2018

ANNUAL REPORT

UNIVERSITY OF WARSAW

CeNT CENTRE OF NEW TECHNOLOGIES

WHAT DRIVES US

OUR VISION:

To grow into a major interdisciplinary research institute dedicated to the understanding of important biological, chemical, and physical phenomena.

NOTE FROM THE DIRECTOR

2018 has been an important year for the Centre of New Technologies of the University of Warsaw (CeNT). Nothing would be possible without our administrative team that has grown and continues to play a vital role in providing the necessary help in the scope of organizational, formal, and financial issues, as described by Iwona Cymerman, the Deputy Director for Research Organization, in her note.

One of the highlights of 2018 which I would like to point out first is the recruitment of new research leaders and the creation of new laboratories within CeNT. We have strengthened our position by implementing two prestigious programmes funded by the Foundation for Polish Science. Within the international research agenda of the University of Warsaw and our partner, the University Medical Center Göttingen at Georg-August-University Göttingen, The Regenerative Mechanisms for Health (ReMedy), we have appointed Piotr Szwedziak, a structural biologist, as the new lab leader, who shall start his Laboratory of Structural Cell Biology in May 2019.

Thanks to the partnership with the University of Oxford under the International Research Agenda Programme, we have been able to launch the Centre for Quantum Optical Technologies (QOT). Within QOT, the following laboratories have been created: The Quantum Memories Laboratory led by Wojciech Wasilewski, The Quantum Information and Inference (QI2) Laboratory with Jan Kołodyński as the lab leader, and The Quantum Resources and Information Laboratory headed by Alexander Streltsov.

Approximately 70% CeNT scientists work in the field of biological sciences in a broad and modern sense. However, we are constantly expanding other scientific areas of research, such as bioinformatics and chemistry. New laboratories that have been opened at CeNT UW shall be led by Stanisław Dunin-Horkawicz - the Laboratory of Structural Bioinformatics and by Renata Solarska - the Laboratory of Molecular Research for Solar Energy Innovations.

Another 2018 highlight is the development of our equipment and resources and improving their availability to scientists. Therefore, I created the position of the Infrastructure Coordinator with the responsibility to reorganize the use of our current equipment and to aim for new infrastructure. Both are indispensable for development of research in a modern institute. Rafał Wierzchosławski was appointed as the Infrastructure Coordinator. We have laid the formal ground for creating the Core Facilities of CeNT UW. This organization scheme assures that our existing and newest equipment is fully accessible to everyone and used in the best possible way based on the international standards. We also provide support from highly qualified specialists recruited in a highly competitive way. Importantly, we also assured the funds to set up the proteomics and cryogenic-transmission electron microscope facilities.

With the organizational schemes and resources currently available at CeNT UW we hope to foster the best possible standards for our researchers and employees. We strive to further build excellence in a fair, stimulating, and friendly atmosphere.

Agnieszka Chacińska

CeNT UW Director until 08.04.2019

NOTE FROM THE DEPUTY DIRECTOR

Starting from June 2018, I have had the privilege of taking on the role of the Deputy Director of CeNT UW. From there on, it has been my goal to continue to develop CeNT UW and to strengthen its scientific potential. The combined efforts of the Administrative Team and my own have allowed us to make some fundamental advancements and improvements.

As the CeNT UW researchers and their well-being are at the core of our institution's activity, we have established our administrative mission's goal: to create the best possible working environment for our scientists.

Therefore, introducing changes and investing in our human resources is one of the areas I am most proud of. Thanks to our highly committed and qualified staff, the support for our scientists is covered and taken care of by the following departments: **Human Resources, Finances and Fixed Assets, Reporting and Analysis, Public Procurement, IT, Grant Office, and the Front Desk Team.** Certain departments have been remodeled over 2018, but the biggest changes have been introduced within the scope of competences of the Financial Department and Grant Office. These modifications allow us to provide comprehensive and thorough back-office service within grants. To fully target our mission, all of the CeNT UW administrative departments closely cooperate with the Infrastructure Department led by Rafał Wierzchosławski.

From the very beginning of their employment, we focus our efforts on the scientists' convenience. To begin with, **we introduce our onboarding procedures** which enable the newcomers to obtain vital information and to get acquainted with how things work and function at CeNT UW. Next, a series of training sessions and individual introductions is presented by the delegates from different departments. We also provide **a specially designed internal information package** to ensure that possible issues which may arise during further employment are described and explained. By **regular updates including the latest feedback**, and by making constant improvements; these procedures enable us to sustain the highest standards of information.

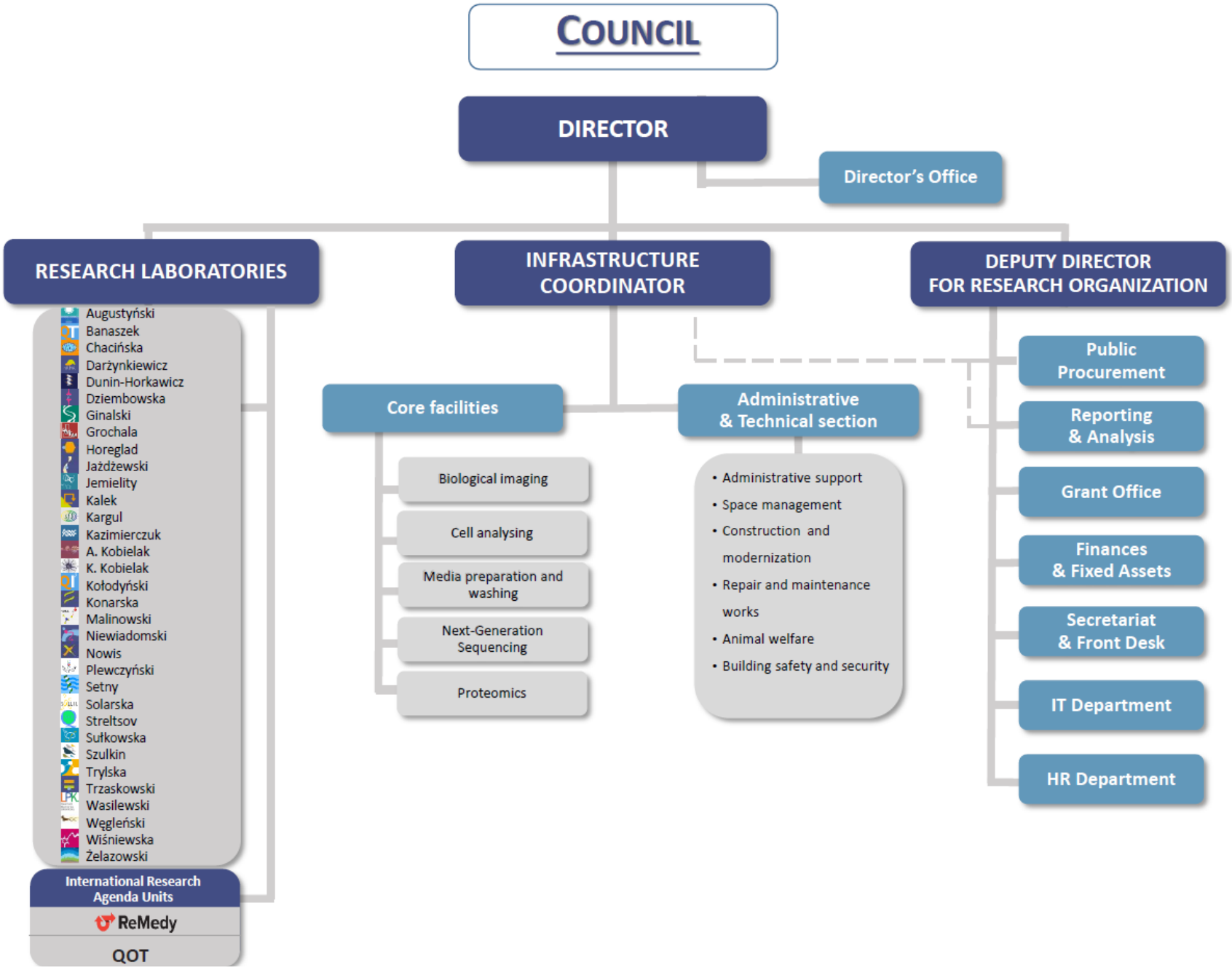
Following such a well-organized start, our Administrative Team is prepared and ready to provide all the necessary daily and ongoing support. As part of our development, we have established a new and improved online **information system which is now easily accessible for all CeNT UW employees: www.info.cent.uw.edu.pl.** This system aims at providing answers and solutions to everyday matters and greatly increases the standard of our services. Our Administrative Team constantly updates these resources based on feedback and new questions.

Thanks to the joint efforts of our Administrative Team, we have now shaped a complete and well-functioning scheme - not only is it scalable and stable enough to accommodate for the needs of the new research groups and the growing number of CeNT UW's employees, but it is also flexible and able to adapt to potential changes. All these improvements have allowed us to persist in our mission to help CeNT UW grow into a state-of-the-art scientific research institute. Being very proud of these changes and new procedures allows for further challenges to be faced, including the development of the communication strategy to make CeNT UW even more accessible, recognizable, and well-known worldwide.

Iwona Cymerman

CeNT UW Deputy Director until 08.04.2019

CeNT UW STRUCTURE



2018 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

Current Research Directions

- **Launching** the planned new project named **the Centre for Quantum Optical Technologies (QOT)**. The implementation of the project was possible thanks to the partnership with the University of Oxford under the International Research Agenda Programme, operated by the Foundation for Polish Science. Within QOT, the following laboratories have been created: The Quantum Memories Laboratory led by Wojciech Wasilewski, The Quantum Information and Inference (QI2) Laboratory with Jan Kołodyński as the lab leader, and The Quantum Resources and Information Laboratory under the guidance of Alexander Streltsov;
- **Expanding** into other scientific areas, such as **bioinformatics and chemistry**. The new laboratories shall be led by Stanisław Dunin-Horkawicz - the Laboratory of Structural Bioinformatics and by Renata Solarska - the Laboratory of Molecular Research for Solar Energy Innovations;
- **Establishing CeNT UW's Core Facilities**, which allow us to centralize the most advanced, state-of-the-art equipment and technologies, ensuring wide accessibility to the scientific community and maximizing the potential for the use of technology

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

SCIENTIFIC HIGHLIGHTS

CeNT UW is proud of the fact that our scientists have successfully published the results of their projects and their work within many prestigious international scientific journals, such as:

- Topf, U.; Suppanz, I.; Samluk, L.; Wrobel, L.; Böser, A.; Sakowska, P.; Knapp, B.; Pietrzyk, M. K.; Chacinska, A.*; Warscheid, B.* Quantitative proteomics identifies redox switches for global translation modulation by mitochondrially produced reactive oxygen species. Nature Communications 2018, 9 (1), 324.
- Wojtczak, B. A.; Sikorski P. J.; Fac-Dąbrowska, K.; Nowicka, A.; Warmiński, M.; Kubacka, D.; Nowak, E.; Nowotny, M.; Kowalska, J.*; Jemielity, J.*, 5′-phosphorothiolate dinucleotide cap analogues: reagents for messenger RNA modification and potent small-molecular inhibitors of decapping enzymes. Journal of the American Chemical Society 2018, 140, 5987-5999.
- Setny, P.*; Wiśniewska, M. D.; Water-mediated conformational preselection mechanism in substrate binding cooperativity to protein kinase A, Proceedings of the National Academy of Sciences 2018, 115 (15), 3852–3857.

AWARDS

CeNT UW is proud of the scientific achievements of our scientists. Amongst the most prestigious awards of 2018 we would like to mention:

Dr. Mariana Derzsi laureate of the L´Oréal-UNESCO For Women In Science International Award

Dr. Mariana Derzsi, from the Faculty of Materials Science at the Slovak University of Technology in Bratislava and member of the Laboratory of Technology of New Functional Materials at CeNT UW, won the L'Oréal-UNESCO For Women In Science competition 2018 (Slovak edition).

The jury awarded Dr. Derzsi for working on new functional materials based on silver and chlorine with exceptional magnetic and electrical properties using computer modelling.

The L'Oréal-UNESCO For Women in Science programme encourages many young women scientists to enter the profession, as well as supports and promotes the talented ones in their career development.

Mateusz Abram from the Solar Fuels Laboratory won 1st prize at ChemSession'18

Mateusz Abram (PhD student in prof. Joanna Kargul's Solar Fuels Laboratory) won the 1st Prize for the poster and presentation at the XV Warsaw Seminar of PhD Candidates in Chemistry (ChemSession'18), organized by the Warsaw Branch of Polish Chemical Society.

The main objective of the event was to present the scientific achievements of doctoral students and young scientists in the field of chemistry and to integrate the Warsaw chemical environment.

Prof. Krystian Jażdżewski - Person of the Year in Science

Prof. Krystian Jażdżewski has been awarded by the readers of Gazeta Wyborcza (one of the leading Polish daily newspapers), with the Person of the Year title in the Science and Innovation category.

"BadamyGeny.pl" is an innovative programme developed by the scientists from Prof. Jażdżewski's team from CeNT UW's Laboratory of Human Cancer Genetics. By using genomic sequencing they assess the risk of breast, ovarian, prostate and many other hereditary cancers. The methodology they have developed checks all the genes responsible for cancer and is more accurate and cheaper than anywhere else in the world.

Prof. Agnieszka Chacińska awarded the Theodor Bücher medal from FEBS

Prof. Agnieszka Chacińska received the 2018 Theodor Bucher medal for her outstanding results in Molecular Biology.

After receiving the award, she presented the lecture 'Management of mitochondrial proteins: sort or destroy' at the 43rd FEBS (Federation of European Biochemical Societies) Congress in Prague.

The Theodor Bücher Lecture and Medal (one of the three most important FEBS medals) is awarded for outstanding achievements in Biochemistry and Molecular Biology or related sciences. The awardees deliver plenary lectures at the FEBS Congress, and contribute review articles based on their lectures to FEBS Journal and FEBS Letters.

Prof. Joanna Sułkowska named RMF Classic's "Person of the Year"

Prof. Joanna Sułkowska has won the "Person of the Year" award in the MocArty 2017 poll by RMF Classic (the Polish classical and film music radio station). The candidates for the award were nominated by the station's listeners.

Prof. Joanna Sułkowska is engaged in chemical sciences and leads a team of scientists at CeNT UW's Interdisciplinary Laboratory of Biological Systems Modelling. She specializes in protein biophysics and molecular and theoretical biophysics. She conducts research on looped proteins. Conclusions from this work can help to explain and treat Alzheimer's disease, Parkinson's disease, and obesity.

Prof. Joanna Trylska - Fulbright Senior Award

Prof. Joanna Trylska, head of CeNT UW's Biomolecular Machines Laboratory, was among the laureates of the Fulbright Senior Award in February 2018.

The Polish-U.S. Fulbright Commission is an educational foundation, which administers the Fulbright Program in Poland. The Fulbright Senior Award is a 4 to 9 month research fellowship for postdoctoral researchers. In the academic year 2018-19, the Polish-American Fulbright Commission awarded 21 such scholarships.

Nominations for the European Inventor Award 2018

Three researchers from CeNT UW: Prof. Jacek Jemielity, Prof. Edward Darżynkiewicz, and Dr. Joanna Kowalska along with a team of researchers, have been nominated for the European Inventor Award 2018 in the research category.

The European Inventor Award is an annual celebration of the incredible contributions of inventors from across Europe and the world to social and economic progress. The award is given by the European Patent Office (EPO). It promotes the remarkable inventors behind some of the most important inventions of our time.

In 2018, there were 530 proposals submitted from all over the world for inventors working in such diverse fields as healthcare, green technologies, engineering and telecommunications. The EPO experts have evaluated them and the jury, composed of internationally renowned personalities from politics, business, journalism and academia, has selected the 15 finalists – 3 in 5 categories: industry, research, non-EPO countries, SMEs and lifetime achievement.

ORGANIZATION AND LEADERSHIP

CeNT UW is administrated by the Board of Directors, whose work is supervised by the Council.

BOARD OF DIRECTORS

According to its regulations, the Centre for New Technologies of the University of Warsaw is managed by the Director.

Composition of the Board of Management:

- Prof. Agnieszka Chacińska – Director of CeNT UW;
- Dr. Iwona Cymerman – Deputy Director for Research Organization since June 2018;
- Dr. Rafał Wierzchosławski – Infrastructure Coordinator since May 2018;
- Artur Zieliński, MSc - Chief Financial Officer;
- Dr. Magdalena Kowalczyk - Deputy Director of scientific research organization from January till June 2018;
- Dr. Robert Dwiliński – Deputy Director of research commercialization from January till August 2018.

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 CeNT UW Council is as follows:

- Professor Peter Rehling – the Chairman of the Council - University Medical Center Göttingen Cellular Biochemistry, Germany;
- Professor Witold Filipowicz – the Vice-Chairman of the Council - 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 - Faculty of Chemical and Process Engineering, 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 - Department of Neuro- and Sensory Physiology, University Medical Center Göttingen, Germany;
- Dr Maciej Wieczorek - Celon Pharma S.A., Poland;
- Professor Michele Vendruscolo - Department of Chemistry, University of Cambridge, United Kingdom;
- Professor Magdalena Żernicka-Goetz - Department of Physiology, Development and Neuroscience, University of Cambridge, United Kingdom.

RESEARCH GROUPS AND INTERNATIONAL AGENDAS

CeNT CENTRE OF NEW TECHNOLOGIES

Laboratory for Photoelectrochemistry and Solar Energy Conversion

Prof. Jan Augustyński

RESEARCH

General Overview

The research conducted in our group is devoted to the study of the interactions of semiconducting materials and metallic nanostructures with light. The investigations focus principally on photo-electrochemical properties of thin-layer semiconducting oxide electrodes, such as tungsten trioxide (WO3) or ferric oxide (Fe2O3) that are employed to split water or decompose contaminants present in water.
In both cases, the photo-electrolysis leads to the formation of hydrogen on the cathode of the cell. Thanks to the light absorption by the semiconducting electrodes, the photo-electrolysis takes place under bias voltages lower than the theoretical value for decomposition of water (1.23 V). The solar-to-chemical energy conversion efficiency relies critically on the composition and preparation method of the semiconducting electrodes; to unable the use of a significant part of the solar spectrum, the employed semiconductors have to have band gap energies in the range of 2 to 2.5 eV.

2018 Research Focus

The main research topic of the laboratory is in identifying and building photo-electrodes based on nanostructured semiconducting transition metal oxides for efficient sunlight conversion into chemical energy, with focus on hydrogen production via water and sea-water splitting. To improve their optoelectronic properties, the photo-materials are modified by doping and inclusion of plasmonic metal nanoparticles. The major recent achievement is the development of Sn-doped WO3 photo-electrodes that effect water splitting with solar-to hydrogen efficiency exceeding 5%.

PUBLICATIONS

- Jelinska, A., Bienkowski, K., Jadwiszczak, M., Pisarek, M., Strawski, M., Kurzydlowski, D., Solarska, R., and Augustynski, J. (2018). Enhanced Photocatalytic Water Splitting on Very Thin WO 3 Films Activated by High-Temperature Annealing. ACS Catalysis 8, 10573–10580.

PROJECTS

- Multifunctional thin -film mixed and/or doped metal oxide materials -from photoelectrochemistry to electrocatalysis, prof. Jan Augustyński, MAESTRO NCN, 2014-2019

STAFF

Group Leader:
Prof. Jan Augustyński

Postdoctoral Fellows:
Aldona Jelińska, PhD

PhD Students:
Katarzyna Jakubów, MSc
Marta Sarnowska, MSc

Students:
Michał Jadwiszczak
Kinga Kobyłecka
Maria Królak

Research Technicians:
Krzysztof Bieńkowski, MSc

Quantum Technologies Laboratory

Prof. Konrad Banaszek

RESEARCH

General Overview

The 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 the 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 bounded by standard quantum limits. This general approach, when implemented using the 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. The 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.

2018 Research Focus

The quantum mechanical approach to optical communication turns out to be most consequential in the so-called photon starved regime, when the average number of detected photons per a single time slot is much less than one. The quantum effect of superadditivity of accessible information has motivated new communication schemes which can overcome for example peak power limitation of conventional modulation formats such as pulse position modulation.

