



Research projects

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Project title	The scientific disciplines, within the project will be realized	Project abstract
Faculty of Biology and Environment Protection		
Root microbiomes as controls of P use efficiency in woody crops	biology, chemistry	<p>Introduction. Due to the dramatic human population growth, 30% of the world's forests were lost during the past 5 000 years. Reforestation programmes exist in many countries to compensate of this loss, however most of the new plantations are single-species monocultures, usually of fast-growing cultivars, what significantly decrease biodiversity and forest functioning. Since the root microbiome of woody plants is the key factor affecting plant health and productivity, its diversity and abundance is crucial. Phosphorus (P), as essential macronutrient, is a limited resource with rising global need, but mainly with low plant-availability in the soil caused by fixation.</p> <p>The main goal of the project is to (I) explore the significance and mechanistic basis of microbial regulation of the P use efficiency in roots of woody crops and (II) evaluate the impact of host plant genotype identity and diversity within the site on the root microbiome to indicate favorable production systems for a high P use efficiency and biomass production.</p> <p>We hypothesise that: (i) the host-specific root microbiome of woody crops is a leading control of the availability and uptake of P in woody crops ; (ii) the root microbiome (especially bacteria, endophytic and mycorrhizal fungi) will promote mobilization and solution of P from the soil pool and functioning as specific linkage between different tree cultivars increasing P availability.</p> <p>Methodology: All experiments will be based on running model sites (partly included in the global TreeDivNet). Analysis of the plant root microbiomes will be conducted according to the methodology described in Thiem at al. 2018. The P supply will be tested from the foliar concentrations in the field and the use efficiency will be tested in subsequent pot experiments by defined P supply and calculated P uptake rates..</p> <p>Expected results. Received results (i) increase the knowledge on the plant-microbial interactions and ecological processes functioning in the plantations of woody crops, (ii) indicate improved</p>

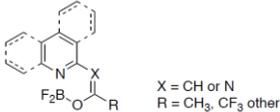
		highly nutrient-efficient management strategies for woody biomass production.
Phosphodiesterases in higher plants - the missing element in cyclic nucleotide signal transduction in plants	biology, chemistry	<p>The aim of the project will be to search for plant phosphodiesterases of cyclic nucleotides, their analysis at the genetic, biochemical and functional level. The project implementation will include the following main stages:</p> <ol style="list-style-type: none"> 1. Bioinformatics analysis of plant cAMP and cGMP phosphodiesterase candidates on base known animal homologues (identification of key catalytic amino acid residues and conserved regions in annotated PDEs) 2. Purification and biochemical analysis of proteins obtained by recombination in bacterial systems (overexpression, purification, complete biochemical analysis, enzymatic activity, in vivo analysis in bacterial mutants) 3. Searching for functional amino acids by protein mutations (single mutations, protein overproduction, biochemical analysis mutated versions, in vivo analysis in bacterial mutants) 4. Functional analysis in planta – creating (by CRISPR method) or analysing existing PDE mutants (knock - down and overexpression, phenotypic analysis, location of gene expression and protein translation in the process of morphogenesis and other external conditions).
Climate changes and xylem plasticity of gymnosperms tree species as an adaptation to droughts in Europe	biology, geography	<p>The problem we are solving concerns whether the described differences in the response of trees to droughts are local and habitat-dependent, whether they are of a supra-regional character and are related to the climate. It has been hypothesized that the adaptation to droughts at the anatomical level is reflected in the distribution of the trees. Supporting this hypothesis will allow us to model the European range of selected species in terms of the expected response to drought. However, its rejection will allow identifying local habitat conditions that determine the type of response during periods of water scarcity.</p>
Effects of extremely low-frequency magnetic field in the brain of rats	biology, physics	<p>Problem of the impact of low frequency electromagnetic field (50 Hz) (ELF-MF) on human health seems to be still far from the definitive explanation. The project aims at explaining the fundamental mechanisms of neuronal responses to ELF-MF and its results will lead to a new view on possible therapeutic properties of magnetic field and will provide new data for reliable risk assessment of the exposure to ELF-MF.</p>
Novel plant adenylyl cyclases and their functions in signal transduction and plant responses to the environment	biology, chemistry	<p>The aim of the project will be to analysis at the genetic, biochemical and functional level new plant proteins with adenylyl cyclase activity in Arabidopsis thaliana. The project implementation will include the following main stages:</p>

