, "Mosaics of topological defects in micropatterned liquid crystal textures", *Science advances*, 2018, **4**, eaau8064.
78. Peter Adler *et al.* (13 authors), "Verwey-type charge ordering transition in an open-shell p-electron compound", *Science advances*, 2018, **4**, eaap7581.
79. Jun-ichi Fukuda, Andriy Nych, Ulyana Ognysta, Slobodan Žumer, Igor Muševič, "Liquid-crystalline half-Skyrmion lattice spotted by Kossel diagrams", *Scientific reports*, 2018, **8**, 17234.
80. Jeffrey Christopher Everts, Miha Ravnik, "Complex electric double layers in charged topological colloids", *Scientific reports*, 2018, **8**, 14119.
81. Uroš Puc, Andreja Abina, Anton Jeglič, Aleksander Zidanšek, Irmantas Kašalynas, Rimvydas Venckevičius, Gintaras Valušis, "Spectroscopic analysis of melatonin in the terahertz frequency range", *Sensors*, 2018, **18**, 12, 4098.
82. Nemanja Aničić, Marija Vukomanović, Tilen Koklič, Danilo Suvorov, "Fewer defects in the surface slows the hydrolysis rate, decreases the ROS generation potential, and improves the Non-ROS antimicrobial activity of MgO", *Small*, 2018, **14**, 26, 1800205.
83. Mojca Vilfan, Natan Osterman, Andrej Vilfan, "Magnetically driven omnidirectional artificial microswimmers", *Soft matter*, 2018, **14**, 17, 3415-3422.
84. S. Masoomeh Hashemi, Miha Ravnik, "Nematic colloidal knots in topological environments", *Soft matter*, 2018, **14**, 24, 4935-4945.
85. Mitja Zidar, Drago Kuzman, Miha Ravnik, "Characterisation of protein aggregation with the Smoluchowski coagulation approach for use in biopharmaceuticals", *Soft matter*, 2018, **14**, 29, 6001-6012.
86. Sergio Diez-Berart, Luana Tortora, Daniele Finotello, Blaž Zupančič, Boštjan Zalar, Lisa Green, Oleg D. Lavrentovich, "Order parameters and time evolution of mesophases in the lyotropic chromonic liquid crystal Sunset Yellow FCF by DNMR", *Soft matter*, 2018, **14**, 35, 7277-7286.
87. Alexander Dubtsov, Sergey V. Pasechnik, Dina V. Shmeliova, Ayvr Sh. Saidgaziev, Ekaterina Gongadze, Aleš Iglič, Samo Kralj, "Liquid crystalline droplets in aqueous environments: electrostatic effects", *Soft matter*, 2018, **14**, 47, 9619-9630.
88. Zoran Arsov, Iztok Urbančič, Janez Štrancar, "Aggregation-induced emission spectral shift as a measure of local concentration of a pH-activatable rhodamine-based smart probe", *Spectrochimica acta. Part A, Molecular and biomolecular spectroscopy*, 2018, **190**, 486-493.
89. Igor Serša, Franci Bajd, Monika Savarin, Tanja Jesenko, Maja Čemažar, Gregor Serša, "Multiparametric high-resolution MRI as a tool for mapping of hypoxic level in tumors", *Technology in cancer research and treatment*, 2018, **17**.
90. Iztok Urbančič, Juliane Brun, Dilip Shrestha, Dominic Waithe, Christian Eggeling, Jakub Chojnacki, "Lipid composition but not curvature is the

determinant factor for the low molecular mobility observed on the membrane of virus-like vesicles", *Viruses*, 2018, **10**, 8, 415.

