UNIVERSITY OF WARSAW | CeNT CENTRE OF NEW TECHNOLOGIES

2017 ANNUAL REPORT

©Adam Zych

NOTE FROM THE DIRECTOR

The year 2017 was a year of change for the Centre of New Technologies at the University of Warsaw. The Centre continued and accelerated its growth as an interdisciplinary research institute, simultaneously working in fields such as biology, chemistry and physics. It was also a year of change for me, as I took over the role of a director. I feel privileged to be in charge of the Centre, and to oversee it while it sets new scientific goals. My personal goal and vision is to create an environment that promotes freedom, creativity and collaborative research recognized at the international level.

The Centre's key characteristic is a synergy, which stems from interdisciplinarity. We carry out both basic and applied research, and can already provide numerous examples of how our findings are being used in the industry. One of the highlights of 2017 for CeNT UW was undoubtedly the establishment of the 'Regenerative Mechanisms for Health' International Research Agenda Unit ('ReMedy'). This is a joint initiative of the University of Warsaw and the University Medical Centre Göttingen financed by the Foundation for Polish Science. The goal of ReMedy is to understand and harness the stress-evoked adaptability of cells at the molecular and biochemical levels in order to combat human diseases and pathologies. The creation of ReMedy will allow us to appoint new lab leaders and consequently create new laboratories, while setting up core facilities for our research and strengthening the administration.

I look forward to new challenges which await us in 2018, both internal (concerning the Centre research and organization) and external, such as the upcoming change in the legal landscape due to an introduction of the Law on Higher Education and Science. This new legislation will influence the way universities are governed and financed. We hope the change will end up supporting the Centre, and Polish science in general, and that it will help us along the way to scientific excellence.

A. Chacińska

Prof. Agnieszka Chacińska

2017 AT A GLANCE

CENT UW WELCOMES THE NEW DIRECTOR

The competition for the position of CeNT UW director was announced by the Rector of the University of Warsaw in October 2016. In December 2016, the competition commission recommended Prof. Agnieszka Chacińska for this position. Prof. Chacińska became the Director of CeNT UW on March 1, 2017.

Prior to taking up her new role, Prof. Chacińska had been – since 2009 – associated with the International Institute of Molecular and Cell Biology in Warsaw, where she was the head of the Mitochondrial Biogenesis Laboratory, and (as of 2015) the Deputy Director for Development. From 2001-2009 she worked as a postdoctoral intern and group leader at the University of Freiburg in Germany.

Prof. Chacińska's group's research is focused on understanding the processes which govern the transport of mitochondrial proteins and allow pools of these proteins to maintain a normal state throughout the life of cells. The group prides itself in the fact that it participated in the discovery of several of these dynamic processes.

CENT UW INVENTION LICENSED TO GLOBAL PHARMA

Prof. Jemielity, Dr. Kowalska, and Prof. Darżynkiewicz from CeNT UW and the Faculty of Physics UW, together with collaborators from the Louisiana State University, have developed and patented methods of increasing mRNA stability and enhancing its productivity in the production of therapeutic proteins. This provided biologists with a universal tool, which could potentially enable the development of effective vaccines against all forms of cancer. The license for the invention was acquired by the German biotechnology company BioNTech, and clinical trials were initiated. Next, BioNTech sublicensed it to other entities, first, in 2015, to a pharmaceutical company – Sanofi (contract worth: 360M USD), then, in 2016, to Genetech (310M USD). It was the most expensive commercialisation of a scientific breakthrough in Polish history.

POLAND-WIDE RECOGNITION FOR WARSAW GENOMICS

Some people inherit gene faults which increase their risk of developing particular types of cancer. Warsaw Genomics – an interdisciplinary research team at the University of Warsaw, led by Prof. Krystian Jażdżewski – has developed a cancer-risk assessment method. This method is based on the analysis of clinical data provided by patients, as well as genomic data obtained by next generation sequencing of all the genes associated with familial cancers.

“Our goal is to identify every person with a high risk of getting cancer within the Polish population of 38 million people. It is estimated there are at least 200,000 women at high risk of breast cancer. We aim to identify them all, and provide a personalized prophylactic program”, says Prof. Jażdżewski.

Warsaw Genomics has been named the best startup in Poland at the Central European Startup Awards festival. On November 23, CESA will announce the winners of the Central and Eastern Europe region. Austria, Bulgaria, Croatia, the Czech Republic, Poland, Romania, Serbia, Slovakia, Slovenia and Hungary will all compete.

Additionally, for the aforementioned achievements, Prof. Jażdżewski received a personal award from the Polish Business Council in the ‘Vision and Innovation’ category.

REMEDY – PRESTIGIOUS GRANT GOES TO CENT UW

‘The International Research Agenda’ is a prestigious grant awarded by the Foundation for Polish Science. The Research Agenda allows for the creation of Innovation Centres of Excellence in Poland in cooperation with foreign entities. The Centre of New Technologies of the University of Warsaw received this grant together with the University Medical Center Göttingen. They will form the joint International Research Agenda Unit ‘Regenerative Mechanisms for Health’ - ReMedy.

The research teams of this new unit will focus on adaptive cellular mechanisms triggered by stress. The goal of ReMedy is to understand and harness the stress-evoked adaptability of cells at the molecular and biochemical levels in order to combat human diseases and pathologies. ReMedy aims to:

- understand the mechanisms of the stress response;
- discover short- and long-term consequences of responses and their crosstalk in physiology;
- apply the acquired knowledge about stress responses to the development of new medical treatments.

TASKS AND THEIR IMPLEMENTATION

CENT AT A GLANCE

The Centre of New Technologies of the University of Warsaw (CeNT UW) is an interdisciplinary research institute dedicated to the understanding of biological, chemical and physical phenomena. Our scientists tackle fundamental scientific problems, collaborate and apply the attained knowledge to the industry.
CeNT UW provides a truly international outlook, establishes a perfect work environment for both young and established researchers, and promotes the education of PhD students.
CeNT UW obtained the scientific rating of "A" (very-good level) in a heterogeneous group on the basis of a comprehensive assessment of scientific and R&D activities of scientific units made by the Ministry of Science and Higher Education for the period of 2013-2016. The institute was established by Resolution No. 362 of the Warsaw University Senate on April 20, 2011, as an organizational unit of the University of Warsaw.

OUR MISSION

LONG-TERM TASKS

The main tasks of CeNT UW are:

- Conducting interdisciplinary scientific research of a cognitive or applicational nature in the fields of mathematics and natural sciences in connection with education.
- Participating in the education of students, in particular at the master's and doctoral level.
- Running laboratories that support educational and research projects, including doctoral studies.
- Cooperating with domestic and foreign centers that provide similar services.
- Organizing and running postdoctoral internships.
- Organizing post-graduate studies, courses and training within the fields available at CeNT UW.

CURRENT RESEARCH DIRECTIONS – WE BECOME STRONGER

2017 saw the addition of the laboratory of Prof. Agnieszka Chacińska, CeNT UW's new Director, who brought along her entire group from the IIMCB. This year was devoted to defining the main research directions pursued at CeNT UW and their further development.

- CeNT UW became a host institution for the ReMedy unit, within which new research groups dealing with the stress-evoked adaptability of cells at the molecular and biochemical level will soon be created. They will conduct significant research and development in the field of Biology.
- Prof. Konrad Banaszek submitted his 'Optical Quantum Technologies' entry for the FNP MAB competition. By the end of 2017, this application was at the last stages of assessment. The project calls for the creation of research groups dealing with quantum optics. Therefore, it is expected to be a strong impetus for the development of specialties in the optics field.
- In 2017, work was also underway on a partial reorganization of research group structure. We wish to strengthen the position and widen the scope of responsibility of laboratory heads. Those previously considered independent researchers become lab leaders, or are included in the organizational structure of other research groups.

INTERNATIONAL COOPERATION DEVELOPS

Scientific cooperation regarding the implementation of research projects is constantly being developed. At CeNT UW, more and more scientific projects are being carried out, with many being a part of FNP programs. The FNP considers the aforementioned cooperation to be the main requirement all submitted applications must meet. Having foreign strategic scientific partners is more and more often one of the conditions for obtaining large research projects.

In 2017, as part of MAB and TEAMING projects, cooperation was also developed with the University Medical Center Göttingen, the Sapienza University of Rome, the Karlsruhe Institute of Technology and the Nanoscience Cooperative Research Centre .

CENT UW WELCOMES A NEW INTERNATIONAL SCIENTIFIC COUNCIL

In 2017, a new international scientific council was established, which included high-class specialists from Polish and foreign research centres as well as representatives of the world of business. Eight of the ten members of the scientific council represent foreign research centres. You can read more about it in the Organization and Leadership subpoint of the Council chapter.

ORGANIZATION

In 2017, great attention was paid to the implementation of changes in the institution's management, in particular those aimed at preparing it for internationalization. They included:

- hiring new administration staff fluent in English;
- preparation and implementation of internal training for both researchers and administrators. Training courses that are carried out at the CeNT UW include fire safety, laboratory health and safety procedures, as well as administration/IT. They are conducted in Polish and English;
- preparation of an information package for new employees, covering the main issues regarding the access to IT services;
- implementation of new solutions, which will make it possible to electronically prepare and send personnel documents, information on scientific achievements, records of orders and invoices, and even animals subjected to procedures.

AWARDS, HONORS AND SCIENTIFIC ACHIEVEMENTS

LAUREATES OF THE ECONOMY AWARD

Professors J. Jemielity and E. Darżynkiewicz (CeNT UW), and Dr. J. Kowalska (Faculty of Physics, Warsaw University) have all been recognized with the Economy Award of the President of Poland in the Research & Development category.

In this category, the laureate can be a team of research units or enterprises that implement a product or technological innovation. Researchers from the University of Warsaw have been studying the interactions of proteins and RNA nucleic acid fragments in cellular processes for more than a decade as well as the chemical synthesis of analogous terminals of mRNA molecules. Since 2006, the team has been searching for a way to refine mRNA molecules to increase their durability.

Group members were awarded individual prizes for their research. They were all nominated for the Award by the Patent Office of the Republic of Poland.

DR. JOANNA SUŁKOWSKA JOINS THE EMBO PROGRAM

Dr. Joanna Sułkowska became the only Polish woman to join the European Young Investigator Program (YIP) within the European Organization for Molecular Biology (EMBO). A three-year term as a Young Investigator recognizes the scientific achievements of young researchers already leading their own research groups. EMBO offers its Young Investigators support, and helps to develop their academic careers.

DR. JOANNA SUŁKOWSKA RECOGNISED BY UNESCO AS ONE OF THE RISING TALENTS OF WORLD SCIENCE

Dr. Sułkowska, the head of the Interdisciplinary Laboratory of Modeling Biological Systems operating at CeNT UW, has received recognition in the prestigious "International Rising Talents" UNESCO ranking in the "Finding potential *new sources* of *drugs*" category. Dr. Sułkowska's work deals with knotted proteins that may be related to many civilization diseases. She uses physical, mathematical and biological methods, has won many awards and is the recipient of various grants.

All those placed on the International Rising Talents list are selected from among 250 winners of national contests financed by the L'Oréal-UNESCO *For Women in Science* programme. They receive annual scholarships.

PROF. MAGDA KONARSKA JOINS EMBO

65 outstanding life scientists will join EMBO – a group composed of the most highly valued researchers, who aim for excellence in life sciences. Among them is Prof. Magda Konarska from UW.

"An EMBO membership is granted in recognition of research excellence, and I am pleased to welcome so many great scientists to our organization", says EMBO Director Maria Leptin.

EMBO members are actively pursuing the organization's goals by evaluating applications for EMBO funding and by serving on the EMBO Council and Committees.

DR. JOANNA SUŁKOWSKA: LAUREATE OF THE 'L'ORÉAL POLAND *FOR WOMEN IN SCIENCE'* CONTEST

During the sixteenth edition of the programme, habilitation scholarships (worth 35,000 PLN each) were awarded. One of them went to Dr. Joanna Sułkowska, head of the Interdisciplinary Laboratory of Modeling of Biological Systems, operating at CeNT UW. Her award-winning project concerns knotted proteins.

BEST BIOTECH STARTUP IN POLAND

Warsaw Genomics, a startup company of CeNT UW, has developed a new cancer-risk assessment method. The company has been recognised by the Central European Startup Awards as the best biotech startup in Poland.

PROF. CHACIŃSKA – LEON MARCHLEWSKI MEDAL

In 2016, Professor Agnieszka Chacińska was awarded with the Leon Marchlewski Medal from the Committee of Molecular Biology on the Cell (Polish Academy of Science) for her outstanding contribution to the development of molecular biology, cell biology, biochemistry and biophysics.

PROF. GINALSKI – THE PRIME MINISTER'S AWARD

Professor Krzysztof Ginalski has been recognized with the Prime Minister's award for his habilitation entitled *The Prediction of the Structure and Function of Proteins*.

PROF. JEMIELITY – THE TADEUSZ SENDZIMIR MEMORIAL MEDAL

Professor Jacek Jemielity was honoured with the Tadeusz Sendzimir Memorial Medal by the Association of Polish Inventors and Rationalizers. The National Council of SPWiR gives these awards to the most outstanding creators of technology and to the organizers of the innovation movement in Poland as well as to institutions that are contributing to the development of innovation.

PROF. JEMIELITY – PORTRAITS OF POLISH MEDICINE

Professor Jacek Jemielity was awarded with the Portrait of Polish Medicine 2017 – an award granted by journalists of the Rynek Zdrowia magazine and webpage – in the Health Market Event category – for developing an approximation method of anti-cancer vaccine production.

ORGANIZATION AND LEADERSHIP

BOARD OF DIRECTORS

According to its regulations, the Centre for New Technologies of the University of Warsaw is managed by the Director. The duties of the Director have been performed by Prof. Agnieszka Chacińska since March 1, 2017.

The director appointed two co-workers to act as Deputy Directors:

- Dr. Robert Dwiliński – Deputy Director of research commercialization
- Ewa Jastrzębska – Deputy Director, in August 2017 succeeded by Dr. Magdalena Kowalczyk – Deputy Director of scientific research organization

COUNCIL

The Council of the Centre of New Technologies of the University of Warsaw for 2016-2020 was appointed by Ordinance No. 65 of the University Rector (published on September 27, 2017). The members of the Council are also members of the International Scientific Committee of ReMedy, according to the Rector's Ordinance No. 91 (December 11, 2017).

The composition of the Council is as follows:

- Professor Peter Rehling – University Medical Center Göttingen, Germany; the Chairman of the Council;
- Professor Witold Filipowicz – Friedrich Miescher Institute for Biomedical Research, Switzerland;
- Professor Ehud Gazit – The George S. Wise Faculty Of Life Science, Tel Aviv University, Israel;
- Professor Leon Gradoń – Warsaw University of Technology, Poland;
- Professor Reinhard Lührmann – Max Planck Institute for Biophysical Chemistry, Germany;
- Professor Fatima Mechta-Grigoriou – Institut Curie – INSERM France;
- Professor Silvio Rizzoli – University Medical Center Göttingen, Germany;
- Dr. Maciej Wieczorek – Celon Pharma S.A., Poland;
- Professor Michele Vendruscolo – University of Cambridge, United Kingdom;
- Professor Magdalena Żernicka-Goetz – University of Cambridge, United Kingdom.

LABORATORIES

ANTOSIEWICZ LABORATORY

RESEARCH INTEREST

Nanophotonics

Interaction of light with matter is dictated by the latter's composition and spatial distribution. An initially identical amount of matter can be formed to behave like a perfect mirror, an ideal absorber, or a scatterer with iridescent colors. In the group we study how spatial distribution of matter on the nanoscale influences light-matter interactions and how these propertiec can be useful in the design of novel devices. We employ knowledge from the fields of optics, electrodynamics, as well as selected topics from condensed matter theory. We carry out analytical and computational modeling and collaborate with in-house and exterior experimental groups.

STAFF

- Tomasz Antosiewicz, PhD
- Krzysztof Czajkowski, MSc
- Dominika Świetlik, MSc

PUBLICATIONS

- Monreal, C. R.; Apell, P. S.; **Antosiewicz, T. J.**, Infrared Absorption and Hot Electron Production in Low Electron-Density Nanospheres: A Look at Real Systems. *Journal of Physical Chemistry Letters* 2017, 8(2), 524 – 530.
- Wersäll, M.; Cuadra, J.; **Antosiewicz, T. J.**; Balci, S.; Shegai, T., Observation of mode splitting in photoluminescence of individual plasmonic nanoparticles strongly coupled to molecular excitons. *Nano Letters* 2017, 17(1), 551-558.
- Nugroho, F. A., Frost, R.; **Antosiewicz, T. J.**; Fritzsche, J.; Larsson Langhammer, E. M.; Langhammer, Ch., Topographically Flat Nanoplasmonic Sensor Chips for Biosensing and Materials Science. *ACS Sensors* 2017, 2(1), 119-127

- Verre, R.; Shao, L.; Odebo Länk, N.; Karpinski, P.; Yankovich, A. B.; **Antosiewicz, T. J.**; Olsson, E.; Käll, M., Metasurfaces and Colloidal Suspensions Composed of 3D Chiral Si Nanoresonators. *Advanced Materials* 2017, 29, 1701352.
- Cuadra, J.; Verre, R.; Wersäll, M.; Krückel, C.; Torres-Company, V.; **Antosiewicz, T. J.**; Shegai, T., Hybrid dielectric waveguide spectroscopy of individual plasmonic nanoparticles. *AIP Advances* 2017, 7(7), 075207.
- Nugroho, F. A. A.; Diaz de Zerio Mendaza, A.; Lindqvist, C.; **Antosiewicz, T. J.**; Müller, Ch.; Langhammer, Ch., Plasmonic Nanospectroscopy for Thermal Analysis of Organic Semiconductor Thin Films. *Analytical Chemistry* 2017, 89(4), 2575-2582.
- Alekseeva, S.; da Silva Fanta, A. B.; Landolo, B.; **Antosiewicz, T. J.**; Nugroho, F. A.; Wagner, J. B.; Burrows, A.; Zhdanov, V. P.; Langhammer, Ch., Grain boundary mediated hydriding phase transformations in individual polycrystalline metal nanoparticles. *Nature Communications* 2017, 8, 1084.
- Aćimović, S. S., Šípová, H.; Emilsson, G.; Dahlin, A. B.; **Antosiewicz, T. J.**; Käll, M., Superior LSPR substrates based on electromagnetic decoupling for on-a-chip high-throughput label-free biosensing. *Light: Science & Applications* 2017, 6, e17042.
- Yang, K.; Verre, R.; Butet, J.; Yan, Ch.; **Antosiewicz, T. J.**; Käll, M.; Martin, O. J. F., Wavevector-Selective Nonlinear Plasmonic Metasurfaces. *Nano Letters* 2017, 17 (9), 5258-5263.

PROJECTS

AWARDED

- Internally structured dielectric nanoresonators and their arrays for light-matter interactions, Antosiewicz, Tomasz, PhD, OPUS NCN, 2018-2021

ENDED

- Nanoplasmonic sensors: limits of detection, stochastic properties, and sintering measurements – Antosiewicz, Tomasz, PhD, SONATA NCN, 2013-2017
- Hetero-metalic plazmonic nanostructures for ligh absorbtion, Antosiewicz, Tomasz, PhD, Iuventus Plus MNiSW, 2014-2017

AUGUSTYŃSKI
LABORATORY FOR PHOTOELECTROCHEMISTRY AND SOLAR ENERGY CONVERSION

RESEARCH INTEREST

Our group's research is focused on studying the ways that semiconducting materials and metallic nanostructures interact with light. We focus principally on the photo-electrochemical properties of thin-layer semiconducting oxide electrodes, such as tungsten trioxide (WO3) or ferric oxide (Fe2O3), which are used to split water molecules or decompose contaminants present in water.

In both cases, the process of photo-electrolysis leads to hydrogen gathering on cell cathodes. Crucially, thanks to the semiconducting electrodes' light absorption properties, the photo-electrolysis takes place under bias voltages lower than the theoretical value required for the decomposition of water (1.23 V). The efficiency of this solar-to-chemical energy conversion depends on the preparation method and composition of the semiconducting electrodes; to utilize a significant part of the solar spectrum, the employed semiconductors' band gap energies must remain in the range of 2 to 2.5 eV.

STAFF

- Prof. Jan Augustyński, PhD
- Renata Solarska, PhD
- Aldona Jelińska, PhD
- Monika Arasimowicz, PhD
- Krzysztof Bieńkowski, MSc
- Olga Krysiak, MSc
- Marta Sarnowska, MSc
- Marta Kwiatkowska, MSc
- Maria Królak
- Michał Jadwiszczak

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/47/

PUBLICATIONS

- **Krysiak, O.**; **Barczuk, P. J.**; **Bienkowski, K.**; Wojciechowski, T.; **Augustynski, J.**, Communication—Continuous Monitoring of Activity of Plasmonic Gold Nanoparticles over Photooxidation Reactions Carried-Out on Au/TiO2 Photocatalysts. *Journal of The Electrochemical Society* **2017**, 164(9), H667-H669.
- **Augustyński, J.**; **Solarska, R.**, Comment on "Commercially Available WO_3 Nanopowders for Photoelectrochemical Water Splitting: Photocurrent versus Oxygen Evolution". *ChemPlusChem* **2017**, 82(9), 1167-1168
- Bärtsch, M.; **Sarnowska, M.**; Krysiak, O.; Willa, Ch.; Huber, Ch.; Pillatsch, L.; Reinhard, S.; Niederberger, M., Multicomposite Nanostructured Hematite–Titania Photoanodes with Improved Oxygen Evolution: The Role of the Oxygen Evolution Catalyst. *ACS Omega* **2017**, 2(8), 4531-4539,

PROJECTS

IMPLEMENTED

- Multifunctional thin-film mixed and/or doped metal oxide materials -from photoelectrochemistry to electrocatalysis - Prof. Jan Augustyński, MAESTRO NCN, 2014-2019
- Insight into combined electrochemical-photochemical activation of carbon dioxide – Solarska, Renata, PhD, OPUS NCN, 2016-2019

AWARDED

- Design, construction and investigations of earth abundant materials based heterojunctions for high efficiency solar energy conversion – Solarska, Renata, PhD, SONATA BIS NCN, 2018-2022

BANASZEK
QUANTUM TECHNOLOGIES LABORATORY

RESEARCH INTEREST

This project will develop new concepts for optical communication systems building on recent advances in quantum information science and quantum optics. The central idea stems from reformulating the communication task as an identification problem for non-orthogonal quantum states describing individual inputs, rather than transmitting information in classical variables, such as the intensity or the phase, whose conventional measurements are bound by standard quantum limits. This general approach, when implemented using state-of-the-art methods for optical signal processing and characterization at the quantum level, opens up new ways to attain sub-shot-noise error rates as well as the superadditivity of accessible information through joint detection. Pursuit of these objectives will be complemented by the development of realistic models for optical communication channels and the general analysis of resources in communication protocols.