		<ol style="list-style-type: none"> 1. Bioinformatics analysis of selected plant proteins with cAMP activity. 2. Purification and biochemical analysis of proteins obtained by recombination in bacterial systems (overexpression, purification, complete biochemical analysis, enzymatic activity, in vivo analysis in bacterial mutants) 3. Functional analysis in planta – creating (by CRISPR method) or analysing cyclases existing mutants (knock - down and overexpression, phenotypic analysis, location of gene expression and protein translation in the process of morphogenesis and in responds to other external conditions).
Immunomodulating and antidepressant properties of Whole Body Hyperthermia	biology, social sciences (behavioral sciences, psychology)	<p>Hyperthermia is a medical therapy based on internal body temperature increase to the range from 38 oC to 40,5 oC. The indications to this kind of treatment are among others: arterial hypertension, chronic back pain, fibromyalgia syndrome, psoriatic arthritis, systemic scleroderma, depressive disorder and cancer. The use of hyperthermia is based mainly on observation regarding the healing properties of the heat. So far, the immunological mechanisms activated by heat in the patient's body are not fully understood. Most published scientific studies on hyperthermia are based on cell culture studies that have been grown in vitro. These conditions, however, do not allow to observe all the changes that occur in the body of a patient subjected to hyperthermia.</p> <p>In the project there is a plan to conduct research concerning the influence of hyperthermia on the activity of the immune system (among other the level of pro- and anti-inflammatory cytokines, the proliferative ability of blood cells) and the evaluation of the consequences of the hyperthermia on the mental condition of the patients. The research will be conducted in cooperation with Medical Institute HiperMe, which owns the complete equipment used in hyperthermia.</p>
Possibilities of using new natural and synthetic biocides to obtain copolymers with biocidal properties	biology, polymer and biopolymer chemistry	<p>The aim of this project is obtaining mixtures of natural and synthetic biocidal substances as well as their application as bioactive additives to polymer matrix. The mixtures of highest antibacterial activity will be then used to create new biocidal polymers. The bioactivity of obtained mixtures and polymers will be again studied. Finally, the bactericidal efficacy of polymeric composites will be evaluated. Then the chemical and some physical functions and properties of obtained polymers will be investigated.</p> <p>The important part of this project will be devoted to investigations of destructive influence of natural and synthetic biocides on the cell membrane, inhibitory effect of cell enzymes,</p>

		<p>inhabitation of DNA replication and inhibition of translation (protein synthesis), which will lead to explanation of mechanism of bactericidal action of such compounds. Moreover, the mutagenic potential of these bioactive chemicals will be also studied.</p> <p>Natural biopolymers (chitosan, collagen, cellulose, starch) and few synthetic vinyl polymers commercially available (e.g. PVC, PS, PMMA or other acrylic resins) will be the matrices for the biocidal compounds or their mixture.</p> <p>This interdisciplinary project will be realized by scientists specializing in microbiology and polymer and biopolymer chemistry.</p>
Role of selected ligands in structural changes and activity of GPCR receptors	physics, biophysics, biology (neurophysiology)	<p>Within this interdisciplinary PhD project mechanisms of activation/deactivation of a series of G-Protein Coupled Receptors (GPCR) will be studied. In particular M1 and M3 muscarinic receptors will be investigated. These receptors play a crucial role in activity of both human and insect neuronal systems. We plan to study chemical compound that modify the activity of mosquito and <i>Periplaneta Americana</i> neurons. The systems (ligand+protein) will be studied experimentally (electrophysiology) and computationally. Protein computer modeling and bioinformatics methods will be applied. We will investigate dynamics of the selected GPCR proteins models. The ultimate goal of this project is to understand better mechanisms of action of insects repellents. This problem is important for the societies worldwide: numerous vector borne diseases (malaria, denga, zika..) are serious threat for humans and having good insect repellents might save many lives.</p>
MicroRNA expression analysis during oocyte maturation and fertilization in Polish HF and Polish Red cattle	agriculture science (specialization: zootechnic, animal genetics), veterinary science (reproductive biology, animal genetics)	<p>Successful fertilization and subsequent embryo development rely on complex molecular processes starting with the development of oocyte competence through maturation. MicroRNAs (miRNAs) are small non-coding RNA molecules that function as gene regulators in many biological systems, including the oocyte and embryo. In the proposed Phd research project, embryonic developmental stages of two native breeds of cattle will be investigated to identify and characterize the breed-specific miRNA populations present in pools of bovine germinal vesicle (GV) oocytes, metaphase II (MII) oocytes, and presumptive zygotes (PZ). By comparing the oocytes MicroRNA profiles of candidate genes in Polish native cattle breeds, we will identify the breed specific gene variants, as well as differential expressed genes (DEGs) at the early embryonic developmental stages, and will provide the detailed insight into the timing of gene activation during early bovine embryo development.</p>

