Sofia University St Kliment Ohridski

Research and project highlights

Sofia University St Kliment Ohridski

Sofia University St Kliment Ohridski, established in 1888, is the oldest and the largest university in Bulgaria. It is the leading Bulgarian academic and research institution ranked among the world's top 750 and Europe's top 300 universities. Its structure comprises 16 faculties, three departments and over 35 centres, with more than 100 bachelor and 500 master's programmes. Sofia University includes the following main structures: the Faculty of Slavonic Philology, the Faculty of Classical and Contemporary Philology, the Faculty of History, the Faculty of Philosophy, the Faculty of Law, the Faculty of Journalism and Mass Communication, the Faculty of Education, the Faculty of Pre-school and Primary School Education, the Faculty of Geology and Geography, the Faculty of Physics, the Faculty of Mathematics and Informatics, the Faculty of Chemistry and Pharmacy, the Faculty of Biology, the Faculty of Economics and Business Administration, the Faculty of Theology, the Faculty of Medicine, the Department of Information and Training of Teachers, the Department of Language Education, and the Department of Sports.

In the academic year 2016/2017, more than 23,000 BA and MA students, as well as more than 1,500 PhD students, studied at Sofia University. The university maintains inter-university agreements with more than 80 universities in numerous countries, hundreds of joint participations in international projects of different types, and multilateral contacts with scholars from all over the world. Sofia University is the leader in the country in terms of the number of participants in the students' and lecturers' mobility and the implementation of the idea of common European area of university education and research.

At present, Sofia University employs over 1,700 full-time teaching and research staff, including a significant part of the best scientists in Bulgaria in all major areas of natural and social sciences and humanities. Currently, Sofia University produces more than 20% of the scientific research output of the country.

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https://www.uni-sofia.bg

Project: EMATTER

Project ID: 280078

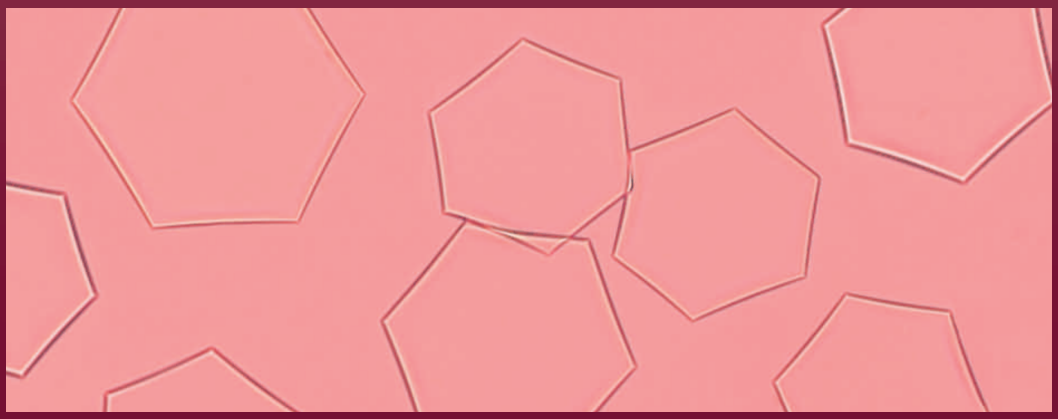
Funded under: FP7-IDEAS-ERC

Principal investigator: Dr Stoyan Smoukov, Cambridge University, UK
Project leader for Bulgarian team: Professor Slavka Tcholakova, Department of Chemical and Pharmaceutical Engineering, Faculty of Chemistry and Pharmacy, Sofia University, Bulgaria

This project develops methods for the fabrication of micro- and nanoparticles with complex shapes using a new method for symmetry breaking, in which oil drops dispersed in surfactant solution spontaneously change their shape. Upon slow cooling the spherical emulsion drops transform into various regular polyhedra, hexagonal, tetrangular and triangular prisms, and ultimately, thin fibres. The fluid particles can be selectively frozen at each of the stages so solid particles with corresponding structures are prepared. This process has been observed with a wide range of chemical substances, including alkanes, alkenes, alcohols and triglycerides. The droplet transformations are driven by the formation of thin layers of plastic 'rotator' phases on the drop surface in which molecules have long-range translational order, but rotate freely around their long axis.