PUBLICATIONS

- Banaszek, K., Lipka, M., and Jarzyna, M. (2018). Feasibility of quantum fingerprinting using optical signals with random global phase. In Quantum Information Science and Technology IV, M.T. Gruneisen, M. Dusek, and J.G. Rarity, eds. (Berlin, Germany: SPIE), p. 19.
- Field-Theodore, T.E., Olejniczak, M., Jaszuński, M., and Wilson, D.J.D. (2018). NMR shielding constants in group 15 trifluorides. Physical Chemistry Chemical Physics 20, 23025–23033.
- Jachura, M., Jarzyna, M., Lipka, M., Wasilewski, W., and Banaszek, K. (2018). Visibility-Based Hypothesis Testing Using Higher-Order Optical Interference. Phys. Rev. Lett. 120, 110502.
- Jarzyna, M., Zwoliński, W., Jachura, M., and Banaszek, K. (2018). Optimizing deep-space optical communication under power constraints. pp. 105240A-10524–10.
- Kunz, L., Paris, M.G.A., and Banaszek, K. (2018). Noisy propagation of coherent states in a lossy Kerr medium. Journal of the Optical Society of America B 35, 214–222.
- Kurek, A.R., Stachowski, A., Banaszek, K., and Pollo, A. (2018). The usability of the optical parametric amplification of light for high-angular-resolution imaging and fast astrometry. Monthly Notices of the Royal Astronomical Society 476, 1696–1704.
- Parniak, M., Borówka, S., Boroszko, K., Wasilewski, W., Banaszek, K., and Demkowicz-Dobrzański, R. (2018). Beating the Rayleigh Limit Using Two-Photon Interference. Physical Review Letters 121, 250503.
- Zwoliński, W., Jarzyna, M., and Banaszek, K. (2018). Range dependence of an optical pulse position modulation link in the presence of background noise. Optics Express 26, 25827.

PROJECTS

- Quantum Optical Communication Systems, Prof. K. Banaszek, TEAM FNP, 2016-2019
- Quantum chemistry solutions for molecules with heavy atoms in realistic environments, M. Olejniczak, PhD, SONATA NCN, 2017-2020
- Centre for Quantum Optical Technologies, Prof. K. Banaszek, MAB IRAP, FNP, 2018-2023

STAFF

Group Leader:
Prof. Konrad Banaszek

Postdoctoral Fellows:
Chandan Datta, PhD
Marcin Jarzyna, PhD
Yink Loong Len, PhD
Olejniczak Małgorzata, PhD

PhD Students:
Michał Jachura, MSc
Ludwig Kunz, MSc
Michał Parniak-Niedojadło, MSc

Students:
Michał Lipka

Laboratory of Mitochondrial Biogenesis

Prof. Agnieszka Chacińska

RESEARCH

General Overview

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 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.

2018 Research Focus

Biogenesis of mitochondrial proteins and their sensitivity to the proteasome in the cytosol reveals a novel approach for the treatment of diseases associated with the decreased levels of mitochondrial proteins. Inefficient import of pathogenic variants of mitochondrial proteins into mitochondria exposes them to an excessive degradation by the proteasome resulting in the impaired mitochondrial respiratory chain assembly. Inhibition of excessive cytosolic degradation of mitochondrial precursor proteins by the proteasome has a potential to restore mitochondrial function.

PUBLICATIONS

- Sokol, A.M., Uszczynska-Ratajczak, B., Collins, M.M., Bazala, M., Topf, U., Lundegaard, P.R., Sugunan, S., Guenther, S., Kuenne, C., Graumann, J., et al. (2018). Loss of the Mia40a oxidoreductase leads to hepato-pancreatic insufficiency in zebrafish. PLOS Genetics 14, e1007743.
- Topf, U., Suppanz, I., Samluk, L., Wrobel, L., Böser, A., Sakowska, P., Knapp, B., Pietrzyk, M.K., Chacinska, A., and Warscheid, B. (2018). Quantitative proteomics identifies redox switches for global translation modulation by mitochondrially produced reactive oxygen species. Nature Communications 9, 324.
- Kowalski, L., Bragoszewski, P., Khmelinskii, A., Glow, E., Knop, M., and Chacinska, A. (2018). Determinants of the cytosolic turnover of mitochondrial intermembrane space proteins. BMC Biology 16, 66.
- Samluk, L., Chroscicki, P., and Chacinska, A. (2018). Mitochondrial protein import stress and signaling. Current Opinion in Physiology 3, 41–48.
- Schendzielorz, A.B., Bragoszewski, P., Naumenko, N., Gomkale, R., Schulz, C., Guiard, B., Chacinska, A., and Rehling, P. (2018). Motor recruitment to the TIM23 channel's lateral gate restricts polypeptide release into the inner membrane. Nature Communications 9, 4028.
- Lewandowska, H., Stępkowski, T.M., Męczyńska-Wielgosz, S., Sikorska, K., Sadło, J., Dudek, J., and Kruszewski, M. (2018). LDL dinitrosyl iron complex acts as an iron donor in mouse macrophages. Journal of Inorganic Biochemistry 188, 29–37.
- Uszczynska-Ratajczak, B., Lagarde, J., Frankish, A., Guigó, R., and Johnson, R. (2018). Towards a complete map of the human long non-coding RNA transcriptome. Nature Reviews Genetics 19, 535–548.

Laboratory of Mitochondrial Biogenesis

Prof. Agnieszka Chacińska

PROJECTS

- Cellular mechanisms handling failed mitochondrial protein translocation events, P. Brągoszewski, PhD, FIRST TEAM FNP, 2017-2020
- The interplay between the translation machinery and the mitochondrial dysfunction under cellular stress, U. Nowicka, PhD, HOMING FNP, 2017-2019
- The link between mitochondria and the protein quality control system, M. Turek, PhD, POLONEZ, NCN, 2017-2019
- Analysis of the mitochondrial proteins translocase TIM22 in human cells, K. Chojnacka, PhD FUGA NCN, 2016-2019
- Characterization of the TIM23 pathway of protein import into mitochondria in mammalian cells, M. Wasilewski, PhD, OPUS NCN, 2016-2019
- Mitochondrial translocation of the DNA repair protein APE1, C. Vascotto, PhD, POLONEZ NCN, 2017-2019
- Principles of mitochondrial protein compartmentalization in vertebrates, B. Uszczyńska-Ratajczak, PhD, POLONEZ NCN, 2017-2019
- Cytosolic chaperone systems for mitochondrial precursor proteins, Prof. Agnieszka Chacińska, IDEA PLUS MNiSW, 2014-2019
- Nicolaus Copernicus Polish-German Research Award, Prof. Agnieszka Chacińska, Copernicus FNP, 2016-2019
- Analysis of the alternative import pathways of mitochondrial proteins, A. Gosk, PhD, Diamentowy Grant MNiSW, 2017-2019
- Cross-talk between the transport of mitochondrial proteins and cellular protein homeostasis, Prof. Agnieszka Chacińska, MAESTRO NCN, 2016-2021
- Regenerative mechanisms for Health, Prof. Agnieszka Chacińska, FNP-MAB, 2017-2022

COMPLETED

- Coupling of synthesis and transport for proteins targeted to the mitochondria, Prof. Agnieszka Chacińska, OPUS NCN, 2014-2018
- Extramitochondrial factors regulating turnover of mitochondrial intermembrane space proteins, P. Brągoszewski, PhD, SONATA NCN, 2014-2017
- Mechanisms protecting from oxidative damage during aging, U. Topf, PhD, OPUS NCN, 2016-2019

We host international collaborators and guests:
Carlo Vascotto, Sabbatical Professor (University of Udine, 01.09.2017 - till now)
Veronica Bazzani, MSc (University of Udine, 01.09.2018-28.02.2019)
Inés Juaristi Santos, MSc (Center for Molecular Biology, Madrid, 01.06.2018-31.08.2018)
Vanessa Tolotto, MSc (University of Udine, 15.07.2018-15.09.2018)

STAFF

Group Leader:
Prof. Agnieszka Chacińska

Lab Manager:
Anna Kozłowska-Makulska, PhD

Senior Scientists:
Piotr Brągoszewski, PhD
Michał Wasilewski, PhD

Sabbatical Professor:
Carlo Vascotto, PhD

Postdoctoral Fellows:
Anna Antosiewicz, PhD
Katarzyna Chojnacka, PhD
Minji Kim, PhD
Agata Kodroń, PhD
Karthik Mohanraj, PhD
Ben Hur Mussulini, PhD
Urszula Nowicka, PhD
Łukasz Samluk, PhD
Tomasz Stępkowski, PhD
Michał Turek, PhD
Barbara Uszczyńska-Ratajczak, PhD

PhD Students:
Praveenraj Elancheliyan, MSc
Karolina Gościńska, MSc
Aleksandra Gosk, Eng.
Łukasz Kowalski, MSc
Martyna Pietrzyk, MSc
Tomasz Sitarz, MSc
Maria Śladowska, MSc
Sreedevi Sugunan, MSc

Students:
Żaneta Bugajska, MSc
Alicja Brudnicka
Konrad Kowalski
Albert Roethel

Research Technicians:
Elżbieta Grzelak
Monika Kwiatkowska, MSc

Visiting Students:
Veronica Bazzani, MSc
Inés Juaristi Santos, MSc
Vanessa Tolotto, MSc

Interdisciplinary Laboratory of Molecular Biology and Biophysics

Prof. Edward Darżynkiewicz

RESEARCH

General Overview

The Laboratory's main field of interest focuses on the so-called cap structures, i.e. the modified nucleotides that decorate the 5' ends of eukaryotic mRNAs and many snRNAs. Our current activities cover interdisciplinary studies on the molecular mechanisms of interactions between cap structures and protein regulator factors that are involved in processes of protein biosynthesis, RNA degradation and RNA recognition by cellular sensors. Results of our work will allow us to understand the significance of cap structure modifications in coordination of various functional processes that take place throughout the mRNA life cycle.

Furthermore, attempts are made to combine basic research with practical applications in order to design and synthesize mRNA transcripts that are stable and highly active translationally in a cell, which in turn can be used for biotechnological protein production and development of mRNA-based therapies. Our long-term goal is to develop modern mRNA-based drugs for protein replacement therapies or stem cells reprogramming. In our research we use a broad range of chemical, biological and biophysical methodologies. Our team cooperates with several laboratories located both in Poland and abroad.

2018 Research Focus

Our research activities were dedicated to understanding how various elements of translational machinery, decapping enzymes and RNA sensors recognize RNAs bearing different cap structures on their 5' end. Particularly we were studying activity of such human proteins as Dcp2, Nudt16, DcpS, and IFIT1. In our work we combined multiple approaches from the fields of organic chemistry, biophysics, biochemistry, and cellular biology. We continued design and synthesis of new cap analogs for stable, highly effective and non-immunogenic mRNAs for biotechnology and medicine.

PUBLICATIONS

- Grzela, R., Nasilowska, K., Lukaszewicz, M., Tyras, M., Stepinski, J., Jankowska-Anyszka, M., Bojarska, E., and Darzynkiewicz, E. (2018). Hydrolytic activity of human Nudt16 enzyme on dinucleotide cap analogs and short capped oligonucleotides. RNA 24, 633–642.
- Kocmik, I., Piecyk, K., Rudzinska, M., Niedzwiecka, A., Darzynkiewicz, E., Grzela, R., and Jankowska-Anyszka, M. (2018). Modified ARCA analogs providing enhanced translational properties of capped mRNAs. Cell Cycle 17, 1624–1636.

PROJECTS

- 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, 2013-2019

- Exploitation of regenerative potential of mesenchymal stem cells EXPLORE ME, Prof. Edward Darżynkiewicz, Prof. Jacek Jemielity, STRATEGMED NCBiR, 2016-2019.

STAFF

Group Leader:
Prof. Edward Darżynkiewicz

Senior Scientists:
Renata Grzela, PhD

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Michał Magda, MSc,
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Laboratory of Structural Bioinformatics

Dr. Stanisław Dunin-Horkawicz

RESEARCH

General Overview

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 machine 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.

2018 Research Focus

In the year 2018, our efforts were mainly focused on the development of bioinformatics tools for protein sequence and structure analysis. These tools have been developed as a part of a project aiming at the design of new protein structures. In particular, we developed deep learning-based methods for the prediction of protein structural features directly from sequences, and general purpose tools for the numerical representation of protein structures. These methods will be used to guide laboratory experiments.

ADDITIONAL INFORMATION

Website: https://lbs.cent.uw.edu.pl/

PUBLICATIONS

- Ludwiczak, J., Winski, A., Szczepaniak, K., Alva, V., and Dunin-Horkawicz, S. (2019). DeepCoil – a fast and accurate prediction of coiled-coil domains in protein sequences. Bioinformatics.
- Nowacka, M., Boccaletto, P., Jankowska, E., Jarzynka, T., Bujnicki, J.M., and Dunin-Horkawicz, S. (2019). RRMdb – an evolutionary-oriented database of RNA recognition motif sequences. Database 2019.
- Grzeszczuk, M.J., Bąk, A., Banaś, A.M., Urbanowicz, P., Dunin-Horkawicz, S., Gieldon, A., Czaplewski, C., Liwo, A., and Jagusztyn-Krynicka, E.K. (2018). Impact of selected amino acids of HP0377 (Helicobacter pylori thiol oxidoreductase) on its functioning as a CcmG (cytochrome c maturation) protein and Dsb (disulfide bond) isomerase. PLOS ONE.
- Ludwiczak, J., Jarmula, A., and Dunin-Horkawicz, S. (2018). Combining Rosetta with molecular dynamics (MD): A benchmark of the MD-based ensemble protein design. Journal of Structural Biology 203, 54–61.
- Szczepaniak, K., Ludwiczak, J., Winski, A., and Dunin-Horkawicz, S. (2018). Variability of the core geometry in parallel coiled-coil bundles. Journal of Structural Biology 204, 117–124.

PROJECTS

- An evolutionary-based approach to design the substrate specificity of the Rossmann fold enzymes, Dunin-Horkawicz Stanisław, PhD, First Team FNP, 2019-2022
- Design of new protein structures with precisely defined features using parametric models, Dunin-Horkawicz Stanisław, PhD, SONATA BIS NCN, 2016-2019
- Molecular mechanisms of the allosteric communication in thymidylate synthase, Ludwiczak Jan, MSc, PRELUDIUM NCN, 2018-2020
- Evolution of protein networks: development of a system to study the evolution of apoptotic molecular machinery, Szczepaniak Krzysztof, PhD and Cieplak-Rotowska Maja, PhD, DSM 2018

STAFF

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Students:
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Laboratory of Molecular Basis of Synaptic Plasticity

Dr. Magdalena Dziembowska

RESEARCH

General Overview

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.

2018 Research Focus

Our primary research interest focus on molecular mechanisms operating in the synapses which dysfunction leads to pathological states. We fous on the molecular analysis of the pathomechanism of fragile X syndrome (FXS). The proteins that were significantly upregulated in synapses isolated from Fmr1 KO mice in basal conditions revealed major processes in which they were involved. This included: calcium signaling, mitochondria and trafficking of synaptic receptors. In 2018 we have particularly explored mitochondrial biogenesis in the synapses of Fmr1 KO mice.

Laboratory of Molecular Basis of Synaptic Plasticity

Dr. Magdalena Dziembowska

PUBLICATIONS

- Chmielewska, J.J., Kuzniewska, B., Milek, J., Urbanska, K., and Dziembowska, M. (2018). Neuroligin 1, 2, and 3 Regulation at the Synapse: FMRP-Dependent Translation and Activity-Induced Proteolytic Cleavage. Molecular Neurobiology 1–19.
- Jones, K.J., Templet, S., Zemoura, K., Kuzniewska, B., Pena, F.X., Hwang, H., Lei, D.J., Haensgen, H., Nguyen, S., Saenz, C., Lewis, M., Dziembowska, M. (2018). Rapid, experience-dependent translation of neurogranin enables memory encoding. Proceedings of the National Academy of Sciences 115, E5805–E5814.
- Kuzniewska, B., Chojnacka, M., Milek, J., and Dziembowska, M. (2018). Preparation of polysomal fractions from mouse brain synaptoneurosomes and analysis of polysomal-bound mRNAs. Journal of Neuroscience Methods 293, 226–233.
- Kuzniewska, B., Sadowski, K., Urbanska, K., Urbanska, M., Kotulska, K., Liszewska, E., Grajkowska, W., Jóźwiak, S., and Dziembowska, M. (2018). The level of microRNA 21 is upregulated by rapamycin in serum of tuberous sclerosis complex patients and subependymal giant cell astrocytoma (SEGA)-derived cell cultures. Folia Neuropathologica 56, 167–174.
- Szczałuba, K., Chmielewska, J.J., Sokolowska, O., Rydzanicz, M., Szymańska, K., Feleszko, W., Włodarski, P., Biernacka, A., Murcia Pienkowski, V., Walczak, A., Bargeł, E., Królewczyk K., Nowacka, A., Stawiński, P., Nowis, D., Dziembowska, M., Płoski, R. (2018). Neurodevelopmental phenotype caused by a de novo PTPN4 single nucleotide variant disrupting protein localization in neuronal dendritic spines. Clinical Genetics 94, 581–585.

PROJECTS

- 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
- The role of microRNA-132 in the structural platicity of dendritic spines, Dziembowska Magdalena, PhD, OPUS NCN, 2015-2018
- The role of Tmcc2 in the development and maintenance of the inner ear mechanosensory hair cells, Kaźmierczak Piotr, PhD, OPUS NCN, 2017-2020
- Ultrastructure of hair cells of the organ of Corti and the effects of minocycline on responses to acustic stimulation in a mouse model of fragile X syndrome,.Dziembowska Magdalena, PhD, OPUSNCN, 2018-2021
- The study of neuroligin 3 mRNA interaction with fragile X mental retardation protein, Chmielewska Joanna Julia, MSc, PRELUDIUM NCN, 2018-2021

STAFF

Group Leader:
Magdalena Dziembowska, PhD

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Monika Roszkowska, PhD

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Research Technicians:
Katarzyna Urbańska, MSc

Laboratory of Bioinformatics and Systems Biology

Prof. Krzysztof Ginalski

RESEARCH

General Overview

The research interest includes development of new theoretical and experimental tools and their application to investigate structure, function and evolution of proteins and their interaction with ligands. Research is also focused on application of next generation sequencing to a wide range of genomic, metagenomic and transcriptomic studies.

2018 Research Focus

Our main research focused on development and application of novel next-generation sequencing methods to studying DNA double-strand breaks. Obtained results provide new perspectives to our understanding of molecular mechanisms of DNA double-strand breaks formation and repair and their influence on genome instability.