Review Article

1. Jayasri Dontabhaktuni, Miha Ravnik, Slobodan Žumer, "Quasicrystalline ordering in thin liquid crystal films", *Crystals*, 2018, **8**, 7, 275.
2. Aleksander Matavž, Barbara Malič, "Inkjet printing of functional oxide nanostructures from solution-based inks", *Journal of sol-gel science and technology*, 2018, **87**, 1, 1-21.
3. Luka Mesarec, Aleš Iglič, Samo Kralj, "In-plane membrane ordering and topological defects", *Nanomedicine & nanotechnology open access*, 2018, **3**, 1, 000134.
4. Aleš Mohorič, "Polarni sij in Zemljino magnetno polje", *Obzornik za matematiko in fiziko*, 2018, **65**, 1, 12-25,
5. Vanessa Cresta, Giuseppe Romano, Alexej Kolpak, Boštjan Zalar, Valentina Domenici, "Nanostructured composites based on liquid-crystalline elastomers", *Polymers*, 2018, **10**, 7, 773.

Short Article

1. Slobodan Žumer, "Elusive torque sensed by liquid crystals", *Nature: the international weekly journal of science*, 2018, **564**, 7736, 350-351.
2. Aleš Mohorič, "Simple demonstration of phosphorescence in a fluorescent lamp by camera panning", *The Physics teacher*, 2018, **56**, 4, 260-261.

Published Conference Contribution

1. Anton Gradišek, Miha Mlakar, Matej Cigale, Luka Lajovic, Mitja Luštrek, Maroje Sorić, Gregor Starc, Bojan Leskošek, Gregor Jurak, "Physical fitness forecasting and risk estimation in slovenian schoolchildren", In: Arie Hasman (ed.), *Data, informatics and technology: an inspiration for improved healthcare*, ICIMTH 2018, [International Conference on Informatics, Management and Technology in Healthcare, 6-8 July 2018 in Athens, Greece], (Studies in health technology and informatics **251**) 2018, 125-128.
2. Matej Cigale, Anton Gradišek, Miha Mlakar, Mitja Luštrek, "Forecasting the physical fitness and all-cause mortality based of schoolchildren's fitness measurements", In: Matjaž Gams (ed.), Aleš Tavčar (ed.), *Workshop Electronic and mobile health and smart cities: proceedings of the 21st International Multiconference Information Society - IS 2018, 8-12 October, 2018, [Ljubljana, Slovenia]: volume I*, 2018, 69-72.
3. Anton Gradišek, Martin Gjoreski, Borut Budna, Monika Simjanoska, Matjaž Gams, Gregor Poglajen, "Zaznavanje srčnega popuščanja z analizo srčnih tonov", In: Matjaž Gams (ed.), Aleš Tavčar (ed.), *Workshop Electronic and mobile health and smart cities: proceedings of the 21st International Multiconference Information Society - IS 2018, 8-12 October, 2018, [Ljubljana, Slovenia]: volume I*, 2018, 32-34.
4. Mitja Gliha, Andreja Abina, Uroš Puc, Aleksander Zidanšek, "Wide frequency ground penetrating radar for non-destructive inspection of building", In: Marko Ban (ed.), *Digital proceedings*, 3rd Conference on Sustainable Development of Energy, Water and Environment Systems, June 30 - July 4, 2018, Novi Sad, Serbia, 2018, 0239.
5. S. R. Amanaganti, D. R. Chowdhury, Miha Ravnik, Jayasri Dontabhaktuni, "Electromagnetic response of dielectric nanostructures in liquid crystals", In: Liang-Chy Chien (ed.), *Emerging Liquid Crystal Technologies XIII, 27 January-1 February 2018, San Francisco, California, United States*, (Proceedings of SPIE **10555**) 2018.
6. Jani Bizjak, Anton Gradišek, Matjaž Gams, "Intelligent assistant for elderly", In: Jérôme Lange (ed.), *IJCAI*, International Joint Conference on Artificial Intelligence, 13-19 July 2018, Stockholm, [Sweden], 2018, 5808-5810.
7. Arlene J. Astell *et al.* (28 authors), "INLIFE - Independent Living support Functions for the Elderly: technology and pilot overview", In: Ioannis Chatzigiannakis (ed.), *Intelligent environments 2018: Workshop Proceedings of the 14th International, Conference on Intelligent Environments, Rome 25th-28th June 2018*, (Ambient intelligence and smart environments **23**) 2018, 526-535.
8. Woei Wu Pai *et al.* (15 authors), "STM studies of the charge-density waves in $NbS_3 - II$", In: *Nanofizika i nanoelektronika: trudi XXII. meždunarodnogo simpoziuma, 13- 15 marta 2018, Nižni Novgorod, Rossia. Tom 1, sek. 1/5*, 2018, 285-286.
9. Urška Mikac, Igor Serša, Mojca Žlahtič Zupanc, Miha Humar, Maks Merela, Primož Oven, "Application of MR microscopy for research in wood science", In: *Proceedings of the 13th International Bologna Conference on Magnetic Resonance in Porous Media (MRPM13), September 4, 2016 - September 8, 2016, Bologna, Italy*, (Microporous and mesoporous materials **269**) 2018, 51-55.
10. Igor Serša, Franci Bajd, Aleš Mohorič, "A study of effects of different echo processing on diffusion spectra measured by the CPMG sequence in a constant gradient", In: *Proceedings of the 13th International Bologna Conference on Magnetic Resonance in Porous Media (MRPM13), September 4, 2016 - September 8, 2016, Bologna, Italy*, (Microporous and mesoporous materials **269**) 2018, 152-155.
11. Anton Gradišek, Nicolas Cheron, David Heise, Candace Galen, Janez Grad, "Monitoring bumblebee daily activities using microphones", In: Mitja Luštrek (ed.), Rok Piltaver (ed.), Matjaž Gams (ed.), *Slovenian Conference on Artificial Intelligence: proceedings of the 21st International Multiconference Information Society - IS 2018, 8-12 October, 2018, [Ljubljana, Slovenia]: volume A*, 2018, 5-8.
12. Drago Strle, Mario Trifković, Anton Gradišek, Marion Van Midden, Nace Pintar, Igor Muševič, "Improving the selectivity of vapor trace detection system", In: Thomas Otto (ed.), *Smart systems integration*, 12th International Conference and Exhibition on Integration Issues of Miniaturized Systems, Dresden, Germany, 11-12 April 2018, 2018, 375-380.
13. Janez Grad, Anton Gradišek, "Analiza temperature satja z zalego v gnezdih čmrljev", In: Maja Ivana Smodiš Škerl (ed.), Ajda Moškrič (ed.), *Book of proceedings*, 3rd Scientific Symposium on Bees and Beekeeping [being] Poklukar's Days, in Ljubljana, 4th-5th October 2018, 2018, 64-69.
14. Anton Gradišek, Nicolas Cheron, David Heise, Candace Galen, Janez Grad, "Monitoring daily foraging activity of bumblebees using a microphone", In: Maja Ivana Smodiš Škerl (ed.), Ajda Moškrič (ed.), *Book of proceedings*, 3rd Scientific Symposium on Bees and Beekeeping [being] Poklukar's Days, in Ljubljana, 4th-5th October 2018, 70-74.