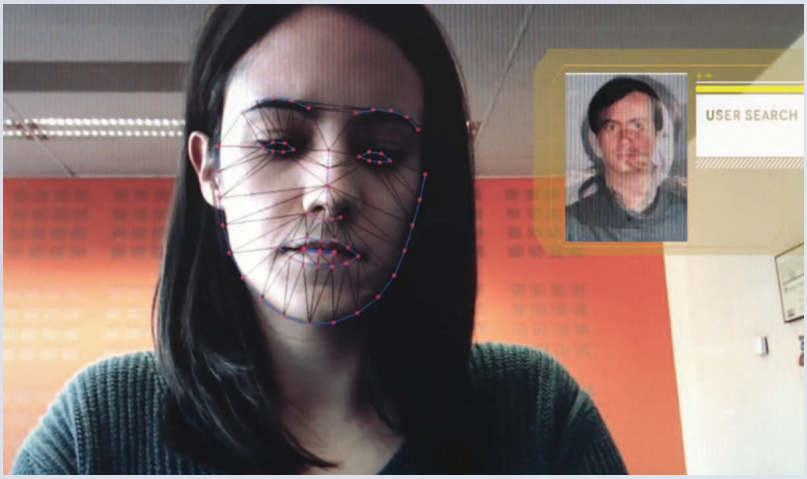
The drop shapes are an energy minimising pathway in a competition between the formation of the rotator phase and the interfacial tension, trying to minimise the interfacial area. This 'drop self-shaping' process is closely connected to another interesting phenomenon – self-emulsification – in which the emulsion drops burst into numerous smaller drops, thus decreasing their volume by more than 10,000 times, after just one freeze-thaw cycle without any mechanical energy applied. This new process could be a breakthrough in the industrial generation of emulsions in general, and specifically in the preparation of temperature-sensitive pharmaceutical formulations, which have not been possible to achieve before on a commercial scale.

We applied for a translational proof-of-concept grant from the European Research Council (ERC) to create an industrially relevant prototype of the process. Some of the largest companies in Europe have expressed interest in these processes and would be partners in their developments.



TeSLA – an innovative e-assessment system

TeSLA, an adaptive Trust-based e-assessment System for Learning, is an Innovation Action project funded by the European Comission under the Horizon 2020 framework programme, ICT 20 (Information and Communication Technologies), with a budget of €7m over three years, beginning January 2016. TeSLA aims at eliminating (or at least reducing to a great extent) the chances of impersonation and plagiarism during the examination process. The system will support the prevention and detection of cheating and academic dishonesty, and the promotion of academic integrity by a unique system of instruments for face, voice, and keystroke recognition, as well as plagiarism control.



TeSLA offers educational institutions, accrediting agencies and society an unambiguous proof of the learner's academic progression, authorship and authentication during the whole learning process. The consortium is composed of 18 partners: eight higher education institutions; four research centres; three technological companies; and three accrediting quality agencies. The co-ordinating institution is Universitat Oberta de Catalunya, Spain.

Sofia University's e-learning centre, led by Professor Roumiana Peytcheva-Forsyth, is one of the partners in this project and co-ordinator of the work package associated with the pilot testing of software solutions for the identification of the learner's authentication and authorship in online assessment. Encompassing more than 20,000 students from all over Europe, Sofia University respects social and cultural differences, guarantees equal opportunities, and provides inclusive solutions.