PROJECTS

- Identification and comprehensive classification of nucleases including human nucleases, Prof. Krzysztof Ginalski, OPUS NCN, 2015-2019
- Genome-wide studies of double-strand DNA breaks in Saccharomyces cerevisiae, Skrzypczak Magdalena, PhD, 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

COMPLETED

- High resolution map of DNA double-strand breaks in human genome, Prof. Krzysztof Ginalski, MAESTRO NCN, 2012-2018

Laboratory of Bioinformatics and Systems Biology

Prof. Krzysztof Ginalski

PUBLICATIONS

- Argemi, X., Matelska, D., Ginalski, K., Riegel, P., Hansmann, Y., Bloom, J., Pestel-Caron, M., Dahyot, S., Lebeurre, J., and Prévost, G. (2018). Comparative genomic analysis of Staphylococcus lugdunensis shows a closed pan-genome and multiple barriers to horizontal gene transfer. BMC Genomics 19, 621.
- Biernacka, A., Zhu, Y., Skrzypczak, M., Forey, R., Pardo, B., Grzelak, M., Nde, J., Mitra, A., Kudlicki, A., Crosetto, N., Pasero, P., Rowicka, M. and Ginalski, K. (2018). i-BLESS is an ultra-sensitive method for detection of DNA double-strand breaks. Communications Biology 1, 181.
- Clouaire, T., Rocher, V., Lashgari, A., Arnould, C., Aguirrebengoa, M., Biernacka, A., Skrzypczak, M., Aymard, F., Fongang, B., Dojer, N., Iacovoni, J. S., Rowicka, M., Ginalski, K., Côté, J. and Legube, G. (2018). Comprehensive Mapping of Histone Modifications at DNA Double-Strand Breaks Deciphers Repair Pathway Chromatin Signatures. Molecular Cell 72, 250-262.e6.
- Goryca, K., Kulecka, M., Paziewska, A., Dabrowska, M., Grzelak, M., Skrzypczak, M., Ginalski, K., Mroz, A., Rutkowski, A., Paczkowska, K., Mikula, M. and Ostrowski J. (2018). Exome scale map of genetic alterations promoting metastasis in colorectal cancer. BMC Genetics 19, 85.
- Gryganskyi, A.P., Golan, J., Dolatabadi, S., Mondo, S., Robb, S., Idnurm, A., Muszewska, A., Steczkiewicz, K., Masonjones, S., Liao, H.-L., Gajdeczka, M.T., Anike, F., Vuek, A., Anishchenko, I.M., Voigt, K., Sybren de Hoog, G., Smith, M.E., Heitman, J., Vilgalys, R. and Stajich, J. E. (2018). Phylogenetic and Phylogenomic Definition of Rhizopus Species. G3: Genes | Genomes | Genetics 8, 2007–2018.
- Kowalczyk, P., Borkowski, A., Czerwonka, G., Cłapa, T., Cieśla, J., Misiewicz, A., Borowiec, M., and Szala, M. (2018). The microbial toxicity of quaternary ammonium ionic liquids is dependent on the type of lipopolysaccharide. Journal of Molecular Liquids 266, 540–547.
- Kuchta, K., Towpik, J., Biernacka, A., Kutner, J., Kudlicki, A., Ginalski, K., and Rowicka, M. (2018). Predicting proteome dynamics using gene expression data. Scientific Reports 8, 13866.
- Kutner, J., Shabalin, I.G., Matelska, D., Handing, K.B., Gasiorowska, O., Sroka, P., Gorna, M.W., Ginalski, K., Wozniak, K., and Minor, W. (2018). Structural, Biochemical, and Evolutionary Characterizations of Glyoxylate/Hydroxypyruvate Reductases Show Their Division into Two Distinct Subfamilies. Biochemistry 57, 963–977.
- Matelska, D., Shabalin, I.G., Jabłońska, J., Domagalski, M.J., Kutner, J., Ginalski, K., and Minor, W. (2018). Classification, substrate specificity and structural features of D-2-hydroxyacid dehydrogenases: 2HADH knowledgebase. BMC Evolutionary Biology 18, 199.
- Mourad, R., Ginalski, K., Legube, G., and Cuvier, O. (2018). Predicting double-strand DNA breaks using epigenome marks or DNA at kilobase resolution. Genome Biology 19, 34.
- Wezyk, M., Spólnicka, M., Pośpiech, E., Pepłońska, B., Zbieć-Piekarska, R., Ilkowski, J., Styczyńska, M., Barczak, A., Zboch, M., Filipek-Gliszczynska, A., Skrzypczak, M., Ginalski, K., Kabza, M., Makałowska, I., Barcikowska-Kotowicz, M., Branicki, W. and Żekanowski, C. (2018). Hypermethylation of TRIM59 and KLF14 Influences Cell Death Signaling in Familial Alzheimer's Disease. Oxidative Medicine and Cellular Longevity 2018, 6918797.
- Wezyk, M., Szybinska, A., Wojsiat, J., Szczerba, M., Day, K., Ronnholm, H., Kele, M., Berdynski, M., Peplonska, B., Fichna, J.P., Ilkowski, J., Styczyńska, M., Barczak, A., Zboch, M., Filipek-Gliszczyńska, A., Bojakowski, K., Skrzypczak, M., Ginalski, K., Kabza, M., Makałowska, I., Barcikowska-Kotowicz, M., Wojda, U., Falk, A., Żekanowski, C. (2018). Overactive BRCA1 Affects Presenilin 1 in Induced Pluripotent Stem Cell-Derived Neurons in Alzheimer's Disease. Journal of Alzheimer's Disease 62, 175–202.

STAFF

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Dorota Matelska, PhD
Kamil Steczkiewicz, PhD

Programmist:
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Research Technicians:
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Magdalena Skrzypczak, PhD

Laboratory of Technology of Novel Functional Materials

Prof. Wojciech Grochala

RESEARCH

General Overview

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 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).

2018 Research Focus

We research related to hydrogen storage materials resulted in preparation of novel lanthanide borohydrides as well as extremely hydrogen-rich $(NH_4)[M(BH_4)_4]$, M = Y, Sc, Al. Position of neon and helium in the Periodic Table was reanalyzed, with unexpected outcome. The phenomenon of high-temperature superconductivity was shown to obey the Maximum Hardness Principle from Pearson. Compressed silver(II) fluoride was shown to hugely increase magnetic superexchange constant and reduce magnetic dimensionality when subjected to high pressure.

ADDITIONAL INFORMATION

Website: http://ltnfm.cent.uw.edu.pl/

PUBLICATIONS

- Grochala, W. (2018). On the position of helium and neon in the Periodic Table of Elements. Foundations of Chemistry 20, 191.
- Grochala, W. (2018). Silverland: the Realm of Compounds of Divalent Silver—and Why They are Interesting. Journal of Superconductivity and Novel Magnetism 31, 737.
- Grochala, W., and Derzsi, M. (2018). High-temperature superconductivity as viewed from the maximum hardness principle. Journal of Molecular Modeling 24, 233.
- Karwowska, M., Fijalkowski, K., and Czerwiński, A. (2018). Corrosion of Hydrogen Storage Metal Alloy LaMm-Ni4.1Al0.3Mn0.4Co 0.45 in the Aqueous Solutions of Alkali Metal Hydroxides. Materials 11, 2423.
- Kurzydłowski, D. (2018). The Jahn-Teller Distortion at High Pressure: The Case of Copper Difluoride. Crystals 8, 140.
- Kurzydłowski, D., Derzsi, M., Barone, P., Grzelak, A., Struzhkin, V., Lorenzana, J., and Grochala, W. (2018). Dramatic enhancement of spin–spin coupling and quenching of magnetic dimensionality in compressed silver difluoride. Chem. Commun. 54, 10252.
- Starobrat, A., Jaroń, T., and Grochala, W. (2018). New hydrogen-rich ammonium metal borohydrides, NH4[M(BH4)4], M = Y, Sc, Al, as potential H2 sources. Dalton Trans. 47, 4442.
- Szczurek, A., Fierro, V., Plyushch, A., Macutkevic, J., Kuzhir, P., and Celzard, A. (2018). Structure and Electromagnetic Properties of Cellular Glassy Carbon Monoliths with Controlled Cell Size. Materials 11, 709.
- Wegner, W., Jaroń, T., and Grochala, W. (2018). Preparation of a series of lanthanide borohydrides and their thermal decomposition to refractory lanthanide borides. Journal of Alloys and Compounds 744, 57.

Laboratory of Technology of Novel Functional Materials

Prof. Wojciech Grochala

PROJECTS

- 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, OPUS NCN, 2015-2019
- 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
- Investigation of the catalytic properties of vanadium compounds for decomposition of diborane and efficient solid-state hydrogen stores, Orłowski Piotr, Diamentowy Grant MNiSW, 2016-2020
- High-pressure synthesis and characterization of the chemical compounds based on boron, hydrogen, and selected main-group elements, Jaroń Tomasz, PhD, SONATA NCN, 2017-2020
- 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, 2017-2020
- Cell for electrical impedance measurements designed for investigation of highly reactive samples, Fijałkowski Karol, PhD, TANGO NCBiR, 2017-2020
- BEACs: new allotropic forms of carbon. Synthesis, doping, and electronic and adsorption properties, Szczurek Andrzej, PhD, SONATA BIS NCN, 2017-2021
- Synthesis, evaluation and recycling of the salts containing highly-fluorinated anions for energy storage applications, Jaroń Tomasz, PhD, HOMING FNP, 2017-2019
- 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, PhD, PRELUDIUM NCN, 2018-2021
- SILVERLAND. Unique silver route to superconducting cuprate analogs, Prof. Wojciech Grochala, MAESTRO NCN, 2018-2022
- Squeezing double perovskites: an insight into high-pressure structures of alkali metal fluoroargentates M_2AgF_4 (M=Na-Cs), Gawraczyński Jakub, MSc, PRELUDIUM NCN, 2018-2021
- Luminescent magnetic materials based on lanthanides and boron, Wegner Wojciech, MSc, PRELUDIUM NCN, 2018-2021

COMPLETED

- Modern functional materials based on lanthanides and boron, Wegner Wojciech, MSc, Diamentowy Grant MNiSW, 2014-2018
- Renewable generation of ammonia form atmospheric nitrogen, Fijałkowski Karol, PhD, MobilityPlus, MNiSW, 2016-2018

STAFF

Group Leader:
Prof. Wojciech Grochala

Postdoctoral Fellows:
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Martyna Rzepecka, PhD
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Paweł Szarek, PhD
Andrzej Szczurek, PhD
Łukasz Wolański, PhD

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Kacper Koteras, MSc
Piotr Orłowski, MSc
Rafał Owarzany, Msc
Agnieszka Starobrat, MSc
Wojciech Wegner, MSc

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Magdalena Grochowska
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Marcin Witkowski
Aleksander Woźniak

Organometallic Chemistry Laboratory

Dr. Paweł Horeglad

RESEARCH

General Overview

"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 investigate the catalytic properties and application of selected catalysts in the synthesis of biodegradable polyesters. Determining the relationship between the structure of 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." (from the internet site of Organometallic Chemistry Laboratory at www.cent.uw.edu.pl)

2018 Research Focus

Activity of members of the Organometallic Chemistry Laboratory, CeNT UW, in 2018 was mainly concerned with both scientific and educational activity. They included the research work within SONATA BIS and PRELUDIUM projects, financed by National Science Centre of Poland as well as research work within PhD and MSc theses

PUBLICATIONS

- Cybularczyk-Cecotka, M., Dąbrowska, A., Guńka, P., and Horeglad, P. (2018). Probing the Effect of Six-Membered N-Heterocyclic Carbene—6-Mes—on the Synthesis, Structure and Reactivity of Me2MOR(NHC) (M = Ga, In) Complexes. Inorganics 6, 28.
- Zaremba, R., Dranka, M., Trzaskowski, B., Chęcińska, L., and Horeglad, P. (2018). Probing the M–C NHC Bond and Its Effect on the Synthesis, Structure, and Reactivity of R 2 MOR(NHC) (M = Al, Ga, In) Complexes. Organometallics 37, 4585–4598.

PROJECTS

- 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, SONATA BIS NCN, 2013-2018
- The influence of asymmetric N-heterocyclic carbenes on synthesis, structure and activity of dialkylgallium alkoxides in the polymerization of rac-lactide, Dąbrowska Anna, MSc, PRELUDIUM NCN, 2017-2019

STAFF

Group Leader:
Paweł Horeglad, PhD, DSc

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Students:
Rafał Zaremba, BSc

Laboratory of Human Cancer Genetics

Prof. Krystian Jażdżewski

RESEARCH

General Overview

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

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

PUBLICATIONS

- Augustyniak, J., Lenart, J., Gaj, P., Kolanowska, M., Jazdzewski, K., Stepien, P.P., and Buzanska, L. (2018). Bezafibrate Upregulates Mitochondrial Biogenesis and Influence Neural Differentiation of Human-Induced Pluripotent Stem Cells. Molecular Neurobiology 1–18.
- Kolanowska, M., Kubiak, A., Jażdżewski, K., and Wójcicka, A. (2018). MicroRNA Analysis Using Next-Generation Sequencing. In MiRNA Biogenesis: Methods and Protocols, U.A.V. Ørom, ed. (New York, NY: Springer New York), pp. 87–101.
- Kotlarek, M., Kubiak, A., Jażdżewski, K., and Wójcicka, A. (2018). MicroRNA Analysis Using the Quantitative Real-Time PCR Reaction. In MiRNA Biogenesis: Methods and Protocols, U.A.V. Ørom, ed. (New York, NY: Springer New York), pp. 69–85.
- Kotlarek, M., Kubiak, A., Czetwertyńska, M., Świerniak, M., Gierlikowski, W., Kolanowska, M., Bakuła-Zalewska, E., Jhiang, M.S., Jażdżewski, K., and Wójcicka, A. (2018). The rs2910164 Genetic Variant of miR-146a-3p Is Associated with Increased Overall Mortality in Patients with Follicular Variant Papillary Thyroid Carcinoma. International Journal of Molecular Sciences 19, 655.

PROJECTS

- Novel approach to a large-scale population screening for genetic diseases - a proof-of-concept, Prof. Krystian Jażdżewski, TEAM FNP, 2016-2019

COMPLETED

- 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
- Molecular functions of the human SUV3 gene, Prof. Piotr Stępień 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, MSc, PRELUDIUM NCN, 2015-2018

STAFF

Group Leader:
Prof. Krystian Jażdżewski, M.D. PhD

Pofessors:
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Postdoctoral Fellows:
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Monika Kolanowska, PhD
Marta Kotlarek, MSc
Anna Kubiak, PhD
Julia Staręga-Rosłan, PhD
Michał Świerniak, PhD

PhD Students:
Ewelina Użarowska, MSc

Laboratory of Bioorganic Chemistry

Prof. Jacek Jemielity

RESEARCH

General Overview

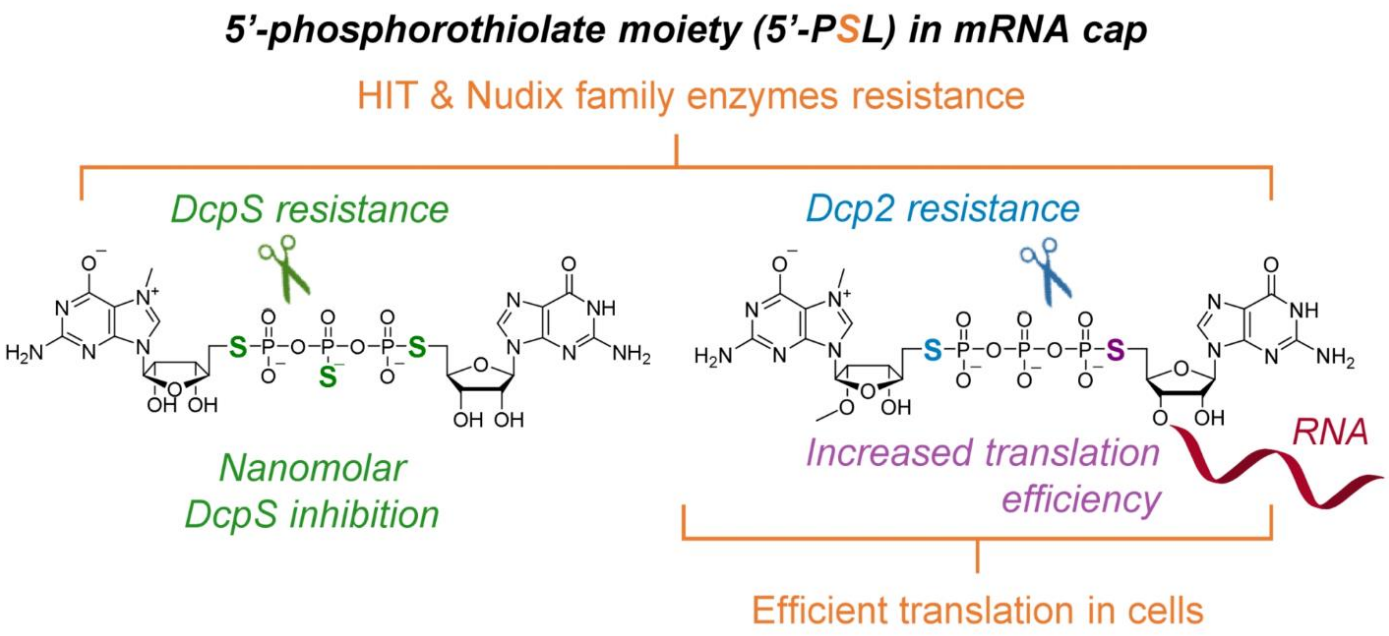
Laboratory of Bioorganic Chemistry is focused on the synthesis, properties and applications of modified nucleotides (including analogs of mRNA 5' cap, nucleoside triphosphates, nucleotide sugars, nucleoside phosphosulfates and many others). The main goal of our research is to create tools useful for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

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

The laboratory operates in two locations – team uses the hospitality of the Department of Biophysics, Faculty of Physics, University of Warsaw.

2018 Research Focus

The aim of the study was the synthesis of modified nucleotide analogs as tools for the study of cell processes, potential therapeutic agents and molecular probes to monitor the activity of proteins involved in the metabolism of nucleotides and nucleic. Several potent inhibitors of cap-dependent proteins have been synthesized, characterized and used in structural and functional studies. New methods of mRNA modifications within both 5' and 3' ends were developed to increase mRNA therapeutic potential.



Laboratory of Bioorganic Chemistry

Prof. Jacek Jemielity

PUBLICATIONS

- Bednarek, S., Madan, V., Sikorski, P.J., Bartenschlager, R., Kowalska, J., and Jemielity, J. (2018). mRNAs biotinylated within the 5′ cap and protected against decapping: new tools to capture RNA–protein complexes. Philosophical Transactions of the Royal Society B: Biological Sciences 373, 20180167.
- Essig, K., Kronbeck, N., Guimaraes, J.C., Lohs, C., Schlundt, A., Hoffmann, A., Behrens, G., Brenner, S., Kowalska, J., Lopez-Rodriguez, C., Jemielity, J., Holtmann, H., Reiche, K., Hackermüller, J., Sattler, M., Zavolan, M., and Heissmeyer, V. (2018). Roquin targets mRNAs in a 3′-UTR-specific manner by different modes of regulation. Nature Communications 9, 3810.
- Kozarski, M., Kubacka, D., Wojtczak, B.A., Kasprzyk, R., Baranowski, M.R., and Kowalska, J. (2018). 7-Methylguanosine monophosphate analogues with 5′-(1,2,3-triazoyl) moiety: Synthesis and evaluation as the inhibitors of cNIIIB nucleotidase. Bioorganic & Medicinal Chemistry 26, 191–199.
- Mlynarska-Cieslak, A., Depaix, A., Grudzien-Nogalska, E., Sikorski, P.J., Warminski, M., Kiledjian, M., Jemielity, J., and Kowalska, J. (2018). Nicotinamide-Containing Di- and Trinucleotides as Chemical Tools for Studies of NAD-Capped RNAs. Organic Letters 20, 7650–7655.
- Mugridge, J.S., Tibble, R.W., Ziemniak, M., Jemielity, J., and Gross, J.D. (2018). Structure of the activated Edc1-Dcp1-Dcp2-Edc3 mRNA decapping complex with substrate analog poised for catalysis. Nature Communications 9, 1152.
- Walczak, S., Sikorski, P.J., Kasprzyk, R., Kowalska, J., and Jemielity, J. (2018). Exploring the potential of phosphotriazole 5′ mRNA cap analogues as efficient translation initiators. Organic & Biomolecular Chemistry 16, 6741–6748.
- Wanat, P., Kasprzyk, R., Kopcial, M., Sikorski, P.J., Strzelecka, D., Jemielity, J., and Kowalska, J. (2018). ExciTides: NTP-derived probes for monitoring pyrophosphatase activity based on excimer-to-monomer transitions. Chemical Communications 54, 9773–9776.
- Wojtczak, B.A., Sikorski, P.J., Fac-Dabrowska, K., Nowicka, A., Warminski, M., Kubacka, D., Nowak, E., Nowotny, M., Kowalska, J., and Jemielity, J. (2018). 5′-Phosphorothiolate Dinucleotide Cap Analogues: Reagents for Messenger RNA Modification and Potent Small-Molecular Inhibitors of Decapping Enzymes. J. Am. Chem. Soc. 140, 5987–5999.