Faculty of Chemistry

<p>Microbiological degradation of nano- and microplastics in the environment</p>	<p>chemical sciences, biological sciences</p>	<p>Plastic is undoubtedly the most widely used synthetic polymer by modern humans. Global production of plastics reached 320 millions of tones in 2016 and constantly increasing. These materials greatly contribute to waste disposal but also leaks to the environment. Over few decades, plastic contamination has become a major cause of concern among scientists, politicians, and the public [1]. Microplastics may also leach plastic additives, including persistent organic pollutants (POPs) and potentially toxic elements that are adsorbed from water column at higher concentrations than in surrounding environment. These pollutants may transfer and accumulate in different tissues of organisms, possibly undergoing biomagnification along the food chain [2].</p> <p>Since polymers are susceptible to degradation via biotic processes, biodiversity and density of microbial communities are crucial in the environments to degrade these dangerous pollutants. Moreover, some selected microorganisms with specific metabolic activity should be considered in biodegradation processes to increase biodegradation processes of polymers.</p> <p>There is still much of inconsistency in methodology of sampling, handling and characterizing these materials in newest literature. Present study concerns therefore on investigate microbially assisted degradation of micro- and nanoplastics and include:</p> <ul style="list-style-type: none"> - Qualitative and quantitative characteristics of nano- and microplastics in aquatic systems and WWTP effluents which require: <ul style="list-style-type: none"> • developing of adequate sampling method; • particle size sorting using field-flow fractionation methods • chemical and physical characteristics of nano- and microplastics laser • scattering and diffraction, microscopy and spectroscopic techniques; <p>All adopted chemical methods will be further used for monitoring of microbiological aspects of the study.</p> <ul style="list-style-type: none"> - Optimization of bioassay method suitable to investigate toxicity of nano- and microplastics on aquatic microorganisms. - Selection of specific microorganisms as environmental-friendly bioremediation method for removal of nano- and microplastics from the environment:
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		<ul style="list-style-type: none"> • biodiversity of microorganisms in the environments (water, soil) polluted with nano- and microplastics; • analysis of metabolic activities of microorganisms and selection of strains with increased properties for degradation of nano- and microplastics. <p>Microorganisms selected during the study will be patented and applied in technologies used in bioremediation of environments contaminated with plastics.</p> <p>Cooperation with WITS University researchers provides new insights for application of membrane technologies for nanoplastics separation and comparison materials collected in different RSA regions.</p> <p>[1] Silva A et al.: Microplastics in the environment: Challenges in analytical chemistry – A review <i>Analytica Chimica Acta</i> 1017 (2018) 1-19.</p> <p>[2] Karami A: Gaps in aquatic toxicological studies of microplastics. <i>Chemosphere</i> 184 (2017) 841-848.</p>
Aromaticity in fluorescent compounds	chemical sciences, physical sciences	<p>The project is focused on the synthesis of benzannulated fluorescent compounds that will be studied in the light of their photophysical properties. The aim is to study their aromatic character both in the ground and excited states. For that purposes a series of compounds will be synthesized and their properties measured by experimental methods.</p> <p>Furthermore, the state-of-the-art quantum chemical methods will be applied to have a deeper insight into electronic structure of investigated compounds. Above-mentioned aromaticity will be studied in the light of the Clar rule with the help of aromatic indices (HOMA, NICS, and others) as in previous series.¹ The main idea is to study if benzannulation in the ground state has a similar effect on properties of molecules and their photophysical behaviour as in their excited state.</p> <p>The following scheme shows the general formula for proposed molecules.^{2,3}</p> <div style="text-align: center;">  <p style="margin-left: 100px;"> X = CH or N R = CH₃, CF₃ other </p> </div> <p>For more information on the topic and references see: https://sites.google.com/view/bosmialowski/publications</p>