STAFF

- Prof. Konrad Banaszek, PhD
- Marcin Jarzyna, PhD
- Małgorzata Olejniczak, PhD
- Ludwig Kunz, MSc
- Michał Jachura, MSc
- Michał Lipka
- Wojciech Zwoliński
- Tomasz Necio

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-technologii-kwantowych/

PUBLICATIONS

- Klimov, A. B.; Zwierz, M.; Wallentowitz, S.; **Jarzyna, M.**; **Banaszek, K.**, Optimal lossy quantum interferometry in phase space. *New Journal of Physics* **2017**, 19, 073013, IF=3.786, Open Access
- Jachura, M.; Karpiński, M.; **Banaszek, K.**; Bharadwaj, D.; Lugani, J.; Thyagarajan, K., Generation and characterization of discrete spatial entanglement in multimode nonlinear waveguides. *ChemPhysChem* **2017**, 18, 2081–2087.
- **Jarzyna, M.**, Classical capacity per unit cost for quantum channels. *Physical Review A* **2017**, 95, 032340.

- Chrostowski, A.; Demkowicz-Dobrzański, R.; **Jarzyna, M.**; **Banaszek, K.**, On superresolution imaging as a multiparameter estimation problem. *International Journal of Quantum Information* **2017**, 15 (8), 1740005,
- Jachura, M.; Lipka, M.; **Jarzyna, M.**; **Banaszek, K.**, Quantum fingerprinting using two-photon interference. *Optics Express* **2017**, 25 (issue 22), 27475,
- **Banaszek, K.**; Jachura, M., Structured Optical Receivers for Efficient Deep-Space Communication. *arXiv* **2017**, 34-37, IEEE International Conference on Space Optical Systems and Applications (ICSOS)
- **Jarzyna, M.**; **Banaszek, K.**, Efficiency of Optimized Pulse Position Modulation with Noisy Direct Detection. *arXiv* **2017**, 166-171, IEEE International Conference on Space Optical Systems and Applications (ICSOS)

PROJECTS

IMPLEMENTED

- Quantum Optical Communication Systems – Prof. Konrad Banaszek, TEAM FNP, 2016-2019

OLEJNICZAK, INDEPENDENT PROJECT

- Quantum chemistry solutions for molecules with heavy atoms in realistic environments – Małgorzata Olejniczak, PhD, SONATA NCN, 2017-2020

CHACIŃSKA
LABORATORY OF MITOCHONDRIAL BIOGENESIS

RESEARCH INTEREST

Mitochondria play a key role in metabolism and regulatory processes within a cell. Thus, the formation of mitochondria is essential for cellular function of every being in the eukaryotic kingdom, from unicellular organisms to mammals. Mitochondria comprise 1000-1500 cellular proteins, which are synthesized outside of the mitochondria in the cytosol.

The biogenesis of mitochondria relies on the efficient import, sorting, and maturation of proteins, all governed by conserved protein translocases and other complex biological machinery.

Our research explores novel and exciting links between protein transport mechanisms and mitochondrial protein homeostasis. We postulate the presence of unique mechanisms involved in protein biogenesis that involve crosstalk between the cytosol and mitochondrial compartments.

Our goal is to better understand the complex and dynamic processes involved in the formation of functional organelles, as well as the maintenance of cellular protein homeostasis and its failures, which result in pathology.

STAFF

- Prof. Agnieszka Chacińska, PhD
- Anna Antosiewicz, PhD
- Piotr Brągoszewski, PhD
- Katarzyna Chojnacka, PhD
- Minji Kim, PhD
- Łukasz Kowalski, PhD
- Ben Hur Mussulini, PhD
- Urszula Nowicka, PhD
- Łukasz Samluk, PhD
- Katarzyna Szatraj, PhD
- Ulrike Topf, PhD
- Michał Wasilewski, PhD
- Michał Turek, PhD
- Barbara Uszczyńska-Ratajczak, PhD
- Carlo Vascotto, PhD
- Karolina Barcikowska, PhD
- Piotr Chrościcki, PhD
- Preveenraj Elancheliyan, MSc
- Monika Kamińska, MSc
- Karthik Mohanraj, MSc
- Martyna Pietrzyk, MSc
- Tomasz Sitarz, MSc
- Maria Śladowska, MSc
- Aleksandra Gosk, Eng
- Elżbieta Grzelak

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-biogenezy-mitochondriow/

PUBLICATIONS

- Bragoszewski, P. M.; Turek, M. R.; **Chacinska, A.**, Control of mitochondrial biogenesis and function by the ubiquitin–proteasome system. *Open Biology* 2017, 7(4), 170007.
- **Chacinska, A.**, Sort and destroy. *Nature* 2017, 543, 324-325.
- Gold, V.; Chroscicki, P.; Bragoszewski, P.; **Chacinska, A.**, Visualization of cytosolic ribosomes on the surface of mitochondria by electron cryo-tomography. *EMBO Reports 2017*, 18(10), 1786-1800.

PROJECTS

IMPLEMENTED

- Regenerative mechanisms for Health – Prof. Agnieszka Chacińska, MAB IRAP FNP, 2017-2022
- Coupling of synthesis and transport for proteins targeted to the mitochondria – Prof. Agnieszka Chacińska, OPUS NCN, 2014-2018
- Cytosolic chaperone systems for mitochondrial precursor proteins – Prof. Agnieszka Chacińska, IDEAS PLUS MNiSW, 2014-2019
- Analysis of the translocation of TIM22 mitochondrial proteins in human cells – Chojnacka, Katarzyna, PhD, FUGA NCN, 2016-2019
- Mechanisms protecting from oxidative damage during aging – Topf, Ulrike, PhD, OPUS NCN, 2016-2019
- Characterization of the TIM23 pathway of protein import into mitochondria in mammalian cells – Wasilewski, Michał, PhD, OPUS NCN, 2016-2019
- Nicolaus Copernicus Polish-German Research Award – Prof. Agnieszka Chacińska, Copernicus FNP, 2016-2019
- Mitochondrial translocation of the DNA repair protein APE1 – Vascotto, Carlo, PhD, POLONEZ NCN, 2017-2019
- Principles of mitochondrial protein compartmentalization in vertebrates – Uszczyńska-Ratajczak, Barbara, PhD, POLONEZ NCN, 2017-2019
- The interplay between the translation machinery and the mitochondrial dysfunction under cellular stress – Nowicka, Urszula, PhD, HOMING FNP, 2017-2019
- The link between mitochondria and the protein quality control system – Turek, Michał, PhD, POLONEZ NCN, 2017-2019
- Analysis of alternative routes of import of proteins to mitochondria – Gosk, Aleksandra, Diamentowy Grant MNiSW, 2017-2019

- Cellular mechanisms handling failed mitochondrial protein translocation events – Brągoszewski, Piotr, PhD, FIRST TEAM FNP, 2017-2020

ENDED

- Extramitochondrial factors regulating turnover of mitochondrial intermembrane space proteins – Brągoszewski, Piotr, PhD, SONATA NCN, 2014-2017

DOBRZAŃSKA, INDEPENDENT PROJECT

- *The role of non-covalent interactions in the formation of supramolecular assemblies and the phenomenon of single-crystal-to-single-crystal transformations. – Dobrzańska Liliana, PhD, program SONATA BIS NCN, 2015-2020*

PUBLICATIONS

- Szczęsny, R.; Szłyk, E.; Kozakiewicz, A.; **Dobrzańska, L.**, Thermal and structural characterization of copper(II) complexes with phenyl-2-pyridylketoxime (HPPK). *Journal of Thermal Analysis and Calorimetry* **2017**, 128, 1591-1599.

DARŻYNKIEWICZ INTERDISCIPLINARY LABORATORY OF MOLECULAR BIOLOGY AND BIOPHYSICS

RESEARCH INTEREST

The Laboratory deals mainly with the structures of the so-called cap, i.e. the 5' end of mRNAs and many snRNAs. Cap analogs which we've previously synthesized, including the natural trimethylguanosine cap and cap-4, have significantly contributed to the discovery of the biological function of these structures. Currently we are preoccupied mostly with interdisciplinary studies on the molecular mechanisms of interactions between cap structures and protein regulator factors involved in protein biosynthesis and intracellular mRNA transport.

Reasearch of a wider scope – focused on mRNA metabolism, the study of biosynthesis, and the degradation of cap structures by capping and decapping enzymes – is currently being carried out as well. Attempts are being made to combine basic research with its practical applications. For instance, we are designing and synthesizing mRNA transcripts (stable and translationally highly active within a cell), which can be used for biotechnological protein production and development of anti-cancer vaccines. In our research we use a broad range of chemical, biological and biophysical methodologies. Our team cooperates with several specialist laboratories located both in Poland and abroad.

STAFF

- Prof. Edward Darżynkiewicz, PhD
- Janusz Stępiński, PhD
- Renata Grzela, PhD
- Elżbieta Bojarska, PhD
- Magdalena Chrabąszczewska, PhD
- Magdalena Rudzińska, PhD
- Beata Miedziak, MSc
- Aleksandra Ferenc-Mrozek, MSc
- Ilona Koćmik, MSc
- Michał Tyras, MSc
- Anna Dobieżyńska, BSc

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/interdyscyplinarne-laboratorium-biologii-i-biofizyki-molekularnej/

PUBLICATIONS

- Warminski, M.; **Sikorski, P. J.**; **Warminska, Z.**; Lukaszewicz, M.; Kropiwnicka, A.; Zuberek, J.; Darzynkiewicz, E.; Kowalska, J.; **Jemielity, J.**, Amino-Functionalized 5′ Cap Analogs as Tools for Site-Specific Sequence-Independent Labeling of mRNA. *Bioconjugate Chemistry* 2017, 28, 1978−1992.
- Rydzik, A. M.; Warminski, M.; **Sikorski, P. J.**; Baranowski, M. R.; **Walczak, S.**; Kowalska, J.; Zuberek, J.; Lukaszewicz, M.; Nowak, E.; Claridge, T. D. W.; Darzynkiewicz, E.; Nowotny, M.; **Jemielity, J.**, mRNA cap analogues substituted in the tetraphosphate chain with CX2: identification of O-to-CCl2 as the first bridging modification that confers resistance to decapping without impairing translation. *Nucleic Acids Research* 2017, 1-15.
- Grzela, R.; Nusbaum, J.; Fieulaine, S.; Lavecchia, F.; Bienvenut, W. V.; Dian, C.; Meinnel, T.; Giglione, C., The C-terminal residue of phage Vp16 PDF, the smallest peptide deformylase, acts as an offset element locking the active conformation. *Scientific Reports* 2017, 8;7(1):11041.
- Grzela, R.; Nusbaum, J.; Fieulaine, S.; Lavecchia, F.; Desmadril, M.; Nhiri, N.; Van Dorsselaer, A.; Cianferani, S.; Jacquet, E.; Meinnel, T.; Giglione, C.; Peptide deformylases from Vibrio parahaemolyticus phage and bacteria display similar deformylase activity and inhibitor binding clefts, *Biochim Biophys Acta*, 2017.

PROJECTS

IMPLEMENTED

- Designing mRNA transcripts resistant to enzymatic cap hydrolysis applicable for anticancer vaccines; multiplexed biochemical and biophysical studies on representative classes of decapping enzymes – Prof. Edward Darżynkiewicz, MAESTRO NCN, 2013-2018
- Exploitation of regenerative potential of mesenchymal stem cells EXPLORE ME - Prof. Edward Darżynkiewicz, Prof. Jacek Jemielity, STRATEGMED NCBiR, 2016-2018

DŁUGOSZ
THEORETICAL MOLECULAR BIOPHYSICS AND SOFT MATTER GROUP

RESEARCH INTEREST

Our research interests lie in the fields of theoretical and computational molecular biophysics, and soft matter physics.

Our current projects focus on diffusion in biological settings, low Reynolds number hydrodynamics, molecular hydrodynamics, and hydrodynamic effects in complex biomolecular systems.

STAFF

- Maciej Długosz, PhD
- Maciej Kamiński, BSc

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-teoretycznej-biofizyki-molekularnej-i-miekkiej-materii/

PUBLICATIONS

- Antosiewicz, J. M., Kamiński, K.; **Długosz, M.**, Hydrodynamic Steering in Protein Association Revisited: Surprisingly Minuscule Effects of Considerable Torques. *Jounal of Physical Chemistry* B **2017**, 121, 8475-8491.

PROJECTS

IMPLEMENTED

- Hydrodynamic interactions in biomolecular systems. Computational studies - Długosz Maciej, PhD, OPUS NCN, 2015-2018

AWARDED

- *Diffusion of proteins near model biological membranes. - Długosz Maciej, PhD, OPUS NCN, 2018-2020*

DUNIN-HORKAWICZ
INDEPENDENT PROJECT

The amount of available biological data, originating from various experimental procedures (genome and transcriptome sequencing, structure determination, functional assays), is vast. In our group, we employ computational techniques, such as deep learning, molecular dynamics simulations, and sequence analysis to make use of this data. We are particularly interested in understanding how protein folds have emerged and how protein structures and functions are encoded by the alphabet of 20 amino acids. In our current project (1), we attempt to tackle these questions by using highly-regular, repetitive protein structures, such as coiled coils, as a model system. The regular nature of such structures means that they can be represented by parametric equations. This is especially useful in interpreting and quantifying the effects of mutations, comparing snapshots of dynamic structures, and understanding the relationship between the sequence, structure and function of proteins.

(1) “The design of new protein structures with precisely defined features using parametric models” – Dunin-Horkawicz, Stanisław, PhD, SONATA BIS NCN, 2016-2019

DZIEMBOWSKA
LABORATORY OF THE MOLECULAR BASIS OF SYNAPTIC PLASTICITY

RESEARCH INTEREST

Neuronal plasticity is the ability of neurons to adapt permanent changes in response to environmental stimuli. This unique property of the nervous system allows for learning and memory formation.

At single-neuron level, plasticity is expressed by the activity of individual synapses, which in turn depends on the type of proteins locally synthesized at the synapse in response to stimulation. Some proteins present in dendrites and synapses are synthesized from mRNAs transported from the cell body in response to synaptic stimulation. Synaptic translation guarantees spatial and temporal control of protein synthesis, and a fast regulatory effect of the synthesized proteins on spine morphology and receptor signaling. This process has proven to be extremely important for the physiology of neurons. Its dysfunction leads to abnormalities observed in such disease syndromes as fragile X syndrome and autism, and is associated with abnormal spine morphology and connectivity.

The Laboratory of Molecular Basis of Synaptic Plasticity focuses on the identification of mRNAs and proteins undergoing local translation at the synapse in response to specific types of stimulation, and on gaining a better understanding of their synaptic functions. Our research will contribute to identification of key proteins important for synaptic plasticity. We use mouse models of human diseases, such as fragile X syndrome, which impair the process of local translation (FMR1 KO mice), as well as neuronal cell imaging techniques, biochemical and molecular methods, next-generation sequencing, and high resolution mass spectroscopy.

STAFF

- Magdalena Dziembowska, PhD
- Kuźniewska Bożena, PhD
- Magdalena Chojnacka, PhD
- Joanna Podsiedłowska, MSc
- Katarzyna Urbańska, MSc
- Klaudia Jączyńska
- Karolina Rejmak

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-molekularnych-podstaw-plastycznosci-synaptycznej/

PUBLICATIONS

- Lepeta, K.; Purzycka, K.; Pachulska-Wieczorek, K.; Mitjans, M.; Begemann, M.; Vafadari, B.; Bijata, K.; Adamiak, R. W.; Ehrenreich, H.; Dziembowska, M. K.; Kaczmarek, L., A normal genetic variation modulates synaptic MMP-9 protein levels and the severity of schizophrenia symptoms. *EMBO Molecular Medicine* **2017**, 9 (8), 1100-1116.

PROJECTS

IMPLEMENTED

- The role of microRNA-132 in the structural plasticity of dendritic spines – Dziembowska, Magdalena, PhD, OPUS NCN, 2015-2018
- Identification of proteins locally synthesized at the synapse in response to neuronal stimulation in physiology and fragile X syndrome – Dziembowska, Magdalena, PhD, SONATA BIS NCN, 2015-2020

KAŹMIERCZAK, INDEPENDENT PROJECT

- The role of Tmcc2 in the development and maintenance of the inner ear mechanosensory hair cells. – Kaźmierczak Piotr, PhD program OPUS NCN, 2017-2019

GINALSKI
LABORATORY OF BIOINFORMATICS AND SYSTEMS BIOLOGY

RESEARCH INTEREST

Our research interest includes the development of new theoretical and experimental tools, as well as their application in studying the structure, function and evolution of proteins, and their interaction with ligands. The laboratory's work is also focused on applying next generation sequencing to a wide range of genomic, metagenomic and transcriptomic studies.

STAFF

- Prof. Krzysztof Ginalski, PhD
- Magdalena Skrzypczak, PhD
- Anna Biernacka, PhD
- Marta Borowiec, PhD
- Łukasz Kniżewski, PhD
- Dorota Matelska, PhD
- Kamil Steczkiewicz, PhD
- Jagoda Jabłońska, MSc
- Justyna Roth
- Łukasz Munio

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-bioinformatyki-i-biologii-systemow/

PUBLICATIONS

- Kulecka, M.; Wierzbicka, A.; Paziewska, A.; Mikula, M.; Habior, A.; Janczyk, W.; Dabrowska, M.; Karczmarski, J.; Lazniewski, M. J.; **Ginalski, K.**; Czlonkowska, A.; Socha, P.; Ostrowski, J., A heterozygous mutation in GOT1 is associated with familial macro-aspartate aminotransferase. *Journal of Hepatology* 2017.
- Muszewska, A.; Stepniewska-Dziubinska, M. M.; **Steczkiewicz, K.**; Pawłowska, J.; Dziedzic, A.; **Ginalski, K.**, Fungal lifestyle reflected in serine protease repertoire. *Scientific Reports* 2017, 7, 9147.
- **Matelska, D.**; **Steczkiewicz, K.**; **Ginalski, K.**, Comprehensive classification of the PIN domain-like superfamily. *Nucleic Acids Research* 2017, 45 (12), 6995–7020.
- Kotlinski, M.; **Knizewski, Ł.**; Muszewska, A.; Rutowicz, K.; Lirski, M.; Schmidt, A.; Baroux, C.; **Ginalski, K.**; Jerzmanowski, A., Phylogeny-based systematization of Arabidopsis proteins with histone H1 globular domain. *Plant Physiology* 2017, 174 (1), 27-34.

- Shi, W.; Vu, T.; Boucher, D.; **Biernacka, A.**; Nde, J.; Pandita, R. K.; Straube, J.; Boyle, G. M.; Al-Ejeh F.; Nag, P.; Jeffery, J.; Harris, J. L.; Bain, A. L.; **Grzelak, M.**; **Skrzypczak, M.**; Mitra, A.; Dojer, N.; Crosetto, N.; Cloonan, N.; Becherel, O. J.; Finnie, J.; Skaar, J. R.; Walkley, C. R.; Pandita, T. K.; Rowicka, M.; **Ginalski, K.**; Lane, S. W.; Khanna, K. K., Ssb1 and Ssb2 cooperate to regulate mouse hematopoietic stem and progenitor cells by resolving replicative stress. *Blood* 2017, 129(18), 2479–2492.
- Aymard, F.; Aguirrebengoa, M.; Guillou, E.; Javierre, B. M.; Bugler, B.; Arnould, C.; Rocher, V.; Iacovoni, J. S.; **Biernacka, A.**; **Skrzypczak, M.**; **Ginalski, K.**; Rowicka, M.; Fraser, P.; Legube, G., Genome-wide mapping of long-range contacts unveils clustering of DNA double-strand breaks at damaged active genes. *Nature Structural & Molecular Biology* 2017, 24, 353–361.
- **Jabłonska, J.**; **Matelska, D.**; **Steczkiewicz, K.**; **Ginalski, K.**, Systematic classification of the His-Me finger superfamily. *Nucleic Acids Research* **2017**, 45 (20),11479-11494.
- Kobylecki, K.; **Kuchta, K.**; Dziembowski, A.; **Ginalski, K.**; Tomecki, R., Biochemical and structural bioinformatics studies of fungal CutA nucleotidyltransferases explain their unusual specificity towards CTP and increased tendency for cytidine incorporation at the 3'-terminal positions of synthesized tails. *RNA* 2017, 23 (12), 1902-1926.
- Muszewska, A.; **Steczkiewicz, K.**; Stepniewska-Dziubinska, M.; **Ginalski, K.**, Cut-and-paste transposons in fungi with diverse lifestyles. *Genome Biology and Evolution* 2017, 9 (12), 3463-3477.
- Fang, D.; Lengronne, A.; Shi, D.; Forey, R.; **Skrzypczak, M.**; **Ginalski, K.**; Yan, Ch.; Wang, X.; Cao, Q.; Pasero, P.; Lou, H., Dbf4 recruitment by forkhead transcription factors defines an upstream rate-limiting step in determining origin firing timing. *Genes & Development* 2017, 31 (23-24), 2405-2415.

PROJECTS

IMPLEMENTED

- High resolution map of DNA double-strand breaks in human genome – Prof. Krzysztof Ginalski, MAESTRO NCN, 2012-2018
- Identification and comprehensive classification of nucleases including human nucleases - Prof. Krzysztof Ginalski, OPUS NCN, 2015-2018
- Genome-wide studies of double-strand DNA breaks in Saccharomyces cerevisiae – Skrzypczak, Magdalena, PhD Eng, SONATA NCN, 2016-2019
- Development and application of novel next-generation sequencing and single-cell genomics methods to studying DNA double-strand breaks – Prof. Krzysztof Ginalski, TEAM FNP, 2017-2019

GROCHALA
LABORATORY OF TECHNOLOGY OF NOVEL FUNCTIONAL MATERIALS

RESEARCH INTEREST

The group explores the synthesis and physicochemical properties of new chemical compounds – both in the solid state ('extended' i.e. 1D, 2D, 3D) and molecular ('0D'). Combinations of diverse chemical elements together with a wide (p,T) range offer / a rich diversity of structures and properties of stoichiometries appearing in the phase diagrams. We focus on their electric, magnetic, thermal, and other properties, as well as their chemical reactivity.