PROJECTS

- 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, Ciechanowicz (z d. Walczak) Sylwia, MSc, PRELUDIUM NCN, 2016-2019
- Synthesis and biological eyaluation of short RNA oligonucieotides ended with a cap structure, Ratajczak Tomasz, PhD, FUGA NCN, 2016-2019
- Synthesis of double-functionalized 5'-end mRNA analogs as molecular probes for cell based studies, Kleczewska Natalia, PhD, FUGA NCN, 2016-2019
- Chemically modified mRNA for studies on cellular processes and therapeutic applications, Prof. Jacek Jemielity, OPUS NCN, 2017-2020
- 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
- Synthesis of trimethyl cap analogs modified with molecular rotors and their application in nuclear transport studies, Wojtczak Błażej, PhD, SONATA NCN, 2018-2021

COMPLETED:

- New reagents and methods in synthesis of modified nucleotides and their application for preparation biochemical tools and nucleotides with great therapeutic potential, Prof. Jacek Jemielity, SONATA BIS NCN, 2013-2018
- New methods of mRNA synthesis for therapeutic applications, Prof. Jacek Jemielity, KONKURS NA GRANT UOTT, 2017-2018

STAFF

Group Leader:
Prof. Jacek Jemielity

Postdoctoral Fellows:
Mikołaj Chromiński, PhD
Anais Depaix, PhD (FUW)
Natalia Kleczewska, PhD
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Dorota Kubacka, PhD (FUW)
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Renata Kasprzyk, MSc
Michał Kopciał, MSc
Mateusz Kozarski, MSc
Adam Mamot, MSc
Agnieszka Młynarska-Cieślak, MSc
Olga Perzanowska, MSc
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Andrzej Kraszewski
Jędrzej Kubica
Teodor Olejko
Radosław Wójcik

Research Technicians:
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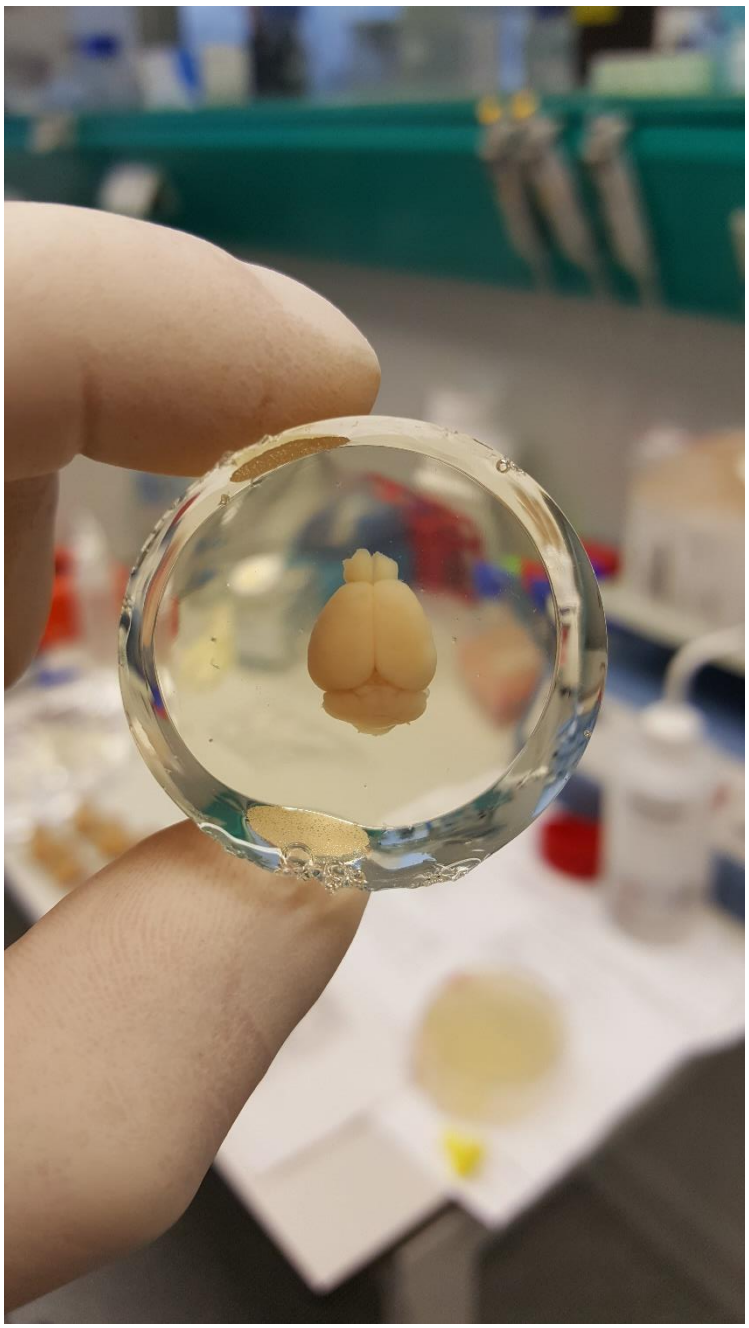

Gelatin embedded post-fixed brain of an adult mouse

Laboratory of Molecular Neurobiology

Prof. Marta Wiśniewska

CeNT CENTRE OF NEW TECHNOLOGIES

Laboratory of Asymmetric Catalysis

Dr. Marcin Kałek

RESEARCH

General Overview

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 in high enantiopurity, which is a prerequisite for present-day pharmaceutical applications. We work in three major areas: asymmetric organocatalysis, organometallic chemistry, and computational chemical modelling.

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 a 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.

2018 Research Focus

In 2018, we were primarily focused on the development of new useful reactions employing hypervalent iodine compounds. In particular, we were able to devise an array of methods allowing for the transfer of various groups, such as aryl, vinyl, and propargyl, from iodonium salts onto different organic acceptors. Additionally, we studied asymmetric dearomatization of phenols promoted by hypervalent iodine oxidants and investigated in depth its mechanism, both experimentally and computationally.

ADDITIONAL INFORMATION

Website: http://kalekgroup.pl/

PUBLICATIONS

- Ghosh, M., Rajkiewicz, A., and Kalek, M. (2018). Organocatalytic Group Transfer Reactions with Hypervalent Iodine- Reagents. Synthesis 51, 359–370.
- Qiu, Y., Mendoza, A., Posevins, D., Himo, F., Kalek, M., and Bäckvall, J.E. (2018). Mechanistic Insight into Enantioselective Palladium-Catalyzed Oxidative Carbocyclization-Borylation of Enallenes. Chemistry - A European Journal 24, 2433–2439.
- Rajkiewicz, A.A., and Kalek, M. (2018). N-Heterocyclic Carbene-Catalyzed Olefination of Aldehydes with Vinyliodonium Salts To Generate α,β-Unsaturated Ketones. Organic Letters 20, 1906–1909.

PROJECTS

- 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

STAFF

Group Leader:
Marcin Kałek, PhD

Postdoctoral Fellows:
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PhD Students:
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Sudeep Sarkar

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Ireneusz Tomczyk
Natalia Wojciechowska

Solar Fuels Laboratory

Prof. Joanna Kargul

RESEARCH

General Overview

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 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.

2018 Research Focus

The Solar Fuels Laboratory at CeNT UW has made several further discoveries related to both natural and bioinspired artificial solar energy conversion. Our biochemical and biophysical experiments with the use of time-resolved absorption spectroscopy and fluorescence have shown that red chlorophylls play a crucial role in slowing down the energy transfer pathways to the photosynthetic reaction centres in extremophilic photosynthetic apparatus. We also showed that significant remodelling of photosynthetic antenna complexes occurs upon not only light stressors but also upon application of salt and temperature stress. Our research on the biohybrid artificial leaf yielded several important discoveries on the role of metal redox centres and plasmonic interactions that can boost the solar energy conversion efficiency.

Solar Fuels Laboratory

Prof. Joanna Kargul

PUBLICATIONS

- Haniewicz, P., Abram, M., Nosek, L., Kirkpatrick, J., El-Mohsnawy, E., Olmos, J.D.J., Kouřil, R., and Kargul, J.M. (2018). Molecular Mechanisms of Photoadaptation of Photosystem I Supercomplex from an Evolutionary Cyanobacterial/Algal Intermediate. Plant Physiol. 176, 1433.
- Kargul, J., Bubak, G., and Andryianau, G. (2018). Biophotovoltaic Systems Based on Photosynthetic Complexes. In Reference Module in Chemistry, Molecular Sciences and Chemical Engineering, (Elsevier), pp. 43–63.
- Kiliszek, M., Harputlu, E., Szalkowski, M., Kowalska, D., Unlu, C.G., Haniewicz, P., Abram, M., Wiwatowski, K., Niedziółka-Jönsson, J., Maćkowski, S., Ocakoglu, K., and Kargul, J. (2018). Orientation of photosystem I on graphene through cytochrome c553 leads to improvement in photocurrent generation. Journal of Materials Chemistry A 6, 18615–18626.
- Osella, S., Kiliszek, M., Harputlu, E., Unlu, C.G., Ocakoglu, K., Kargul, J., and Trzaskowski, B. (2018). Controlling the charge transfer flow at the graphene/pyrene–nitrilotriacetic acid interface. Journal of Materials Chemistry C 6, 5046–5054.

PROJECTS

- Structural and functional characterisation of the photosynthetic apparatus of an extremophilic red microalga Cyanidioschyzon merolae, Kargul Joanna, PhD, OPUS NCN, 2015-2018
- Graphene-derived electrodes for bio-inspired solar-fuel device - GraphESol – Prof. Joanna Kargul, Polish-Turkish bilateral cooperation NCBiR, 2016-2019
- Design and optimisation of molecular interface for efficient electron transfer within photosystem I-based photovoltaic devices, Kargul Joanna, PhD, OPUS NCN, 2018-2021

STAFF

Group Leader:
Prof. Joanna Kargul

Postdoctoral Fellows:
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Margot Jacquet, PhD
Małgorzata Kiliszek, PhD
Jarosław Sar, PhD

PhD Students:
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Alumni:
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Anita Jarzębińska, MSc
Grzegorz Bubak, PhD Eng
Gleb Andryianau, MSc Eng
Tomasz Kalinowski, BSc
Paulina Misiukiewicz, BSc
Julia Dreksler, BSc
Gaweł Bojanowski, BSc
Jacek Rymuszka, BSc
Marcin Kleibert
Jędrzej Machtyl
Szymon Piaszczyński
Rafał Stachura
Szymon Górnisiewicz
Justyna Kiełbasa
Małgorzata Kucia

Laboratory of NMR Spectroscopy

Prof. Krzysztof Kazimierczuk

RESEARCH

General Overview

We develop new tools for multidimensional spectroscopy by puting into practice the recent achievements of applied mathemathics. Among them, the area of compressed sensing (CS) particularly attracts our attention.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 with much smaller number of samples than assumed by a conventional sampling theory. The group of methods is developing very rapidly and found applications in many fields of science, e.g. MRI, astronomy, biology and many others. It was also introduced to NMR spectroscopy. In case of NMR, the use of CS allows the significant shortening of experiments and the implementation of novel techniques that are infeasible with conventional sampling. Currently, our group works on the theory and practice of CS-NMR by developing new signal processing algorithms and signal acquisition methods. We elaborate techniques dedicated for particular cases of NMR experiments – analysis of chemical reactions and processes, NMR diffusometry and relaxometry and metabolomics. The laboratory provides an access to equipment for NMR of proteins, solid state materials and suspensions. We are open to the scientific collaboration with academic and industrial groups.

2018 Research Focus

2018 was an important year in the activity of LSNMR. Some of the lab members leaved the group, and newly recruited ones entered new areas of research funded by FIRST TEAM and HARMONIA grants. Our current studies are focused on the novel methods of acquiring and processing NMR signals that are based on time-frequency analysis. The approach is known in other fields, but never applied to NMR spectroscopy. It opens way to new experiments providing insight into molecular dynamics.

PUBLICATIONS

- Gołowicz, D., Urbańczyk, M., Shchukina, A., and Kazimierczuk, K. (2018). SCoT: Swept coherence transfer for quantitative heteronuclear 2D NMR. Journal of Magnetic Resonance 294, 1–6.
- Kazimierczuk, K. (2018). Compressed Sampling in NMR Spectroscopy. In EMagRes, (American Cancer Society), pp. 1–8.

PROJECTS

- Time-resolved N-dimensional spectroscopy for monitoring of physical and chemical processes, Kazimierczuk Krzysztof, PhD, OPUS NCN, 2016-2020
- 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

COMPLETED:

- Sparse and approximately-sparse representations in problems of NMR, Kazimierczuk Krzysztof, PhD, SONATA BIS NCN, 2013-2018

STAFF

Group Leader:
Prof. Krzysztof Kazimierczuk,
Postdoctoral Fellows:
Alexandra Shchukina, PhD

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Ewa Nawrocka, MSc

Students:
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Research Technicians:
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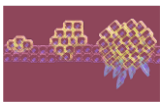
ADDITIONAL INFORMATION

Website:
http://nmr.cent.uw.edu.pl/

Laboratory of the Molecular Biology of Cancer

Dr. Agnieszka Kobielak



RESEARCH

General Overview

The progression of cancer from locally growing to treatment-resistant and metastatic is most often the event responsible for treatment failures. Cancer stem cells have been increasingly shown to play an integral role in tumor initiation, disease progression, metastasis, and treatment resistance. Therefore our research is focused on the characterization of cells of origin of epithelial cancers, signaling pathways involved in tumor heterogeneity with the focus on cancer cells with invasive potential and also on the role of EMT and microenvironment in the development of the phenotypic and functional diversity of cancer cells. In our experimental approach, we are using different molecular and cellular approaches. We are also developing reporter systems combined with lineage tracing to study cancer stem cells, cancer invasion and metastasis as well as cancer heterogeneity in primary mouse tumor models and in human cancers.

2018 Research Focus

The cancer stem-cell model suggests that within the tumor there is a small population of cells named cancer stem cells (CSC) that have potential to reestablish the tumor and are more resistant to currently available treatments and responsible for cancer metastasis. The biggest challenge is to isolate specific populations of cancer stem cells and invasive cells in order to better characterize them and develop potential new, specific treatments. Therefore we developed two reporter systems to unravel biological properties and signaling pathways that govern the highly plastic phenotypic states of cancer stem cells and invasive cancer cells in squamous cell carcinoma (SCC) and in breast cancer (BC) models. We have identified so far a molecular signature of SCC cancer initiating cells and invasive cancer cells. From a future therapeutic standpoint, our research will have a strong impact since the high plasticity within cancer cells suggest that in order to effectively target cancer we have to develop strategies that not only eradicate CSCs but also eliminate non-CSCs to CSCs transition.

PROJECTS

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

STAFF

Group Leader:
Agnieszka Kobielak, PhD

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Laboratory of Stem Cells, Tissue Development and Regeneration

Dr. Krzysztof Kobielak

RESEARCH

General Overview

Unveiling fundamental biological processes in adult stem cells regulation is important, since stem cells are not only required for physiological tissue or organ self-renewal but also play critical role during their regeneration after injury. Therefore understanding a precise regulation of adult stem cells homeostasis is very crucial since deregulation of stem cells self-renewal might result in organ failure or tumor formation. Thus, further discovery of the molecular factors tightly governing intrinsic balance of signaling pathways in stem cells is very important question in regenerative medicine and one of the goals of my laboratory. This knowledge might be very essential to understand a common mechanism of stem cells homeostasis and tissue regeneration and might be useful to adopt these basic discoveries to novel form of stem cell therapies in human. To address it, my laboratory will use 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. Dissecting the underlying similarities and differences which occur during distinct skin appendages renewal may prove highly beneficial in unraveling the fundamental principles which govern tissue or organ regeneration in vivo.

2018 Research Focus

During 2018, we focused further on identifying the key interactions of known transducers of canonical BMP signaling namely phosphorylated Smads (pSmads) in genes regulation of hair follicle Stem Cells (hfSCs) using our recently developed triple transgenic system. Moreover, since we identified Id2 gene as a target of BMP signaling in hfSCs with transcriptional down-regulation following targeted BMP inhibition, therefore, we decided to further test the functional role of the BMP effector, Id2 in hfSCs using an in vivo Id2 Gain of Function (Id2-GOF) approach. To address it we generated conditionally inducible transgenic mice to specifically activate Id2 gene in genetically labeled hfSCs. Our data demonstrated that Id2 overexpression in hfSCs results in delay of anagen activation and a prolonged telogen.

To further characterize molecular consequences of Id2 overexpression in hfSCs we performed RNA-seq analysis on FACS sorted hfSCs (gated through YFP+ and CD34+ and α6 integrin+ for bulge stem cells population) from Id2-GOF and control mice at p23 with biologically independent replicates, respectively. At first we compared pool of common signature genes of quiescent hfSCs (Greco et al., Cell Stem Cell 2009) with the gene changes observed after overexpression of Id2 in quiescence hfSCs. We confirmed that 41 out of 426 common previously published signature genes have been affected by overexpression of Id2 in quiescence bulge hfSCs. Interestingly, we found 22 (out of 41) genes to be commonly affected by both BMP signaling and Id2 in the common signature genes in hfSCs whereas 19 genes have been independently regulated by Id2 transcription factor. Overall, pool all overlapped genes between BMPR1A-KO and Id2-GOF in hfSCs comprise of 405 genes and consistently we observed 338 out 405 genes (more than 83%) to be indeed expressed in opposite direction between these transgenic models. Thus, these opposite molecular changes in genes expression correlate very well with observed in these transgenic mice biological functions which results in either activation and inhibition of hfSCs after BMP ablation or Id2 overexpression, respectively. In conclusion, our data support hierarchy of BMP signaling being crucial for regulation of homeostasis in hfSCs where activation of BMP signaling is essential to directly activate downstream key effector gene Id2. We demonstrated that BMP/pSmads pathway regulates gene network working synergistically with Id2 effector gene (83% of overlapped genes work in the same direction) to maintain quiescence in hfSCs during telogen. Thus, Id2 effector gene enhanced the function of BMP signaling pathway in regulation of some “core” genes responsible for hfSCs quiescence. Our data also suggest, that Id2 effector gene expends and complements network of genes which are regulated independently from BMP/pSmads pathway during quiescent phase of hair cycle, since 88% of the Id2-GOF gene changes not overlapped with our previous change genes observed in BMPR1A-KO model.

Last year, these data have been presented on several occasion on international scientific meetings such as: International Investigative Dermatology (IID meeting in Orlando, Florida, USA 2018) and 4th Baltic Stem Cell meeting (in Warsaw, Poland, 2018

Laboratory of Stem Cells, Tissue Development and Regeneration

Dr. Krzysztof Kobielak

PUBLICATIONS

- Szyndler, J., Maciejak, P., Kołosowska, K., Chmielewska, N., Skórzewska, A., Daszczuk, P., and Płaźnik, A. (2018). Altered expression of GABA-A receptor subunits in the hippocampus of PTZ-kindled rats. Pharmacological Reports 70, 14–21.
- Wang, X., Wang, G., Ramos, R., Wang, X., Daszczuk, P., Mazurek, P., Yun, K., Israel, M., Plikus, M., and Kobielak, K. (2018). 1392 Activation of Id2 gene regulatory network ruling quiescence of hair follicle stem cells. Journal of Investigative Dermatology 138, S236.

PROJECTS

- Hair follicle stem cells regulation during hair cyclic regeneration, Kobielak Krzysztof, PhD, OPUS NCN, 2016-2022
- Regulators of BMP and WNT signaling pathways in homeostasis of hair follicle stem cells, Daszczuk Patrycja, MSc, PRELUDIUM NCN, 2018-2021
- Reciprocal interaction between hair follicle Steam Cells and surrounding niche during skin and hair regeneration, Kobielak Krzysztof, PhD, TEAM FNP, 2018-2021

STAFF

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Monika Lasocka
Konrad Łukaszyk

Research Technicians:
Agnieszka Kikulska, PhD Eng.

Quantum Information and Inference (QI2) Laboratory

Dr. Jan Kołodyński

RESEARCH

General Overview

Quantum information science is a research area that investigates quantum systems as natural and fundamental building-blocks for transmitting, storing and processing information. It explores how to exploit quantum properties of light and matter in order to perform tasks of communication, computation and sensing in the most efficient and, sometimes, also completely secure fashion.

However, as quantum mechanics is probabilistic by nature and, moreover, quantum systems are very fragile—being vulnerable to any external noise—advanced statistical inference and signal processing techniques turn out to be essential in order to exploit the full potential of any real-life quantum device. Quantum inference theory studies how to tailor such data inference tools so that quantum properties of systems can not only be accounted for but also extensively benefited from.

Within QI2-lab we primarily work on quantum metrology and sensing tasks. We develop the fundamental theory of quantum estimation protocols in order to focus on their optical implementations, with a particular interest in quantum sensors based on atomic-spin ensembles. We also seek novel practical solutions in quantum information tasks of cryptography and communication, while exploring the applicability of their state-of-art photonic implementations. Last but not least, we work on quantum software—our aim is to create an open-source library that will encompass various “quantum-tailored” data inference tools (such as filtering, compressive sampling or machine learning) so that they can be directly implemented in quantum control and sensing experiments that involve continuous-time measurements.

2018 Research Focus

The QI2 laboratory has been established only in November 2018, so the final months of 2018 were primarily devoted to the launch of the laboratory. In particular, this has involved setting in at the CeNT premises, organisation and order of the necessary equipment, recruitment of both masters and PhD students, as well as teaching at the Faculty of Physics where potential candidates could have been directly approached.

STAFF

Group Leader:
Jan Kołodyński, PhD

Laboratory of RNA Biology

Prof. M. Magda Konarska

RESEARCH

General Overview

The focus of the 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 investiagte 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.

2018 Research Focus

We have mapped mutations within the core of yeast U6 snRNA that modulate conformational changes between the two catalytic steps. We propose that U6-ISL within the spliceosome exists in two competing states, changing between default, non-catalytic and transient, catalytic conformations, which differ by a degree of flexibility within the lower ISL segment. Thus, in addition to the catalytic triplex, U6-ISL acts as an important dynamic component of the catalytic center, and the conservation of these elements in all eukaryotes argues for the generality of the proposed mechanism

PROJECTS

- 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, 2013-2020

STAFF

Group Leader:
Prof. M. Magda Konarska

Postdoctoral Fellows:
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Marcin Magnus, PhD
Katarzyna Matylla-Kulińska ,PhD

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Hanna Góra, MSc
Agata Jaskulska, MSc
Adarsh Mohapatra, MSc

Students:
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Łukasz Widło

Research Technicians:
Jacek Miłek, MSc
Marta Skiba, PhD

Laboratory of Small Molecules' Activation

Dr. Przemysław Malinowski

RESEARCH

General Overview

Research performed at the Small Molecules Activation Laboratory is focused on utilizing highly reactive salts of weakly coordinating anions in transformations of small and 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 extend also to 1st row transition metals from titanium to copper.