		<p>References</p> <ol style="list-style-type: none"> 1. T. M. Krygowski, J. E. Zachara, B. Ośmiałowski and R. Gawinecki, <i>J. Org. Chem.</i>, 2006, 71, 7678–7682. 2. A. M. Grabarz, B. Jędrzejewska, A. Zakrzewska, R. Zalesny, A. D. Laurent, D. Jacquemin and B. Ośmiałowski, <i>J. Org. Chem.</i>, 2017, 82, 1529-1537. 3. B. Ośmiałowski, A. Zakrzewska, B. Jędrzejewska, A. Grabarz, R. Zalesny, W. Bartkowiak and E. Kolehmainen, <i>J. Org. Chem.</i>, 2015, 80, 2072–2080.
Ruthenium(II) complexes with flavonoid derivatives. Cytotoxic activity and mechanistic insight in biological studies	chemical sciences, biological sciences	<p>Compounds of almost all metals of the periodic table have been investigated, in terms of their potential anticancer activity. Many metals have shown activity against tumour cells. However, most often their activity against tumour cell has not been paralleled by their therapeutic efficiency, and only a few of the many metal compounds have shown similar biological activity in clinical trials. Among them, the ruthenium compounds are the most promising and potent chemotherapeutics that competitive against cisplatin, the first inorganic anticancer drug. A possible explanation for the success of ruthenium compounds derived from their similar reactivity. Similarly to cisplatin, ruthenium is a relatively nonreactive metal, and is transformed into more reactive form of drug typically within the same timescale as cellular division processes. Therefore ruthenium provide an attractive alternative to cisplatin and other platinum compounds due to their similar reactivity, which result in fewer side effects and leads to higher biological activity. Scientific research will focus on synthesis, spectroscopic analysis and biological studies on diamagnetic ruthenium(II) coordination compounds with derivatives of flavanones, flavonols, flavanols, flavones, flavanonols and dihydroflavonols. The research will include (i) spectroscopic analysis of ligands, (ii) synthesis of the studied complexes with selected flavonoid derivatives, (iii) determination of the composition and structure of selected synthesized compounds using elemental analysis and X-ray diffraction methods, (iv) determination of physicochemical properties of the compounds obtained using FT-IR, FT-Raman, UV-Vis, NMR (¹H, ¹³C, ¹⁵N NMR) spectroscopy, MS, quantum mechanical calculations (structure geometry, IR theoretical spectrum, NMR distribution, electron charge distribution), (v) biological study <i>in vitro</i> on selected tumour cell lines and the research of an interaction of these potential inorganic pharmaceuticals with the components of DNA using NMR methods. The biological activity of the compounds will be tested on selected normal</p>

		<p>and tumour cell lines. Taking into account their potential biological activities, the influence of structural factors in ruthenium complexes on their cytotoxic properties will be analysed and the correlation between their reactivity in solutions and biological activity will be determined. Flavonoid derivatives have been chosen on account of their documented antioxidant properties, protecting against oxidative stress, antineoplastic and antimicrobial properties, and the fact that they are easily absorbed by the human body. Their presence in the inner coordination sphere of the metal makes it possible to analyze the possibilities of various applications of synthesized coordination compounds with flavonoid derivatives in antitumor therapy.</p>
<p>Implementation of nanomaterials in the conservation of damaged paintings and destroyed paper objects</p>	<p>chemical sciences, arts, art conservation and restoration</p>	<p>The conservation and reparation of the damaged artworks is one of the important activities of the art galleries, libraries, and museums. The project is focused on the implementation of nanomaterials (hydrophobic membranes as well as nanoparticles) in the conservation of damaged painting and the spontaneous acidified paper objects.</p> <p>The main hypothesis of the planned research is following: treatment of the artworks with membranes or nanoparticles can be an important step in the conservation and restoration procedure.</p> <p>Paintings are complex multilayer structures, composed not only of linen canvas (which gained a wide recognition since 16th century) but also sizing, ground, paint layers, and varnish. The complex structure of paintings presents itself a problem because of different response of each layer to negative issues weakening the material layers. The main factors contributing to paintings damage and ageing are climate variations such as humidity and temperature fluctuations, light or even environmental pollution. Moreover, an improper storage, transportation and unskillful reparations can be also critical for paintings. All that results in picture layers cracking, lifting and cupping, which disallows the proper painting appreciation. Humidification is a very important element of the treatment of paintings canvas. This process can be performed using special humidification chambers or applying nanomaterials - porous and nanoporous hydrophobic membranes.</p>

		<p>The spontaneous acid catalyzed depolymerization of cellulose is one of the major problems in paper conservation. The depolymerization of cellulose results in the progressive lost of tensile strength and color change of the paper. Moreover, the oxidation of cellulose contributes for the raising of acid concentration in paper. There are several methods which can be implemented in the paper deacidification processes, however their effectiveness is not sufficient. There are several drawbacks of these treatments, e.g. they are restricted to papers with insoluble inks or there is an accumulation of by-products changing the appearance of the documents.</p> <p>The PhD project will explore: a) novel hydrophobic porous membrane materials for the humidification of paintings; novel membrane materials will be prepared, characterized, and compared with the properties of the available membranes; b) preparation, extended characterization, and evaluation of the methods for the deacidification of paper artwork. Project will focus on the application of ion-exchange membranes for the aqueous treatment leading to the acidity neutralization and/or preparation of nanoparticles for the non-aqueous treatment.</p> <p>The internship of PhD student at University Complutense of Madrid (Spain) is planned.</p>
Faculty of Languages		
Pointing and language acquisition: an eye-tracking and EGG study of infants and toddlers (8-18 month-olds)	linguistics; cognitive science	The aim of the project is to trace the development of joint attention understood in this case as a child's ability to follow gaze patterns and pointing. Additionally, during the observation of such events, children's brain responses will be measured by of the EEG equipment. The research question that the project will seek to answer is: "Does the EEG of children change significantly (especially in terms of MU rhythm (an early sensorimotor rhythm) when children begin to join in dyadic behaviours such as pointing?"
Towards a New Poetics of Space: Intersections of the Feminine and the Environmental in North	languages and literature: literary studies; social sciences: social and	Women's rights and environmental concerns appear to be significant contemporary issues for Indigenous nations in North America, voiced, among others, by the United Nations and the Canadian movement 'Idle No More.' This project is to explore in an