Our interdisciplinary research is situated at the intersection of chemistry of novel materials, physical chemistry, solid state physics, and computer modeling (utilizing quantum chemistry methods). The groups of most intensely explored systems encompass novel magnetic and electronic materials based on divalent silver, Ag^{2+} (in particular fluorides), silver-based oxidizers as initiators of organic reactions (CH bond activation and CC coupling), materials and technologies for hydrogen storage (notably the N- and B-rich systems), and novel noble gas compounds (particularly for He and Ne, explored only theoretically).

STAFF

- Prof. Wojciech Grochala, PhD
- Mariana Derzsi, PhD,
- Karol Fijałkowski, PhD
- Tomasz Jaroń, PhD
- Dominik Kurzydłowski, PhD
- Piotr Leszczyński, PhD
- Martyna Rzepecka, PhD
- Paweł Szarek, PhD
- Andrzej Szczurek, PhD
- Łukasz Wolański, PhD
- Adam Grzelak, MSc
- Jakub Gawraczyński, MSc
- Piotr Orłowski, MSc
- Rafał Owarzany, MSc
- Wojciech Wegner, MSc
- Agnieszka Starobrat, MSc
- Jan Derdziuk
- Wiktoria Dołębska
- Małgorzata Domańska
- Mateusz Domański
- Magdalena Grochowska
- Mikołaj Grzeszkiewicz
- Katarzyna Węgrzyn
- Mateusz Winny
- Marcin Witkowski
- Aleksander Woźniak
- Paula Zdybska

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-technologii-nowych-materialow-funkcjonalnych/

PUBLICATIONS

- **Szarek, P.**, Electric Permittivity in Individual Atomic and Molecular Systems through Direct Associations with Electric Dipole Polarizability and Chemical Hardness. *The Journal Of Physical Chemistry C* **2017**, 121 (23), 12593–12602.
- **Grzelak, A.**; **Gawraczyński, J.**; **Jaroń, T.**; Somayazulu, M.**; Derzsi, M.**; Struzhkin, V.; **Grochala, W.**, Persistence of Mixed and Non-intermediate Valence in the High-Pressure Structure of Silver(I,III) Oxide, AgO: A Combined Raman, X-ray Diffraction (XRD), and Density Functional Theory (DFT) Study. *Inorganic Chemistry* **2017**, 56 (10), 5804–5812.
- **Kurzydłowski, D.**; **Grochala, W.**, Prediction of Extremely Strong Antiferromagnetic Superexchange in Silver(II) Fluorides: Challenging the Oxocuprates(II). *Angewandte Chemie International Edition* **2017**, 56(34), 10114-10117.
- **Gilewski, T.** , **Gawraczyński, J.; Derzsi, M.**; Jagličić, Z.; Mazej, Z.; Połczyński, P.; Jurczakowski, R.; **Leszczyński, P. J.**; **Grochala, W.**, [Ag(OH2)2][Ag(SO4)2]: A Hydrate of a Silver(II) Salt. *Chemistry - A European Journal* **2017**, 23, 1805-1813.
- Mazej, Z.; **Gilewski, T.**; Goreshnik, E. A.; Jagličić, Z.; **Derzsi, M.**; **Grochala, W.**, Canted Antiferromagnetism in Two-Dimensional Silver(II) Bis[pentafluoridooxidotungstate(VI)]. *Inorganic Chemistry* **2017**, 56, 224−233.
- **Budniak, A.**; Masny, M.; **Prezelj, K.**; Grzeszkiewicz, M.; **Gawraczyński, J.**; Dobrzycki, Ł.; Cyrański, M. K.; Koźmiński, W.; Mazej, Z.; **Fijałkowski, K. J.**; **Grochala, W.**; **Leszczyński, P. J.**, Reconnaissance of reactivity of Ag(II)SO4 one-electron oxidizer towards naphthalene derivatives. *New Journal of Chemistry* **2017**, *41* (19), 10742-10749.
- **Kurzydłowski, D.**; **Grochala, W.,** Large exchange anisotropy in quasi-one-dimensional spin-1/2 fluoride antiferromagnets with a d(z(2))(1) ground state. *Physical Review B* **2017,** 96(15): 155140.
- **Grochala, W.**, The generalized maximum hardness principle revisited and applied to solids (Part 2). *Physical Chemistry Chemical Physics* **2017**,*19* (46), 30984-31006 2017.
- **Grzelak, A.**; **Gawraczyński, J.**; **Jaroń, T**.; **Kurzydłowski, D.**; Mazej, Z.; **Leszczyński, P. J.**; Prakapenka, V. B.; **Derzsi, M.**; Struzhkin, V.; **Grochala, W.**, Metal fluoride nanowires featuring square-planar building blocks in a high-pressure polymorph of AgF2. *Dalton Transactions*, 46(43): 14742-14745 2017.
- **Owarzany, R.**; **Jaroń, T.**; **Leszczyński, P. J.**; **Fijalkowski, K. J.**; **Grochala, W.**, Amidoboranes of rubidium and caesium: the last missing members of the alkali metal amidoborane family. *Dalton Transactions* **2017**, *46* (46), 16315-16320.
- **Grochala, W.**, The generalized maximum hardness principle revisited and applied to atoms and molecules (Part 1). *Physical Chemistry Chemical Physics* **2017**, *19* (46), 30964-30983.

- **Grzelak, A.**; **Gawraczyński, J.**; **Jaroń, T.**; **Kurzydłowski, D.**; **Budzianowski, A.**; Mazej, Z.; **Leszczyński, P. J.**, Vitali B. Prakapenka, **Derzsi, M.**; Struzhkin, V. V.; **Grochala, W.**, High-Pressure Behavior of Silver Fluorides up to 40 GPa. *Inorganic Chemistry 56(23)*: **2017**, 14651-14661.
- **Kurzydłowski, D.**; Sołtysiak, M.; Dżoleva, A.; Zaleski-Ejgierd, P., High-Pressure Reactivity of Kr and F2—Stabilization of Krypton in the +4 Oxidation State. *Crystals* **2017**, 7(11), 329.
- **Grochala, W.**, Beyond GGA: benefits from hybrid HSE06 functional for correct description of crystal and electronic structure and lattice dynamics of solids at ambient and elevated pressure. *Journal of Physics: Conference Series* **2017**, *950* (3), 032021.
- Karwowska, M.; **Fijałkowski, K. J.**; Czerwiński, A. A., Comparative study of hydrogen electrosorption from alkali metals electrolytes and hydrogen sorption from gas phase in AB5 alloy. *Electrochimica Acta* **2017**, *252*, 381-386.
- **Grochala, W.**, On the position of helium and neon in the Periodic Table of Elements. *Foundations of Chemistry* **2017**, 1-17.
- Kundan, J.; **Jaroń, T**.; Chowdhury, A., On the peculiarities of phase developments involving Zn2+-doped ZrO2 system, *Scripta Materialia* **2017**, 138, 71-74.

PROJECTS

IMPLEMENTED

- ACTIVE-OX. Oxidative C-H bond activation in light alkanes by Ag(II) salts containing weakly coordinating anions - Leszczyński, Piotr, PhD, OPUS NCN, 2016-2019
- BIS-TRIS. Theoretical modeling of redox-tailored bi and tri-heterometallic transition metal complexes as devices for molecular electronics. – Szarek, Paweł, PhD Eng, OPUS NCN, 2016-2019
- Modern functional materials based on lanthanides and boron – Wegner, Wojciech, MSc, program Diamentowy Grant MNiSW, 2014-2018
- NFO: Nitrogen trifluoride as an oxidizer – Kurzydłowski, Dominik, PhD, SONATA NCN, 2015-2019
- HYDRA. From efficient hydrogen stores in the solid state to novel multinary and composite functional materials – Prof. Wojciech Grochala, PhD, OPUS NCN, 2015-2019
- Cell for electrical impedance measurements designed for investigation of highly reactive samples. – Fijałkowski, Karol, PhD, TANGO NCBiR, 2017-2019
- Synthesis, evaluation and recycling of the salts containing highly-fluorinated anions for energy storage applications – Jaroń, Tomasz, PhD, HOMING FNP, 2017-2019
- Renewable generation of ammonia from athmospheric nitrogen – Fijałkowski, Karol, PhD, Mobility Plus MNISW, 2016-2018
- Hi-Ox: Journey to the core of the atom - pushing the limits of the reachable oxidation states of metal atoms. – Szarek, Paweł, PhD Eng, OPUS NCN, 2017-2019

- Badanie zdolności katalitycznych związków wanadu do rozkładu diboranu oraz wysokowydajnych borowodorkowych stałych magazynów wodoru – Piotr Orłowski, Diamentowy Grant MNiSW, 2016-2020
- BEACs: new allotropic forms of carbon. Synthesis, doping, and electronic and adsorption properties. – Szczurek, Andrzej, PhD, SONATA BIS NCN, 2017-2021
- High-pressure synthesis and characterization of the chemical compounds based on boron, hydrogen, and selected main-group elements – Jaroń, Tomasz, PhD, SONATA NCN, 2017-2019

AWARDED

- SILVERLAND. Unique silver route to superconducting cuprate analogs. - Prof. Wojciech Grochala, MAESTRO NCN, 2018-2022
- Enhancement of magnetic interactions in lanthanide compounds using Ag(II) as spin-superpolarizer – Prof. Wojciech Grochala, BEETHOVEN NCN, 2018-2021
- Salts of $[BH_3NH_2BH_2NH_2BH_3]$- anion as cubic boron nitride precursors and ionic conductors – Owarzany, Rafał, MSc, PRELUDIUM NCN, 2018-2021
- High-pressure synthesis and characterization of novel compounds of silver and chlorine– Grzelak, Adam, MSc, PRELUDIUM NCN, 2018-2021

ENDED

- HP. Use of high pressures for modification of stoichiometry, crystal and electronic structures and magnetism of functional materials. - Prof. Wojciech Grochala, HARMONIA NCN, 2013-2017
- Comparative analysis of the reactivity and test of Ag(II)SO4, Ag(I)2S2O8 and Ag(I)Ag(III)O2 reactivity – Leszczyński, Piotr, PhD, OPUS NCN, 2013-2017

HOREGLAD
ORGANOMETALLIC CHEMISTRY LABORATORY

RESEARCH INTEREST

The research work conducted in our laboratory concerns the catalysts for the Ring-Opening Polymerization (ROP) of heterocyclic monomers based on main group metal complexes, as well as the main group metal complexes with N-heterocyclic carbenes (NHCs).

With regard to the former we are mainly interested in group 13 and 14 metal alkoxides – catalysts for the ROP of cyclic esters leading to the formation of biodegradable polyesters, especially in the stereoselective catalysts for the ROP of lactide. Notably, while our research has shown that gallium alkoxides with NHCs are highly active and stereoselective catalysts for the ROP of lactide, little is known about main group metal alkoxides or the aryloxides stabilized with N-heterocyclic carbenes. Thus, our current research work concerning group 13 and 14 metal alkoxides and aryloxides with NHCs focuses on the explanation of the role of NHC, as well as the character of the M–C(NHC) bond; on their structure and properties, including catalytic properties.

With regard to our studies on catalysts offering new possibilities of the synthesis of biodegradable polyesters, it should be noted that such polymers are of great interest due to their wide range of applications, including in medicine. In the course of our research, we develop synthetic methods and determine the structure of model metal alkoxides, as well as investigating the catalytic properties and application of selected catalysts in the synthesis of biodegradable polyesters. Determining the relationship between the structure of the investigated complexes and their catalytic properties is a crucial part of our studies. We consider this approach especially important from the point of view of the synthesis of polyesters of desired structure and properties.

STAFF

- Paweł Horeglad, PhD
- Martyna Cybularczyk–Cecotka, MSc
- Aleksander Hurko, MSc
- Anna Maria Dąbrowska, MSc
- Rafał Zaręba

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-chemii-metaloorganicznej/

PUBLICATIONS

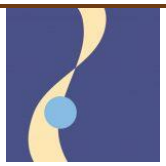
- **Dąbrowska, A. M.**; **Hurko, A.**; Dranka, M.; Varga, V.; **Urbańczyk, M.**; **Horeglad, P.**, Towards NHC stabilized alkylgallium alkoxide/aryloxide cations – The advances, the limitations and the challenges. *Journal of Organometallic Chemistry* **2017**, 840, 63-69.
- **Cybularczyk-Cecotka, M.**; **Zaremba, R.**; **Hurko, A.**; Plichta, A.; Dranka, M.; **Horeglad, P.**, Dialkylgallium alkoxides - a tool for facile and stereoselective synthesis of PLA-drug conjugates. *New Journal of Chemistry* **2017**, 14851-14854.

PROJECTS

IMPLEMENTED

- The effect of strong Lewis bases on the structure of group 13 and 14 metal alkoxides and their catalytic activity in the polymerization of heterocyclic monomers – Horeglad, Paweł, PhD Eng, SONATA BIS NCN, 2013-2018
- The influence of asymmetric N-heterocyclic carbenes on the synthesis, structure and activity of dialkylgallium alkoxides in the polymerization of rac-lactide. – Dąbrowska, Anna, MSc, PRELUDIUM NCN, 2017-2019

JAŻDŻEWSKI
LABORATORY OF HUMAN CANCER GENETICS



RESEARCH INTEREST

The aim of the projects carried out at the Laboratory of Human Cancer Genetics is to identify the molecular changes underlying the heritability and pathogenesis of human malignancies. Using the most innovative methods of molecular and genetic analysis, including next-generation sequencing, we seek out mutations that predispose to carcinogenesis.

We also analyze the function of regulatory RNAs, such as microRNAs, and the role their disturbed expression or sequence plays in the development and progression of cancer. Moreover, we aim to elucidate non-invasive molecular panels, based on measurements of microRNA expression in blood, which will allow doctors to predict and diagnose human cancers. Such panels might serve as a basis for personalized medicine. The Laboratory of Human Cancer Genetics is an interdisciplinary team, comprised of medical doctors, molecular biologists, geneticists, and bioinformaticians.

STAFF

- Prof. Krystian Jażdżewski, PhD, MD.
- Anna Wójcicka, PhD
- Julia Staręga-Rosłan, PhD
- Anna Kubiak, PhD
- Paweł Gaj, PhD
- Michał Świerniak, PhD
- Marta Kotlarek, MSc
- Ewelina Użarowska, MSc Eng

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-genetyki-nowotworow-czlowieka/

PUBLICATIONS

- Kula, D.; Kalemba, M.; Puch, Z.; Polańska, J.; **Świerniak, M.**; Rusinek, D.; Żebracka-Gala, J.; Kowalska, M.; Handkiewicz-Junak, D.; Kowal, M.; Tyszkiewicz, T.; Piasna, E.; Czarniecka, A.; Pawlaczek, A.; Krajewska, J.; Szpak-Ulczok, S.; Jarząb, B., Age at diagnosis and gender modify the risk of 9q22 and 14q13 polymorphisms for papillary thyroid carcinoma. *Endokrynologia Polska* **2017**, *68* (3), 283-289.
- Klimczak, D.; **Jażdżewski, K.**; Kuch, M., Regulatory mechanisms in arterial hypertension: role of microRNA in pathophysiology and therapy, *Blood Pressure* **2017**, 2-8.

- Koperski, Ł.; Kotlarek, M.; Świerniak, M.; **Kolanowska, M.**; **Kubiak, A.**; Górnicka, B.; Jażdżewski, K.; **Wójcicka, A.**, Next-generation sequencing reveals microRNA markers of adrenocortical tumors malignancy, *Oncotarget* **2017**, 8, 49191-49200.
- Przybył, J.; Kowalewska, M.; Quattrone, A.; Dewaele, B.; Vanspauwen, V.; Varma, S.; Vennam, S.; Newman, A.; **Swierniak, M.**; Bakuła-Zalewska, E.; Siedlecki, J. A.; Bidzinski, M.; Cools, J.; van de Rijn, M.; Debiec-Rychter, M., Macrophage infiltration and genetic landscape of undifferentiated uterine sarcomas. *JCI Insight* **2017**, 2(11), e94033.
- **Kolanowska, M.**; Wójcicka, A.; Kubiak, A.; **Świerniak, M.**; **Kotlarek, M.**; Maciąg, M.; **Gaj, P.**; Koperski, Ł.; Górnicka, B.; Jażdżewski, K., Functional analysis of a novel, thyroglobulin-embedded microRNA gene deregulated in papillary thyroid carcinoma. *Scientific Reports* **2017**, *7*, 9942.
- Augustyniak, J.; Lenart, J.; Zychowicz, M.; Lipka, G.; **Gaj, P.**; Kolanowska, M.; Stepien, P. P.; Buzanska, L., Sensitivity of hiPSC-derived neural stem cells (NSC) to Pyrroloquinoline quinone depends on their developmental stage. *Toxicology in Vitro* **2017**, *45* (3), 434-444.
- Tomsic, J.; Fultz, R.; Liyanarachchi, S.; Genutis, L. K.; Wang, Y.; Li, W.; Volina, S.; **Jażdżewski, K.**; He, H.; Wakely Jr., P. E.; Senter, L.; de la Chapelle, A., Variants in microRNA genes in familial papillary thyroid carcinoma. *Oncotarget* 2017, 8(4), 6475-6482.

PROJECTS

IMPLEMENTED

- The role of microRNA mutations in pathology of the thyroid gland and in genetic predisposition to papillary thyroid carcinoma - Prof. Krystian Jażdżewski, OPUS NCN, 2014-2018
- The use of next-generation sequencing for elucidation of sensitive and specific molecular panel for diagnostics of thyroid cancers – Wójcicka, Anna, PhD, Lider NCBiR, 2014-2018
- The use of microRNA inhibitors for restoration of the physiological expression of sodium iodide symporter NIS in thyroid cancer cells - an attempt to develop a new adjuvant therapy for cancer – Kotlarek, Marta, PhD, PRELUDIUM NCN, 2015-2018
- Novel approach to a large-scale population screening for genetic diseases - a proof-of-concept - Prof. Krystian Jażdżewski, TEAM FNP , 2016-2019

ENDED

- Attempt to use microRNA inhibitors to increase the efficiency of adjuvant thyroid cancer therapy – Wójcicka, Anna, PhD, Iuventus Plus MNiSW, 2014-2017

JEMIELITY
LABORATORY OF BIOORGANIC CHEMISTRY

RESEARCH INTEREST

The Laboratory of Bioorganic Chemistry is focused on the synthesis, properties and applications of modified nucleotides (including analogs of mRNA 5' cap, nucleoside triphosphates, nucleotide sugars, nucleoside phosphosulfates and many others). The main goal of our research is to create tools useful for elucidating biological processes involving nucleotides and to discover potential new nucleotide-derived therapeutics.

To do so, we develop new synthetic methods of chemical and enzymatic synthesis of nucleotides and their analogs. We are particularly interested in the synthesis and properties of nucleotides modified within phosphate moieties. We design nucleotide analogs that increase the cellular stability of mRNA and nucleotide-derived inhibitors of protein biosynthesis, especially under cellular conditions. We synthesize fluorescently labeled nucleotides, nucleotides with affinity tags, and nucleotide-probes for NMR and EPR experiments. We also prepare and evaluate conjugates of nucleotides with nano(bio)materials.

STAFF

- Prof. Jacek Jemielity, PhD
- Błażej Wojtczak, PhD
- Paweł Sikorski, PhD
- Tomasz Ratajczak, PhD
- Natalia Kleczewska, PhD
- Mirosław Śmietański, PhD
- Mikołaj Chromiński, PhD
- Sebastian Chmieliński, MSc Eng
- Zofia Warmińska, MSc
- Marcin Warmiński, PhD
- Kaja Fac, MSc
- Michał Kopciał, MSc
- Anna Nowicka, MSc
- Sylwia Walczak, MSc
- Przemysław Wanat, MSc
- Marek Baranowski, MSc
- Renata Kasprzyk, MSc
- Dominika Strzelecka, MSc
- Agnieszka Młynarska, MSc
- Marcelina Bednarczyk, MSc
- Andrzej Kraszewski
- Adam Mamot
- Mateusz Kozarski
- Olga Perzanowska
- Agnieszka Brzezińska
- Paweł Kowalski
- Beata Starek
- Sebastian Gołojuch
- Teodor Olejko
- Radosław Wójcik
- Piotr Flak

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-chemii-bioorganicznej/

PUBLICATIONS

- **Walczak, S.**; Nowicka, A.; Kubacka, D.; Fac K. J.; Wanat, P.; Mroczek, S.; Kowalska, J.; **Jemielity, J.**, A novel route for preparing 5' cap mimics and capped RNAs: phosphate-modified cap analogues obtained via click chemistry. *Chemical Science* **2017**, 8, 260-267.
- Warminski, M.; **Sikorski, P. J.**; Kowalska, J.; **Jemielity, J.**, Applications of Phosphate Modification and Labeling to Study (m)RNA Caps. *Topics in Current Chemistry* **2017**, 375, 16.
- Kroczynska, B.; Blyth, G. T.; Rafidi, R. L.; Majchrzak-Kita, B.; Xu, L.; Saleiro, D.; Kosciuczuk, E. M.; **Jemielity, J.**; Su, B.; Altman, J. K.; Eklund, E. A.; Fish, E. N.; Platanias, L. C., Central Regulatory Role for SIN1 in Interferon γ (IFNγ) Signaling and Generation of Biological Responses. *Journal of Biological Chemistry* **2017**, 292, 4743-4752.
- Kyung-Won, M.; Davila, S.; Zealy, R. W.; Lloyd, L. T.; Lee, I. Y.; Lee, R.; Roh, K. H.; Jung, A.; **Jemielity, J.**; Choi, Ch. E.; Chang, J. H.; Yoon, J. H., eIF4E phosphorylation by MST1 reduces translation of a subset of mRNAs, but increases lncRNA translation. *Biochimica et Biophysica Acta (BBA) - Gene Regulatory Mechanisms* **2017**, 1860(7), 761-772.
- Warminski, M.; **Sikorski, P. J.**; **Warminska, Z.**; Lukaszewicz, M.; Kropiwnicka, A.; Zuberek, J.; Darzynkiewicz, E.; Kowalska, J.; **Jemielity, J.**, Amino-Functionalized 5′ Cap Analogs as Tools for Site-Specific Sequence-Independent Labeling of mRNA. *Bioconjugate Chemistry* **2017**, 28, 1978−1992.
- Warminski, M.; Kowalska, J.; **Jemielity, J.**, Synthesis of RNA 5′-Azides from 2′-O-Pivaloyloxymethyl-Protected RNAs and Their Reactivity in Azide−Alkyne Cycloaddition Reactions. *Organic Letters* **2017**, 19, 3624−3627.
- Rydzik, A. M.; Warminski, M.; **Sikorski, P. J.**; Baranowski, M. R.; **Walczak, S.**; Kowalska, J.; Zuberek, J.; Lukaszewicz, M.; Nowak, E.; Claridge, T. D. W.; Darzynkiewicz, E.; Nowotny, M.; **Jemielity, J.**, mRNA cap analogues substituted in the tetraphosphate chain with CX2: identification of O-to-CCl2 as the first bridging modification that confers resistance to decapping without impairing translation. *Nucleic Acids Research* **2017**, 1-15.
- Granqvist, L.; **Kraszewski, A.**; Tähtinen, V.; Virta, P., Synthesis of Aminoglycoside-2'-O-Methyl Oligoribonucleotide Fusions. *Molecules* **2017**, 22(5), 760.
- Tomecki, R.; **Sikorski, P. J.**; Zakrzewska-Placzek, M., Comparison of preribosomal RNA processing pathways in yeast, plant and human cells – focus on coordinated action of endo- and exoribonucleases. *FEBS Letters* **2017**, 591(13), 1801–1850.
- Czaja, K.; Kujawski, J.; Jodłowska-Siewert, E.; Szulc, P.; **Ratajczak, T. R.**; Krygier, D.; Chmielewski, M. K.; Bernard, M. K.; On the Interactions of Fused Pyrazole Derivative with Selected Amino Acids: DFT Calculations. *Journal of Chemistry* **2017**, 8124323.