Independent Component Part or a Chapter in a Monograph

1. Andrej Ferlež, Boris Petrič, Maja Ovsenik, Luka Prodnik, Jernej Vidmar, Ksenija Cankar, Lidija Nemeth, "Magnetno resonančno slikanje odziva zobne pulpe na ortodontske premike zob: prikaz primera", In: Maja Ovsenik (ed.), Jasmina Primožič (ed.), *20 let raziskovalnega in strokovnega dela: zbornik: Zavod Orthos*, 2018, 308-315.
2. Janez Dolinšek, "Electronic transport properties of complex intermetallics", In: Peter Gille (ed.), Yuri Grin (ed.), *Crystal growth of intermetallics*, 2018, 260-278.
3. Denis Arčon, I. Heinmaa, R. Stern, "Low-temperature NMR: techniques and applications", In: Paul Hodgkinson (ed.), *Modern methods in solid-state NMR: a practioner's guide*, (New developments in NMR **15**) 2018, 231-261.
4. Ivan Sedmak, Iztok Urbančič, Janez Štrancar, Michel Mortier, Iztok Golobič, "High-Resolution thermal imaging based on the fluorescence of Erbium/Ytterbium co-doped ceramic", V: Sergey Y. Yurish (ed.), *Physical sensors, sensor networks and remote sensing*, (Advances in sensors: Reviews **5**) 2018, 325-338.