American Indigenous Fiction in English	economic geography	interdisciplinary perspective the dimensions of the feminine and the environmental as well as their convergence in North American Indigenous fiction in English. My objective is to demonstrate the strong association of female characters with land and nature in Indigenous writings and to indicate its changing character. The aim of such an analysis is to provide space for further reflection on the functions that such representations would perform, especially in the context of decolonizing tendencies. My intention is to address established American and Canadian writers, such as Lee Maracle, Linda Hogan, Thomas King, Louise Erdrich, and Eden Robinson as well as more recent voices, for instance Leanne Simpson or Tracey Lindberg. My approach is founded on the synthesis of different methodological perspectives, including: literary studies, Indigenous studies, Indigenous methodologies, Indigenous feminism, posthumanism, postcolonial studies, including postcolonial history and geographies, environmental studies, and sociology.
Faculty of Physics, Astronomy and Informatics		
Breaking the curse of dimension in computational many-body physics and chemistry: simplified and inexpensive Coupled-Cluster-type methods to provide an efficient and robust computational model for the electronic structure of complex molecular systems	physics, chemistry	The proposed PhD project focuses on the development, implementation, and application of novel electronic structure methods and their validation using the picture of interacting orbitals. The proposed wave function models should be applicable to heavy-element chemistry and hence must allow for a balanced treatment of electron correlation and relativistic effects. Furthermore, the PhD student will be involved in the development of our own quantum-chemical software package, called PIERNIK.
Printed plasmonics for efficient biosensing	biophysics, chemistry	The project will focus on the one hand on developing simple yet reproducible technology of printing metallic nanostructures, and secondly on testing these novel substrates as chips for detection of dyes, proteins, viruses. In addition to fabrication, the project will aim at developing functionalization techniques for required biofunctionality. Selectivity and sensitivity of printed plasmonic chips will be tested and verified using advanced fluorescence microscopy techniques. Collaboration will include material science aspects of the project and sensor development (prof. Sabine Szunerits) as well as surface functionalization (prof. J. Niedziolka-Jonsson).

<p>Few- and many-body physics of distinguishable fermions: from interactions in ensembles of fermionic atoms to biomolecules</p>	<p>physics, chemistry</p>	<p>Describing ensembles of many-fermion systems is one of the major problems in contemporary physics. In this project we will develop the tools which can deal with systems which consist of ensembles of two distinguishable (fermionic) particles A and B which are based on coupled cluster theory. Our main goal is to apply it to the interaction of dimers of large, polyatomic molecules in ground - and excited states. The same tool can be applied to mixture of fermionic atoms in optical trap which interact through the contact potential, which we will also explore.</p>
<p>A new formation mechanism for low surface-brightness galaxies and implications for dark matter (astronomy, atomic physics)</p>	<p>astronomy, physics</p>	<p>Low surface-brightness galaxies (LSBGs) are typically big disc galaxies with very low historical star formation rates, despite their inferred high masses of dark and baryonic matter, and are often located in voids. It is unclear whether the formation of these LSBGs is consistent with the Lambda Cold Dark Matter (LCDM) cosmological model. This thesis project aims to study a new hypothesis for the formation of LSBGs via numerical and analytical calculations and to propose observational tests for the role of fundamental physics (dark matter, nature of gravity) in the formation of this type of galaxy.</p>
<p>Statistics of null geodesics of photons on cosmological scales (astronomy, atomic physics)</p>	<p>astronomy, physics</p>	<p>Gravitational lensing observations are a powerful tool in modern cosmology, but are interpreted under the assumption that the Weyl curvature through spacetime is zero. However, the inhomogeneous nature of the dark matter distribution generates non-zero Weyl curvature and enhances astronomical shear, one of the effects of gravitational lensing on the paths of photons through spacetime. This thesis project aims to model the astronomical shear expected from an inhomogeneous dark matter distribution and make observational predictions to test these fundamental physics assumptions using next-generation cosmological surveys.</p>
<p>Atomistic calculations of nanostructures: from semi-empirical to ab-initio approaches</p>	<p>physics, chemistry</p>	<p>Quantum dots main spectral properties are governed by quantum confinement which is related to nanostructure's overall size, shape and average chemical composition. However, the fine structure of optical spectra, which plays an essential role for applications in quantum optics and information, is determined by atomic scale details related to microscopic symmetry of underlying lattice, presence of faceting and alloying randomness. In this project we aim for atomistic calculations of detailed spectral properties of various realistic quantum dots and nanowires. First, we plan to utilize semi-empirical tools such as the empirical tight-binding method coupled with the configuration interaction method. These will be demanding numerical calculations involving one million of atoms and more. Further, for systems with much lesser number of atoms (such as small diameter nanowires) we plan to perform density functional theory calculations as well, thus comparing and benchmarking both approaches. Increasing</p>