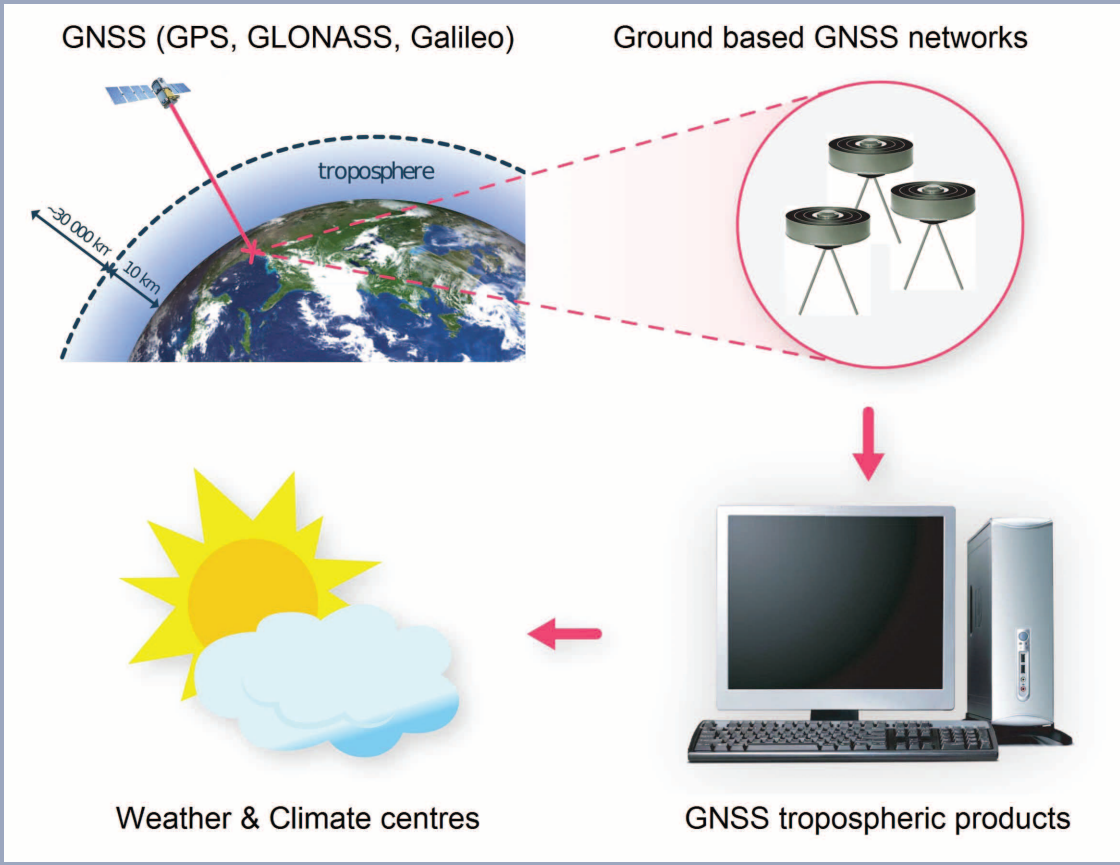
For more information visit http://tesla-project.eu/

BalkanMed real-time severe weather service (BeRTISS)

The BeRTISS project is developing a pilot transnational severe weather service exploiting Global Navigation Satellite Systems (GNSS) products to enhance safety, quality of life and environmental protection in the Balkan-Mediterranean region (Bulgaria, Cyprus and Greece). The project aims to provide timely information and warnings regarding severe weather events, as well as the long-term monitoring of weather and climate change in the region through the mapping and visualisation of water vapour, the most abundant greenhouse gas accounting for ~70% of global warming and a critical meteorological parameter for accurate weather prediction.

Remote sensing of atmospheric water vapour with GNSS is an established technique (GNSS meteorology) that provides reliable information of its high spatiotemporal variability. GNSS meteorology-based pilot services will monitor the conditions of the development of severe weather events like intense precipitation, hail and thunder storms, and will provide guidance for forecasters and private users in the Balkan-Mediterranean region, which is known to have high sensitivity to severe weather events.

The BeRTISS project – a bridge between the geodetic community, the GNSS remote sense data provider, the atmospheric community and the data user – is led by the Frederick Research Center in Cyprus. The Bulgarian Hail Suppression Agency, the Aristotle University of Thessaloniki, the National Observatory of Athens, and the Department of Meteorology of Cyprus are all partners of the Department of Meteorology and Geophysics at Sofia University.



RAGE project

The RAGE project (www.rageproject.eu) is the principal Horizon 2020 research and innovation project on applied gaming with 21 partners from eight EU countries, beginning in 2015 and ending in 2019. It aims to stimulate the applied game industry by making available a set of advanced reusable game technology components (software assets) that game studios can easily integrate in their game development projects. The software assets cover a variety of functionalities, including game analytics, emotion recognition, assessment, personalised learning, game balancing and player-centric adaptation, procedural animation, language technologies, interactive storytelling, and social gamification.