- Kujawski, J.; Czaja, K.; Jodłowska-Siewert, E.; Dettlaff, K.; Żwawiak, J.; Kujawski, R.; **Ratajczak, T. R.**; Bernard, M. K., Structural and spectroscopic properties of itraconazole and ketoconazole – Experimental and theoretical studies. *Journal of Molecular Structure* **2017**, 1146, 259-266.
- **Mamot, A.**; **Sikorski, P. J.**; Warminski, M.; Kowalska, J.; **Jemielity, J.**, Azido-Functionalized 5′-Cap Analogs for Preparation of Translationally Active mRNAs Suitable for Fluorescent Labeling in Living Cells. *Angewandte Chemie International Edition* **2017**, 56(49):15628-15632.
- Strzelecka, D.; **Chmielinski, S.**; **Bednarek, S.**; **Jemielity, J.**; Kowalska, J., Analysis of mononucleotides by tandem mass spectrometry: investigation of fragmentation pathways for phosphate- and ribose-modified nucleotide analogues. *Scientific Reports* **2017**, 7(1):8931.
- Kozarski, M.; Kubacka, D.; **Wojtczak, B. A**.; **Kasprzyk, R.**; Baranowski, M.; Kowalska, J., 7-Methylguanosine monophosphate analogues with 5′-(1,2,3-triazoyl) moiety: Synthesis and evaluation as the inhibitors of cNIIIB nucleotidase. *Bioorganic & Medicinal Chemistry*, 26(1):191-199.

PROJECTS

IMPLEMENTED

- New reagents and methods in synthesis of modified nucleotides and their application for preparation of biochemical tools and nucleotides with great therapeutic potential – Prof. Jacek Jemielity, SONATA BIS NCN, 2013-2018
- Chemically modified mRNA for studies on cellular processes and therapeutic applications – Prof. Jacek Jemielity, OPUS NCN, 2017-2020
- Exploitation of the regenerative potential of mesenchymal stem cells EXPLORE ME – Prof. Edward Darżynkiewicz, Prof. Jacek Jemielity, STRATEGMED NCBiR, 2016-2018
- New nucleotide analogs containing triazole within oligophosphate bridge as mimics of the 5' end of mRNA - synthesis, properties and incorporation into mRNA at its 5' end - Walczak, Sylwia, MSc, PRELUDIUM NCN, 2016-2019
- Properties of mRNA Oligonucleotide fragments with a cap structure ending - synthesis and investigation – Ratajczak, Tomasz, PhD, FUGA NCN, 2016-2019
- Synthesis of double-functionalized 5'-end mRNA analogs as molecular probes for cell-based applications – Kleczewska, Natalia, PhD, FUGA NCN, 2016-2019
- New selective inhibitors of cap dependent proteins: synthesis, delivery and characterization – Prof. Jacek Jemielity, TEAM FNP, 2017-2020
- Development of HTS method based on fluorescently labelled guanosine analogues: novel route for RNA (guanosine-N7)-methyltransferase (N7MTase) activity studies and inhibitors searching – Kasprzyk, Renata, MSc, PRELUDIUM NCN, 2017-2020

AWARDED

- Synthesis of trimethyl cap analogs modified with molecular rotors and their application in nuclear transport studies – Wojtczak, Błażej, PhD, SONATA NCN, 2018-2021

ENDED

- New methods for mRNA 5' end labeling and examples of their application in studies on RNA metabolism and searching for inhibitors of cap-structure-recognizing proteins with therapeutic relevance – Prof. Jacek Jemielity, OPUS NCN, 2014-2017

KAŁEK

LABORATORY OF ASYMMETRIC CATALYSIS

RESEARCH INTEREST

Our laboratory's research is aimed at the development of new methodologies for synthetic organic chemistry. The central focus of our work is directed toward the use of efficient chiral catalysts that can deliver products with a high degree of enantiopurity, which is a prerequisite for present-day pharmaceutical applications. We work in three major areas: asymmetric organocatalysis, organometallic chemistry, and computational chemical modeling.

We are principally interested in new chemical reactions that can be promoted by two families of nucleophilic catalysts, namely, N-heterocyclic carbenes (NHCs) and phosphines. An important area of our research is the development of reactions involving a cooperative (synergistic) catalysis by an NHC/phosphine and a transition metal. Combining well-known reactivities of organometallic species with novel modes of activation offered by the nucleophilic catalysts lets us have the best of both worlds, allowing currently impossible reactions to occur. We make extensive use of modern computational methods to investigate reaction mechanisms and the origins of various selectivities displayed by catalytic processes, as well as to design new efficient chiral catalysts and fine-tune their structure.

STAFF

- Marcin Kałek, PhD
- Manoj Kumar Ghosh, PhD
- Adam Rajkiewicz, MSc
- Karol Kraszewski, MSc
- Jan Rzymkowski, MSc

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-katalizy-asymetrycznej/

PUBLICATIONS

- **Kalek, M.**; Fu, G. C., Caution in the use of nonlinear effects as a mechanistic tool for catalytic enantioconvergent reactions: Intrinsic negative nonlinear effects in the absence of higher order species. *Journal of the American Chemical Society* **2017**, 139, 4225-4229.
- **Kalek, M.**; Himo, F., Mechanism and selectivity of cooperatively-catalyzed Meyer-Schuster rearrangement/Tsuji-Trost allylic substitution. Evaluation of synergistic catalysis by means of combined DFT and kinetics simulations. *Journal of the American Chemical Society* **2017**, 139, 10250-10266.

PROJECTS

IMPLEMENTED

- Asymmetric nucleophilic catalysis with N-heterocyclic carbenes and phosphines. New reactions, catalysts, and methods of research. – Kałek, Marcin, PhD, SONATA NCN, 2015-2019
- Asymmetric transformations with hypervalent iodine reagents. Merger with nucleophilic catalysis and novel chiral iodoarenes as entry to powerful synthetic reactions. – Kałek, Marcin, PhD, SONATA BIS NCN, 2017-2022

KARGUL

SOLAR FUELS LABORATORY

RESEARCH INTEREST

The sun powers almost all life on earth *via* the fundamental process of photosynthesis. The natural photosystems (photosystems I and II) are capable of capturing light and converting solar energy into chemical bonds within reduced carbon compounds. These are large macromolecular membrane protein complexes that hold pigments and redox active cofactors together to form biological nanoscale solar energy converters operating at an internal quantum efficiency close to unity.

Solar energy conversion is one of the few renewable ways to produce clean energy to meet the increasing demands of modern civilization. In the era of global climate change, there is a strong need to understand photosynthetic processes and their regulatory basis, particularly in relation to solar fuel production in extreme environments.

Our research focuses on three main long-term objectives:

- to understand the mechanisms of photosynthetic energy conversion at the molecular level in the extremophilic photosynthetic apparatus, using model extremophiles such as the red microalga *Cyanidioschyzon merolae* and cyanobacterium *Thermosynechococcus elongatus*,
- to dissect molecular mechanisms of photosynthetic adaptation under extreme conditions and fluctuating light,
- to construct truly 'green', viable, biohybrid solar-to-fuel nanodevices that mimic the most crucial steps of the early stages of photosynthesis to produce fuels, such as molecular hydrogen and renewable carbon-based fuels.

As members of major European collaborative initiatives, the EuroSolarFuels (2011-2014) and PolTur/GraphESol (2016-present) consortia, we work on optimizing the construction and performance of biophotoelectrodes, which can be built into the heterojunction tandem devices to achieve efficient solar-to-hydrogen conversion.

Methods used in the Kargul lab include an array of chromatographic approaches (AEC, HIC, IMAC, SEC), biochemical techniques (SDS-PAGE, BN-PAGE, Western blotting, sucrose gradient fractionation etc.), molecular biology methods (RT-PCR, DNA cloning), spectroscopic methods (fluorescence and absorption spectroscopy), photoelectrochemistry, organic chemistry and bioinformatics. We also have close collaboration with top national and international experts in materials science, photovoltaics, AFM photophysics, and computational chemistry to characterize and optimize the electron and energy transfer processes within the constructed artificial leaf devices.

STAFF

- Prof. Joanna Kargul, PhD
- Małgorzata Kiliszek, PhD
- Patrycja Haniewicz, PhD
- Grzegorz Bubak, PhD
- Julian David Janna Olmos, PhD
- Mateusz Abram, MSc
- Gleb Andryianau, MSc

PUBLICATIONS

- Szalkowski, M.; **Janna-Olmos, J. D.**; Buczyńska, D.; Maćkowski, S.; Kowalska, D.; **Kargul, J.**, Plasmon-induced absorption of blind chlorophylls in photosynthetic proteins assembled on silver nanowires. *Nanoscale* **2017**, *9*, 10475–10486.
- Iminger-Finger, I.; **Kargul, J.**; Laurent, G. J., Diabetes: Present and Future. *The International Journal of Biochemistry & Cell Biology* **2017**, 88, 196.
- **Janna-Olmos, J. D.**; Becquet, P.; Gront, D.; Sar, J.; Dąbrowski, A.; Gawlik, G.; Teodorczyk, M.; **Pawlak, D**.; **Kargul, J.**, Biofunctionalisation of p-doped silicon with cytochrome c553 minimises charge recombination and enhances photovoltaic performance of the all-solid-state photosystem I-based biophotoelectrode. *RSC Advances* **2017**, *7* (75), 47854-47866.
- **Kargul, J.**; Irminger-Finger, I.; Laurent, G., Metabolomics: Taking snapshots of cellular physiology in health and disease. *The International Journal of Biochemistry & Cell Biology* **2017**, *93*, 86.
- **Kargul, J.**; Irminger-Finger, I.; Laurent, G. J., RNA splicing: An ingenious gene self editing tool. *The International Journal of Biochemistry & Cell Biology* **2017**, *91*, 81.
- **Kargul, J.; Bubak, G.; Andryianau, G**., Biophotovoltaic Systems Based on Photosynthetic Complexes, In: *Encyclopedia of Interfacial Chemistry: Surface Science and Electrochemistry* **2017**, Ed. P. Vadgama, Elsevier

PROJECTS

IMPLEMENTED

- Structural and functional characterisation of the photosynthetic apparatus of an extremophilic red microalga Cyanidioschyzon merolae – Prof. Joanna Kargul, OPUS NCN, 2015-2018
- Graphene-derived electrodes for bio-inspired solar-fuel device - GraphESol – Prof. Joanna Kargul, Polish-Turkish bilateral cooperation NCBiR, 2016-2019

ENDED

- Solar energy based technologies to produce renewable fuels by direct conversion of CO2 with biophotoelectrodes using extremophilic organisms – Prof. Joanna Kargul, Grants for Grants programme MNiSW

KAZIMIERCZUK
LABORATORY OF NMR SPECTROSCOPY

RESEARCH INTEREST

We develop new tools for multidimensional spectroscopy, utilizing recent achievements in applied mathemathics – particularly in the area of compressed sensing (CS).

The key idea of CS is a new signal sampling theorem, stating that in many cases the perfect reconstruction of a signal can be achieved using many fewer samples than required by a conventional sampling theory. These methods are being developed very rapidly and have already found applications in many fields of science, e.g. MRI, astronomy, biology and many others. They have also been introduced to NMR spectroscopy. In the case of NMR, the use of CS allows for a significant shortening of experiment length, and the implementation of novel techniques that are infeasible with conventional sampling.

Our group currently works on the theory and practice of CS-NMR, by developing new signal processing algorithms and signal acquisition methods. We develop techniques suitable for particular NMR experiments – the analysis of chemical reactions and processes, NMR diffusometry, and relaxometry and metabolomics.

The laboratory provides access to equipment for the NMR of proteins, solid state materials and suspensions. We are open to the scientific collaboration with academic and industrial groups.

STAFF

- Krzysztof Kazimierczuk, PhD
- Alexandra Shchukina, PhD
- Mateusz Urbańczyk, PhD
- Dariusz Gołowicz, MSc

PUBLICATIONS

- Urbańczyk, M.; Nowakowski, M.; Koźmiński, W.; Kazimierczuk, K., Joint non-uniform sampling of all incremented time delays for quicker acquisition in protein relaxation studies. Journal of Biomolecular NMR 2017, 68(2), 155–161, IF=2.410, Open Acces
- Ndukwe, I. E., Shchukina, A.; Zorin, V.; Cobas, C.; Kazimierczuk, K.; Butts, C. P., Enabling Fast Pseudo-2D NMR Spectral Acquisition for Broadband Homonuclear Decoupling: The EXACT NMR Approach. ChemPhysChem 2017, 18, 2081-2087, IF=3.075
- Dass, R.; Grudziąż, K.; Ishikawa, T.; Nowakowski, M.; Dębowska, R.; Kazimierczuk, K., Fast 2D NMR Spectroscopy for In vivo Monitoring of Bacterial Metabolism in Complex Mixtures. Frontiers in Microbiology 2017, 8, 1306, IF=4.076, Open Access

- Dass, R., Kasprzak, P.; Kazimierczuk, K., Quick, sensitive serial NMR experiments with Radon transform. Journal of Magnetic Resonance 2017, 282, 114-118, IF=2.432
- Shchukina, A.; Kasprzak, P.; Dass, R.; Nowakowski, M.; Kazimierczuk, K., Erratum to: Pitfalls in compressed sensing reconstruction and how to avoid them. Journal of Biomolecular NMR 2017, 68 (2), 99-100, IF=2.41

PROJECTS

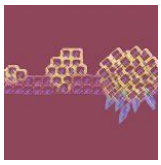
IMPLEMENTED

- Sparse and approximately-sparse representations in problems of NMR - Kazimierczuk Krzysztof, PhD, SONATA BIS NCN, 2013-2018
- □ Time-resolved N-dimensional spectroscopy for monitoring of physical and chemical processes - Kazimierczuk Krzysztof, PhD, OPUS NCN, 2016-2020

AWARDED

- Radon transform in NMR spectroscopy of proteins - Kazimierczuk Krzysztof, PhD, HARMONIA NCN, 2018-2021
- □ Methods of non-stationary signal processing for more sensitive NMR spectroscopy - Kazimierczuk Krzysztof, PhD, First TEAM FNP, 2018-2021

KOBIELAK AGNIESZKA
LABORATORY OF THE MOLECULAR BIOLOGY OF CANCER



RESEARCH INTEREST

The progression of cancer from locally growing to treatment-resistant and metastatic is most often the event responsible for treatment failure. The biology underpinning the fact that some tumor cells are more resistant to currently available treatments, or are prone to becoming invasive, is largely unknown. The theory of cancer-initiating cells suggests phenotypic and functional heterogeneity within the primary tumor. Cancer-initiating cells have been increasingly shown to play an integral role in tumor initiation, disease progression, metastasis and treatment resistance. Therefore, our laboratory's goal is to understand signaling pathways on a molecular level, as well as the molecules involved in tumor heterogeneity. We are also interested in the role of the microenvironment in the development of the phenotypic and functional diversity of tumor cells. In our experimental approach, we use tools of molecular biology, tumor mouse models, functional genomics, and in vivo imaging.

STAFF

- Agnieszka Kobielak, PhD
- Łucja Krzemień-Ojak, PhD
- Kamila Karpińska, PhD
- Mateusz Gielata, MSc
- Gaweł Bojanowski
- Anna Sokołow

PUBLICATIONS:

- Shen, J.; Ha, D. P.; Zhu, G.; Rangel, D. F.; **Kobielak, A.**; Gill, P. S.; Groshen, S.; Dubeau, L.; Lee, A.S., GRP78 haploinsufficiency suppresses acinar-to-ductal metaplasia, signaling, and mutant Kras-driven pancreatic tumorigenesis in mice, *Proceedings of the National Academy of Sciences of the United States of America* **2017**, 114(20), E4020-E4029.

PROJECTS

IMPLEMENTED

- Understanding cancer stem cell heterogeneity and plasticity and its role in the progression of oral cancer. – Kobielak, Agnieszka, PhD, OPUS NCN, 2016-2019

AWARDED

- Role of catulin in the regulation of cell-extracellular matrix interactions in tumor invasion and metastasis of head and neck squamous cell carcinoma – Kobielak, Agnieszka, PhD, OPUS NCN, 2018-2021

KOBIELAK KRZYSZTOF
LABORATORY OF STEM CELLS, TISSUE DEVELOPMENT AND REGENERATION

RESEARCH INTEREST

Revealing the fundamental biological processes governing adult stem cell regulation is important since stem cells are not only a prerequisite of physiological tissue or organ self-renewal, but also because they play a critical role in the post-injury regeneration of these tissues and organs. Therefore, precisely understanding the regulation of adult stem cells' homeostasis is crucial, as deregulation of the stem cells' self-renewal process might result in organ failure or tumor formation. Thus, further discovery of molecular factors governing the intrinsic balance of signaling pathways in stem cells is a very important aspect of regenerative medicine, and one of the goals of my laboratory. This knowledge might prove to be essential in understanding the common mechanisms of stem cell homeostasis and tissue regeneration. It might also be useful when utilizing these basic discoveries to develop novel forms of stem cell therapy in humans. To reach this goal, my laboratory uses independent skin stem cells from hair, sweat glands, and nails as a model to decipher their molecular mechanism of regulation, and their properties during skin, hair and limb/digit regeneration. Analizing the underlying similarities and differences between the renewal processes of distinct skin appendages may prove highly beneficial in unraveling the fundamental principles which govern tissue or organ regeneration in vivo.

STAFF

- Krzysztof Kobielak, PhD
- Agnieszka Kilkulska, PhD
- Patrycja Daszczuk, MSc
- Paula Mazurek, MSc

PUBLICATIONS

- Wang, Q.; Oh, J. W.; Lee, H. L.; Dhar, A.; Peng, T.; Ramos, R.; Guerrero-Juarez, Ch. F.; Wang, X.; Zhao, R.; Cao, X.; Le, J.; Fuentes, M. A.; Jocoy, S. C.; Rossi, A. R.; Vu, B.; Pham, K.; Wang, X.; Mali, N. M.; Park, J. M.; Choi, J. H.; Lee, H.; Legrand, J.; Kandyba, E.; Kim, J. Ch.; Kim, M.; Foley, J.; Yu, Z.; **Kobielak, K.**; Andersen, B.; Khosrotehrani, K.; Nie, Q.; Plikus, M. V., A multi-scale model for hair follicles reveals heterogeneous domains driving rapid spatiotemporal hair growth patterning. *eLife* **2017**, 6, e22772.

- Lee, P.; Gund, R.; Dutta, A.; Pincha, N.; Rana, I.; Ghosh, S.; Witherden, D.; Kandyba, E.; MacLeod, A.; **Kobielak, K**.; Havran, W. L.; Jamora, C., Stimulation of hair follicle stem cell proliferation through an IL-1 dependent activation of γδT-cells. *Elife* **2017**, e28875.

PROJECTS

IMPLEMENTED

- Hair follicle stem cell regulation during hair cyclic regeneration. – Kobielak, Krzysztof, PhD, OPUS NCN, 2016-2019
- Regulators of BMP and WNT signaling pathways in homeostasis of hair follicle stem cells, Daszczuk, Patrycja, MSc, PRELUDIUM NCN, 2018-2021

AWARDED

- Reciprocal interaction between hair follicle Stem Cells and surrounding niche during skin and hair regeneration – Kobielak, Krzysztof, PhD, TEAM FNP, 2018-2021

KONARSKA
LABORATORY OF RNA BIOLOGY

RESEARCH INTEREST

The focus of my laboratory's work are the biological functions of RNA; we will use the spliceosome as a model, concentrating on the study of molecular mechanisms that govern pre-mRNA splicing. Our goal is to understand the complex set of substrate-spliceosome interactions during assembly and catalysis, which affect the positioning of reactive groups at the active site.

We anticipate that our mechanistic studies in yeast will help us to understand the molecular interactions that influence splicing fidelity and alternative splicing in metazoan systems. We have proposed a two-state model of spliceosome function, according to which substrate selectivity can be modulated by the competition of spliceosomal conformations between the 1st and 2nd step of splicing (Query and Konarska, 2004); studies of some implications of this model form the basis of the lab's activity.