		computation power of modern computer clusters and recent developments in linear scaling approaches should allow us to study systems with several thousands of atoms in the computational box. This will be an important step forward, spanning a bridge between the traditional world of solid state theory and the realm of quantum chemistry. Results of our calculations will be compared with experiments performed by closely collaborating group from Sweden (KTH/Stockholm).
Preparation of mixed crystals of All-BVI compounds with selected rare earth elements and transition metals, and their characterization for optoelectronic applications	physics, chemistry	Rare earth elements (REE) and transition metals (TM) show interesting optical properties including light conversion in UV-Vis-IR regions. Many All-BVI semiconductors (i.e. CdTe, CdS, ZnS, ZnSe, ZnO) were already tested for their usability in optoelectronic devices. Therefore, the goal of this project is to achieve controlled light conversion in REE/TM doped All-BVI semiconductors, as well as to study the changes in these semiconductors caused by REE/TM doping and to examine their optical properties.
Faculty of Mathematics and Computer Science		
Dynamic aspects of combinatorial algorithms and of the asymptotic representation theory	mathematics, computer science	What can we say about combinatorial objects in the limit when they become really large? What can we say about their dynamics? The goal of this project is to answer such quite general questions in the setup of some concrete classical examples coming from the algebraic combinatorics, the representation theory and the statistical mechanics. This proposal is focused on the dynamic phenomena: trajectories of particles, asymptotics of combinatorial algorithms, the hydrodynamic limits and, in general, the question of existence of the dynamic limit shape.
Faculty of Economic Sciences and Management		
People in Organizations	management and public policy studies	Human behaviors are among the key determinants of all economic phenomena and processes, both in the microscale (organization) and the macroscale (economy). Research proposed within the project may concern individual and group level of organizational behaviors. First perspective includes individual traits and psychological mechanisms while the second one is linked with issues such as social relationships, communication and cooperation, organizational and national culture.
Application of Data Mining, Artificial	economics, computer	Successful management of business processes is the most relevant success factor

Intelligence and Analytics in Decision Support	science	<p>of an enterprise. Decision support using data mining, artificial intelligence and analytics to support the management with “high quality” and decision relevant information (regarding e.g. relevance, timeliness and inexpensiveness) to generate the best decision is mainly driven by a technical perspective. Consequently, an end to end framework or process model how to use these methods from a holistic perspective in an enterprise is lacking. Technology and software companies are providing an enthusiastic “everything is possible” view without concretising how, why and more important to what benefit methods of data mining, artificial intelligence and analytics should be used within a business context.</p> <p>In theory, sufficient high-quality information for decision support is to enable the management to make good decisions all over the enterprise, by now a comprehensive approach to achieve the above mentioned high quality does not exist. Most of the research investigating approaches or frameworks to provide high quality decision relevant information is solely focused on specific domains, like supply chain analytics, risk management, customer analytics or specific industries, like manufacturing or retail.</p> <p>This research draws upon a literature review on the main topics (data mining, artificial intelligence, analytics and decision theory and decision support) and addresses the development of a comprehensive process and evaluation model for the application of data mining, artificial intelligence and analytics to support decision making in an enterprise end to end, on a strategic as well as on an operational level and their application in a real-world enterprise.</p>
Faculty of History		
Religious foundations in medieval Stockholm	history, ethnology	Territorial and chronological frameworks: The territorial framework is quite simple to define as it is marked with the boundaries of the town of Stockholm. The chronological scope starts with the establishment of the town and finishes in the 1530s. The period of the Reformation brought a significant change in the religious life of the inhabitants of the Kingdom of Sweden and especially affected the idea of the foundation. Swedish