Research within SMALab is financed by Foundation for Polish Science (Homing) and National Centre of Science (Sonata).

2018 Research Focus

The research resulted in synthesis and thorough characterization of novel and by far the most stable metal complex with nitrous oxide, what was the topic of the paper published in Angewandte Chemie. Among other achievements, it was possible to obtain and characterize several highly reactive salts of divalent metals, including calcium, manganese, iron, nickel and cobalt, some of which have proven highly active catalysts in organic reactions

PUBLICATIONS

- Zhuravlev, V., and Malinowski, P.J. (2018). A Stable Crystalline Copper(I)–N2O Complex Stabilized as the Salt of a Weakly Coordinating Anion. Angewandte Chemie International Edition 57, 11697–11700.

PROJECTS

- 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, 2015-2019
- Transition metal salts of weekly coordination anions as model scavengers of nitrous oxide and halogenated hydrtocarbons, Malinowski Przemysław, PhD, HOMING FNP, 2017-2019

STAFF

Group Leader:
Przemysław Malinowski, PhD

Students:
Michał Jadwiszczak
Vadim Zhuravlev

Laboratory of Molecular and Cellular Signaling

Dr. Paweł Niewiadomski

RESEARCH

General Overview

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 particular 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 Gli transcription factors, which are the main effectors of the pathway in the nucleus. To achieve that 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 implications for the treatment of human disease, including cancer.

2018 Research Focus

The focus of the Laboratory of Molecular and Cellular signaling is the molecular dissection of mechanisms governing cellular signal transduction in development and in disease, with particular emphasis on carcinogenesis. We use state-of-the-art methods such as bioinformatics, data mining, mass spectrometry, confocal microscopy, and CRISPR-based mutagenesis to gain insight into cellular signaling pathways, such as the Hedgehog pathway and MAPK/ERK pathway. Our work should contribute to novel treatments against malignancies such as medulloblastoma and melanoma.

ADDITIONAL INFORMATION

Website: http://lmcs.cent.uw.edu.pl/

PROJECTS

- Role of primary cilia in the activation of Gli transcription factors in Hedgehog signalling, Niewiadomski Paweł, PhD, SONATA BIS NCN, 2015-2020
- Determinants of the nuclear location of Oli proteins, Markiewicz Łukasz, PhD, FUGA NCN, 2016-2019
- Role of the exocyst complex in transport of cytoplasmic proteins to the primary cilium, Niedziółka Sylwia, MSc, PRELUDIUM, 2018-2021
- Role of proteasome in the regulation of Gli protein activity by the Hedgehog pathway, Niewiadomski Paweł, PhD, OPUS NCN, 2018-2021

STAFF

Group Leader:
Paweł Niewiadomski, PhD

Postdoctoral Fellows:
Katarzyna Chojnowska, PhD
Łukasz Markiewicz, PhD
Anna Strzeszewska-Potyrała, PhD

PhD Students:
Brygida Baran, MSc
Sylwia Niedziółka, MSc
Tomasz Uśpieński, MSc

Students:
Klaudia Kosieradzka

Laboratory of Experimental Medicine

Prof. Dominika Nowis

RESEARCH

General Overview

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 the main focus on mechanisms regulating protein homeostasis in mammalian cells (such as ubiquitin-proteasome system, autophagy, endoplasmic reticulum-associated degradation, and unfolded protein response);

- study the role on the immune system in the tumor development, progression and sensitivity to anti-cancer treatments and to elucidate novel targets/protocols for the immunotherapy of tumors;

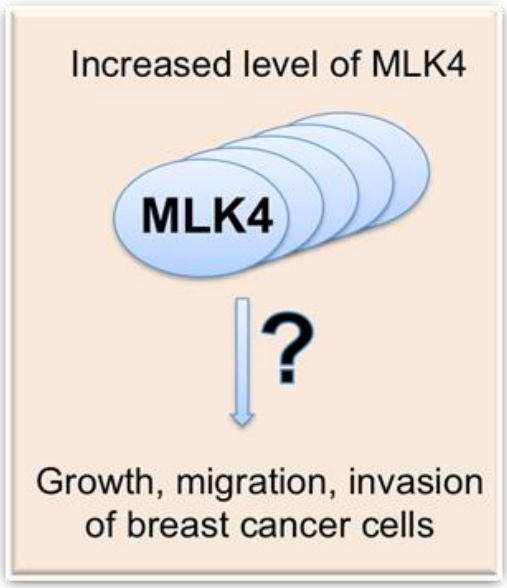
- study the role of selected signaling pathways in the development and progression of tumors.

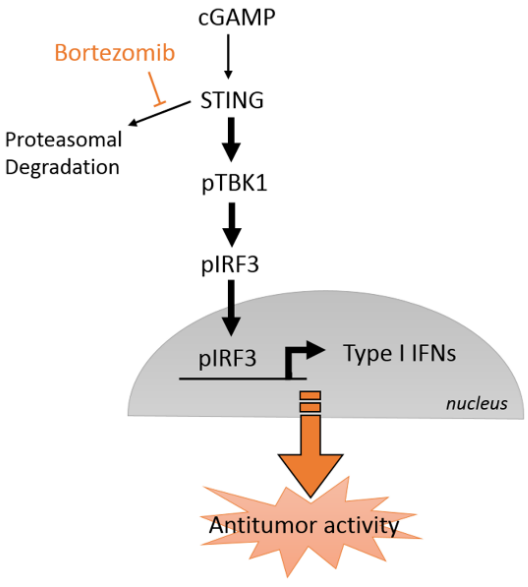
Our research involves studies in primary human cancer cells, established human and mouse cancer cell lines and syngeneic as well as xenograft tumor models in mice. We have developed numerous syngeneic tumor models for the in vivo study of the innate as well as antigen-specific immune responses and focused our attempts to improve 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 medicine, molecular biology and bioinformatics to discover novel, effective and clinically applicable anti-tumor treatment modalities.

2018 Research Focus

In 2018 we finalized and published the results of two research projects implemented in our laboratory. 1) We discovered and validated a new molecular target, namely the family of protein disulfide isomerases (PDIs), for the treatment of acute myeloid leukemia (Chlebowska-Tuz et al., Haematologica, 2018). 2) We discovered that MLK4 (mixed lineage kinase 4) drives invasiveness and metastatic potential of triple negative breast cancer in the nuclear factor kappa B (NFKB)-dependent mechanism (Marusiak et al., Oncogene 2018).





Laboratory of Experimental Medicine

Prof. Dominika Nowis

PUBLICATIONS

- Chlebowska-Tuz, J., Sokolowska, O., Gaj, P., Lazniewski, M., Firczuk, M., Borowiec, K., Sas-Nowosielska, H., Bajor, M., Malinowska, A., Muchowicz, A., Ramji, K., Stawiński, P., Sobczak, P., Pilch, Z., Rodziewicz-Lurzyńska, A., Zając, M., Giannopoulos, K., Juszczyński, P., Basak, G.W., Plewczyński, D., Płoski, R., Gołąb, J., and Nowis, D. (2018). Inhibition of protein disulfide isomerase induces differentiation of acute myeloid leukemia cells. Haematologica 103, 1843–1852.
- Guglielmi, V., Voermans, N.C., Oosterhof, A., Nowis, D., van Engelen, B.G., Tomelleri, G., and Vattemi, G. (2018). Evidence of ER stress and UPR activation in patients with Brody disease and Brody syndrome. Neuropathology and Applied Neurobiology 44, 533–536.
- Marusiak, A.A., Prelowska, M.K., Mehlich, D., Lazniewski, M., Kaminska, K., Gorczynski, A., Korwat, A., Sokolowska, O., Kedzierska, H., Golab, J., Biernat, W., Plewczyński, D., Brognard, J., and Nowis, D. (2018). Upregulation of MLK4 promotes migratory and invasive potential of breast cancer cells. Oncogene.
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- Szczałuba, K., Chmielewska, J.J., Sokolowska, O., Rydzanicz, M., Szymańska, K., Feleszko, W., Włodarski, P., Biernacka, A., Murcia Pienkowski, V., Walczak, A., Bargeł, E., Królewczyk, K., Nowacka, A., Stawiński, P., Nowis, D., Dziembowska, M., and Płoski, R. (2018). Neurodevelopmental phenotype caused by a de novo PTPN4 single nucleotide variant disrupting protein localization in neuronal dendritic spines. Clinical Genetics 94, 581–585.
- Waligora, M., Bala, M.M., Koperny, M., Wasylewski, M.T., Strzebonska, K., Jaeschke, R.R., Wozniak, A., Piasecki, J., Sliwka, A., Mitus, J.W., Polak, M., Nowis, D., Fergusson, D., and Kimmelman, J. (2018). Risk and surrogate benefit for pediatric Phase I trials in oncology: A systematic review with meta-analysis. PLOS Medicine 15, e1002505.

PROJECTS

- Evaluation of anticancer potential of glutamine metabolism modulation in multiple myeloma sensitive and resistant to chemotherapy, Prełowska Monika, MSc, PRELUDIUM NCN, 2017-2020
- 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
- The functional role of MLK4 kinase in triple negative breast cancer chemoresistance, Mehlich Dawid Grzegorz, MSc, Diamentowy Grant MNiSW, 2018-2021

COMPLETED:

- The effect of MLK4 amplification on 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 signalling, Sokołowska Olga, MSc, PRELUDIUM NCN, 2016-2018

STAFF

Group Leader:
Prof. Dominika Nowis

Postdoctoral Fellows:
Hanna Kędzierska, PhD
Anna Marusiak, PhD

PhD Students:
Monika Prełowska, MSc
Olga Sokołowska, MSc Eng.

Students:
Dawid Mehlich, MSc

Laboratory of Functional and Structural Genomics

Prof. Dariusz Plewczyński

RESEARCH

General Overview

In the Laboratory of Functional and Structural Genomics we perform theoretical studies, whose main objective is to analyze and predict 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 the groups of patients, and their three-dimensional localization in the structure of the nucleus.

We also examine the relationship of the expression levels of selected genes from 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 that are important in the context of personalized medicine.

For this purpose, first we are developing a variety of large-scale computational tools for analysis of whole genome sequences, the identification of structural variants, determining the statistical significance of the observed number 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 for example in the 1000 Genomes Project Consortium. Thirdly, we infer the biological function of these genomic regions using publicly available databases. Fourthly, we identify unique local three-dimensional environment for selected sites, eg. 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.

2018 Research Focus

Developing of 3DEpiLoop algorithm that links sequence information, epigenomic reversible modifications and 3D structure using statistical learning. Our aim was to understand the basic biophysical mechanisms behind three-dimensional folding of epigenomes. The 3DEpiLoop algorithm predicts three-dimensional chromatin looping interactions within topologically associating domains (TADs) from one-dimensional epigenomics and transcription factor profiles using the statistical learning. The predictions obtained by 3DEpiLoop are highly consistent with the reported experimental interactions. The complex signatures of epigenomic and transcription factors within the physically interacting chromatin regions (anchors) are similar across all genomic scales: genomic domains, chromosomal territories, cell types, and different individuals. We report [5] the most important epigenetic and transcription factor features used for interaction identification either shared, or unique for each of sixteen (16) cell lines. The analysis shows that CTCF interaction anchors are enriched by transcription factors yet deficient in histone modifications, while the opposite is true in the case of RNAP II mediated interactions. The code is accessible freely at the LGFS software repository https://bitbucket.org/4dnucleome/3depiloop .

PROJECTS

- 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
- COST BM1408: A collaborative European network of C. elegans early-stage researchers and young principal investigators (GENiE), Prof. Dariusz Plewczyński Dariusz, COST, BM1408, 2015-2019
- Three-dimensional Human Genome structure at the population scale: computational algorithm and experimental validation for lymmphoblastoid cell lines of selected families from 1000 Genomes Project, Prof. Dariusz Plewczyński, TEAM FNP, 2017-2020
- Michał Piętal, PhD, MINIATURA NCN, 2018-2019
- Biochemical Adjustments of native EBOV Glycoprotein in Patient Sample to Unmask target-Epitopes for Rapid Diagnostic Testing, Prof. Dariusz Plewczyński, Mobilisation of research funds in case of Public Health Emergencies - RIA2018 Emergency Funding Mechanism EDCTP (according to H2020), 2018-2019

COMPLETED:

- Genetic biomarkers for breast cancer subtypes: the role of membrane receptors in modeling of heterogenous populations of tumor cells, Prof. Dariusz Plewczyński, international staff exchange with the Republic of India, MNiSW, 2017-2018

Laboratory of Functional and Structural Genomics

Prof. Dariusz Plewczyński

PUBLICATIONS

- Al Bkhetan, Z., and Plewczynski, D. (2018). Three-dimensional Epigenome Statistical Model: Genome-wide Chromatin Looping Prediction. Scientific Reports 8, 5217.
- Babkiewicz, E., Czarnocka-Cieciura, M., Gliwicz, Z.M., Maszczyk, P., Uchmański, J., and Urban, P. (2018). Ideal free distribution of Daphnia under predation risk—model predictions and experimental verification. Journal of Plankton Research 40, 471–485.
- Basu, S., and Plewczynski, D. (2018). Emerging and threatening infectious diseases. Briefings in Functional Genomics 17, 372–373.
- Basu, S., Saha, P.K., Roszkowska, M., Magnowska, M., Baczynska, E., Das, N., Plewczynski, D., and Wlodarczyk, J. (2018). Author Correction: Quantitative 3-D morphometric analysis of individual dendritic spines. Scientific Reports 8, 17142.
- Basu, S., Saha, P.K., Roszkowska, M., Magnowska, M., Baczynska, E., Das, N., Plewczynski, D., and Wlodarczyk, J. (2018). Quantitative 3-D morphometric analysis of individual dendritic spines. Scientific Reports 8, 3545.
- Chlebowska-Tuz, J., Sokolowska, O., Gaj, P., Lazniewski, M., Firczuk, M., Borowiec, K., Sas-Nowosielska, H., Bajor, M., Malinowska, A., Muchowicz, A., Ramji, K., Stawiński, P., Sobczak, P., Pilch, Z., Rodziewicz-Lurzyńska, A., Zając, M., Giannopoulos, K., Juszczyński, P., Basak, G.W., Plewczyński, D., Płoski, R., Gołąb, J., and Nowis, D. (2018). Inhibition of protein disulfide isomerase induces differentiation of acute myeloid leukemia cells. Haematologica 103, 1843–1852.
- Ciara, E., Rokicki, D., Lazniewski, M., Mierzewska, H., Jurkiewicz, E., Bekiesińska-Figatowska, M., Piekutowska-Abramczuk, D., Iwanicka-Pronicka, K., Szymańska, E., Stawiński, P., Kosińska, J., Pollak, A., Pronicki, M., Plewczyński, D., Płoski, R., and Pronicka, E. (2018). Clinical and molecular characteristics of newly reported mitochondrial disease entity caused by biallelic PARS2 mutations. Journal of Human Genetics 63, 473–485.
- Lazniewski, M., Dawson, W.K., Rusek, A.M., and Plewczynski, D. (2018). One protein to rule them all: The role of CCCTC-binding factor in shaping human genome in health and disease. Seminars in Cell & Developmental Biology.
- Malkowska, M., Zubek, J., Plewczynski, D., and Wyrwicz, L.S. (2018). ShapeGTB: the role of local DNA shape in prioritization of functional variants in human promoters with machine learning. PeerJ 6, e5742.
- Marusiak, A.A., Prelowska, M.K., Mehlich, D., Lazniewski, M., Kaminska, K., Gorczynski, A., Korwat, A., Sokolowska, O., Kedzierska, H., Golab, J., Biernat, W., Plewczynski, D., Brognard, J., and Nowis, D. (2018). Upregulation of MLK4 promotes migratory and invasive potential of breast cancer cells. Oncogene.
- Rezaei Tabar, V., Plewczyński, D., Fathipor, Fathipor, H., Fathipor, H., and Financial Mathematics Group, Faculty of Financial Sciences, University of Kharazmi, Tehran, Iran (2018). Generalized Baum-Welch and Viterbi Algorithms Based on the Direct Dependency among Observations. Journal of the Iranian Statistical Society 17, 205–225.
- Szalaj, P., and Plewczynski, D. (2018). Three-dimensional organization and dynamics of the genome. Cell Biology and Toxicology 34, 381–404.
- Wang, X., Li, X., Zhang, L., Wong, S.H., Wang, M.H.T., Tse, G., Dai, R.Z.W., Nakatsu, G., Coker, O.O., Chen, Z., Ko, H., Chan, J.Y.K., Liu, T., Cheng, C.H.K., Cheng, A.S.L., To, K.F., Plewczynski, D., Sung, J.J.Y., Yu, J., Gin, T., Chan, M.T.V., and Wu, W.K.K. (2018). Oncogenes expand during evolution to withstand somatic amplification. Annals of Oncology 29, 2254–2260.

ADDITIONAL INFORMATION

Website: https://4dnucleome.cent.uw.edu.pl/

STAFF

Group Leader:
Prof. Dariusz Plewczyński

Sabbatical Professor:
Prof. Vahid Rezaei Tabar

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Michał Łaźniewski, PhD
Ayatullah Faruk Mollah, PhD
Michał Piętal, PhD
Teresa Szczepińska, PhD

PhD Students:
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Michał Denkiewicz, MSc
Anup Kumar Halder, MSc
Michał Kadlof, MSc Eng.
Somnath Rakshit, B. Tech
Anna Maria Rusek, MSc
Przemyslaw Szałaj, MSc
Paulina Urban, MSc
Michał Własnowolski, MSc

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Zofia Parteka, BSc
Julia Różycka
Michał Sadowski, BSc
Piotr Skłodkowski, BSc
Andrzej Szczepanczyk, BSc
Kamila Winnicka
Natalia Zawrotna, Eng.

Biomolecular Modelling Group

Dr. Piotr Setny

RESEARCH

General Overview

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

We apply physical models to describe and simulate biological molecules in order to gain insight into principles governing their structure, dynamics and function.

We are particularly interested in the interplay between the molecules themselves and aqueous environment they live in. To this end, we are studying conformation dependent protein hydration free energies, investigate the role buried water molecules, and develop new theoretical approaches to describe macromolecular hydration.

2018 Research Focus

We characterised the involvement of water in allosteric communication within protein kinase A, providing atomistc explanation to a number of puzzling experimental observations. We described the role of influenza virus fusion peptide termini for its fusogenic acton. We developed a web server for calculatng protein hydration properties. We initated work on a new theoretical approach to contact-based description of protein allostery and causality relaonships.We acquired a new NCN Opus grant.

ADDITIONAL INFORMATION

Website: https://biomod.cent.uw.edu.pl/

PUBLICATIONS

- Setny, P. (2018). Protein Hydraulics: Water Mediated Cooperativity of Substrate Binding in PKA. Biophysical Journal 114, 397a-398a.
- Setny, P., and Wiśniewska, M.D. (2018). Water-mediated conformational preselection mechanism in substrate binding cooperativity to protein kinase A. Proceedings of the National Academy of Sciences of the United States of America 115, 3852.
- Weiß, R.G., Chudoba, R., Setny, P., and Dzubiella, J. (2018). Affinity, kinetics, and pathways of anisotropic ligands binding to hydrophobic model pockets. The Journal of Chemical Physics 149, 094902.
- Worch, R., Dudek, A., Krupa, J., Szymaniec, A., and Setny, P. (2018). Charged N-terminus of Influenza Fusion Peptide Facilitates Membrane Fusion. International Journal of Molecular Sciences 19, 578.

PROJECTS

- Hydratation effects in proteins: from bulk hydratation to localised water molecules, Setny Piotr, PhD, Installation Grants EMBO, 2015-2019

COMPLETED:
- Hydratation effects in protein kinases, Setny Piotr, PhD, SONATA NCN, 2014-1018

STAFF

Group Leader:
Piotr Setny, PhD

PhD Students:
Anita Dudek, Msc
Marcin Sobieraj, Msc
Marta Dorota Wiśniewska, MSc

Students:
Jan Malinowski

Alumni:
Marta D. Wiśniewska

Laboratory of Molecular Research for Solar Energy Innovations

Dr. Renata Solarska

RESEARCH

General Overview

Research interests of SOLEIL Group focus on design, synthesis & application of nanomaterials and advanced architectures for solar energy technologies and photo-driven biocatalytic applications. However, now, it starts to be obvious that with deep knowledge on synthesis and functionalization of metal oxide nano-architectures for solar energy conversion we can start to ask new questions about underlying understanding of elementary chemical reactions and photoelectrochemical processes and finally address them by new ultrafast spectroscopic and in-situ conceptual techniques allowing to directly investigate charge transfer kinetics phenomena We believe, that this conceptual approach to the molecular systems to identify the major bottlenecks hampering the efficiency of current solar systems has a bright future.