Fig. 1 Asset repository architecture

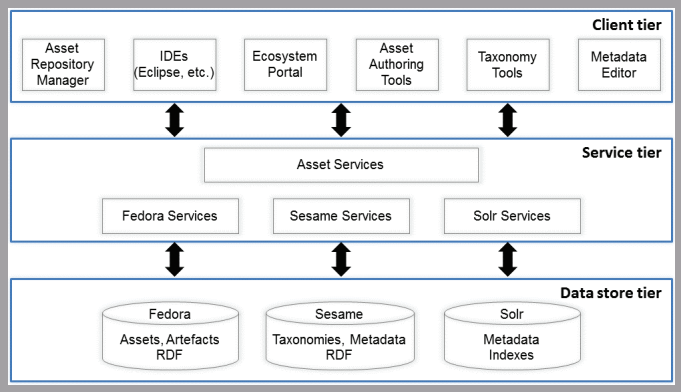
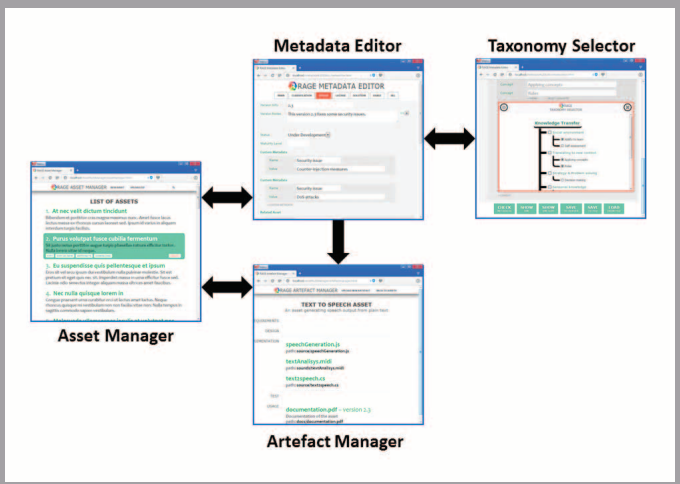


Fig. 2 RAGE asset manager, metadata editor and other tools to populate the repository



The main contribution of the Sofia University research team, led by Professor Krassen Stefanov, is related to the design and development of the asset software repository architecture aimed to support the process of the development, sharing and reuse of software gaming assets. It will be embedded in a social platform for asset developers and other users. A dedicated asset repository manager provides the main functionality of the repository, and its integration with other systems and tools supporting the asset manager are presented and discussed. When the RAGE repository is in full operation, applied game developers will be able to enhance the quality of their games by including selected advanced game software assets. Making available the RAGE repository system and its variety of software assets aims to enhance the coherence and decisiveness of the applied game industry.

In addition, we have developed two specific gaming assets: the player-centric rule-and-pattern-based adaptation asset, and the real-time arousal detection using a galvanic skin response (GSR) asset. The former is built as a pure software component searching for a pattern or a rule in the development of a given player's metrics (such as performance registered while solving a game task) and using its occurrence for game adaptation purposes. In contrast, the latter includes software artefacts plus a cheap custom hardware device for measuring the GSR signal from a particular player, which is applied for inferring the tonic and phasic arousal of the player.

www.rageproject.eu

Bulgaria's presence in Antarctica started about 30 years ago at the auditoriums of the Sofia University St Kliment Ohridski, where a small group of professors, mainly from the Faculty of Geology and Geography, organised the first Bulgarian Antarctic expedition (1987-1988), celebrating the 100th anniversary of our oldest higher school. The main goals of this polar campaign were the conducting of geological research on Alexander Island, Antarctic Peninsula, by geology professors of Sofia University St Kliment Ohridski and laying the foundations of the Bulgarian Antarctic Base of two small huts on Livingston Island, South Shetland Islands.

For the past 30-year period of Bulgarian exploration of the icy continent, our polar base, known as St Kliment Ohridski, has become a small settlement with normal conditions for life and work, where alongside the Bulgarian scientists work many of their colleagues from over 35 countries worldwide. In the region of the South Shetland Islands, Antarctica, long-term scientific research in the area of geology, biology, physics, glaciology, psychology and medicine has been carried out. The accent of these projects was placed on investigations related to the global climate changes. The results of these studies have been presented in over 1,000 publications in many international science journals and nine monographies.