We are interested in the catalytic center's general architecture. We test new models of snRNA:snRNA interactions at the catalytic center, and analyze several spliceosomal factors involved in the substrate positioning for catalysis. These projects form a part of a broader initiative to develop an orthogonal spliceosome system, in which selected spliceosome mutants function only in the context of a specialized, orthogonal substrate.

To better understand how pre-mRNA is positioned for catalysis, we investigate exon sequences that compensate for the defects of the 5'SS. Isolated yeast exon motifs are similar to metazoan exon enhancers; this striking sequence similarity is suggestive of common underlying mechanisms of action. We hypothesize that yeast exon motifs represent substrate binding sites recognized by the spliceosome; we study the molecular mechanisms underlying the function of these motifs.

STAFF

- Prof. Magda Konarska, PhD
- Katarzyna Matylla-Kulińska, PhD
- Agata Jaskulska, MSc
- Katarzyna Eysmont, MSc
- Jacek Miłek, MSc
- Jadwiga Meissner
- Łukasz Widło

PROJECTS

IMPLEMENTED

- Interactions of U6 snRNA within the catalytic center of the spliceosome- modulation of pre-mRNA splicing by U6-like exon sequences. – Prof. Magda Konarska, MAESTRO NCN, 2013-2018
- Regenerative mechanisms for Health – Prof. Magda Konarska, MAB IRAP FNP, 2017-2022, Group Lider.

MALINOWSKI
SMALL MOLECULES ACTIVATION LABORATORY

RESEARCH INTEREST

The research performed at the Small Molecules Activation Laboratory is focused on utilizing highly reactive salts of weakly coordinating anions in the transformation of small, often inert molecules such as aliphatic or halogenated hydrocarbons, nitrous oxide or dinitrogen. Our goal is to develop novel systems that could facilitate functionalization of these simple compounds in mild conditions (preferably room temperature and ambient pressure).

Species we investigate include salts of main group elements like calcium or barium, but also extend to 1st row transition metals from titanium to copper.

The research conducted within SMALab is financed by the Foundation for Polish Science (Homing) and the National Centre of Science (Sonata).

STAFF

- Przemysław Malinowski, PhD
- Vadim Zhuravlev,
- Michał Jadwiszczak
- Jakub Czajka, Eng
- Kacper Koteras, Eng
- Grzegorz Kołodziej

PROJECTS

IMPLEMENTED

- Hi-REX. Highly reactive salts of oxocationic species of Fe, Cu and Co and Weakly Coordinating Anions as reagents for activation of light saturated hydrocarbons. – Malinowski, Przemysław, PhD, SONATA NCN, 2015-2018
- Transition metal salts of weakly coordination anions as model scavengers of nitrous oxide and halogenated hydrocarbons – Malinowski, Przemysław, PhD, HOMING FNP, 2017-2018

NIEWIADOMSKI LABORATORY OF MOLECULAR AND CELLULAR SIGNALING

RESEARCH INTEREST

Communication between cells is an essential feature of living organisms. Signals received from the environment are processed and integrated by the cell, leading to changes in its morphology and behavior. Many human diseases, such as developmental defects and cancer, are caused by defective signal transduction.

Our laboratory studies various aspects of cellular signaling, with focus on the Hedgehog pathway. Hedgehog signaling is involved in the development of limbs, the spinal cord, the heart, and the brain. Its aberrant activation leads to many types of cancer, including the most common childhood brain tumor: medulloblastoma. We want to find out how the signal is transmitted from the Hedgehog receptor Patched to the Gli transcription factors, which are the main effectors of the pathway in the nucleus. To achieve this goal, we use a variety of techniques, including mathematical modeling, genetic manipulation of mammalian cells, fluorescence imaging, qualitative and quantitative proteomics, transcriptomic analyses, mouse models of cancer, and in vivo manipulation of vertebrate embryos. This broad toolbox allows us to approach basic questions in molecular and cell biology from a variety of angles and to shed new light on fundamental mechanisms of signal transduction. We hope that our work will have positive implications for the treatment of human disease, including cancer.

STAFF

- Paweł Niewiadomski, PhD
- Łukasz Markiewicz, PhD
- Sylwia Niedziółka, MSc
- Edyta Kawka, MSc
- Katarzyna Chojnowska, PhD

PUBLICATIONS

- Coni, S.; Mancuso, A. B.; Di Magno, L.; Sdruscia, G.; Manni, S.; Serrao, S. M.; Rotili, D.; Spiombi, E.; Bufalieri, F.; Petroni, M.; Kusio-Kobialka, M.; De Smaele, E.; Ferretti, E.; Capalbo, C.; Mai, A.; **Niewiadomski, P.**; Screpanti, I.; Di Marcotullio, L.; Canettieri, G., Selective targeting of HDAC1/2 elicits anticancer effects through Gli1 acetylation in preclinical models of SHH Medulloblastoma. *Scientific Reports* 2017, 7, 44079

- Waschek, J. A.; Cohen, J. R.; Chi, G. C.; Proszynski, T. J.; **Niewiadomski, P.**, PACAP Promotes Matrix-Driven Adhesion of Cultured Adult Murine Neural Progenitors. *ASN Neuro* 2017, 9(3), 1-16.
- Bernadzki, K. M.; Gawor, M.; Pęziński, M.; Mazurek, P.; Niewiadomski, P.; Rędowicz, M. J.; Prószyński, T. J; Liprin-α-1 is a novel component of the murine neuromuscular junction and is involved in the organization of the postsynaptic machinery, *Scientific Reports* **2017**, 7 (1), 9116.

PROJECTS

IMPLEMENTED

- Determinants of the location of Gli proteins in cell nucleus – Markiewicz, Łukasz, PhD, FUGA NCN, 2016-2019
- Role of primary cilia in the activation of Gli transcription factors in Hedgehog signaling – Niewiadomski, Paweł, PhD, SONATA BIS NCN, 2015-2020

NOWIS
LABORATORY OF EXPERIMENTAL MEDICINE

RESEARCH INTEREST

The aim of the projects carried out in the Laboratory of Experimental Medicine is to:

- identify and validate novel molecular targets for anti-cancer therapies with a focus on mechanisms regulating protein homeostasis in mammalian cells (such as the ubiquitin-proteasome system, autophagy, endoplasmic reticulum-associated degradation, and unfolded protein response);
- study the role of the immune system in tumor development, progression and sensitivity to anti-cancer treatments, and to elucidate novel targets/protocols for the immunotherapy of tumors;
- study the role of selected signaling pathways in the development and progression of tumors.

Our research involves studies in primary human cancer cells, established human and mouse cancer cell lines, and syngeneic as well as xenograft tumor models in mice. We have developed numerous syngeneic tumor models for the in vivo study of innate, as well as antigen-specific immune responses, and have focused on attempting to improve the multicolor flow cytometry-based immunophenotyping of tumor-infiltrating cells. We use 3D cell cultures as well as invasion and migration assays to better characterize tumor cells and their microenvironment.

We do our best to combine our knowledge in the areas of medicine, molecular biology, and bioinformatics to discover novel, effective and clinically applicable anti-tumor treatment modalities.

STAFF

- Prof. Dominika Nowis, PhD MD
- Anna Marusiak, PhD
- Justyna Chlebowska-Tuz, PhD
- Mateusz Sobczak, MSc
- Monika Prełowska, MSc
- Olga Sokołowska, MSc Eng
- Dawid Mehlich
- Artur Kośnik
- Klaudia Kamińska

PUBLICATIONS:

- **Sokolowska, O.**; **Nowis, D.**, STING Signaling in Cancer Cells: Important or Not? *Archivum Immunologiae et Therapiae Experimentalis* **2017**.
- Guglielmi, V.; Nowis, D.; Tinelli, M.; Malatesta, M.; Paoli, L.; Marini, M.; Manganotti, P.; Sadowski, R.; Wilczynski, G. M.; Meneghini, V.; Tomelleri, G.; Vattemi, G., Bortezomib-

induced muscle toxicity in multiple myeloma. *Journal of Neuropathology and Experimental Neurology* **2017**, 76(7), 620-630.

- Winiarska, M.; Nowis, D.; Firczuk, M.; Zagozdzon, A.; Gabrysiak, M.; Sadowski, R.; Barankiewicz, J.; Dwojak, M.; Golab J., Selection of optimal promoter for gene expression in normal B cells. *Molecular Medicine Reports* **2017**, 3041-3048.
- Mroczek, S.; Chlebowska, J.; Kulinski, T.; Gewartowska, O.; Gruchota, J.; Cysewski, D.; Liudkovska, V.; Borsuk, E.; **Nowis, D.**; Dziembowski, A., The FAM46C gene encodes a non-canonical poly(A) polymerase and acts as an onco- suppressor in multiple myeloma. in: *RNA 2017 The 22nd Annual Meeting of the RNA Society* **2017**.
- Mroczek, S.; Chlebowska, J.; Kuliński, T. M.; Gewartowska, O.; Gruchota, J.; Cysewski, D.; Liudkovska, V.; Borsuk, E.; **Nowis D.**; Dziembowski, A., The non-canonical poly(A) polymerase FAM46Cacts as an onco-suppressor in multiple myeloma. *Nature Communications* **2017**, *8*, 619.
- Prełowska, M.; Kaczyńska, A.; Herman-Antosiewicz, A., 4-(methylthio) butyl isothiocyanate inhibits the proliferation of breast cancer cells with different receptor status. *Pharmacological Reports* **2017**, 69(5), 1059-1066.

PROJECTS

IMPLEMENTED

- The effect of increased expression of MLK4 kinase on the development of breast cancer progression - Marusiak, Anna, PhD, FUGA NCN, 2015-2018
- Investigation of the antitumor potential of stimulator of interferon genes (STING) - an adaptor protein in innate immune signaling – Sokołowska, Olga, MSc, PRELUDIUM NCN, 2016-2018
- Evaluation of anticancer potential of glutamine metabolism modulation in multiple myeloma sensitive and resistant to chemotherapy – Prełowska, Monika, MSc, PRELUDIUM NCN, 2017-2019
- The role of MLK4 amplification in breast cancer progression - studies in 3D cell culture and in vivo models – Marusiak, Anna, PhD, HOMING FNP, 2017-2019
- The role of arginase-1 in antitumor efficacy of cancer immunotherapy using checkpoint inhibitors – Prof. Dominika Nowis, OPUS NCN, 2017-2020

ENDED

- Investigation of the molecular mechanisms of anti-leukemic activity of SK053, a small molecule compound targeting enzymes involved in allosteric disulphide bonds formation – Prof. Dominika Nowis, SONATA BIS NCN, 2014-2017

PAWLAK
LABORATORY OF MATERIALS TECHNOLOGY

RESEARCH INTEREST

The Laboratory of Material Technologies is a shared initiative of two scientific centers: the Centre of New Technologies (Warsaw University) and the Institute of Electronic Materials Technology (ITME). The Laboratory works closely with the Laboratory of Functional Materials in ITME. Prof. D. A. Pawlak is the leader of both laboratories, which specialize in developing new material technologies and in obtaining novel materials applicable in photonics, optoelectronics, photoelectrochemistry, and potentially in photovoltaics and medicine.

Both laboratories – operating under a single supervisor – act jointly, each utilizing the other's appliances, resources, and expertise. This symbiosis allows for a combination of basic research and clearly specified applications.

Plasmonic materials are obtained by doping dielectric matrices with plasmonic nanoparticles, and with the use of directional solidification of two-phase materials, such as eutectic materials. As a result, new nanoplasmonic composite materials are being obtained. Some examples of these are: i) three-dimensional micro and nanostructured materials, ii) materials with isotropic properties, iii) materials with anisotropic properties, iv) materials which show plasmonic resonance properties at various wavelengths (from visible to infrared), v) materials with narrow and broadband resonances, and vi) materials with enhanced electromagnetic properties, such as luminescence, up-conversion and others.

Metamaterials are composite materials exhibiting exceptional electromagnetic properties, unobserved either in their component phases, or in nature. Metamaterials can display extraordinary properties, such as artificial magnetism, a negative refractive index, a giant dielectric constant, the ability to render objects invisible, and others. They can also enable imaging with subwavelength resolution.

Eutectic materials may also find use in photoelectrochemistry or photovoltaics – as photoactive materials, which participate in the process of converting solar power into other types of energy. Eutectic materials have numerous merits when it comes to solar energy conversion: i) the availability of two or more phases may allow for a broadening of the light absorption spectrum, ii) the interface boundaries may lead to more efficient discharge of electric charge produced by photoaging, iii) a high crystallinity, iv) components, which are normally unavailable, can be used, v) various means of controlling properties, such as: doping, annealing, etching, combining with other materials.

STAFF

- Prof. Anna Dorota Pawlak, PhD
- Rafał Nowaczyński, MSc Eng
- Kamil Szlachetko, MSc Eng
- Piotr Paszke, Eng
- Mihai Suster

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-technologii-materialowych/

PUBLICATIONS

- Orlinski, K.; Diduszko, R.; Kopcewicz, M.; Pawlak, D., The influence of chromium substitution on crystal structure and shift of Néel transition in GdFe1−xCrxO3 mixed oxides. *Journal of Thermal Analysis and Calorimetry* **2017**, 127(1), 181-187.
- Deska, R.; Sadecka, K.; Olesiak-Bańska, J.; Matczyszyn, K.; Pawlak, D.; Samoć, M., Nonlinear plasmonics in eutectic composites: second harmonic generation and two-photon luminescence in a volumetric eutectic-based Bi2O3-Ag metamaterial. *Applied Physics Letters* **2017**, 110(3), 031102-031105.
- Sadecka, K.; Berger, N. H.; Orlinski, K.; Jozwik, Iwona.; Pawlak, D. A., Evolution of silver in a eutectic-based Bi2O3–Ag metamaterial. *Journal of Materials Science* **2017**, 52(10), 5503–5510.
- Osewski, P.; Belardini, A.; Petronijevic, E.; Centini, M.; Leahu, G.; Diduszko, R.; Pawlak, D. A.; Sibilia, C., et al. Self-Phase-Matched Second-Harmonic and White-Light Generation in a Biaxial Zinc Tungstate Single Crystal. *Scientific Reports* **2017**, *7*, 45247.
- Wysmulek, K.; Sar, J.; Osewski, P., Orlinskia, K.; Kolodziejaka, K.; Trenczek-Zajacb, A.; Radeckab, M.; **Pawlak, D. A.,** et al. A SrTiO3-TiO2 eutectic composite as a stable photoanode material for photoelectrochemical hydrogen production. *Applied Catalysis B: Environmental* **2017**, *206*, 538-546.
- Szubka, M.; Talik, E.; Sadecka, K., et al. Characterization of raw materials and self-organized Bi2O3–Ag eutectic by X-ray diffraction, scanning electron microscopy, and X-ray photoelectron spectroscopy. *Crystal Research and Technology* **2017**, *52* (8), 1700044.
- Kołodziejak, K.; Sar, J.; Wysmulek, K.; Osewski, P.; Warczak, M.; Sadkowski, A.; Radecka, M.; Pawlak, D. A., When eutectic composites meet photoelectrochemistry – Highly stable and efficient UV–visible hybrid photoanodes. *Journal of Catalysis* **2017**, 352, 93-101.
- **Janna-Olmos, J. D.**; Becquet, P.; Gront, D.; Sar, J.; Dąbrowski, A.; Gawlik, G.; Teodorczyk, M.; **Pawlak, D.**; **Kargul, J.**, Biofunctionalisation of p-doped silicon with cytochrome c553 minimises charge recombination and enhances photovoltaic performance of the all-solid-state photosystem I-based biophotoelectrode. *RSC Advances* **2017**, *7* (75), 47854-47866.

PROJECTS

IMPLEMENTED

- Selective express tumor diagnostic with narrow band nanophotonic structures – EXODIAGNOS – Prof. Dorota Pawlak, Era.Net RUS Plus – INNOVATION NCBiR, 2015-2018
- Centre of ExcelleNce for nanophotonicS, advancEd Materials and novel crystal growth-Based technoLogiEs – Prof. Dorota Pawlak, Grants for Grants programme MNiSW, 2018-2018

PLEWCZYŃSKI LABORATORY OF FUNCTIONAL AND STRUCTURAL GENOMICS

RESEARCH INTEREST

In the Laboratory of Functional and Structural Genomics, we perform theoretical studies, with the objective of analyzing and predicting the three-dimensional structure of the Human genome, and its relation with the genomic diversity of human populations, both natural and pathological. In particular, we investigate structural variants, copy number variants (observed in various sub-populations and groups of patients), and their three-dimensional localization in the nucleus structure.

We also examine the relationship of the expression levels of selected genes and their location in three-dimensional space. In addition, we use structural information to enrich the sequential genomic analysis, in order to better define the function of selected genomic regions, which are important in the context of personalized medicine.

We are committed to achieving this goal. Firstly, we are developing various large-scale computational tools enabling an analysis of whole genome sequences, the identification of structural variants, and determining the statistical significance of observed numbers of copies of genomic regions in selected cohorts of patients. Secondly, we evaluate their uniqueness, comparing the observed changes with typical and natural genomic diversity, that has been cataloged earlier, by the 1000 Genomes Project Consortium for instance. Thirdly, we infer the biological function of these genomic regions using publicly available databases. Fourthly, we identify a unique, local three-dimensional environment for selected sites, e.g. regulatory ones. In the fifth step, we analyze the impact of structural re-arrangements of those local neighborhoods on the gene expression profiles, which is related to the presence of transcription factories.

STAFF

- Prof. Dariusz Plewczyński, PhD
- Michał Łaźniewski, PhD
- Michał Piętal, PhD
- Grzegorz Bokota, MSc
- Michał Denkiewicz, MSc
- Michał Kadlof, MSc
- Giovani Mazzocco, MSc
- Anna Rusek, MSc
- Przemysław Szałaj, MSc
- Paulina Urban, MSc
- Michał Własnowolski, MSc
- Anna Bugaj
- Agnieszka Kraft
- Zofia Parteka
- Michał Sadowski
- Piotr Skłodowski
- Andrzej Szczepanczyk
- Natalia Zawrotna

- Marcin Tatjewski, MSc

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-genomiki-funkcjonalnej-i-strukturalnej/

PUBLICATIONS

- Ołdak, M.; Oziębło, D.; Pollak, A.; Stępniak, I.; **Łaźniewski, M.**; Lechowicz, U.; Kochanek, K.; Furmanek, M.; Tacikowska, G.; **Plewczynski, D.**; Wolak, T.; Płoski, R.; Skarżyński, H., Novel neuro-audiological findings and further evidence for TWNK involvement in Perrault syndrome. *Journal of Translational Medicine* **2017**, 15, 25.
- **Zubek, J.**; **Denkiewicz, M.**; **Barański, J.**; **Wróblewski, P.**; Rączaszek-Leonardi, J.; **Plewczynski, D.**, Social adaptation in multi-agent model of linguistic categorization is affected by network information flow. *PLoS ONE* **2017**, 12(8), e0182490.
- Dekker, J.; Belmont, A. S.; Guttman, M.; Leshyk, V.; Lis, J. T.; Lomvardas, S.; Mirny, L. A.; O'Shea C. C.; Park, P. J.; Ren, B.; Ritland Politz, C. J.; Shendure, J., Zhong, S. & the 4D Nucleome Network (**Plewczyński, D.**), The 4D nucleome project, *Nature* **2017**, 549, 219–226.
- **Dawson, W. K.**; **Łazniewski, M.**; **Plewczynski, D.**; RNA structure interactions and ribonucleoprotein processes of the influenza A virus. *Briefings in Functional Genomics* **2017**, 1-13.
- **Łazniewski, M.**; **Dawson, W.**; **Szczepińska, T.**; **Plewczynski, D.**, The structural variability of the influenza A hemagglutinin receptor-binding site. *Briefings in Functional Genomics* **2017**, elx042.
- Tatjewski, M. W.; Kierczak, M.; **Plewczynski, D.**, Predicting Post-Translational Modifications from Local Sequence Fragments Using Machine Learning Algorithms: Overview and Best Practices, in: Prediction of Protein Secondary Structure. Methods in Molecular Biology 2017, 1484, 275-300, ISBN 978-1-4939-6404-8
- Al Bkhetan, Z.; **Plewczynski, D.**, Multi-levels 3D Chromatin Interactions Prediction Using Epigenomic Profiles. International Symposium on Methodologies for Intelligent Systems. Springer, 2017

PROJECTS

IMPLEMENTED

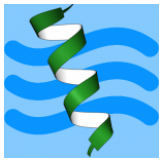
- iCell: information processing in living organisms. The role of three-dimensional structure and multi-scale properties in controlling the biological processes in a cell. – Prof. Dariusz Plewczyński, OPUS NCN, 2015-2019

- Action COST BM1408: A collaborative European network of C. elegans early-stage researchers and young principal investigators (GENiE) – Prof. Dariusz Plewczyński, COST BM1408, from 2015
- Genetic markers of breast cancer: the role of various membrane receptors in the modeling of a heterogeneous population of cancer cells – Prof. Dariusz Plewczyński, Polish-India personnel exchange MNiSW, 2017-2019
- Three-dimensional Human Genome structure at the population scale: computational algorithm and experimental validation for lymmphoblastoid cell lines of selected families from the 1000 Genomes Project – Prof. Dariusz Plewczyński, TEAM FNP, 2017-2020

ENDED

- Virtual High Throughput Screening (vHTS) derivation of a cross-immunity model for Influenza-A Virus Infections. – Prof. Dariusz Plewczyński, OPUS NCN, 2014-2017

SETNY
BIOMOLECULAR MODELLING GROUP



RESEARCH INTEREST

We are a theoretical group located at the Centre of New Technologies (CeNT UW), University of Warsaw, Poland.

We apply physical models to describe and simulate biological molecules in order to gain insight into the the principles governing their structure, dynamics and function (particularly the interplay between the molecules themselves and the aqueous environment they live in). To this end, we are studying conformation dependent, protein hydration free energies, investigate the role of buried water molecules, and develop new theoretical approaches to describe macromolecular hydration.

One important area of our interest are protein kinases. By using molecular dynamics simulations we analyze the role of specifically located, structural water molecules for allosteric effects occurring within kinase catalytic subunits. Here, we aim at answering the question of whether such water molecules are indeed important for kinase function and its regulation, or are just passive objects filling empty spaces left within a folded polypeptide chain.