Research Topics:

- Investigation of the combined electro-photo-reduction of CO2 at selected catalysts taking in parallel, profit from the extra activation of the process provided by the plasmonic nanostructures
- Identification and recognition of the kinetic processes governing the performance of the earth abundant materials and their integrated systems with use of the ultrafast TAS approach (combined charge carrier dynamics & kinetic analysis)
- Identification & synthesis of radically new photoactive materials
- Design, construction & understanding of a sensing mechanism of the photoelectrochemical biosensors based on the polycrystalline semiconductors and demonstrate a proof of concept through the quantification of the biosensing activity and efficiency of the overall PEC sensor for a number of selected bioanalytes.

2018 Research Focus

LMIS's scientific activity is currently focused intensively on obtaining new grants (submitted SHENG1 with a Chinese partner and SOLAR_DRIVEN CHEMISTRY in a consortium with UniCO Germany and EPFL Switzerland). Research topic which is the leading theme are the mechanisms of carbon dioxide activation for the purpose of the NCN research project. The subject, just started, is the synthesis of semi-conductor materials found abundantly in nature and the search for mechanisms for transporting cargo in connector systems in line with the SONATA BIS project trend.

PUBLICATIONS

- Jelinska, A., Bienkowski, K., Jadwiszczak, M., Pisarek, M., Strawski, M., Kurzydlowski, D., Solarska, R., and Augustynski, J. (2018). Enhanced Photocatalytic Water Splitting on Very Thin WO 3 Films Activated by High-Temperature Annealing. ACS Catalysis 8, 10573–10580.
- Szaniawska, E., Bienkowski, K., Rutkowska, I.A., Kulesza, P.J., and Solarska, R. (2018). Enhanced photoelectrochemical CO2-reduction system based on mixed Cu2O – nonstoichiometric TiO2 photocathode. Catalysis Today 300, 145–151.

PROJECTS

- Insight into combined electrochemical-photochemical activation of carbon dioxide, Solarska Renata, PhD, OPUS NCN, 2016-2019
- Design, construction and investigations of earth abundant materials based heterojunctions for high efficiency solar energy conversion, Solarska Renata, PhD, SONATA BIS NCN, 2018-2022

STAFF

Group Leader:
Renata Solarska, PhD

Postdoctoral Fellows:
Monika Arasimowicz, PhD

PhD Students:
Adrian Dubiel, MSc
Marta Kwiatkowska, MSc

Quantum Resources and Information Laboratory

Dr. Alexander Streltsov

RESEARCH

General Overview

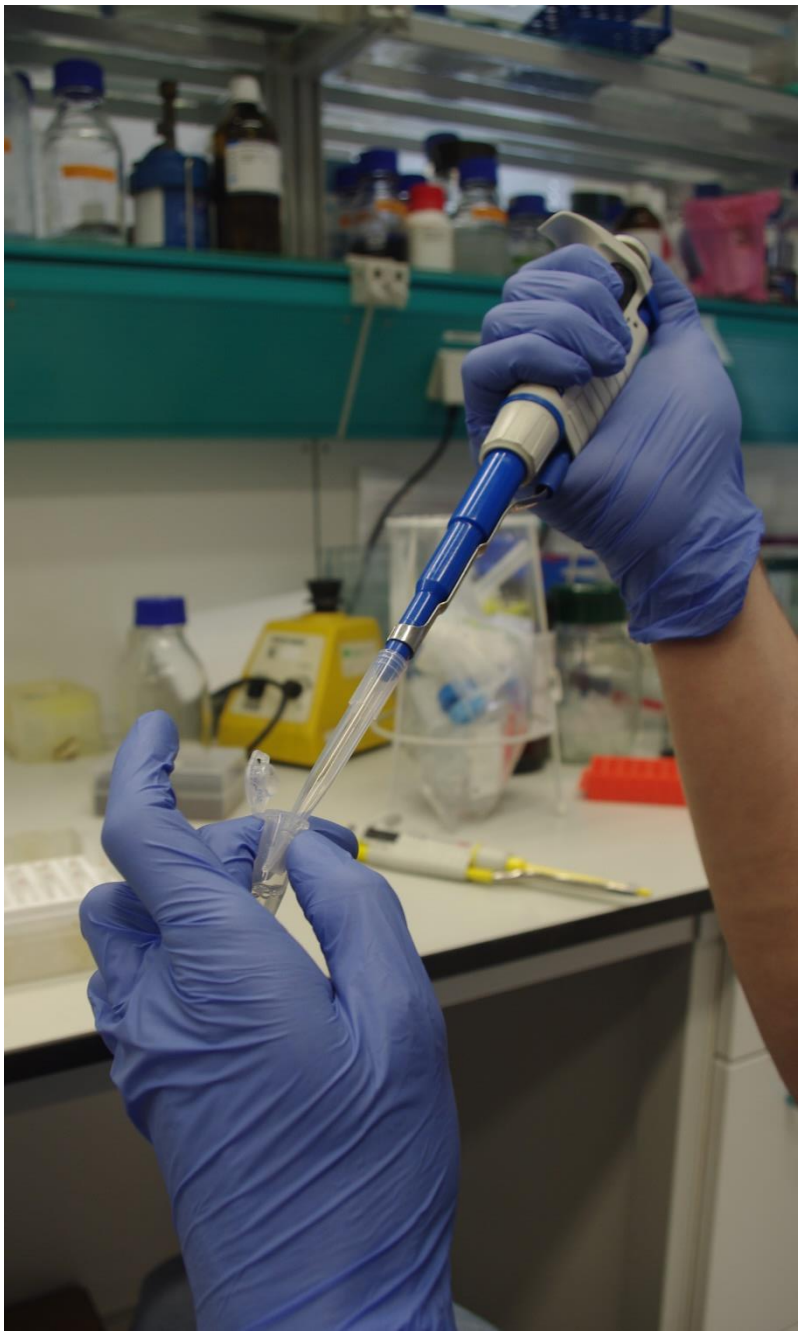
Main research interest of the group are general quantum resource theories and their applications for quantum technology.

Quantum resource theories provide a strong mathematical framework for studying general quantum phenomena, such as quantum entanglement and coherence. Quantum thermodynamics can also be formulated as a resource theory. Quantum entanglement and coherence play an important role in quantum technology, most importantly in quantum communication and computation. Our team studies the role of general quantum resources for quantum technologies, investigating already existing protocols for quantum communication and computation. Since entanglement is a very fragile feature and quickly disappears in the presence of noise, we also aim to develop new quantum protocols which do not require entanglement, but are based on other types of quantum resources, such as quantum coherence.

STAFF

Group Leader:
Alexander Streltsov, PhD

Postdoctoral Fellows:
Swapan Rana, PhD



Laboratory of Mitochondrial Biogenesis

Prof. Agnieszka Chacińska

CeNT CENTRE OF NEW TECHNOLOGIES

Interdisciplinary Laboratory of Biological Systems Modelling

Prof. Joanna Sułkowska

RESEARCH

General Overview

Scientific interests:

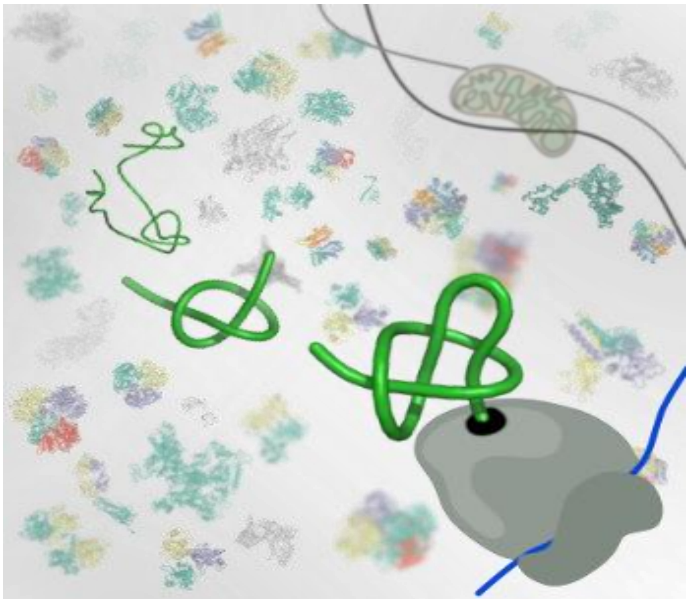
- development of multi dimensional models for the analysis of energy landscape of proteins with complex structures, as proteins with non trivial topology;
- development of analytical methods as direct coupling analysis (DCA) and bioinformatics tools for analysis of amino acids evolution and their application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

2018 Research Focus

In our research we are looking for sequential and structural features responsible for the conservation of non-trivial topology such as knots, slipknots, links and lassos in different families of entangled proteins. Identifying these features we hope will be a milestone in understanding the evolution of entangled proteins and their biological role. Proteins with non-trivial topology represent around 8% of proteins deposited in the PDB. Such sequences we have found in pathogens, as well as organisms living in extreme conditions (extremophiles). The project is of interdisciplinary nature and involves aspects of knot theory (mathematics), bioinformatics, computer simulations, biophysics, and structural biology, and involves both in vivio and in silico studies.

ADDITIONAL INFORMATION

Website: https://jsulkowska.cent.uw.edu.pl/



Interdisciplinary Laboratory of Biological Systems Modelling

Prof. Joanna Sułkowska

PUBLICATIONS

- Dabrowski-Tumanski, P., and Sulkowska, J.I. (2018). The APS-bracket – A topological tool to classify lasso proteins, RNAs and other tadpole-like structures. Reactive and Functional Polymers 132, 19–25.
- Dabrowski-Tumanski, P., Piejko, M., Niewieczerzal, S., Stasiak, A., and Sulkowska, J.I. (2018). Protein Knotting by Active Threading of Nascent Polypeptide Chain Exiting from the Ribosome Exit Channel. The Journal of Physical Chemistry B 122, 11616–11625.
- Jarmolinska, A.I., Kadlof, M., Dabrowski-Tumanski, P., and Sulkowska, J.I. (2018). GapRepairer: a server to model a structural gap and validate it using topological analysis. Bioinformatics 34, 3300–3307.
- Kutkowska-Kaźmierczak, A., Rydzanicz, M., Chlebowski, A., Kłosowska-Kosicka, K., Mika, A., Gruchota, J., Jurkiewicz, E., Kowalewski, C., Pollak, A., Stradomska, T.J., Kmieć, T., Jakubowski, R., Gasperowicz, P., Walczak, A., Śladowski, D., Jankowska-Steifer, E., Korniszewski, L., Kosińska, J., Obersztyn, E., Nowak, W., Śledziński, T., Dziembowski, A., and Płoski, R. (2018). Dominant ELOVL1 mutation causes neurological disorder with ichthyotic keratoderma, spasticity, hypomyelination and dysmorphic features. Journal of Medical Genetics 55, 408–414.
- Rydzewski, J., Jakubowski, R., Nowak, W., and Grubmüller, H. (2018). Kinetics of Huperzine A Dissociation from Acetylcholinesterase via Multiple Unbinding Pathways. Journal of Chemical Theory and Computation 14, 2843–2851.
- Sulkowska, J.I., and Sułkowski, P. (2018). Entangled Proteins: Knots, Slipknots, Links, and Lassos. In The Role of Topology in Materials, S. Gupta, and A. Saxena, eds. (Cham: Springer International Publishing), pp. 201–226.
- Sulkowska, J.I., Niewieczerzal, S., Jarmolinska, A.I., Siebert, J.T., Virnau, P., and Niemyska, W. (2018). KnotGenome: a server to analyze entanglements of chromosomes. Nucleic Acids Research 46, W17–W24.
- Zając, S., Geary, C., Andersen, E.S., Dabrowski-Tumanski, P., Sulkowska, J.I., and Sułkowski, P. (2018). Genus trace reveals the topological complexity and domain structure of biomolecules. Scientific Reports 8, 17537.
- Zhao, Y., Dabrowski-Tumanski, P., Niewieczerzal, S., and Sulkowska, J.I. (2018). The exclusive effects of chaperonin on the behavior of proteins with 52 knot. PLOS Computational Biology 14, e1005970.

PROJECTS

- Influence of knotted structure on function of proteins, Prof. Joanna Sułkowska, SONATA BIS NCN, 2013-2019
- Comprehensive analysis of knotted proteins – from folding to function, Prof. Joanna Sułkowska, Installation Grants EMBO, 2014-2019
- Mysteries of entanglement - protein, life and physics, Prof. Joanna Sułkowska, IDEAS PLUS MNiSW, 2016-2019
- Structural study of entangled proteins, Prof. Joanna Sułkowska, Small Grant Programme EMBO
- Mysteries of entanglement – SPOUT methyltransferases enzymes, Prof. Joanna Sułkowska, Young Investigator Programme EMBO – 2018-2022

STAFF

Group Leader:
Prof. Joanna Sułkowska

Postdoctoral Fellows:
Rafał Jakubowski, PhD
Wanda Niemyska, PhD
Szymon Niewieczerzal, PhD
Vasilina Zayas, PhD

PhD Students:
Paweł Dąbrowski-Tumański, MSc
Aleksandra Jarmolińska, MSc
Agata Perlińska, MSc
Adam Stasiulewicz, MSc

Students:
Bartosz Greń
Borys Jastrzębski, MSc
Maciej Piejko
Maciej Sikora

Programmists:
Paweł Rubach, PhD

Research Technicians:
Agata Bernat,

Wild Urban Evolution and Ecology Lab

Prof. Marta Szulkin

RESEARCH

General Overview

Our research focuses on the evolution and ecology of wild vertebrates in the Anthropocene – a human-dominated time period with a significant global impact on Earth's ecosystems. In particular, we aim to infer patterns and processes related to natural variation in wild organisms living in a gradient of environments – this ideally includes primeval and secondary forests as much as sub-urban green areas and highly urbanised space such as cities.

Until recently, virtually all long-term studies of vertebrates investigated in the wild and used as cornerstone in evolutionary ecology research were started 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 several-fold between 2000 and 2050. As urban space is an environment with conspicuously altered ecological dynamics relative to original natural habitat, more insight into the evolutionary ecology of free-living animals in urban environments is needed. Urbanisation 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 urbanisation.

2018 Research Focus

The Wild Urban Evolution & Ecology Lab is a thriving research lab that has accumulated in the past 3 years significant knowledge on urban ecological and evolutionary dynamics – much of that scientific output is in the writing-up proces, with several publications planned for 2019. We have also organised a national conference on evolutionary biology (PEC2018), and Marta Szulkin is currently under contract (lead editor) with Oxford University Press for editing the first academic book on Urban Evolutionary Biology, to be published in 2020.

PUBLICATIONS

- Di Lecce, I., Bazzocchi, C., Cecere, J.G., Epis, S., Sassera, D., Villani, B.M., Bazzi, G., Negri, A., Saino, N., Spina, F., Bandi, C., and Rubolini, D. (2018). Patterns of Midichloria infection in avian-borne African ticks and their trans-Saharan migratory hosts. Parasites & Vectors 11, 106.
- Olsson, M., Friesen, C.R., Rollings, N., Sudyka, J., Lindsay, W., Whittington, C.M., and Wilson, M. (2018). Long-term effects of superoxide and DNA repair on lizard telomeres. Molecular Ecology 27, 5154–5164.
- Perrier, C., Lozano del Campo, A., Szulkin, M., Demeyrier, V., Gregoire, A., and Charmantier, A. (2018). Great tits and the city: Distribution of genomic diversity and gene–environment associations along an urbanization gradient. Evolutionary Applications 11, 593–613.

PROJECTS

- 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, 2017-2020
- Impact of food availability on avian reproduction in a gradient of urbanisation, Corsini Michaela, MSc, PRELUDIUM NCN, 2018-2021

COMPLETED :

- 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

STAFF

Group Leader:
Prof. Marta Szulkin

Postdoctoral Fellows:
Marion Chatelain, PhD
Joanna Sudyka, PhD

PhD Students:
Michela Corsini, MSc
Irene Di Lecce, MSc

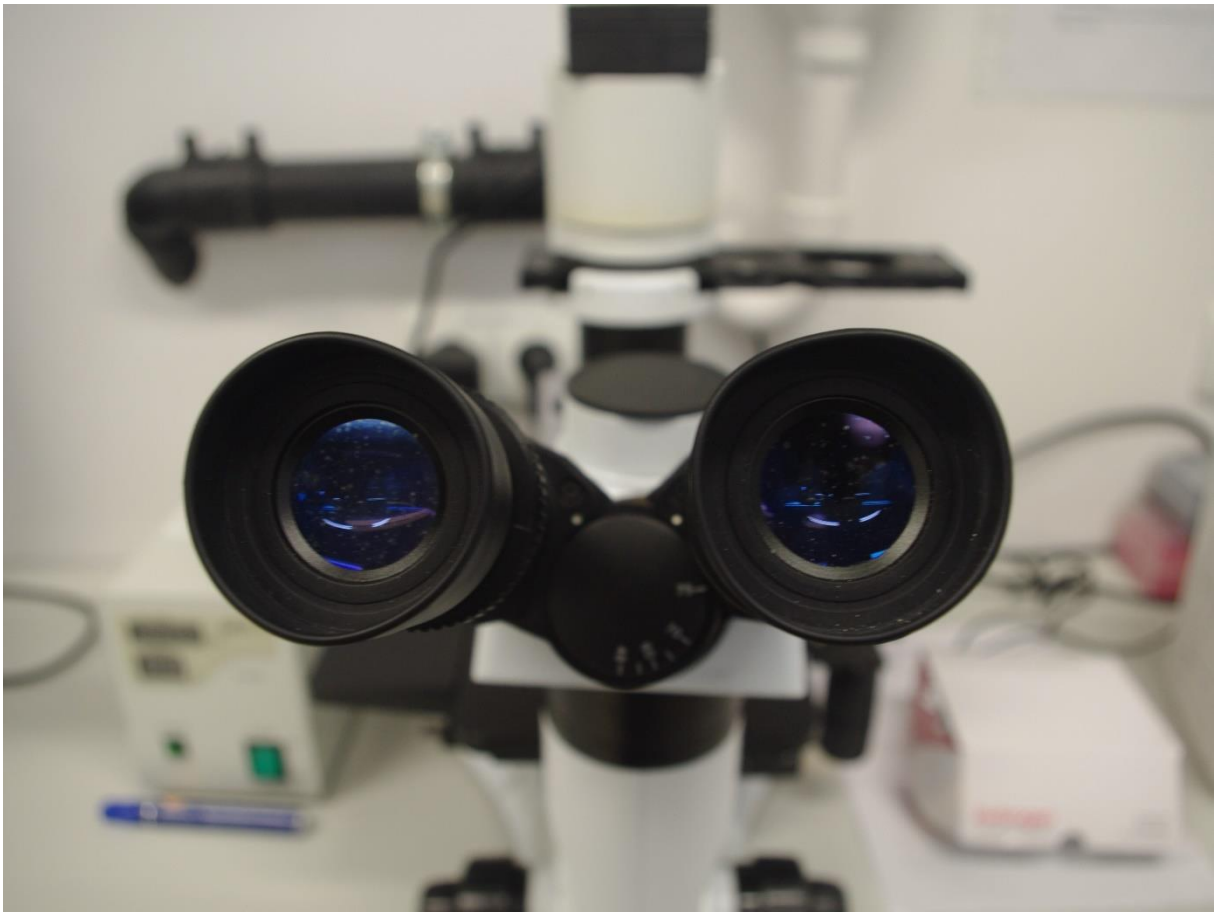
Students:
Marta Celej

Research Technicians:
Michał Adamowicz
Justyna Szulc
Lucyna Wojas, MSc

Alumni:
Arnaud Da Silva, PhD
Karol Kobiałka

ADDITIONAL INFORMATION

Website:
http://leem.cent.uw.edu.pl/



Scientific equipment

CeNT UW

CeNT CENTRE OF NEW TECHNOLOGIES

Biomolecular Machines Laboratory

Prof. Joanna Trylska

RESEARCH

General Overview

Our research interests involve studying the function, dynamics, and physico-chemical properties of nanoscale assemblies to understand and modulate 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 verify experimentally simulation techniques to study the association of ligands with various kinds of RNA. The ultimate long-term goal is to develop antibacterial compounds that would be transported through the bacterial cell envelope and target essential RNA in order to inhibit bacterial growth.

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)..