Scientific Monograph

1. Matej Ogrin (avtor, fotograf), Katja Vintar Mally (avtor, fotograf), Anton Planinšek, Griša Močnik, Luka Drinovec, Asta Gregorič, Ivan Iskra, *Onesnaženost zraka v Ljubljani: koncentracije dušikovih oksidov, ozona, benzena in črnega ogljika v letih 2013 in 2014*, Ljubljana: Znanstvena založba Filozofske fakultete, 2018.
2. Gregor Posnjak, *Topological formations in chiral nematic droplets*, Cham: Springer, (Springer Theses), 2018.

University, Higher Education or Higher Vocational Education Textbook

1. Andrej Zorko, Miha Nemevšek, Nejc Košnik, Matic Lubej, *Zbirka rešenih nalog iz moderne fizike*, Ljubljana: DMFA - založništvo, (Zbirka izbranih poglavij iz fizike **55**) 2018.

Secondary and Primary School Textbook or Other Textbook

1. Aleš Mohorič, Vito Babič, *Fizika 1: učbenik za fiziko v 1. letniku gimnazij in štiriletnih strokovnih šol*, Ljubljana: Mladinska knjiga, 2018.

2. Vito Babič, Ruben Belina, Peter Gabrovec, Marko Jagodič, Aleš Mohorič, Mirijam Pirc, Gorazd Planinšič, Mitja Slavinec, Ivica Tomić, *Fizika. Zbirka maturitetnih nalog z rešitvami 2012-2017*, Ljubljana: Državni izpitni center, 2018.

PATENT

1. Andraž Rešetič, Jerneja Milavec, Blaž Zupančič, Boštjan Zalar, *Polymer dispersed liquid crystal elastomers (PDLCE),* US9969847 (B2), US Patent and Trademark Office, 15. 05. 2018.
2. Barbara Malič, Hana Uršič, Marija Kosec, Silvo Drnovšek, Jena Cilenšek, Zdravko Kutnjak, Brigita Rožič, Uroš Flisar, Andrej Kitanovski, Marko Ožbolt, Uroš Plaznik, Alojz Poredoš, Urban Tomc, Jaka Tušek, *Method for electrocaloric energy conversion,* US9915446 (B2), US Patent and Trademark Office, 13. 03. 2018.

MENTORING

1. Jure Aplinc, *Field structures in active and passive liquid crystals:* doctoral dissertation, Ljubljana, 2018 (mentor Miha Ravnik).
2. Lovro Fulanović, *Relaxor-ferroelectric-based ceramic multilayer elements for viable electrocaloric cooling:* doctoral dissertation, Ljubljana, 2018 (mentor Barbara Malič; co-mentor Vid Bobnar).
3. Matjaž Gomilšek, *Quantum spin liquids on geometrically frustrated kagome lattices:* doctoral dissertation, Ljubljana, 2018 (mentor Andrej Zorko).
4. Marta Lavrič, *Stabilization of cholesteric blue phases by nanoparticles and nematic caloric effects induced by external fields:* doctoral dissertation, Ljubljana, 2018 (mentor Zdravko Kutnjak).
5. Janez Lužnik, *Physical properties of hexagonal high-entropy alloys:* doctoral dissertation, Ljubljana, 2018 (mentor Janez Dolinšek).
6. Luka Mesarec, *Impact of curvature on nematic topological defects:* doctoral dissertation, Maribor, 2018 (mentor Samo Kralj; co-mentor Aleš Iglič).
7. Melita Sluban, *One-dimensional Ti,O-based nanostructures: synthesis and application:* doctoral dissertation, Ljubljana, 2018 (mentor Polona Umek).