Another active research topic is related to the structure and function of the influenza virus fusion peptide, with the aim of gaining atomistic insights into the process of virus fusion with the target cell membrane. In this respect we investigate how the interplay between intramolecular and solvation forces determines the behavior of the fusion peptide within lipid membranes, and how particular peptide conformations perturb lipid structure in order to initiate membrane fusion.

On the methods and software development side, we are currently establishing a web server for the analysis of protein hydration. Based on the structural model of a protein provided by the user, the server predicts the distribution of water molecules buried within the protein structure and their affinities to respective hydration sites. It also provides a spatial map of local hydration propensity for protein surface, helpful in predicting of interface regions involved in interaction with potential binding partners.

STAFF

- Piotr Setny, PhD
- Marta Wiśniewska, MSc
- Anita Dudek, MSc
- Marcin Sobieraj, MSc

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-modelowania-biomolekularnego/

PUBLICATIONS

- Worch, R.; Krupa, J.; Filipek, A,; Szymaniec, A.; **Setny, P.**, Three conserved C-terminal residues of influenza fusion peptide alter its behavior at the membrane interface. *Biochimica et Biophysica Acta (BBA) - General Subjects* **2017**, 1861(2), 97-105.
- **Setny, P.**; **Dudek, A.**, Explicit Solvent Hydration Benchmark for Proteins with Application to the PBSA Method, *Journal of Chemical Theory and Computation* **2017**, 13(6), 2762-2776.
- **Setny, P.**; Dzubiella, J., Principles for Tuning Hydrophobic Ligand–Receptor Binding Kinetics. *Journal of Chemical Theory and Computation* **2017**, 13(6), 3012-3019.

PROJECTS

IMPLEMENTED

- Hydratation effects in protein kinases – Setny, Piotr, PhD, SONATA NCN, 2014-2018
- Hydratation effects in proteins: from bulk hydratation to localised water molecules - Setny Piotr, PhD, Installation Grants EMBO, 2015-2017

SUŁKOWSKA INTERDISCIPLINARY LABORATORY OF BIOLOGICAL SYSTEMS MODELING

RESEARCH INTEREST

- Development of multi dimensional models for the analysis of the energy landscape of proteins with complex structures, such as proteins with non-trivial topology.
- Development of analytical methods such as direct coupling analysis (DCA), and bioinformatics tools for analysis of amino acid evolution and their application to prediction of protein structures (including membrane proteins) and alternative protein folding mechanisms.
- Development of analysis methods regarding the mechanical properties of proteins, and mechanical degradation and translation across membranes.
- Development and application of mathematical knot theory to determine the topology of an open chain and its application to proteins and nucleic acids.

STAFF

- Joanna Sułkowska, PhD
- Rafał Jakubowski, PhD
- Vasilina Zayats, PhD
- Wanda Niemyska, PhD
- Szymon Niewieczerzał, PhD
- Paweł Dąbrowski-Tumański, MSc
- Agata Perlińska, MSc
- Aleksandra Jarmolińska, MSc
- Paweł Pasznik, MSc
- Agata Bernat, MSc
- Aleksandra Gierut
- Mateusz Skłowoski
- Jacek Kędzierski

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/interdyscyplinarne-laboratorium-modelowania-ukladow-biologicznych/

PUBLICATIONS

- Dabrowski-Tumanski, P. A.; **Jarmolinska, A.**; **Niemyska, W.**; Rawdon, E. J.; Millett, K. C.; **Sułkowska, J.I**, LinkProt: database collecting information about biological links. *Nucleic Acids Research* **2017**, 45(D1), D243-D249.
- Dąbrowski-Tumański, P. A.; **Sułkowska, J. I.**, Topological knots and links in proteins. *Proceedings of the National Academy of Sciences* **2017**, 114 (13), 3415–3420.
- **Niewieczerzał, Sz**.; **Sulkowska, J. I.**, Knotting and unknotting proteins in the chaperonin cage: effects of the excluded volume, *PLOS ONE* **2017**, 12(5), e0176744.
- **Gierut, A.**; **Niemyska, W.**; Dąbrowski-Tumański, P.; Sułkowski, P.; **Sułkowska, J. I.**, PyLasso: a PyMOL plugin to identify lassos. *Bioinformatics* **2017**, *33* (23), 3819-3821.
- Frischauf, I.; Litviňuková, M.; Schober, R.; **Zayats, V**.; Svobodová, B.; Bonhenry, D.; Lunz, V.; Cappello, S.; Tociu, L.; Reha, D.; Stallinger, A.; Hochreiter, A.; Pammer, T.; Butorac, C.; Muik, M.; Bogeski, I.; Ettrich, R. H.; Romanin, Ch.; Schindl, R., Transmembrane helix connectivity in Orai1 controls two gates for calcium-dependent transcription. *Science Signaling* **2017**, *10* (507), eaao0358.
- Hou, Y. M.; Matsubara, R.; Takase, R.; Masuda, I.; Sułkowska, J., TrmD: A Methyl Transferase for tRNA Methylation With m1 G37. *The National Center for Biotechnology Information* **2017**, 41, 89-115, ISBN: 9780128117774
- **Dąbrowski-Tumański, P.**; **Sułkowska, J. I.**, To Tie or Not to Tie? That Is the Question. *Polymers* **2017**, *9* (9), 454.

PROJECTS

IMPLEMENTED

- Influence of knotted structure on the function of proteins – Sułkowska, Joanna, PhD, SONATA BIS NCN, 2013-2018
- Young Investigator Programme – Sułkowska, Joanna, PhD, Installation Grants EMBO, 2014-2018
- Knotted proteins – study of new structures and solving their riddles – Sułkowska, Joanna, PhD, IDEAS PLUS MNiSW, 2016-2019
- Sułkowska, Joanna, PhD, Small Grant Program EMBO

SZULKIN
WILD URBAN EVOLUTION AND ECOLOGY LAB

RESEARCH INTEREST

We are based at the Centre of New Technologies at the University of Warsaw in Poland. Our research focuses on the evolution and ecology of wild vertebrates in the Anthropocene – a time period characterized by the domination of humans and their significant, global impact on the Earth's ecosystems. In particular, we aim to infer patterns and processes related to the natural variation in wild organisms living in a gradient of environments – ideally, this includes primeval and secondary forests as well as sub-urban green areas and highly urbanized spaces, such as cities.

Until recently, virtually all long-term studies of vertebrates conducted in the wild and used as a cornerstone in evolutionary ecology research were initiated in natural environments with little or no human interference. Currently, urban areas cover *c.* 0.5% of the planet's land area, and are predicted to expand severalfold between 2000 and 2050. As urban space is an environment with conspicuously altered ecological dynamics (when compared to original natural habitats), more insight into the evolutionary ecology of free-living animals in urban environments is needed. Urbanization should also be viewed as a fascinating opportunity to study patterns of selection and rates of adaptation to novel environments.

To understand the footprint of cities on the phenotype and genotype of wild passerine birds, the Wild Urban Evolution & Ecology Lab is starting a new, long-term study of great tits *Parus major* and blue tits *Cyanistes caeruleus* in a gradient of urbanization.

STAFF

- Prof. Marta Szulkin, PhD
- Joanna Sudyka, PhD
- Marion Chatelain, PhD
- Lucyna Wojas, PhD
- Michaela Corsini, MSc
- Irene DiLecce, MSc
- Marta Celej

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-ewolucji-i-ekologii-w-miescie/

PUBLICATIONS

- **Corsini, M.**; Dubiec, A.; Marrot, P.; **Szulkin, M.**, Humans and Tits in the City: Quantifying the Effects of Human Presence on Great Tit and Blue Tit Reproductive Trait Variation. *Frontiers in Ecology and Evolution* **2017**, 5, 82, Open Access
- Perrier, Ch.; Lozano del Campo, A.; **Szulkin, M.**; Demeyrier, V.; Gregoire, A.; Charmantier, A., Great tits and the city: Distribution of genomic diversity and gene–environment associations along an urbanization gradient. *Evolutionary Applications* **2017**.

PROJECTS

IMPLEMENTED

- Trace metal effects on wild great tit Parus major oxidative stress and fitness in a gradient of urbanisation - Chatelain Marion, Bernadette, PhD, POLONEZ NCN, 2016-2018
- Ecological genetics of the great tit in a new, long-term population study set along a rural-urban environmental gradient – Prof. Marta Szulkin, SONATA BIS NCN, 2015-2020
- Tit extra-pair mating in the Anthropocene: from life in a primeval forest to life in the city – Prof. Marta Szulkin, OPUS NCN, 2017-2019

AWARDED

- Impact of food availability on avian reproduction in a gradient of urbanisation – Corsini, Michaela, MSc, PRELUDIUM NCN, 2018-2021

TOMZA
LABORATORY OF QUANTUM MOLECULAR SYSTEMS

RESEARCH INTEREST

We are an interdisciplinary group of theoretical chemists and physicists working on the intersection of theoretical atomic, molecular, and optical (AMO) physics and quantum chemistry. We are primarily interested in engineering novel controllable quantum molecular systems for both fundamental research and upcoming quantum technologies.

Research topics investigated in our group include:

- Cold hybrid ion-neutral systems.
- Formation, dynamics, and control of ultracold molecules.
- Ultracold controlled collisions and chemical reactions.
- Magnetically tunable Feshbach resonances in ultracold gases.
- Quantum dynamics and simulations with quantum few-body systems.
- Matter-light interactions and photochemistry.

We use and develop state-of-the-art ab initio electronic structure methods of quantum chemistry as well as computational approaches of atomic, molecular, and optical physics. We are also very open to and enjoy close collaboration with experimental groups.

At the end of the year, the laboratory was moved to the University of Warsaw, Faculty of Physics, because the group leader received a permanent position there.

STAFF

- Michał Tomza, PhD
- Mateusz Lisaj, PhD
- Anna Dawid, MSc
- Michał Śmiałkowski, MSc
- Paweł Wójcik
- Klaudia Zaremba-Kopczyk
- Jacek Gębala
- Jan Kwapisz
- Joanna Dziekańska

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-kwantowych-ukladow-molekularnych/

PUBLICATIONS:

- **Tomza, M.**, Cold interactions and chemical reactions of linear polyatomic anions with alkali-metal and alkaline-earth-metal atoms. *Physical Chemistry Chemical Physics* **2017**, 19, 16512-16523.
- Joger, J.; Furst, H.; Ewald, N.; Feldker, T.; **Tomza, M.**; Gerritsma, R., Observation of collisions between cold Li atoms and Yb+ ions. *Physical Review A* **2017**, 96: 030703(R).

PROJECTS

IMPLEMENTED

- Ultracold quantum mixtures of ions with atoms, molecules, and Rydberg atoms: novel hybrid systems and applications – Tomza, Michał, PhD, OPUS NCN, 2017-2020
- Quantum simulations, computations, and sensing with novel quantum molecular systems – Tomza, Michał, PhD, HOMING FNP, 2017-2019
- Cooling and dynamics of polyatomic molecular ions immersed in ultracold atomic gases – Tomza, Michał, PhD, SONATA NCN, 2016-2019

TRYLSKA
BIOMOLECULAR MACHINES LABORATORY

RESEARCH INTEREST

Our research interests involve studying the function, dynamics, and physico-chemical properties of nanoscale assemblies to understand their activities in the cell. The main object of our studies is the ribosome – the macromolecular complex responsible for protein synthesis.

The focus of our research is to extend, apply and experimentally verify simulation techniques to study the association of ligands with ribosomal RNA. The goal is to explore ribosomal internal motions and electrostatic properties as well as the thermodynamics and kinetics of the binding of antibiotics, inhibiting the bacterial ribosome.

Research areas include:

- physicochemical properties of macromolecular complexes
- design of ligands targeting the bacterial ribosome
- thermodynamics of interactions between modified oligonucleotides
- coarse-grained models for proteins and nucleic acids
- molecular dynamics simulations of RNA systems
- academic software development for molecular modeling and simulations

We combine theoretical approaches (computational simulations and molecular modeling) with experimental biophysical measurements (absorbance, fluorescence, circular dichroism spectroscopy, isothermal titration calorimetry).

STAFF

- Prof. Joanna Trylska, PhD
- Ksenia Maximova, PhD
- Marta Dudek, PhD
- Joanna Panecka-Hofman, PhD
- Agnieszka Markowska-Zagrajek, MSc
- Marcin Równicki, MSc
- Tomasz Pieńko, MSc
- Joanna Miszkiewicz, MSc
- Natalia Ostrowska, MSc
- Jakub Wojtczak
- Paulina Jońca

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-maszyn-biomolekularnych/

PUBLICATIONS

- **Równicki, M.**; **Wojciechowska, M.**; Wierzba, A. J.; Czarnecki, J.; Bartosik, D.; Gryko, D.; **Trylska, J. D.**, Vitamin B12 as a carrier of peptide nucleic acid (PNA) into bacterial cells. *Scientific Reports* **2017**, 7, 7644.
- **Kulik, M.**; **Markowska-Zagrajek, A.**; **Wojciechowska, M.**; **Grzela, R.**; **Wituła, T.**; **Trylska, J.**, Helix 69 of Escherichia coli 23S ribosomal RNA as a peptide nucleic acid target. *Biochimie* **2017**, 138, 32-42.
- **Pieńko, T.**; Wierzba, A. J.; **Wojciechowska, M.**; Gryko, D.; **Trylska, J.**, Conformational dynamics of cyanocobalamin and its conjugates with peptide nucleic acids. *The Journal of Physical Chemistry B* **2017**, 121 (14), 2968−2979.
- **Dudek, M.**; **Trylska, J. D.**, Molecular Dynamics Simulations of l-RNA Involving Homo- and Heterochiral Complexes. *Journal of Chemical Theory and Computation* **2017**, 13 (3), 1244−1253.
- **Thoduka, S.**; Zaleski, P. A.; **Dąbrowska, Z.**; **Równicki, M.**; Stróżecka, J.; **Górska, A.**; Olejniczak, M.; **Trylska, J.**, Analysis of ribosomal inter-subunit sites as targets for complementary oligonucleotides. *Biopolymers* 2017, 107(4), 23004.
- **Dudek, M.**; **Trylska, J.**, Molecular Dynamics Simulations of l-RNA Involving Homo- and Heterochiral Complexes. *Journal of Chemical Theory and Computation* **2017**, 13 (3), 1244−1253.

PROJECTS

IMPLEMENTED

- Exploring the Mutual Interactions between RNA Enantiomers – Dudek, Marta, MD PhD, PRELUDIUM NCN, 2014-2018
- Vitamin B12 as a delivery vehicle for antibacterial aligonucleotide analogues – Prof. Joanna Trylska, SYMFONIA NCN, 2014-2019

ENDED

- Mem Thera Targeting neutrophil peripheral membrane proteins: novel therapeutic avenues in chronic inflammatory diseases – Prof. Joanna Trylska, CORE NCBiR, 2013-2017
- Interactions of peptide nucleic acids with biologically relevant RNA – Prof. Joanna Trylska, OPUS NCN, 2013-2017
- Interaction of synthetic oligomers with ribosomal RNA – Jasiński, Maciej, PhD, ETIUDA NCN, 2016-2017

AWARDED

- Bacterial toxin-antitoxin systems as novel targets for the development of potential antibiotics – Równicki, Marcin, MSc, PRELUDIUM NCN, 2018-2020

PANECKA-HOFMAN, INDEPENDENT PROJECT

- Computational investigation of the dynamic and physico-chemical properties of pteridine reductase 1 of human trypanosomatid parasites, and its interactions with substrates and drugs. – Panecka-Hofman, Joanna, PhD, SONATA NCN, 2017-2019

PUBLICATIONS:

- Jedwabny, W.; **Panecka-Hofman, J.**; Dyguda-Kazimierowicz, E.; Wade, R. C.; Sokalski, W. A., Application of a simple quantum chemical approach to ligand fragment scoring for Trypanosoma brucei pteridine reductase 1 inhibition. *Journal of Computer-Aided Molecular Design* **2017**.
- **Panecka-Hofman, J.**; Pöhner, I.; Spyrakis, F.; Zeppelin, T.; Di Pisa, F.; Dello Iacono, L.; Bonucci, A.; Quotadamo, A.; Venturelli, A.; Mangani, S.; Costi, M. P.; Wade, R., Comparative mapping of on-targets and off-targets for the discovery of anti-trypanosomatid folate pathway inhibitors. *Biochimica et Biophysica Acta (BBA) - General Subjects* **2017**, *1861* (12), 3215-3230.

TRZASKOWSKI
CHEMICAL AND BIOLOGICAL SYSTEMS SIMULATION LABORATORY

RESEARCH INTEREST

The aim of the LSSCB (Chemical and Biological Systems Simulation Lab) is to develop theoretical and computational methods (ranging from quantum chemistry to molecular mechanics/dynamics), and apply them in order to describe chemical, physical and biological phenomena. The particular focus of the lab is the prediction of protein structures, nanotechnology, homogeneous catalysis and physical organic chemistry. We are interested both in basic research and its application in helping to solve real industrial problems. The LSSCB is affiliated with the Centre of New Technologies, University of Warsaw.

Currently our main focus is the olefin metathesis reaction, which involves the recombination of the groups attached to carbon-carbon double bonds. This reaction is accomplished by the use of metal catalysts, the first of which was synthesized and well-defined for this purpose by Richard R. Schrock and co-workers in 1980. Our goal is to explore new analogues of N-heterocyclic carbenes via molecular design and computational modeling. In this topic we are collaborating with experts in chemical synthesis and structural analysis. Our research will contribute to a better understanding of how structural changes in carbenes affect the reactivity of Ruthenium-based catalysts of olefin metathesis. The new analogues of N-heterocyclic carbenes will offer new challenges for synthetic chemists, increase our knowledge about them and promise, in the future, to create faster and more efficient catalysts.

STAFF

- Bartosz Trzaskowski, PhD
- Silvio Osella, PhD
- Katarzyna Młodzikowska, MSc
- Alicja Kowalska
- Angelika Janaszkiewicz

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-symulacji-systemow-chemicznych-i-biologicznych/

PUBLICATIONS

- **Trzaskowski, B.**; Goddard, W. A.; Grela, K., Faster initiating olefin metathesis catalysts from introducing double bonds into cyclopropyl, cyclobutyl and cyclopentyl derivatives of Hoveyda-Grubbs precatalysts. *Journal of Molecular Catalysis A* **2017**, 433, 313-320.
- **Trzaskowski, B.**; Ostrowska, K., A computational study of structures and catalytic activities of Hoveyda-Grubbs analogues bearing coumarin or isopropoxycoumarin moiety. *Catalysis Communications* **2017**, 91, 43-47.
- Żyżyńska-Granica, B.; **Trzaskowski, B.**; **Niewieczerzał, Sz.**; Filipek, S.; Zegrocka-Stendel, O.; Dutkiewicz, M.; Krzeczyński, P.; Kowalewska, M.; Koziak, K., Pharmacophore guided discovery of small-molecule interleukin 15 inhibitors. *European Journal of Medicinal Chemistry* **2017**, 136, 543-547.
- Ostrowska, K.; Grzeszczuk, D.; Głuch-Lutwin, M.; Gryboś, A.; Siwek, A.; Dobrzycki, Ł.; **Trzaskowski, B.**, Development of selective agents targeting serotonin 5HT1A receptor with subnanomolar activities based on a coumarin core. *MedChemComm* **2017**, 8, 1690-1696.
- Gawin, R.; Tracz, A.; Chwalba, M.; Kozakiewicz, A.; **Trzaskowski, B.**; Skowerski, K., Cyclic Alkyl Amino Carbene Ruthenium Complexes – Unprecedented Efficiency in Macrocyclization and Acrylonitrile Cross Metathesis. *ACS Catalysis* **2017**, 7 (8), 5443–5449.
- Grudzień, K.; **Trzaskowski, B.**; Smoleń, M.; Gajda, R.; Woźniak, R.; Grela, K., Hoveyda-Grubbs catalyst analogues bearing derivatives of N-phenylpyrrol in carbene ligand - structure, stability, activity and unique ruthenium-phenyl interactions. *Dalton Transactions* **2017**, *46* (35), 11790-11799.
-

PROJECTS

IMPLEMENTED

- Towards an efficient design of biosensors: an investigation of the interplay between light harvesting proteins and graphene – Osella, Silvio, PhD, POLONEZ NCN, 2017-2018
- Anionic, cationic and mesoionic analogues of N-heterocyclic carbenes in homogenous catalysis – Trzaskowski, Bartosz, PhD, SONATA BIS NCN, 2017-2021

AWARDED

- Anionic carbenes and Borylanions: Tuning the properties of ruthenium metal complexes in olefin metathesis – Trzaskowski, Bartosz, PhD, BEETHOVEN NCN, 2018-2021

WĘGLEŃSKI LABORATORY OF PALEOGENETICS AND CONSERVATION GENETICS

RESEARCH INTEREST

Ancient DNA is a powerful tool allowing for a reconstruction of evolutionary processes, which occurred thousands of years ago. The extraction of DNA from various kinds of remains, coupled with high-throughput sequencing, radiocarbon dating and isotopic analyses, enables the investigation of ancient populations and tracking the way they change over time and space. In our laboratory we use state of the art techniques to answer a wide range of intriguing questions pertaining to biology, paleontology, anthropology and archaeology.

Our research is currently focused on the two main topics. The first is the reconstruction of evolutionary histories of Late Pleistocene mammal species. We examine the population dynamics and migration patterns appearing as a reaction to past climatic changes. The knowledge gained in this way could help predict many species' responses to future climatic changes. We were studying the Pleistocene populations of red deer, cave bear and lemmings. In cooperation with the fishermen community of Władysławowo, we have performed the genetic analysis of endangered Baltic population of sturgeon. The aim of this study was, among others, to find the genetically closest sturgeon population, which could serve as a source of breeding material for rebuilding the sturgeon population in the Puck Bay. Such population was found in the St. John River in Canada. Currently, we are working on phylogenetics of several small mammal species from Eurasia, such as the common vole (*Microtus arvalis*), the field vole (*M. agrestis*), the narrow-headed vole (*M. gregalis*), the bank vole (*Clethrionomys glareolus*), and the root vole (*M. oeconomus).*

Our second group of projects encompasses paleogenomics of pre-Columbian populations from the South America. The genetic analyzes were performed on populations representing the two Andean civilizations – Tiwanaku and Inka.