		<p>monasteries were gradually dissolved, whereas the acts of founding of ceremonial objects or masses started to be perceived as a relic of the Catholic era.</p> <p>Factual framework: Basing on the findings of my predecessors I may indicate three constitutive features of a religious foundation. Firstly, it is the duration in time. It is the foundation understood as an institution which was planned to last until the Day of Judgement that is the subject of my project, unlike a single foundation act. The next feature is the aim of the religious foundation which consists in the salvation of the souls of its founder and his/her family. The last element is the worship of the founded object by people gathering around it and praying for its founder. This definition embraces the foundations of whole temples, chapels, altars and also liturgical equipment. Apart from the foundations in the strict sense I would like to discuss also the activities which do not fulfil the above-mentioned criteria but are still connected with the foundation activity, namely various forms of aid to the poor and sick, who were supposed to repay their benefactors with their prayers, and gifts for religious institutions, which did not guarantee regular mass services or prayers.</p> <p>Condition of the sources: The physical condition of the sources is promising. I shall use Swedish documents, mainly last wills and donation documents. Other sources of great importance are town books preserved in Stockholm from the late Middle Ages and the early modern period. I may also use some narrative sources such as The Chronicle of Duke Eric and sources known as the books of deceased (<i>libri memoriales</i>).</p> <p>State of the research: The religious foundations made by burgers in Stockholm or any other Swedish town have not attracted the interest of scholars so far. In general, the issue of religious foundations in medieval Sweden was not treated as an autonomous research field. It does not mean, however, that the subject matter has not been addressed at all. Few articles, which I find particularly interesting, include reflections on the foundation process and the figure of a founder. But it needs to be emphasized that the historiography most frequently took into account the foundations and gifts associated with the Swedish monarchs and nobles. The innovative character of my</p>
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		<p>research consists in including activities of burgers and parish clergy as well as in using the methodology concentrated on the mentality of the founders and social aspects of the foundation rather than on legal and purely economic elements.</p> <p>Methodology: I plan to use the methodology developed by researchers who dealt with the history of foundations. The German historians such as Otto Gerhard Oexle and Michael Borgolte contributed considerably in this field. They belonged to the more recent research trend, which emphasized the cultural aspects of the foundation. The researchers and their followers inscribed the phenomenon of the foundation in a broader context of the medieval memory. The anthropological findings of Marcel Mauss, the author of the famous book <i>The Gift</i>, and the religious studies by Mircea Eliade would allow me to supplement my methodological approach with the interdisciplinary inspiration. I may also use more general studies concerning memory, remembering and reminding in the context of historical sciences, the examples of which are the works by Pierre Nora and Aleida Assmann.</p> <p>Exemplary questions from the research questionnaire:</p> <ul style="list-style-type: none"> o The typology of activities which are referred to in the source texts as the "aid for the soul". o Social groups in medieval Stockholm and their connections with particular foundations. o Economic and prestigious aspects of religious foundations (e.g. self-presentation of town elites). o The problem of the urban autonomy in the light of last wills and donation documents. o Participation of guilds and monastery fraternities in the foundation process. o Trends visible in religious customs and beliefs of Stockholm townsmen in the context of their foundation activity. o Foreign influences and local uniqueness of foundations in medieval Stockholm.
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Faculty of Earth Sciences		
Reconstruction of air temperature and atmospheric precipitation in Chelmińsko-Dobrzyńskie Lakeland from the 13th century to present using stable carbon and oxygen isotopes from tree rings	geography, biology	The main aim of the project is a reconstruction of air temperature and atmospheric precipitation for the Chelmińsko-Dobrzyńskie Lakeland from the 13th century to the present. The research material will include dendrochronological data from living trees (the last 100-150 years) and historical wood taken from old buildings such as churches, granaries, etc. The base method of the reconstruction includes an analysis of stable carbon and oxygen isotopes from tree rings.
Late Weichselian glacial megafloods at the southern sector of the Scandinavian ice sheet: geomorphic records and palaeogeographic implications	geography, geology	<p>Research project objectives: the principal aim of research project is to identify and analysis of landforms which unambiguously prove the existence of extreme glacial events – sudden discharges of large quantities of meltwaters in the south-eastern periphery of the ice sheet during the last glaciation.</p> <p>Significance of the project: the main cognitive importance of the planned research lies in its identification of extreme processes associated with NE Poland’s deglaciation and was responsible for the creation of spectacular, megascale landforms which have never before been found in Baltic lowland and which unambiguously indicate catastrophic megafloods. Such Pleistocene landforms have been identified along the flow pathways of meltwaters in North America and in Altai, which makes this project’s anticipated research results of global significance.</p> <p>Research methodology: analysis of landforms morphology using GIS tools; building of geomorphological and geological digital databases; geomorphological research to identify the morphology and geological structure of landforms created by ice sheet surges and sub- and proglacial floods; interpretation of field-study and laboratory results; paleohydraulic estimations; building semi-quantitative models of extreme processes in the marginal zone of the Scandinavian Ice Sheet.</p> <p>Expected results: the results will make it possible to determine the impact that glacial megafloods had on the formation of Europe’s valley system during the last glaciations – an impact which has never been fully understood. This also requires the</p>