The main organiser of the annual Bulgarian Antarctic campaigns is Sofia University St Kliment Ohridski, through its independent unit the National Centre for Polar Research, in which not only professors but also students from the Faculty of Geology and Geography take active participation. Many a diploma and doctoral thesis on Antarctic topics has been presented so far.

Geological work at Livingston Island, Antarctica from the professors of the Faculty of Geology and Geography (from left to right: Dr Yanko Gerdjikov, DSc Christo Pimpirev and Dr Dimo Dimov)

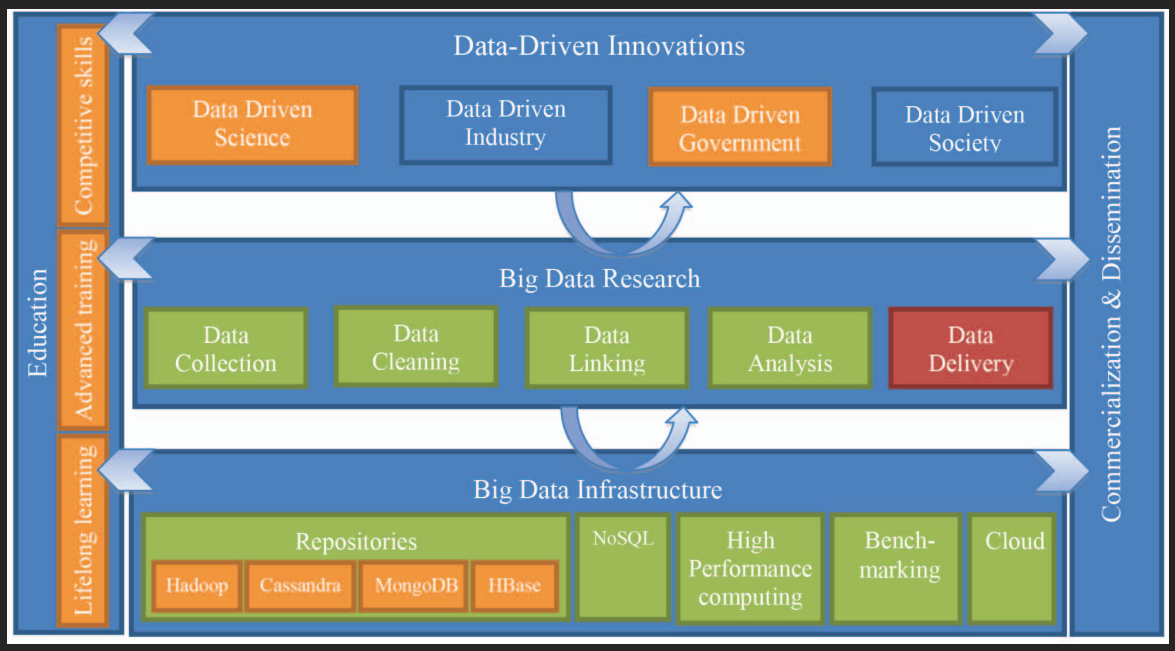
BIG DATA FOR SMART SOCIETY - GATE

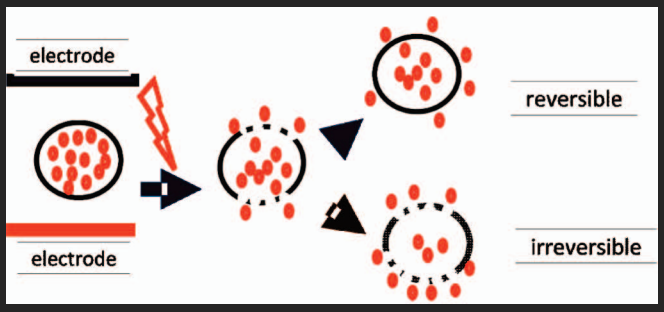
The general objective of GATE is to establish a centre of excellence on 'Big Data for Smart Society – GATE' that will fulfill the vision of open innovation through building a sustainable university-government-industry-society ecosystem. The CoE will be established as joint initiative between Sofia University, the most prestigious educational and scientific hub in Bulgaria, and Chalmers University of Technology, Sweden – a leading European institution with extensive experience in research, education and innovation. The CoE's main research objective is to advance the state-of-the-art in the whole Big Data Value Chain, including development of advanced methods and tools for data collection from a variety of structured and unstructured sources, data consistency checking and cleaning, data aggregation and linking, data processing, modelling and analysis, data delivery by providing both accessibility and proper visualisation. Following the challenges of Horizon 2020 and the Bulgarian Innovation Strategy for Smart Specialization 2014-2020, the project team selected the most promising data driven innovation pillars: data driven government (public services based on open data); data driven industry (manufacturing and production); data driven society (smart cities); and data driven science.