STAFF

- Prof. Piotr Węgleński, PhD
- Mateusz Baca, PhD
- Danijela Popović, PhD
- Joanna Gawlik, MSc Eng

WEB PAGE

http://cent.uw.edu.pl/en/laboratories/laboratorium-paleogenetyki-i-genetyki-konserwatorskiej/

PUBLICATIONS

- **Baca, M.**; Nadachowski, A.; Lipiecki, G.; Mackiewicz, P.; Marciszak, A.; **Popović, D.**; Socha, P.; Stefaniak, K.; Wojtal, P., Impact of climatic changes in the Late Pleistocene on migrations and extinctions of mammals in Europe: four case studies. *Geological Quarterly* **2017**, 61 (2), 291–304.
- Panagiotopoulou, H.; Austin, J. D.; Zalewska, K.; Gonciarz, M.; Czarnogórska, K.; Gawor, J.; **Węgleński, P.**; **Popović, D.**, Microsatellite Mutation Rate in Atlantic Sturgeon (Acipenser oxyrinchus). *Journal of Heredity*, **2017**, 108, 6: 686–692.
- Sikora, B.; Kowalik, P.; Mikulski, J.; Fronc, K.; Kamińska, I.; Szewczyk, M.; Konopka, A.; Zajdel, K.; Minikayev, R.; Sobczak, K.; Zaleszczyk, W.; Borodziuk, A.; Rybusiński, J.; Szczytko, J.; Sienkiewicz, A.; Wojciechowski, T.; Stępień, P. P.; Frontczak-Baniewicz, M.; Łapiński, M.; Wilczyński, I. G.; Paszkowicz, W.; Twardowski, A.; Elbaum, D., Mammalian cell defence mechanisms against the cytotoxicity of NaYF4:(Er,Yb,Gd) nanoparticles. *Nanoscale* **2017**, *9* (37), 14259-14271.

PROJECTS

IMPLEMENTED

- Molecular functions of the human SUV3 gene – Prof. Piotr Stępień, OPUS NCN, 2014-2018
- Evaluation of DNA preservation in human remains from Maucallacta site (Peru) and attempt to reconstruct social structure of its pre-Columbian population – Popovic, Danijela, PhD, MINIATURA NCN, 2017-2018
- Late Pleistocene and Holocene evolutionary histories of two vole species. Reconstruction of populations' responses to climate change using ancient DNA and radiocarbon dating. – Baca, Mateusz, PhD, SONATA NCN, 2016-2019
- The new role of KAEA, the highly conserved subunit of the KEOPS/EKC complex, in the model filamentous fungus Aspergillus nidulans. – Gawlik, Joanna, MSc Eng, PRELUDIUM NCN, 2017-2019

AWARDED

- Impact of climate and environmental changes on population dynamics, migration and extinction events of selected rodent species in Late Pleistocene and Holocene. – Baca, Mateusz, PhD, OPUS NCN together with the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, 2018-2021

ENDED

- SUDPRO – the global regulatory protein – Prof. Piotr Węgleński, OPUS NCN, 2013-2017

WIŚNIEWSKA
LABORATORY OF MOLECULAR NEUROBIOLOGY

RESEARCH INTEREST

Neurons connect with one another to form electrical circuits that are further grouped into systems, with a collection of these systems finally forming the brain. Among these systems are loops between the thalamus and cortex, which play a key role in the processing of sensory information, regulating the level of awareness, directing attention and producing a behavioural response. Because thalamic dysfunctions are observed in the pathophysiology of mental disorders, such as schizophrenia and autism, understanding how neurons are specified and maturate in the thalamus may be relevant to understanding the aetiology of these psychiatric conditions.

The Laboratory of Molecular Neurobiology explores molecular mechanisms regulating thalamic identity and function. We are interested in how the differentiation of thalamic neurons and thalamic axon growth and guiding are controlled by intrinsic and extrinsic factors, focusing on the role of the LEF1/TCF transcription factors. We are also studying the effects of developmental impairments and the maintenance of thalamocortical circuits on the brain and behaviour. In addition, we are investigating the involvement of LEF1/TCF in the differentiation of glial cells. We work with primary neuronal and glial cultures, organotypic cultures and in vivo models, and our methodology include a variety of molecular biology, biochemistry and cell biology techniques, gene modifications, as well as bioinformatics.

STAFF

- Prof. Marta Wiśniewska, PhD
- Kamil Koziński, PhD
- Tomasz Zajkowski, PhD
- Łukasz Szewczyk, PhD
- Chaitali Chakraborty, PhD
- Andrzej Nagalski, PhD
- Nikola Brożko, MSc Eng
- Marcin Lipiec, MSc
- Marta Jankowska
- Kacper Posyniak

PUBLICATIONS

- **Szewczyk, Ł.**; **Brożko, N.**; Nagalski, A.; Röckle, I.; Werneburg, S.; Hildebrandt, H.; **Wisniewska, M. B.**; Kuznicki, J., ST8SIA2 promotes oligodendrocyte differentiation and the integrity of myelin and axons. *Glia* **2017**, 65(1), 34-49.
- Misztal, K.; **Brozko, N.**; **Nagalski, A.**; Szewczyk, Ł.; Krolak, M.; **Brzozowska, K.**; Kuznicki, J.; **Wisniewska, M. B.**, TCF7L2 mediates the cellular and behavioral response to chronic lithium treatment in animal models. *Neuropharmacology* **2017**, 113(Pt A), 490-501.

PROJECTS

IMPLEMENTED

- Metabolic and behavioral characterization of mice with conditional knockout of Tcf7l2, a risk gene for diabetes and schizophrenia – Nagalski, Andrzej, PhD, OPUS NCN, 2016-2019
- Transcription factors and afferent connections in shaping molecular diversity of thalamic neurons - Prof. Marta Wiśniewska, OPUS NCN, 2016-2019
- The involvement of LEF1/TCF transcription factors in astrogenesis – Szewczyk, Łukasz, PhD, SONATINA NCN, 2017-2019

AWARDED

- The role of prions in the early evolution of organisms – Zajkowski, Tomasz, PhD, Mobilność Plus MNISW, 2018-2020
- Changes in transcription factor isoforms as a mechanism to switch gene expression during the differentiation of thalamic neurons – Prof. Marta Wiśniewska, OPUS NCN, 2018-2021

ENDED

- Specification of thalamic neurons in zebrafish (Danio rerio) morphants of lef1 and tcf7l2 – Brożko, Nikola, MSc, PRELUDIUM NCN, 2014-2017
- Analysis of oligodendrocyte differentiation and maturation in St8sia2 knockout mice – a model of polysialylation deficiency – Szewczyk, Łukasz, PhD, PRELUDIUM NCN, 2014-2017

ŻELAZOWSKI LABORATORY OF REMOTE SENSING AND ENVIRONMENTAL MODELLING

RESEARCH INTEREST

Our lab studies the environment through analyses of satellite data and their integration with models of biological, physical and chemical processes. Our interests include various spatial scales: from the whole Earth System to individual agricultural fields.

Currently we are working on the following projects:

- The extent of the eastern Andean tree line over the last 30 years – a global analysis in the context of Amazonia's climate adaptation. 2015 – 2019, NCN (Sonata)
- Compiling a global set of local climate change characteristics, based on the database of Global Circulation Models' runs, CMIP5 – a pattern-scaling dataset for the weather and climate simulator IMOGEN (Integrated Model Of Global Effects of climatic aNomalies)
- "Separating MycOtoxin-contaminated Wheat grains using Precision Farming technologies" – a project conducted within the EIT FOOD consortium, funded by the European Institute for Innovation and Technology (https://eit.europa.eu/eit-community/eit-food)
- Estimating spatial variability in crop field soil moisture using integrated observations from radar and optical Sentinel satellites – a project funded by the University Technology Transfer Centre
- Satellite data analysis in support of evolutionary biology research (in collaboration with the Wild Urban Evolution and Ecology Lab, http://leem.cent.uw.edu.pl/)
- Technical support for the SatAgro project (www.satagro.pl; an internet service for ongoing satellite monitoring of individual agricultural fields)
- LandCor – software for atmospheric correction of optical satellite data (Landsat/Sentinel 2)

STAFF

- Przemysław Żelazowski, PhD
- Krzysztof Stopa
- Stefan Józefowicz, MSc

PROJECTS

IMPLEMENTED

- The extent of the eastern Andean tree line over the last 30 years – a global analysis in the context of Amazonia's climate adaptation. – Żelazowski, Przemysław, PhD, SONATA NCN, 2015-2019

AWARDED

- Separating MycOtoxin-contaminated Wheat grains using Precision Farming technologies - Żelazowski Przemysław, PhD, EIT Food EIT, 2018

RESEARCH AND DEVELOPMENT

OUR TEAM AT A GLANCE

In 2017, CeNT UW hosted 32 research groups (an increase of five in comparison to the previous year). The group headed by Professor Agnieszka Chacińska was also set up in 2017.

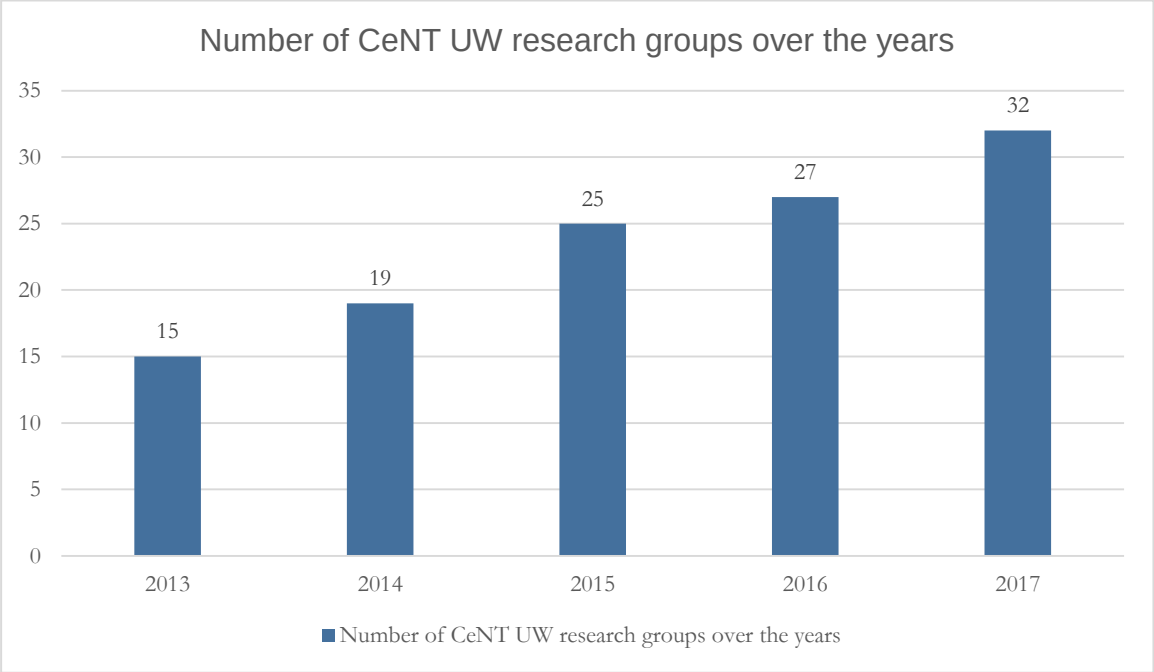


FIGURE 1. INCREASE IN THE NUMBER OF RESEARCH GROUPS OVER TIME

There was a significant increase in the number of employees in 2017 thanks to the the intensive development of existing research teams and the relocation of Prof. Chacińska's research team from the International Institute of Molecular and Cell Biology in Warsaw to CeNT UW. The new scientific positions are filled by scientists hired with external funds obtained by Group Leaders.

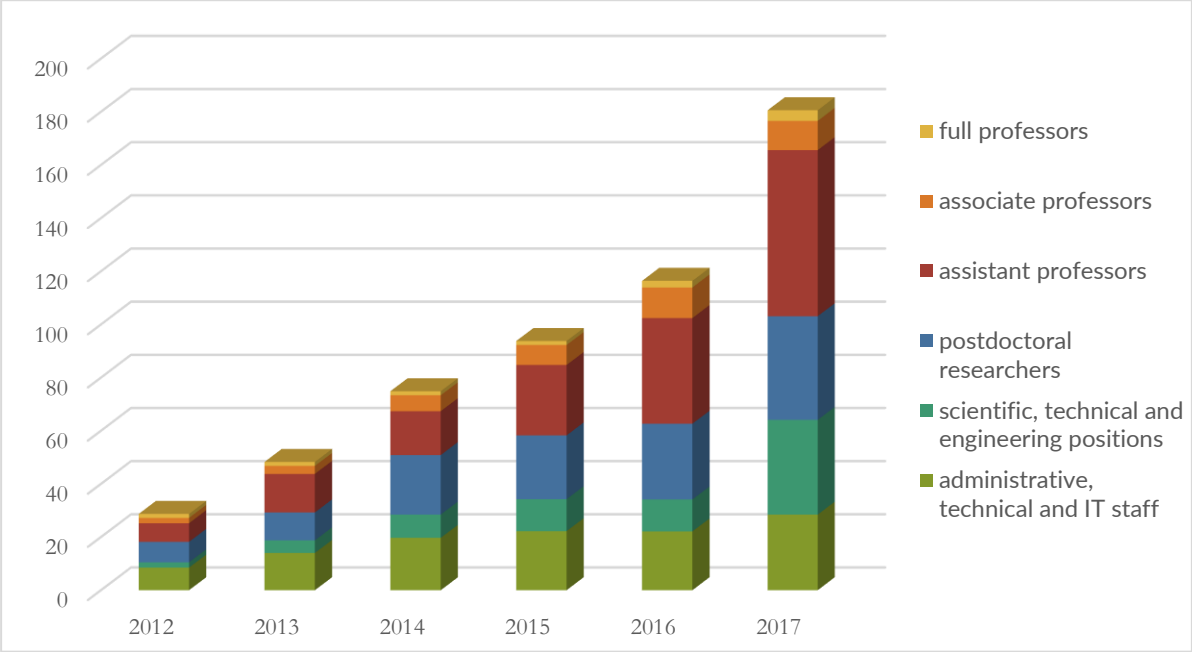


FIGURE 2. GROWTH IN THE NUMBER OF EMPLOYEES OVER THE YEARS

It is expected that in 2018 the employment dynamics will remain at the high level reached in 2017, due to the start of the ReMedy project, which entails the creation of new research groups.

STAFF DEVELOPMENT

SCIENTIFIC TITLES OBTAINED

NAME	TITLE OBTAINED	DATE OF OBTAINING DEGREE	INSTITUTION
PROF. JOANNA TRYLSKA	PROFESSOR	2017-09-15	UNIVERSITY OF WARSAW, FACULTY OF PHYSICS
DR. TOMASZ ANTOSIEWICZ	HABILITATION	2017-09-18	UNIVERSITY OF WARSAW, FACULTY OF PHYSICS
DR. PAWEŁ HOREGLAD	HABILITATION	2017-09-06	UNIVERSITY OF WARSAW, FACULTY OF CHEMISTRY

DR. KRZYSZTOF KAZIMIERCZUK	HABILITATION	2017-02-08	UNIVERSITY OF WARSAW, FACULTY OF CHEMISTRY
DR. BARTOSZ TRZASKOWSKI	HABILITATION	2017-06-28	UNIVERSITY OF WARSAW, FACULTY OF CHEMISTRY

PRIME MINISTER AWARD FOR SCIENTIFIC ACHIEVEMENTS RECEIVED, HABILITATION GRANTED

- Prof. Krzysztof Ginalski

THE UNIVERSITY OF WARSAW RECTOR'S AWARD RECIPIENTS

- Dr. Joanna Sułkowska – Individual award
- Prof. Agnieszka Chacińska – Individual award

AWARD FOR SCIENTIFIC STAFF ACHIEVING OUTSTANDING RESULTS IN RESEARCH – RECIPIENTS

- Prof. Wojciech Grochala
- Prof. Krzysztof Ginalski
- Prof. Jacek Jemielity
- Prof. Dariusz Plewczyński
- Dr. Krzysztof Kazimierczuk

'MOBILITY PLUS' PROGRAM

As part of the 'Mobility Plus' program, Dr. Karol Fijałkowski participates in research conducted at the University of Cambridge (United Kingdom), under the supervision of Professor Erwin Reisner. Karol is working on a project entitled *'Renewable generation of ammonia from atmospheric nitrogen*', gaining knowledge and experience in one of the best research centers in the world.

MINISTERIAL STIPENDS FOR OUTSTANDING YOUNG SCIENTISTS

- Prof. Marta Szulkin

- Dr. Marcin Kałek
- Dr. Katarzyna Chojnacka

FOUNDATION FOR POLISH SCIENCE STIPENDS FOR YOUNG, TALENTED RESEARCHERS

- Dr. Michał Turek

STUDENTS AND EDUCATION

CeNT UW's didactic activities include: educating students and doctoral candidates through their involvement in scientific research and organizing postdoctoral internships, as well as offering regular classes for faculties of the university or general university courses.

By participating in research projects carried out at CeNT UW, under the guidance of experienced researchers, students gain competence in various research techniques, the operation of measuring devices, result analysis, proper research planning etc. All of these skills are necessary for their future professional careers.

CeNT UW teaching activities (conducting bachelor's, master's or doctoral studies) are possible thanks to cooperation with the following units:

- the Faculty of Biology, University of Warsaw,
- the Faculty of Physics, University of Warsaw,
- the Faculty of Chemistry, University of Warsaw – cooperation coordinated by Dr. Bartosz Trzaskowski as the Plenipotentiary for Studies
- the Institute of Biochemistry and Biophysics, Polish Academy of Sciences,
- the Nencki Institute of Experimental Biology, Polish Academy of Sciences.

The work of CeNT UW students has been acknowledged by a number of prestigious scholarships, such as:

- the **MNiSW scholarships** for students' outstanding achievements granted to:
  - the Laboratory of Bioorganic Chemistry: Adam Mamot, Olga Perzanowska, Mateusz Kozarski,
  - the Interdisciplinary Laboratory of Biological Systems Modelling: Paweł Dąbrowski-Tumański, Aleksandra Gierut,
  - the Laboratory of Quantum Molecular Systems: Paweł Wójcik, Klaudia Zaremba-Kopczyk,
  - the Laboratory of Technology of Novel Functional Materials: Marcin Witkowski,
  - the Organometallic Chemistry Laboratory: Rafał Zaremba.
- **START scholarships funded by the Foundation for Polish Science**:

  - the Quantum Technologies Laboratory: Michał Jachura,
  - the Interdisciplinary Laboratory of Biological Systems Modelling: Paweł Dąbrowski-Tumański.
- Recognition of the Polish Bioinformatics Society for her master's thesis: Anita Dudek

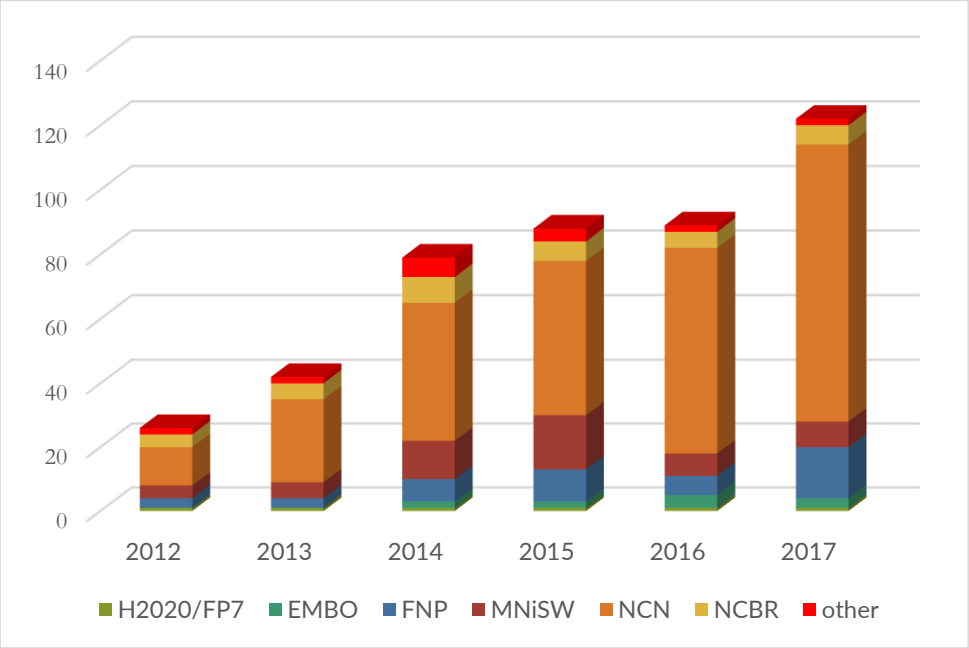
CeNT UW also supports other academic units by organizing additional classes. In the first half of 2017, an entrepreneurship study was organized in CeNT UW lecture rooms, in collaboration with the Faculty of Management. The aim of this cooperation was to offer students of the University of Warsaw classes that would teach them to become active employers in the job market. The course included lectures on business plans, entrepreneurship, building the market position of a small company, the programs and instruments supporting business operations, accounting and finance of a small business, and the legal aspects of starting and running your own business.
CeNT UW lecture rooms were also used to organize classes in the field of Cognitive Science. These are full-time interdisciplinary studies combining such disciplines as: psychology, IT, philosophy or neurology. The following classes are being held at CeNT UW: Introduction to Mathematics, How the Brain Works, Linguistics, The Philosophy of Language, Statistics, Ethical Problems in Cognitive Science, Experimental Psychology, Design and Programming, EEG Laboratory, and The Basics of Application Programming.