2018 Research Focus

We develop novel antibacterial compounds, which are needed due to emergence of bacterial resistance and overuse of antibiotics. We design oligonucleotides that target functional bacterial RNA and inhibit bacterial growth. Since natural oligonucleotides are not biostable, we use their analogs: peptide nucleic acid and 2'O-methyl RNA. We search for oligonucleotide carriers; we found that vitamin B_{12} transports peptide nucleic acids and 2'O-methyl RNA to bacteria. We also modify aminoglycoside antibiotics to make them selective toward bacterial ribosomes. In our research we use both experiments and simulations.

ADDITIONAL INFORMATION

Website: https://bionano.cent.uw.edu.pl/

Biomolecular Machines Laboratory

Prof. Joanna Trylska

PUBLICATIONS

- Castillo, J.I., Równicki, M., Wojciechowska, M., and Trylska, J. (2018). Antimicrobial synergy between mRNA targeted peptide nucleic acid and antibiotics in *E. coli*. Bioorganic & Medicinal Chemistry Letters 28, 3094–3098.
- Jasiński, M., Feig, M., and Trylska, J. (2018). Improved Force Fields for Peptide Nucleic Acids with Optimized Backbone Torsion Parameters. J. Chem. Theory Comput. 14, 3603–3620.
- Jasiński, M., Kulik, M., Wojciechowska, M., Stolarski, R., and Trylska, J. (2018). Interactions of 2'-O-methyl oligoribonucleotides with the RNA models of the 30S subunit A-site. PLOS ONE 13, 1–29.
- Kulczycka-Mierzejewska, K., Sadlej, J., and Trylska, J. (2018). Molecular dynamics simulations suggest why the A2058G mutation in 23S RNA results in bacterial resistance against clindamycin. Journal of Molecular Modeling 24, 191.
- Kulik, M., Mori, T., Sugita, Y., and Trylska, J. (2018). Molecular mechanisms for dynamic regulation of N1 riboswitch by aminoglycosides. Nucleic Acids Research 46, 9960–9970.
- Maximova, K., Venken, T., Reuter, N., and Trylska, J. (2018). D-peptides as inhibitors of PR3-membrane interactions. Biochimica et Biophysica Acta (BBA) - Biomembranes 1860, 458–466.
- Równicki, M., Pieńko, T., Czarnecki, J., Kolanowska, M., Bartosik, D., and Trylska, J. (2018). Artificial Activation of *Escherichia coli* mazEF and hipBA Toxin–Antitoxin Systems by Antisense Peptide Nucleic Acids as an Antibacterial Strategy. Frontiers in Microbiology 9, 2870.
- Sabbavarapu, N.M., Pieńko, T., Zalman, B.-H., Trylska, J., and Baasov, T. (2018). Exploring eukaryotic versus prokaryotic ribosomal RNA recognition with aminoglycoside derivatives. MedChemComm 9, 503–508.
- Wierzba, A.J., Maximova, K., Wincenciuk, A., Równicki, M., Wojciechowska, M., Nexø, E., Trylska, J., and Gryko, D. (2018). Does a Conjugation Site Affect Transport of Vitamin B 12 –Peptide Nucleic Acid Conjugates into Bacterial Cells? Chemistry – A European Journal 24, 18772–18778.
- Wojciechowska, M., Dudek, M., and Trylska, J. (2018). Thermodynamics of the pseudo-knot in helix 18 of 16S ribosomal RNA. Biopolymers 109, e23116.

PROJECTS

- Vitamin B12 as a delivery vehicle for antibacterial oligonucleotide analogues, Prof. Joanna Trylska, SYMFONIA NCN, 2014-2019
- The effect of crowded environment on the catalytic activity and dynamics of viral proteases, Prof. Joanna Trylska, OPUS NCN, 2017-2020
- Bacterial toxin-antitoxin systems as novel target for the development of potential antibiotics, Równicki Marcin, MSc, PRELUDIUM NCN, 2018-2020
- Predicting affinity of ligands to RNA. The case of an aminoglycoside-sensing riboswitch, Prof. Joanna Trylska, HARMONIA NCN, 2018-2021
- In quest for the mechanism of transport of vitamin B12-peptide nucleic acid conjugates to E. coli cells, Pieńko Tomasz, MSc, PRELUDIUM NCN, 2018-2021

COMPLETED:

- *Exploring the Mutual Interactions between RNA Enantiomers, Dudek Marta, MD, PRELUDIUM NCN, 2014-2018*

STAFF

Group Leader:
Prof. Joanna Trylska

Postdoctoral Fellows:
Marta Dudek, MD
Ksenia Maximova, PhD
Agnieszka Popielec, PhD
Monika Wojciechowska, PhD

PhD Students:
Joanna Miszkiewicz, MSc
Natalia Ostrowska, MSc
Tomasz Pieńko, MSc
Marcin Równicki, MSc

Students:
Paweł Kowalski, BSc
Jakub Wojtczak, BSc

Chemical and Biological Systems Simulation Laboratory

Dr. Bartosz Trzaskowski

RESEARCH

General Overview

The aim of LSSCB (Chemical and Biological Systems Simulation Lab) is to develop and apply theoretical and computational methods (ranging from quantum chemistry to molecular mechanics/dynamics) to describe the chemical, physical and biological phenomena. The particular focus of the lab is on the prediction of protein structures, nanotechnology, homogeneous catalysis and physical organic chemistry.

We are interested both in basic research as well as its applications to help solve real industrial problems.

2018 Research Focus

In 2018 we have continued our research in three major areas. In the homogenous catalysis field we have published 5 papers describing the new ruthenium-based olefin metathesis catalysts and their mode of action as well as new gallium catalysts for. In the chemistry of materials part we have published first two studies describing new biointerfaces, which in future may lead to new photovoltaic devices. Finally, in the bio field we have continued our exploration of the mode of action of antipsychotic agents and other ligands with expected biological activities.

ADDITIONAL INFORMATION

Website: http://chembio.cent.uw.edu.pl/

Chemical and Biological Systems Simulation Laboratory

Dr. Bartosz Trzaskowski

PUBLICATIONS

- Diez-Cabanes, V., Gonzalez, S.R., Osella, S., Cornil, D., Dyck, C., and Cornil, J. (2018). Energy Level Alignment at Interfaces Between Au (111) and Thiolated Oligophenylenes of Increasing Chain Size: Theoretical Evidence of Pinning Effects. Advanced Theory and Simulations 1, 1700020.
- Jawiczuk, M., Janaszkiewicz, A., and Trzaskowski, B. (2018). The influence of the cationic carbenes on the initiation kinetics of ruthenium-based metathesis catalysts; a DFT study. Beilstein Journal of Organic Chemistry 14, 2872–2880.
- Jolly, P.I., Marczyk, A., Małecki, P., Ablialimov, O., Trzybiński, D., Woźniak, K., Osella, S., Trzaskowski, B., and Grela, K. (2018). Azoliniums, Adducts, NHCs and Azomethine Ylides: Divergence in Wanzlick Equilibrium and Olefin Metathesis Catalyst Formation. Chemistry – A European Journal 24, 4785–4789.
- Knippenberg, S., Fabre, G., Osella, S., Di Meo, F., Paloncýová, M., Ameloot, M., and Trouillas, P. (2018). Atomistic Picture of Fluorescent Probes with Hydrocarbon Tails in Lipid Bilayer Membranes: An Investigation of Selective Affinities and Fluorescent Anisotropies in Different Environmental Phases. Langmuir 34, 9072–9084.
- Kowalska, A.M., Trzaskowski, B., and Osella, S. (2018). Assessing the Charge Transfer at the Cytochrome c 553 /Graphene Interface: A Multiscale Investigation. The Journal of Physical Chemistry C 122, 29405–29413.
- Młodzikowska, K., Rajkiewicz, A.A., Grela, K., and Trzaskowski, B. (2018). Boron–boron, carbon–carbon and nitrogen–nitrogen bonding in N-heterocyclic carbenes and their diazaboryl and triazole analogues: Wanzlick equilibrium revisited. New Journal of Chemistry 42, 6183–6190.
- Osella, S., Di Meo, F., Murugan, N.A., Fabre, G., Ameloot, M., Trouillas, P., and Knippenberg, S. (2018). Combining (Non)linear Optical and Fluorescence Analysis of DiD To Enhance Lipid Phase Recognition. Journal of Chemical Theory and Computation 14, 5350–5359.
- Osella, S., Kiliszek, M., Harputlu, E., Unlu, C.G., Ocakoglu, K., Kargul, J., and Trzaskowski, B. (2018). Controlling the charge transfer flow at the graphene/pyrene–nitrilotriacetic acid interface. Journal of Materials Chemistry C 6, 5046–5054.
- Ostrowska, K., Grzeszczuk, D., Głuch-Lutwin, M., Gryboś, A., Siwek, A., Leśniak, A., Sacharczuk, M., and Trzaskowski, B. (2018). 5-HT1A and 5-HT2A receptors affinity, docking studies and pharmacological evaluation of a series of 8-acetyl-7-hydroxy-4-methylcoumarin derivatives. Bioorganic & Medicinal Chemistry 26, 527–535.
- Sidoryk, K., Cmoch, P., Świtalska, M., Trzaskowski, B., Wietrzyk, J., and Cybulski, M. (2018). Efficient glycosylation of natural Danshensu and its enantiomer by sugar and 2-deoxy sugar donors. Carbohydrate Research 460, 19–28.
- Zaremba, R., Dranka, M., Trzaskowski, B., Chęcińska, L., and Horeglad, P. (2018). Probing the M–C NHC Bond and Its Effect on the Synthesis, Structure, and Reactivity of R 2 MOR(NHC) (M = Al, Ga, In) Complexes. Organometallics 37, 4585–4598.
- Zieliński, A., Szczepaniak, G., Gajda, R., Woźniak, K., Trzaskowski, B., Vidović, D., Kajetanowicz, A., and Grela, K. (2018). Ruthenium Olefin Metathesis Catalysts Systematically Modified in Chelating Benzylidene Ether Fragment: Experiment and Computations. European Journal of Inorganic Chemistry 2018, 3675–3685.

PROJECTS

- Anionic, cationic and mesoionic analogues of N-heterocyclic carbenes in homogenous catalysis, Trzaskowski Bartosz, PhD, SONATA BIS NCN, 2017-2021
- Anionic carbenes and Borylanions: Tuning the properties of ruthenium metal complexes in olefin metathesis, Trzaskowski Bartosz, PhD, BEETHOVEN NCN, 2018-2021

COMPLETED:

- Towards an efficient design of biosensors: an investigation of the interplay between light harvesting proteins and graphene, Osella Silvio, PhD, POLONEZ NCN, 2017-2018

STAFF

Group Leader:
Bartosz Trzaskowski, PhD

Postdoctoral Fellows:
Ashim Baishya, PhD
Magdalena Jawiczuk, PhD
Nirmalya Mukherjee, PhD
Silvio Osella, PhD
Anna Rybicka, PhD

PhD Students:
Anna Marczyk, MSc
Katarzyna Młodzikowska, MSc

Students:
Angelika Janaszkiewicz
Alicja Kowalska
Ewa Suska-Kauf

Research Technicians:
Magdalena Kurowska

Quantum Memories Laboratory

Prof. Wojciech Wasilewski

RESEARCH

General Overview

Our group constructed massively multimode DLCZ quantum memory in cold rubidium vapor. Thanks to spatially resolved detection this memory is equivalent to few thousand down-conversion sources, beating world records. Recent additions of stark modulation and gradient magnetic fields enabled successful demonstration of multimode interference and processing capabilities. In particular interference of two single spinwaves have been successfully demonstrated. The memory may enable generation or arbitrary quantum states for quantum technologies, in particular communication and measurements.

We also constructed and operate a unique fast, single photon sensitive camera capable of 30kfps. Together with SPDC sources this camera enabled a number of important demonstrations of novel quantum information protocols.

The camera is subject of active development that will enable real time feedback. Our laboratory is capable of developing custom optical and electronic hardware and software and conducting demonstrations of complex protocols for processing quantum information. We are experienced in understanding theorists and casting abstract ideas in forms fit for optical table.

2018 Research Focus

The laboratory has been transferred into QOT IRAU in CENT UW starting from August 2018.

1. New setup fo SPDC and single photon camera develpement is being build.

2. Single spinwave interference project has been finalized (see https://doi.org/10.1103/PhysRevLett.122.063604)

3. Spinwave processor project has been finalized (M. Parniak, M. Mazelanik, A. Leszczyński, M. Lipka, M. Dąbrowski, W. Wasilewski, Multidimensional quantum optics of spin waves through ac-Stark modulation, arXiv:1804.05854)

4. Parametric downconversion of spinwaves project is being finished.

5. Banaszek receiver protocol is being implemented in multimode memory – currently in the preparation phase.

PUBLICATIONS

- Dąbrowski, M., Mazelanik, M., Parniak, M., Leszczyński, A., Lipka, M., and Wasilewski, W. (2018). Certification of high-dimensional entanglement and Einstein-Podolsky-Rosen steering with cold atomic quantum memory. Physical Review A 98, 042126.
- Parniak, M., Borówka, S., Boroszko, K., Wasilewski, W., Banaszek, K., and Demkowicz-Dobrzański, R. (2018). Beating the Rayleigh Limit Using Two-Photon Interference. Physical Review Letters 121, 250503.

PROJECTS

- Spin-wave tomography, Mazelanik Mateusz, MSc, Diamentowy Grant MNiSW, 2017-2021
- Multimode quantum memory in cold atoms: spinwave engineering, Wasilewski Wojciech, PhD, OPUS NCN, 2017-2020
- Development of quantum imaging techniques in optical and atomic systems, Parniak-Niedojadło Michał Paweł, MSc, PRELUDIUM NCN, 2018-2020
- Selective and multiple reading from multimode quantum memory, Leszczyński Adam, MSc, PRELUDIUM NCN, 2018-2021

STAFF

Group Leader:
Prof. Wojciech Wasilewski

PhD Students:
Adam Leszczyński, MSc
Mateusz Mazelanik, MSc, Eng.

Students:
Tomasz Kowalczyk

Research Technicians:
Michał Dąbrowski, PhD

Media preparation

CeNT UW

CeNT CENTRE OF NEW TECHNOLOGIES

Laboratory of Paleogenetics and Conservation Genetics

Prof. Piotr Węgleński

RESEARCH

General Overview

Ancient DNA is powerful tool to reconstruct evolutionary processes which occurred thousands of years ago. Extraction of DNA from various kind of remains coupled with the high throughput sequencing, radiocarbon dating and isotopic analyses enables investigation ancient populations and tracing its changes through the time and space. In our laboratory we use state of the art techniques to resolve wide range of intriguing questions pertaining to biology, palaeontology, anthropology and archaeology. Currently our research focuses on the two main topics.

First one is reconstruction of evolutionary histories of Late Pleistocene mammal species. We investigate population dynamics and migration patterns as a reaction on the climatic changes which took place in the past. The knowledge learnt form past populations could help to predict species' responses to the climatic changes in the future. Currently, we explore several small mammal species throughout Eurasia such as common vole (M. arvalis), field vole (M. agrestis), narow-heded vole (M. gregalis), bank vole (Clethrionomys glareolus) and root vole (Microtus oeconomus).

The second group of projects encompasses paleogenomics of pre-Columbian populations with the main objective to broaden the knowledge about the social structure and history of the two Andean civilizations – Tiwanaku and Inka.

2018 Research Focus

During 2018 two main topics were investigated in the Laboratory. The first one consider human pre-Columbian populations from South America. Sequencing of mitochondrial and low-coverage nuclear genomes were performed to test several archaeological hypothesis and to resolve population structure and ancestry. The second one was the reconstruction of evolutionary histories of small mammals in western Eurasia. Particularly we focused on post-glacial recolonization of Europe and the impact of Younger Dryas cooling on common vole's populations in Central and Sothern Europe.

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Sample collection site at Chullpas, Burial Towers in Sillustani, Peru

*https://www.flickr.com/photos/pedrosz/1865679572

Laboratory of Paleogenetics and Conservation Genetics

Prof. Piotr Węgleński

PUBLICATIONS

- Augustyniak, J., Lenart, J., Gaj, P., Kolanowska, M., Jazdzewski, K., Stepien, P.P., and Buzanska, L. (2018). Bezafibrate Upregulates Mitochondrial Biogenesis and Influence Neural Differentiation of Human-Induced Pluripotent Stem Cells. Molecular Neurobiology 1–18.
- Baca, M., Popović, D., Panagiotopoulou, H., Marciszak, A., Krajcarz, M., Krajcarz, M.T., Makowiecki, D., Węgleński, P., and Nadachowski, A. (2018). Human-mediated dispersal of cats in the Neolithic Central Europe. Heredity 121, 557–563.
- Doan, K., Mackiewicz, P., Sandoval-Castellanos, E., Stefaniak, K., Ridush, B., Dalén, L., Węgleński, P., and Stankovic, A. (2018). The history of Crimean red deer population and Cervus phylogeography in Eurasia. Zoological Journal of the Linnean Society 183, 208–225.
- Nadachowski, A., Lipecki, G., Baca, M., Żmihorski, M., and Wilczyński, J. (2018). Impact of climate and humans on the range dynamics of the woolly mammoth (Mammuthus primigenius) in Europe during MIS 2. Quaternary Research 90, 439–456.

PROJECTS

- Late Pleistocene and Holocene evolutionary histories of two vole species. Reconstruction of populations responses on climate change using ancient DNA and radiocarbona 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, PRELUDIUM NCN, 2017-2019
- 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, 2018-2021

COMPLETED:

- 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

ADDITIONAL INFORMATION

Website: http://adna.cent.uw.edu.pl/

STAFF

Group Leader:
Prof. Piotr Węgleński

Postdoctoral Fellows:
Mateusz Baca, PhD
Danijela Popovic, PhD

Laboratory of Molecular Neurobiology

Prof. Marta Wiśniewska

RESEARCH

General Overview

Mental illnesses, such as schizophrenia or autism, are caused by the disruption of dynamic balance between activation and inhibition in neural circuits, and malfunctioning of glia, which support brain homeostasis. Our Laboratory seeks to understand the molecular mechanisms that underlie brain circuit development and maintenance, and link risk genes with structural or functional pathologies in mental disorders.

Laboratory of Molecular Neurobiology explores the role of gene expression regulation in the establishment and maintaining of thalamocortical neural network and astrocyte system. To address our questions we develop and employed genetically modified animal models using classical and CRISPR/Cas9 based approaches. We use a combination of molecular biology, imaging and bioinformatics tools. We also collaborate with computational biologists, anatomists, electrophysiologists and behaviourists.

2018 Research Focus

In 2018, we implemented four research projects, focusing on the role of canonical Wnt signalling and transcription factor TCF7L2 in brain development and homeostasis. We discovered a critical role of TCF7L2 in orchestrating a network of transcription factors to regulate axon guiding and terminal differentiation program in the thalamus. We also investigated the role of Wnt signalling in controlling astrocyte population and brain metabolic profile. Two master and two doctoral theses were carried out in the laboratory. Moreover, the laboratory held an internship for several students from foreign research centres and co-organized classes for teenagers from the National Fund for Talented Children.

ADDITIONAL INFORMATION

Website: https://sites.google.com/view/lmn-cent

PUBLICATIONS

- Nieznanska, H., Bandyszewska, M., Surewicz, K., Zajkowski, T., Surewicz, W.K., and Nieznanski, K. (2018). Identification of prion protein-derived peptides of potential use in Alzheimer's disease therapy. Biochimica et Biophysica Acta (BBA) - Molecular Basis of Disease 1864, 2143–2153.

PROJECTS

- 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
- Changes in transcription factor isoforms as a mechanism to switch gene expression during the differentiation of thalamic neurons, Prof. Marta Wiśniewska Marta, OPUS NCN, 2018-2021

STAFF

Group Leader:
Prof. Marta Wiśniewska

Postdoctoral Fellows:
Joanna Maria Bem, PhD
Chaitali Chakraborty, PhD
Kamil Koziński, PhD
Andrzej Nagalski, PhD
Łukasz Szewczyk, PhD

PhD Students:
Nikola Brożko, MSc
Marcin Lipiec, MSc

Students:
Kacper Posyniak
Aleksandra Stawikowska

Alumni:
Tomasz Zajkowski, PhD
Katarzyna Brzozowska, MSc
Marta Jankowska, MSc
Maria Domańska, MSc

Laboratory of Remote Sensing and Environmental Modelling

Dr. Przemysław Żelazowski

RESEARCH

General Overview

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

Currently we are working on these projects:

- The extent of eastern Andean tree line over the last 30 years – a global analysis in the context of Amazonia's climate adaptation. 2015 – 2018, NCN (Sonata)
- LandCor – software for atmospheric correction of optical satellite data (Landsat / Sentinel 2)
- A global set of local climate change characteristics based on 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)
- Satellite data analysis in support of evolutionary biology research (in collaboration with the Wild Urban Evolution and Ecology Lab)
- Technical support for the SatAgro project (an Internet service for an ongoing satellite monitoring of individual agricultural fields).