The specific objectives of the teaming one phase are to establish a solid background for the creation and sustainability of a CoE at a national, regional and EU level through: 1) Elaboration of a detailed and robust business plan with a long term vision for setting-up and sustaining of the CoE; 2) Strengthening the research capacity and potential in big data; 3) Establishment of an international collaborative network of big data and related fields researchers; 4) Increasing quality of education and training and offering measures for motivation and involvement of the next-generation early-stage researchers; and 5) Wide dissemination and promotion of project aims, activities and expected outputs.

Horizon2020

Topic: WIDESPREAD-04-2017
Call: H2020-WIDESPREAD-2016-2017 (WIDESPREAD)
Type of action: CSA Co-ordination and support action





Gaining productivity, cost-efficiency and sustainability in the downstreaming processing of bio products by novel integration and intensification strategies (Intenso)

IN the project are involved ten SME companies from seven EU countries (Czech Republic, Estonia, Germany, the Netherlands, Slovenia, Spain and the UK) and five universities from Argentina, Austria, Bulgaria, Germany and Portugal. At its core, the Intenso project is about identifying the bottlenecks of the currently used techniques in downstream processing (primary recovery, high resolution purification and polishing/formulation of the product), and finding new solutions to circumvent them. The goals of the Intenso project are closely linked to the four technological pillars: 1) the development of aqueous two phase systems (ATPSs); 2) development of a better expanded bed adsorption (EBA) chromatographic system; 3) investigation of convective flow systems with aim to develop monolith and convective flow systems especially for hard to purify products; and 4) development of a novel type of hybrid disposable cartridge (HDC) based on non-woven functionalised fibres.

Sofia University's team has a strong expertise in the application of pulsed electric field (PEF) for recovery of biologically active compounds from micro-organisms. In the frame of this project we developed protocols for efficient and selective electronic extraction of recombinant proteins from different yeast strains and investigated various approaches to scale up the process. Scalability and optimisation of energy consumption of the PEF treatment has been explored also with non-recombinant yeast which are source of different biologically active compounds. In collaboration with the partners the efficiency of different techniques for purification of the extracted products was tested. We showed that the PEF treatment applied in a flow mode is a suitable alternative technique for the recovery of homologous and recombinant proteins form yeast as well as other intracellular products of interest for the food industry, pharmacy and biotechnology.

The MAXCAP Project

The research project entitled 'Maximizing the integration capacity of the European Union: Lessons and prospects for enlargement and beyond' (MAXCAP) aimed to evaluate the European Union's enlargement to the east in response to the topic SSH.2012.5.2-1, in the European Commission's Seventh Framework Programme for research and innovation.[1] Research under the MAXCAP project took place between 2013 and 2016 and started from the assumption that despite the existence of an impressive body of studies evaluating aspects and effects of the 2004-2007 enlargement, a broad assessment of its lessons and effects for the EU and for the former candidates was still needed. The consortium of nine European universities and think tanks carried out the research and all teams have contributed to MAXCAP's conceptualisation of integration capacity and definition of main lines of inquiry in the project, with team leaders: Tanja A Boerzel (Co-ordinator, Free University Berlin), Antoaneta Dimitrova (Joint co-ordinator, Leiden University), Frank Schimmelfennig (ETH Zurich), Ulrich Sedelmeier and Adam Fagan (LSE), Laszlo Bruszt (EUI), Dorothee Bohle (CEU), Georgi Dimitrov (Sofia University St Kliment Ochridski), Meltem Muftuler-Bac (Sabanci University Istanbul), and Tanja Hafner Ademi (BCSDN).