SCIENTIFIC GRANTS

Currently at CeNT UW, over 120 research projects are carried out by scientists at different stages of their scientific careers. Many of these projects are conducted in cooperation with entities from Poland and other countries, with financing from both national and foreign institutions.
Funding agencies provided over 24 million PLN for the implementation of projects. The status of the projects as of December 2017 was as follows:

- 15 projects were completed,
- 33 new projects were started,
- 11 projects were transferred from other entities to CeNT UW,
- 2 projects were transferred from CeNT UW to the Faculty of Physics UW,
- 12 new projects were approved for financing – their implementation will begin in 2018

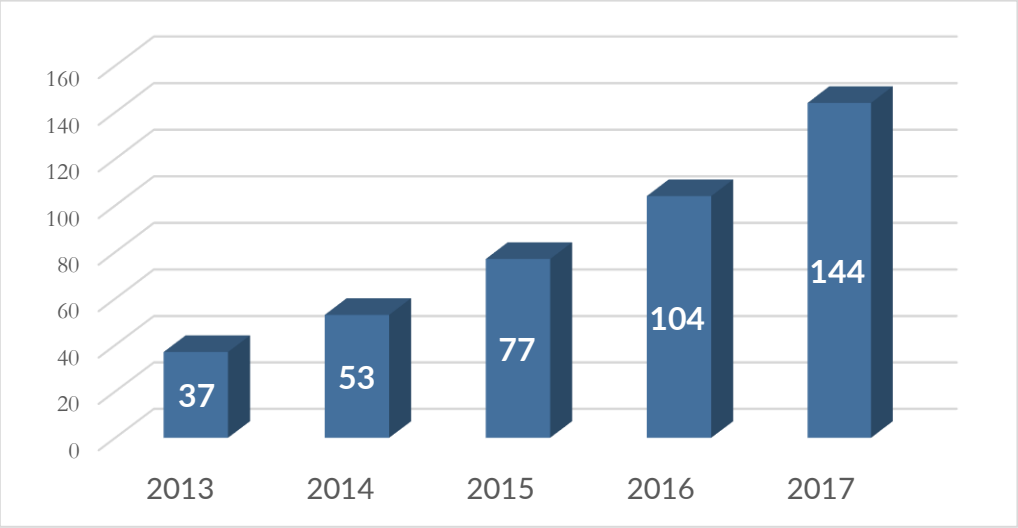
FIGURE 3. INCREASE OF THE NUMBERS OF GRANTS IN YEARS


140
120
100
80
60
40
20
0
2012
2013
2014
2015
2016
2017
H2020/FP7
EMBO
FNP
MNiSW
NCN
NCBR
other

PUBLICATIONS

In 2017, CeNT UW employees contributed to the publication of such prestigious journals as: Nature, Blood, Angewandte Chemie Int.Ed., EMBO Reports, Chemical Science, JACS, Nature Structural & Molecular Biology, Nature Communications, Nature Cell Biology, PNAS, and Nucleic Acid Research. The total number of publications published by CeNT UW researchers is presented in Figure 4 below.

FIGURE 4. CHANGE IN THE NUMBER OF PUBLICATIONS WITH CENT UW AFILLIATION OVER THE YEARS



PATENTS

LIST OF GRANTED PATENTS

- Cell and method for electrical measurements of highly reactive powder and liquid samples – 16.05.2017 – patent number US9654595, patent protection in USA – 28.10.2017 – patent number JP6219831, patent protection in Japan.
- Fluorophosphate analogs of the 5' end of mRNA (cap) - the method of preparation and application – 19.09.2017 – patent number P.406893, patent protection in Poland.
- The RNA molecule, a method for obtaining RNA and a method for obtaining peptides or proteins – 22.12.2017 – patent number CN 201410246751.1, patent protection in China.
- mRNA Cap Analogs – 2017 – patent number 2.727.091, patent protection in Canada.

LIST OF PATENT APPLICATIONS

- A cryogenic disc or ball milling vessel for a laboratory mill, suitable for milling reactive samples 26.10.2017 – European patent application number EP 16730467.4, potential patent protection in EPC convention.
- A receiver for receiving information transmitted using very weak light pulses, an information transmission system containing such a receiver, and a method of transmitting information using very weak light pulses 30.10.2017 – patent application number P.423300, potential patent protection in Poland.
- Dialkyl complexes of gallium and indium and their use for the preparation of polylactide-pharmaceutically active compound conjugates and for immortal ring–opening polymerization of heterocyclic monomers 23.10.2017 – patent application number 10P38641PL00, potential patent protection in Poland (currently – from 23.01.2018 – also in PCT mode PCT/IB2018/050402).
- An optimized medium for growing neurons, specifically the primary cortical and thalamic neurons 5.09.2017 – patent application number P.422747, potential patent protection in Poland
- Novel phosphotriazole mRNA 5'–end (cap) analogs, composition comprising the same, RNA molecule incorporating the same, uses thereof and method of synthesizing RNA molecule, protein or peptide 12.07.2017 – patent application number PCT/IB2017/054221, potential patent protection in the countries of the Patent Cooperation Treaty.
- 5'–phosphorothiolate mRNA 5'–end (cap) analogs, mRNA comprising the same, method of obtaining and uses thereof 27.01.2017 – patent application number PCT/IB2017/050447, potential patent protection in the countries of the Patent Cooperation Treaty.

SCIENTIFIC COOPERATION

The Centre of New Technologies of the University of Warsaw focuses its strategy on building lasting, stable and balanced relations with other UW units, as well as external domestic and foreign institutions. This cooperation takes various forms and levels – from the collaboration of particular scientists representing individual units in joint research projects, to formalized cooperation within existing or newly created initiatives of joint research centres. Examples of such cooperation include ReMedy and the agreements on cooperation in the education of doctoral students.

FORMATION OF THE INTERNATIONAL AGENDA UNIT *REMEDY* (REGENERATIVE MECHANISMS FOR HEALTH)

On November 19, 2017, the University of Warsaw and the University Medical Center Göttingen signed an agreement on the formation of the International Agenda Unit ReMedy (Regenerative Mechanisms for Health). The unit is located in CeNT UW and has an independent research policy. The University Medical Center Göttingen shares its experience in the coordination of research centers, and supports the process of setting up operations and management.

Additionally, two excellent professors from UMG have joined the scientific board of ReMedy: Professor Peter Rehling and Professor Silvio Rizzoli.

AGREEMENTS ON COOPERATION IN THE EDUCATION OF DOCTORAL STUDENTS

The year 2017 saw the signing of three agreements with other UW units and scientific institutions which enabled doctoral students from CeNT UW to obtain their PhDs within their structures:

- Agreement with the Faculty of Chemistry, University of Warsaw, signed on 10.02.2017,
- Agreement with the Institute of Biochemistry and Biophysics, Polish Academy of Sciences, signed on 29.06.2017,
- Agreement with the Nencki Institute of Experimental Biolog,y Polish Academy of Sciences, signed on 29.06.2017.

SCIENTIFIC EVENTS

SEMINARS

The Centre of New Technologies of the University of Warsaw organizes weekly scientific seminars. In 2017, Professor Joanna Kargul, leader of the Solar Fuels Laboratory, was the host of these seminars. The following lectures were given as part of this cycle:

- 12.01.2017, Joanna Sułkowska, CeNT UW, "Influence of Knotted Structure on the Function of Proteins".
- 19.01.2017, Janusz Bujnicki, IIMCB, "Computational Modeling of Macromolecular Complexes".
- 26.01.2017, Dorota Pawlak, CeNT UW & ITME (Institute of Electronic Materials Technology), "Introduction to Novel Crystal Growth-Based Materials at CeNT – ITME and their Potential Applications".
- 02.02.2017, Adam Kubas, Institute of Physical Chemistry, PAS, "Towards Oxygen-insensitive [FeFe]-hydrogenases".
- 09.02.2017, Dorota Gryko, Institute of Organic Chemistry, PAS, "Porphyrinoids as Photocatalysts for Visible-light Induced Selective Functionalizations".
- 23.02.2017, Jacek Stawiński, Institute of Bioorganic Chemistry, PAS, Poznań & University of Stockholm, "How to Get the Most out of Two Phosphorus Chemistries. Studies on H-phosphonates".
- 02.03.2017, Jacek Jaworski, IIMCB, "Molecular Control of Neuronal Shape in Health and Disease".
- 09.03.2017, Konrad Banaszek, CeNT UW, "Optical Communication in the Low-power Regime".
- 16.03.2017, Ewelina Knapska, Nencki Institute, PAS, "Neural Correlates of Socially Transferred Emotions".
- 30.03.2017, Marta Miączyńska, IIMCB, "Inflammatory Signaling from the Endocytic Pathway".
- 06.04.2017, Dominik Kurzydłowski, CeNT UW, "Magnetic Properties and Reactivity of Exotic Inorganic Fluorides".
- 13.04.2017, John F. Allen, University College London, "Why Chloroplasts and Mitochondria Retain Their Own Genomes and Genetic Systems: Co-location for Redox Regulation of Gene Expression".
- 20.04.2017, Wiesław Gruszecki, UMCS Lublin, "Regulation of the Photosynthetic Light Harvesting".

- 27.04.2017, Marek Samoć, Wrocław University of Science and Technology, “Towards More Efficient Materials for Nonlinear Absorption and Nonlinear Refraction Applications”.
- 11.05.2017, Zbigniew Darżynkiewicz, Brander Cancer Research Institute, New York Medical College, “Birth and Death of the Cell Explored by Multiparameter Flow and Imaging Cytometry”.
- 18.05.2017, Leszek Kaczmarek, Nencki, PAS, “Brain to Mind: a Cleavable Connection”.
- 25.05.2017, Michael Feig, Michigan State University, “Bacterial Chromosome Models”.
- 01.06.2017, Robert Rhoads, Louisiana State University, “Synergistic Application of Organic Chemistry and Biochemistry to Illuminate the Translation and Turnover of Messenger RNA”.
- 08.06.2017, Stanisław Dunin-Horkawicz, CeNT UW, “Design of New Protein Structures”.
- 22.06.2017, Paweł Niewiadomski, CeNT UW, “Mechanisms of Gli-protein Regulation in Hedgehog Signalling”.
- 29.06.2017, Cecilia Winata, IIMCB, “The Zebrafish as a Model for Studying RNA Biology”.
- 05.10.2017, Marcin Drąg, Wrocław University of Science and Technology, “Unnatural Amino Acids in Design of Activity-based Probes for Proteolytic Enzymes Visualization”.
- 12.10.2017, Bartosz Trzaskowski, CeNT UW, “Computational Studies of Olefin Metathesis and Other Homogenous Catalytic Reactions”.
- 19.10.2017, Michał Tomza, CeNT UW, “Engineering Ultracold Quantum Molecular Systems”.
- 26.10.2017, Piotr Setny, CeNT UW, “Hydration Effects in Biomolecular Systems”.
- 09.11.2017, Michael Feig, Michigan, State University, “Structures of Bacterial DNA Chromosomes - Paving the Way to Gene-structure-function Relationships at the Genomic Level”.
- 23.11.2017, Zoltan Molnar, University of Oxford, “Evolution of Brain Development”.
- 30.11.2017, Maciej Długosz, CeNT UW, “Hydrodynamic Effects in Biological Systems”.
- 07.12.2017, Daniel Gryko, Institute of Organic Chemistry, PAS, “From Pyrrolo[3,2-b]pyrroles to π-expanded diketopyrrolopyrroles – the Fluorophores for the Future”.
- 14.12.2017, Barbara Tudek, Institute of Biochemistry and Biophysics PAS/Faculty of Biology UW, “Repair of Oxidatively Damaged DNA in Etiology and Therapy of Cancer”.

The Laboratory of Technology of Novel Functional Materials organized a press conference, “The Exceptional Ag2F”, devoted to recent discoveries in Ag2F research.

The Wild Urban Evolution & Ecology Lab of Professor Marta Szulkin, together with the Mammal Research Institute PAS Białowieża, is developing another initiative – a series of seminars dealing with ecology and evolution. The seminars are held monthly and throughout the academic year. In 2017 the following lectures were given:

- 11.01.2017, Arnaud Da Silva, Max Planck Institute, Seewiesen, Germany, “Effects of Light Pollution on the Ecology & Evolution of Tits”,
- 08.02.2017, Marion Chatelain, Pierre & Marie Curie University, Paris, France, “Urban Ecotoxicology, Ecology and Evolution”,
- 08.03.2017, Rafał Kowalczyk, Mammal Research Institute PAS, Bialowieża, “Why has the European Bison Survived, While the Other Large Beasts Have Gone?”,
- 12.04.2017, Michael Griesser, Anthropology Department University of Zurich, Switzerland, “Learn for Life From Your Parents: the Fitness Benefits of Social Learning”,
- 10.05.2017, Anna Karnkowska, Faculty of Biology, University of Warsaw, “Biology’s ‘Dark Matter’ – Eukaryotic Microbes”,
- 07.06.2017, Jarosław Stolarski, Institute of Paleobiology PAS, Warsaw, “The Origin of Coral Symbiosis: the Skeletal Record”,
- 11.10.2017, Antica Culina, Netherlands Institute of Ecology , “How Can Fast-Growing Data-Landscapes Help Ecological and Evolutionary Synthesis?”,
- 08.11.2017, Frank E. Zachos, Natural History Museum Vienna, Austria, “The Species Concept”,
- 13.12.2017, Bogumiła Jędrzejewska, Mammal Research Institute Białowieża, PAS, “Two Centuries of Dominant Tree Species Turnover in the Oldgrowth Forests of Białowieża”.

CONFERENCES

The following conferences were supported with organizational involvement of CeNT UW employees:

- Theoretical Models of Chemical Bonding & Reactivity Spanning the Periodic Table: A Symposium in Honor of Roald Hoffmann (within the 254th ACS Meeting), 20-24.08.2017, Washington DC, USA,
- EUROMAR 2017, 2-6.07 2017, Warsaw, Poland,
- 3rd EMBO Workshop on Computational and Structural Biology, 3-5.05.2017, Serock, Poland,
- 7th Visegrad Symposium on Structural Systems Biology, 21-24.06.2017, Nove Hrady, Czech Republic,
- 13th International Congress of the Polish Neuroscience Society, 28-31.08.2017, Warsaw, Poland,
- 2nd PolTur/GrapESol Workshop on Biohybrid Graphene Solar Cells, 3-4.07.2017, Toruń, Poland
- 3rd PolTur/GrapESol Workshop on Biohybrid Graphene Solar Cells, 22-23.11.2017, Mersin, Turkey,
- Life science imaging – workshop on visualisation of molecules, interactions and biological processes. SMM summer school, 5-7.06.2017, Warsaw, Poland,

- Bioinformatics in Torun, 17, 22-24.06.2017, Toruń, Poland,
- The Geometry and Topology of Knotting and Entanglement in Proteins, 5-10.10, 2017, Oxaca, Mexico,
- Coarse graining of biomolecules and beyond: theory and applications 07.10.2017, Warsaw, Poland.

PhDs & POSTDOCS SCIENTIFIC PODCAST MEETINGS

PhD and postdoctoral students were involved in podcast meetings which featured interesting lectures by specialists from different scientific fields:

- 7.11.2017 the webcast of Bert Vogelstein's talk "Earlier Detection as a Key to Low Cancer Death Rates" from the AACR conference (2017) was presented. After the webcast there was a lively discussion about cancer prevention.
- 5.12.2017 the webcast of Jennifer Doudna's lecture "CRISPR Basics" from the 2017 CRISPR Workshop at UC Berkeley was presented, followed by an equally lively discussion about CRISPR limitations and its future.

POPULARIZATION OF SCIENCE

CeNT UW scientists and doctoral students have popularized science in a number of different ways and on many occasions, trying to reach the broadest possible audience. Their activities include press articles and broadcasts (national and foreign) aimed at presenting research results to the layman, lectures and meetings with young scientists to promote further development of their scientific careers, as well as shows, lectures and workshops for children and youth, popularizing biological and exact sciences.

ACTIVITIES ADDRESSED TO CHILDREN AND YOUTH

CeNT UW's employees and doctoral students engage in a number of events which promote biological and exact sciences among children and youth and in 2017 they made a significant contribution to the organization of many events, such as:

April 8, 2017: Open Day of the Warsaw University "Ochota" Campus – the aim of the event was to promote the University of Warsaw among high school students and encourage them to study at the university. Classes and workshops were conducted in laboratories with that specific age group in mind. In 2017, CeNT UW also organized a Scientific Cafe to promote and discuss the scientific career path of

women. Employees from 6 CeNT UW laboratories participated in the event, while 5 laboratories held practical workshops. You can find out more at http://doko.mimuw.edu.pl/2017.
June 19 – 23, 2017: CeNT UW offered lectures and research workshops during an event hosted by the Polish Children's Fund. Twenty scholarship holders took part in the event, which involved 4 lectures and workshops organised in 6 CeNT UW laboratories.

ACTIVITIES ADDRESSED TO STUDENTS AND YOUNG SCIENTISTS

CeNT UW employees also actively participated in events promoting science and scientific career paths by giving lectures for students and young researchers. Some of the the more significant events are:

- Do Science! – a lecture given by Professor Dominika Nowis – is an initiative of PhD students. Its goal is to organize lectures and informal meetings with brilliant scientists.
- The Falling Walls Lab Warsaw and the Falling Walls Lab Berlin – popular science lectures by Dr. Michał Tomza about the research conducted in his laboratory earned him the first place in a Polish qualification competition for the Falling Walls Lab in Warsaw. Dr. Michał Tomza also represented the Polish team during the final in Berlin.
- An ERC Mentoring session, “Perspective of an ERC Panel Member”, Polish Academy of Science – Professor Agnieszka Chacińska gave a lecture on ERC grants for researchers.
- Lectures: “Mitochondria – a Tale of the Cellular Power Plants” for the Warsaw Scientific Society, “Societas Humboldtiana Polonorum”; “Science: the Polish Perspective” Meetup in Berlin; “Cellular stress management”, Berlin, Germany given by Professor Agnieszka Chacińska, aimed at popularizing science among young researchers.
- A lecture entitled “ReMedy Regenerative Mechanisms for Health” for the Foundation for Polish Science by Professor Agnieszka Chacińska, aimed at promoting ReMedy among Polish scientists.
- A Summer School in Molecular Biophysics and Systems Biology, Nove Hrady, South Bohemia, Czech Republic – an initiative for foreign students, giving a chance to cooperate with prominent lecturers, participate in lectures, and gain a new outlook on methodology and research. In 2017, one of the lecturers was Dr. Joanna Sułkowska.

FINANCES

The main sources of CeNT UW income are funds raised for the realization of R&D grants. We are delighted to note that there has been a systematic increase in the number and value of projects implemented by this entity. The funds obtained are used mainly to conduct research projects, and, in terms of the institution, to upgrade and develop CeNT UW infrastructure. The structure of income is presented in Figure 5 below.

FIGURE 5. FINANCIAL MANAGEMENT

		PLN	EUR*
I	**Sources of Funding**	34 976 000	8 386 000
1	Statutory and Budgetary Subvention	8 336 000	1 999 000
2	Domestic and Foreign Grants	24 229 000	5 809 000
3	other, including commercialization	2 411 000	578 000
II	**Expenditures**	35 964 000	8 622 000
1	Personnel cost	15 797 000	3 787 000
2	Scientific instruments and equipment	4 304 000	1 032 000
3	Consumables, including research materials	8 760 000	2 100 000
3.1	Cost of building maintenance	5 358 000	1 285 000
4	Other	1 745 000	418 000
	OUTCOME	**-988 000**	**-236 000**

**1 EUR = PLN 4.1709, exchange rate of the National Bank of Poland as of 31 Dec, 2017*

In 2017, the costs of maintaining CeNT UW's new building at ul. Banacha 2C exceeded the amount of PLN 5.3 mln (EUR 1.2 mln), including personnel costs, out of which operating costs were covered by a subsidy in the amount of PLN 3 336 000 (EUR 800 000). The building's high maintenance cost means that its upkeep is possible only with the Rector's grants. The facility's maintenance expenses are also presented in the figure above.

HOUSING RESOURCES

The CeNT UW building also hosts other entities and institutions:

- The Faculty of Physics, University of Warsaw (1 000 m^2),
- The Centre for Open and Multimedia Education, University of Warsaw (COME) (260 m^2),
- The College of Inter-Faculty Individual Studies in Mathematics and Natural Sciences (MISMaP) (130 m^2),
- Digital Humanities Centre (200 m^2),
- The UW and Polish-American Freedom Foundation School of Education (518 m^2),
- The UW Real Estate Office "Ochota" (110 m^2).

Additionally, the laboratories of Prof. Wojciech Grochala, Prof. Krzysztof Ginalski and Dr. Przemysław Malinowski are located in the building of the Faculty of Geology UW at ul. Żwirki i Wigury 93.

MISCELLANEOUS MINOR INFRASTRUCTURE IMPROVEMENTS

- The CeNT UW administration focuses on insuring maximum security for all researchers and employees (monitoring the access of unauthorized personnel, introducing personalized access cards),
- We are increasing workplace safety (emergency door release mechanisms in the chemical/biological waste room, reconstruction of the roof ventilation system); security announcements are also made in English,
- We are working to ensure that CeNT UW is as open to the scientific community (making our lecture and meeting rooms available for educational purposes, publicly accessible online reservation system, online help desk and technical support ticketing system).

INVESTMENTS

In 2017 we focused on the efficiency and effectiveness of existing infrastructure. Additional equipment was purchased for a total amount of PLN 3 942 759 (EUR 945 302). The funding sources were research grants. A list of main items is presented in the figure below.

FIGURE 6. INVESTMENTS IN EQUIPMENT

EQUIPMENT	VALUE (PLN)	VALUE (EUR)*
Electrochemical tests workstation (ANDY)	149 998	35 963
Macromolecular interreaction testing apparatus using bio-layer interferometry (LKB Biotech)	109 986	26 370
Gas chromatograph with mass detector (Shim-pol)	375 150	89 945
Ultrafast reduction gas detector (Labsolutions)	130 318	31 244
Thermophoresis device (NanoTemper)	499 999	119 878
Device for transmittance and absorbance of photoelectrochemical systems 'in situ' (Amecam)	211 956	50 818

**1 EUR = PLN 4.1709, exchange rate of the National Bank of Poland as of 31 Dec, 2017*

Additionally, the infrastructure of the building was supplemented by the amount of PLN 356 989 (EUR 85 590).

The infrastructure of the building was modified, with office space being adapted to become laboratory space. The modifications also consisted in fitting laboratories with small-scale equipment and new furniture. One of the main purchases was the autoclave for the Central Washroom in the amount of PLN 260 177 (EUR 62 379).