		identification of the source of meltwaters. Moreover, the results of the planned research will help in providing a quantitative description of the extreme glacial floods which took place in northern Poland.
Light pollution of the night sky in Toruń	geography, physics	The aim of the project is to analyze the light pollution of the night sky of Toruń and its nearest surroundings. The project assumes the implementation of repetitive measurement sessions performed during two years in a network of several dozen field stations. The effect of the project will be to determine the seasonal variability of the brightness of the sky depending on the type of land-use/cover and the astronomical and weather conditions.
Faculty of Educational Sciences		
Empowerment and Disability	education, sociology	<p>The project includes research on conditions of empowerment developed through non-formal educational processes, connecting the phenomena of disability, dependence, support and in the contexts of the social and cultural models of disability.</p> <p>The project will explore: empowerment behind the enculturation and transmission of cultural knowledge about disability, dependence and support in dominant culture and disability cultures. The explorations will cover individual and/or group empowerment processes inside disability cultures, in real cultures and cyber-cultures. The project assumes research into the phenomena of empowerment of the disabled and dependent people in the media and social media.</p>
Communication strategies and motivations as innovation in the learning process in education within new technologies	media in education, media pedagogy, online education, sociology of education, learning process, education with new technologies (for the regular and for the students with special	The student will develop current research skills through a proper methodological research within the different approach of communicational strategies using adequate sources for defining motivations that will encircle initial goal of establishing comprehensive interaction between strategies and motivations for the purposes of learning. In the same time, innovations, based on new technologies (micro-learning and blended learning) in educational process will use mentioned strategies and motivations to create pedestal of the development of educational skills for the learning process. The student will carry out research on the relationship between the teacher and the

	needs), intercultural communication; additional disciplines: psychology, social media studies	student in relation to the communication strategies. The main goal of the doctoral thesis is to provide innovative indications for effective education based on new technologies. The motivational factor and innovative activities are crucial for the dissertation. Additional requirements: field of pedagogy, social media studies, traditional media, media communication, media literacy, education, IT in education, social innovations, media studies, cultural studies.
Support at the end of human life in local communities and assistance after loss - an interdisciplinary approach	educational sciences, social work	Demographic changes in Europe weigh heavily on the health and social welfare systems by the growing number of old and dependent people who need support at the end of their lives. Experiences of Western Europe about the key role of social workers to mobilize local communities to support people at the end of their lives in 'small homelands' can be used in Poland and Eastern Europe. On the other hand, numerous innovative activities of hospice volunteering from Poland which include people and various institutions (schools, correctional facilities, science and knowledge centers, etc.) in these activities may become an inspiration for countries already burdened with a large number of dependent people staying in homes or in caring institutions.
Faculty of Fine Arts		
Synthetic materials as a matter of contemporary works of art in process of conservation	conservation and restoration of works of art; chemistry	The aim of the project Synthetic materials as a matter of contemporary works of art in process of conservation is to gain greater knowledge on selected synthetic materials used by Polish artists, their identification, investigation of deterioration process and of their condition implementing the most recent testing methods.
State of danger. Artistic and curatorial strategies in the conditions of hybrid war in Ukraine (2014-2018)	art studies (history of art), political science	State of danger. Artistic and curatorial strategies in the conditions of hybrid war in Ukraine (2014-2018). The doctoral dissertation will be devoted to the research on contemporary Ukrainian art created in the conditions of hybrid war with Russia, which consists of armed conflict, ideological war and propaganda. The main issue is the question about instrumentalization of art in the face of ultimate goal, which is the transmission of political content (in art works itself, in curatorial strategies, in systems

		of functioning of cultural institutions as well as in creating politics of memory in Ukraine), observation of art and politics fields of influence and manifestations of political and social attitudes in modern culture.
The use of modern technologies to create new types of matrix in artistic graphic and building interdisciplinary graphic forms	art studies, technical sciences	The use of modern technologies to create new types of matrix in artistic graphic and building interdisciplinary graphic forms. The use of 3D technology in graphic workshop techniques - an attempt to consolidate modern 3D printing technologies with traditional artistic graphic techniques. Checking the possibility of obtaining a graphic matrix, by designing it in a computer program and printing using a 3D printer.
Faculty of Theology		
Science and Religion in contemporary theology	philosophy of science, systematic theology, history of theology; anthropology	The relationship between science and religion in XX century is one of the most important topic: the progress of science is conditioned by some philosophical and theological assumptions. Science and religion (theology) answer to different questions: science to "how" and religion to "why". Within the project can be analyzed many particular issues related to achievements of contemporary science (evolution, quantum mechanics, biological immortality, artificial intelligence) and theological insights (Divine Action; the meaning of nature; the personal and apersonal concept of God; Providence and Evil). The investigation could be also about historical aspects of science-religion relationships (from medieval to contemporary time) and ethics in science and technology.