1 The project was funded by FP 7 grant, number 320115.

The project as a whole has greatly benefitted by input of MAXCAP advisory board members and friends, Heather Grabbe, Klaudijs Maniokas, Daniel Kelemen and Malinka Ristevska-Jordanova.

The team was led by the idea that evaluating the EU's approach and mode of integration in the eastern enlargement would help to assess the current enlargement process encompassing candidates and aspirant countries from the Western Balkans as well as Turkey. Last but not least, this broad evaluation was intended to provide grounds for policy proposals how the EU could improve its integration capacity for the future. In academic terms, the project engaged with several streams and themes in the social science literature: the question about the relationship between widening and deepening of European integration, research into the structural effects of external actors on democratisation, good governance and economic growth, work on compliance and decision making in the EU, modes of integration, public opinion and citizen discourses.

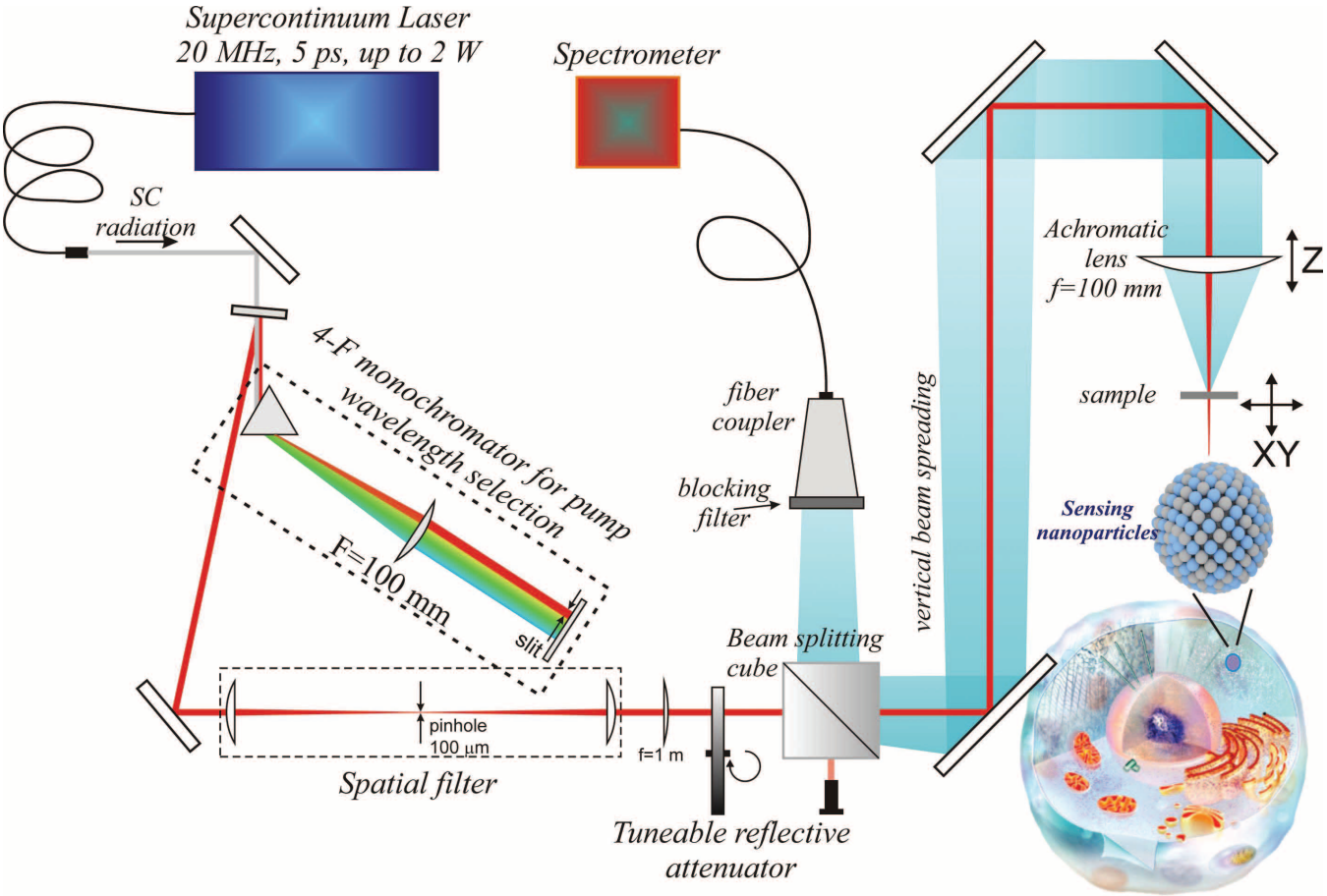
In the course of this research work more than 30 working papers were produced, which later appeared as articles in renowned academic journals or in edited volumes such as *Has the EU's Eastern Enlargement Brought Europe Together?/ South Eastern Perspectives,* St Kl. Ohridski University of Sofia Press, 2016 (Dimitrova, A, Dimitrov G, (editors)).

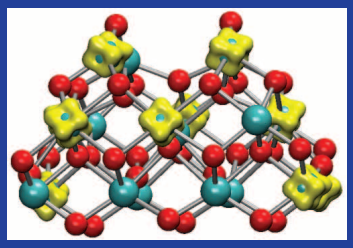
More information about the project, its activities and outcomes is available at the project's website: **http://userpage.fu-berlin.de/kfgeu/maxcap/about.html**.

HypoSens project

The aim of the HypoSens project is to develop a widely accepted, non-invasive and crucial prognostic tool for breast cancer progression in the early stages to help clinicians and oncologists decide about prompt therapy approaches to patients, improving both quality of life and life expectancy. Our research targets development, preclinical and clinical validation, as well as the industrial demonstration of a unique, all-optical cancer prognostic system that will determine and characterise the presence of cancer cells in the breast lymph nodes, which correlates with the presence of metastasis and bad prognosis.

The HypoSens prognostic system consists of a nano-confined, minimally-invasive IR-A imaging device able to register signals through scattering media (human skin) and enabled by the implementation of excitation light wavefront-shaping. The local temperature distribution and the evolution of the local oxygen concentration in the cancer cells will be delivered by the injected tumour-targeted, antibody-functionalised nanoparticles, containing optimised ensembles of metallised porphyrins, aromatic hydrocarbon dyes, and singlet oxygen scavenging moieties. The HypoSens imaging system is strategically designed to offer a minimally invasive alternative to the sentinel lymph node biopsy. The initial target of the project is metastatic breast cancer, with potential later involvement in other cancer markets, e.g. vulval, renal, colorectal, gastric, etc. (via the use of different tumour targeting moiety).





Project Materials Networking – Horizon 2020 (GA 692146)

The Materials Networking project is supported under the TWINNING call of the Spreading Excellence and Widening Participation pillar of the European Commission's Horizon 2020 programme. Its main objective is the enhancement of the science and technology capacity of the Faculty of Chemistry and Pharmacy at Sofia University (FCP-SU), Bulgaria, and raising the research profile of the faculty and its staff in the field of advanced functional materials via networking with three worldwide leading institutions – Department of Materials Science and Metallurgy, University of Cambridge, UK; Max-Plank Institute of Polymer Research and Faculty of Chemistry, Germany; and the University of Barcelona, Spain.

The FCP-SU is a leading research centre in functional materials and its networking and collaboration with global leaders in this research field will help develop its potential to become known across Europe with increasing research and innovation contributions and achievements. Such achievements will increase the participation of the teams from FCP-SU in European and international projects and will encourage a higher performance of Bulgaria's other research institutions. The partners from research intensive institutions have high international reputation and expertise in the various aspects of synthesis, modification, characterisation, testing and modelling of functional materials. Additional advantages for the FCP-SU are that the leading research partners have complementary competences ranging from the various fields of chemistry, to broad areas in materials science. Based on the expertise and achievements of the research groups in FCP-SU, the present project will contribute to two of the priority areas of Bulgaria's Smart Specialisation Strategy, with the relevant thematic priorities: "Materials for clean energy and environment protection" and "Materials with pharmaceutical and medical applications". The work programme of the project is distributed in five work packages and includes various co-operation activities – networking visits, summer schools, workshops, participation in scientific events, and contacts with industry.