2018 Research Focus

The Laboratory is in the process of establishing itself in the area of satellite monitoring of crop production. An important aspect of this development is that the PI in parallel develops a company which supports farms and other entities with tools enabling more efficient crop production. As a consequence, the Lab has access to original primary data (as permitted by the clients) and insight into the gap in knowledge which can be filled-in. However, this pathway of development requires extra efforts to establish a duo of the Lab and a spin-off with synergistic interactions.

PUBLICATIONS

- Mercado, L.M., Medlyn, B.E., Huntingford, C., Oliver, R.J., Clark, D.B., Sitch, S., Zelazowski, P., Kattge, J., Harper, A.B., and Cox, P.M. (2018). Large sensitivity in land carbon storage due to geographical and temporal variation in the thermal response of photosynthetic capacity. New Phytologist 218, 1462–1477.
- Zelazowski, P., Huntingford, C., Mercado, L.M., and Schaller, N. (2018). Climate pattern-scaling set for an ensemble of 22 GCMs – adding uncertainty to the IMOGEN version 2.0 impact system. Geoscientific Model Development 11, 541–560.

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, Żelazowski Przemysław, PhD, SONATA NCN, 2015-2019

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

STAFF

Group Leader:
Przemysław Żelazowski, PhD

Programmist:
Krzysztof Stopa

Research Technicians:
Przemysław Grocholski
Stefan Józefowicz, MSc
Ryszard Krakowski
Krzysztof Płatek

Regenerative Mechanisms for Health

Prof. Agnieszka Chacińska
International Research Agenda Unit

General Overview

The **„Regenerative Mechanisms for Health"** International Research Agenda Unit ("ReMedy") is a joint unit of the University of Warsaw and University Medical Center Göttingen at Georg-August-University Göttingen, funded by a grant by the Foundation for Polish Science. The goal of ReMedy is to understand and to harness stress-evoked adaptability of cells at the molecular and biochemical level, in order to combat human diseases and pathologies.

Director: Prof. Agnieszka Chacińska (a.chacinska@cent.uw.edu.pl)

Deputy director: Prof. Magda Konarska (m.konarska@cent.uw.edu.pl)

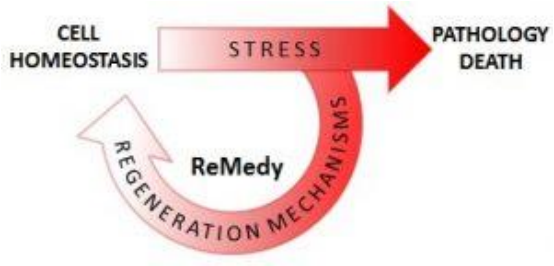
Project coordinator: Michał Wrzesiński, PhD (m.wrzesinski@cent.uw.edu.pl)

ReMedy aims to:

- understand mechanisms of stress response
- discover short- and long-term consequences of cellular responses and their crosstalk in physiology
- apply the gained knowledge about stress responses for the development of new medical treatments.
- More detailed ReMedy agenda in printable format can be found here.

Prof. Chacińska will seek to identify global consequences of translational inhibition in human cells. Preliminary data show that although acute stress leads to rapid inhibition of protein synthesis, this stress is not lethal and frequently cells become even more resistant to further insults. Unknown adaptive mechanisms lead to re-initiation of protein translation. Prof. Chacińska's group will undertake a system analysis of gene expression changes that accompany dysfunctional mitochondria, aiming to identify changes in transcription various steps of mRNA biogenesis and stability, including splicing – in collaboration with the Konarska lab – as well as translation activity/recruitment of mRNA during translation initiation. Studies of the group will deliver a comprehensive gene expression profiling under mitochondrial dysfunction and will lead to a discovery of yet unknown responses and adaptive pathways that have a potential to rescue cells and organisms from organellar stress and may in general benefit cellular and organismal fitness.

Prof. Konarska group will study the mechanisms by which aging or environmental signals influence the function of the splicing machinery and affect splicing outcomes. Changes in patterns of alternative splicing in higher eukaryotes are characteristic signatures of stress and disease, but little is known about the underlying mechanisms. These studies will help to understand how environmental changes or ageing affect regulation of gene expression at the splicing level. They will also help to understand the function of the spliceosome and suggest new ways to modulate it. Ultimately, the mechanisms utilized by yeast to regulate pre-mRNA splicing will also be validated in mammalian cells, and the way how they affect more complex regulation of alternative splicing will be studied in collaboration with the Chacińska group.



The Centre for Quantum Optical Technologies

Prof. Konrad Banaszek
International Research Agenda Unit

General Overview

The Centre for Quantum Optical Technologies (QOT) aims to explore quantum phenomena, such as superpositions and entanglement, in optical and optically controlled system, with the long-term prospects of their practical utilisation. The Centre has been established in partnership with the University of Oxford under the International Research Agenda Programme operated by the Foundation for Polish Science and is hosted by the Centre of New Technologies, an interdisciplinary scientific unit of the University of Warsaw focused on research and technology development.

Director: Prof. Konrad Banaszek

Director for Scientific Affairs: Lidia Tańska, PhD

CORE FACILITIES

CeNT UW Core Facilities commenced operations in late 2018, on the basis of Ordinance No. 4/2018 of the Director of CeNT UW dated September 12th,2018. The idea behind the establishment of the Core Facilities was to centralize CENT UW's most advanced, state-of-the-art equipment and technologies into dedicated facilities and to make them widely accessible to the scientific community through an online booking system. Operated by experienced staff and meticulously organized, CeNT UW Core Facilities deliver the maximum potential from the technology and offer high-quality results at competitive rates.

Currently, CeNT UW has two fully operational Core Facilities:

- **Biological Imaging CF** – for confocal, bight field and fluorescent microscopy equipped with Zeiss LSM700 Confocal microscope, Olympus IX73 fluorescence microscope and Nikon Eclipse fluorescence microscope. CF is led by Tomasz Góral;
- **Proteomics CF** – for ultra-fast and ultra-high mass range protein identification equipped with hybrid quadrupole-orbitrap instruments (UPLC-coupled Q-Exactive UHMR and already purchased from ReMedy funds nLC-coupled Q-Exactive HF-X). CF is led by Remigiusz Serwa and Tomasz Banach.

In the 2nd quarter of 2019, the following Core Facilities will start operations:

- **Cryogenic Transmission Electron Microscopy CF** – for structural analysis of dynamic biological macromolecules at near-atomic resolution – funds from ReMedy International Research Agenda Unit are secured for the purchase of Glacios Cryo-TEM;
- **Next-Generation Sequencing CF** – for high throughput SBS technology-based DNA/RNA sequencing – in a process of consolidating and getting new Sequenator NovaSeq;
- **Cell Analysis CF** – for multiparameter cell analysis and sorting, currently at the stage of search of an oparator.

The organization of the Centre's high-end equipment into Core Facilities offers a number of advantages over the previously used dispersed model, including:

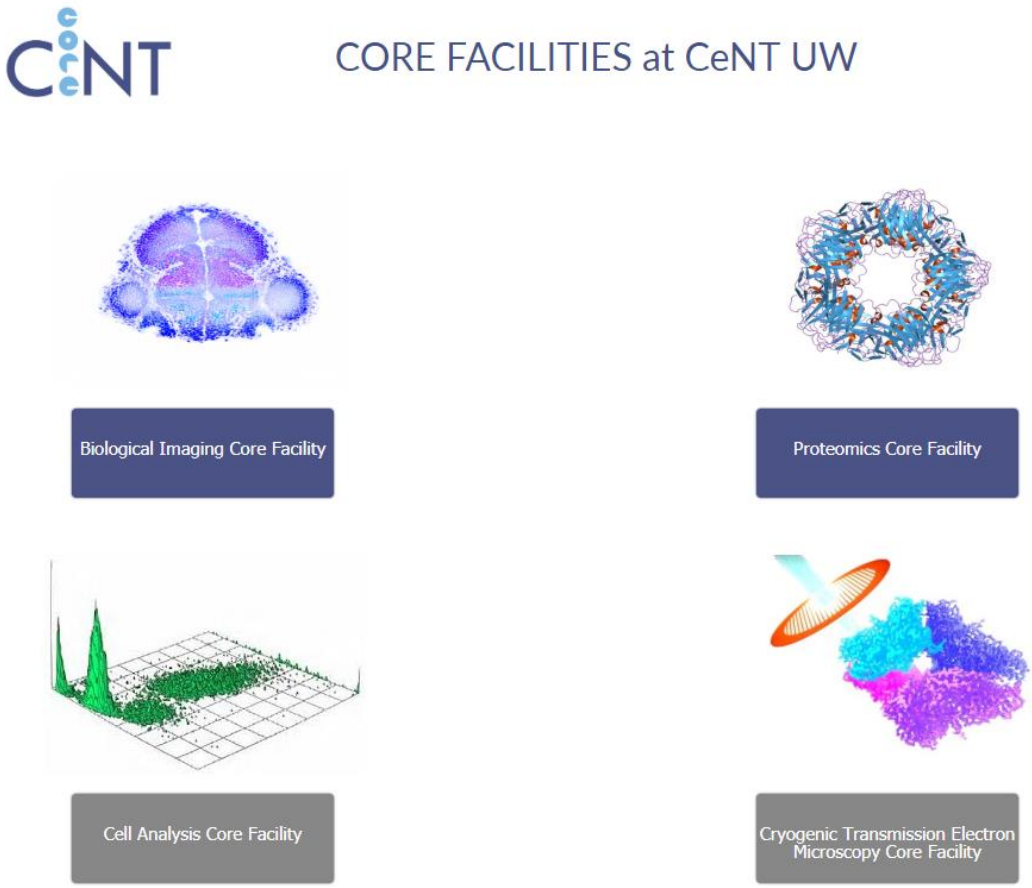
- more efficient working time management,
- possibility to set up and benefit from experimental/analytical workflows,
- maintaining optimal care of equipment in terms of timeliness of technical inspections, servicing as well as orders of consumables,
- maintaining full service contract coverage,
- reduction of operating costs through bulk ordering,
- raising awareness of the availability of equipment among users,
- user workshops and seminars organized by the Core Facilities staff,
- staff's hands-on experience guarantying optimal use of the equipment and obtaining high quality, reproducible results.

The Core Facilities are operated by highly qualified specialists:

Tomasz Góral, PhD - experiment design consultant, microscope operator and data analyst.

Remigiusz Serwa, PhD - experiment design consultant and data analyst.

Tomasz Banach, MSc - instrument operator and data analyst.



Core Facilities webpage:

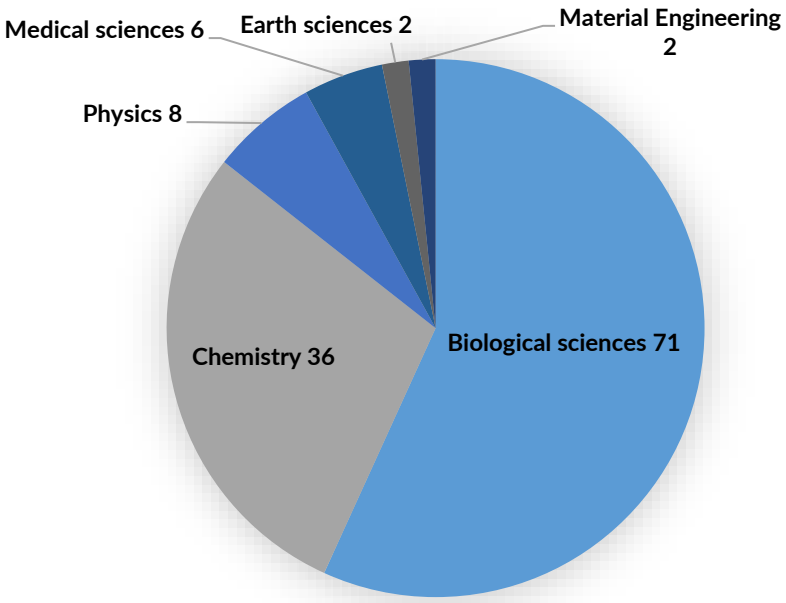
http://cent.uw.edu.pl/en/core-facilities/

CeNT UW'S INTERNATIONAL TEAM

Countries of origin of CeNT UW employees

CeNT UW is proud to be a truly international research centre with employees coming from more than 12 different countries from around the world. We are constantly developing and aiming at increasing our international reach. The red dots represent the countries of origin of CeNT UW researchers.

Number of representatives of different scientific disciplines at CeNT UW

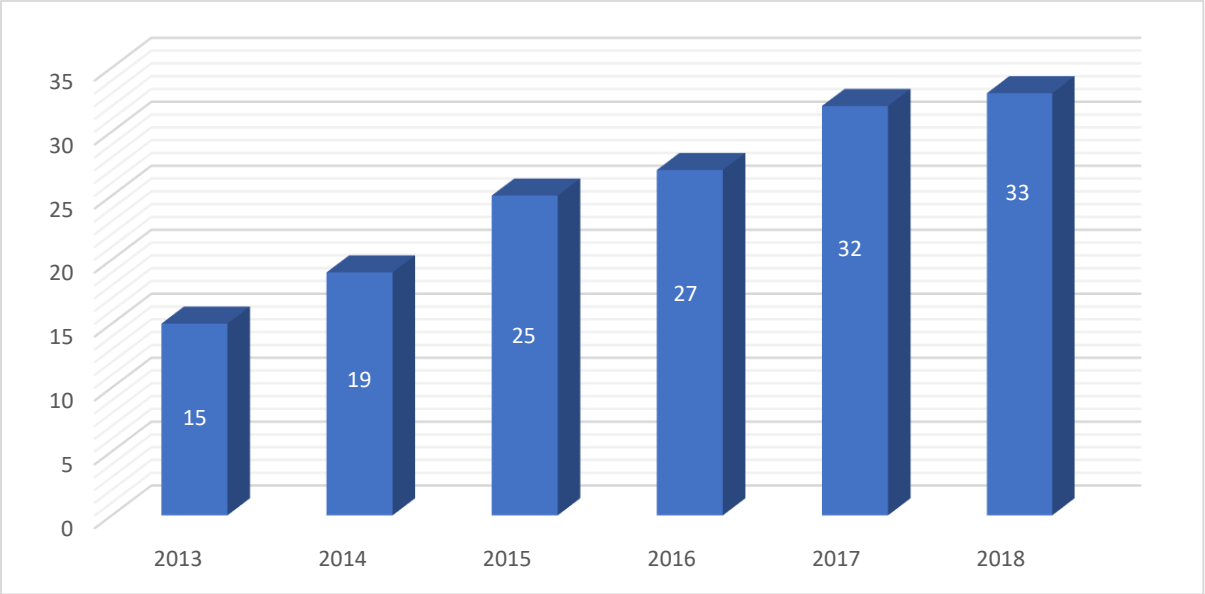


Scientists (125)*

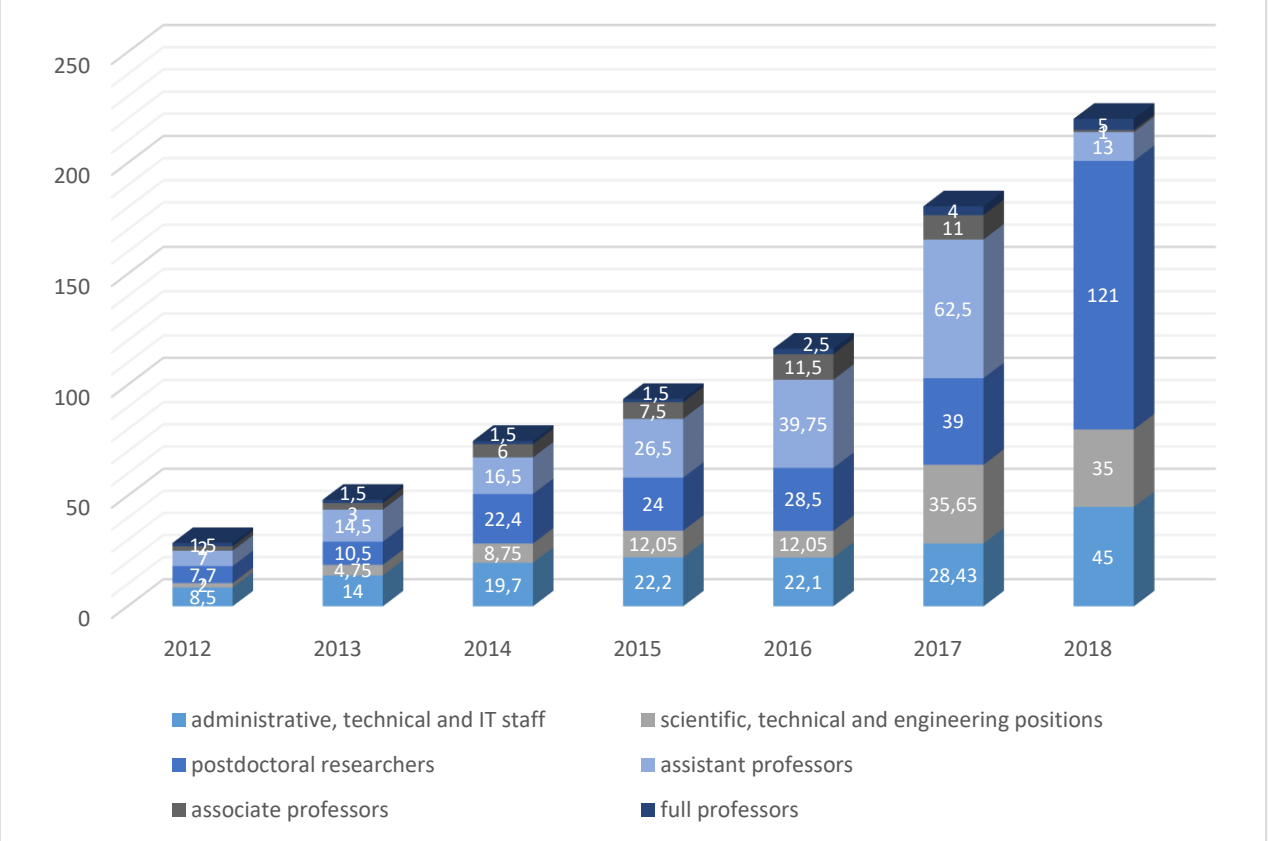
* excluding PhD students

CeNT UW IN NUMBERS

Number of CeNT UW research groups over the years



Growth in the number of CeNT UW employees over the years



STAFF PROMOTIONS – SCIENTIFIC TITLES OBTAINED

Name	Title obtained	Date of obtaining the degree	Institution
Joanna Bem	PhD	25.06.2018	University of Warsaw, Faculty of Biology
Krzysztof Szczepaniak	PhD	30.01.2018	Institute of Biochemistry and Biophysics of the Polish Academy of Sciences
Tomasz Stępkowski	PhD	18.01.2018	Jan Kochanowski University in Kielce The Faculty of Mathematics and Natural Sciences
Karthik Mohanraj	PhD	13.04.2018	Nencki Institute of Experimental Biology of the Polish Academy of Sciences
Maja Cieplak-Rotowska	PhD	26.02.2018	University of Warsaw, Faculty of Physics
Monika Roszkowska	PhD Eng.	13.04.2018	Nencki Institute of Experimental Biology of the Polish Academy of Sciences
Anna Strzeszewska-Potyrała	PhD	28.09.2018	Nencki Institute of Experimental Biology of the Polish Academy of Sciences
Adam Grzelak	PhD	14.11.2018	University of Warsaw, Faculty of Chemistry
Margot Jacquet	PhD	24.08.2018	Communauté Université Grenoble Alpes
Chandan Datta	PhD	12.11.2018	

MOBILITY OF CeNT UW SCIENTISTS

As part of the **Mobility Plus programme, Karol Fijałkowski, Ph.D.** participated in research conducted at the University of Cambridge (United Kingdom) under the supervision of Dr. Erwin Reisner. Dr. Fijałkowski is carrying out the project 'Renewable generation of ammonia from athmospheric nitrogen', gaining knowledge and experience in one of the best scientific centres in the world.

Within the **Mobility Plus programme financed by MNISW, Dr. Tomasz Zajkowski** started a 3-year internship at NASA Ames Research Center (USA) under the supervision of Prof. Lynn Rothschild. There he implements the project "The role of prions in the early evolution of organisms". The research conducted there by Dr. Zajkowski is in line with the trend of intensive development of a multidisciplinary field - astrobiology, which NASA considered to be one of the most dynamically developing sciences of the 21st century.

Under the **SONATINA program financed by the NCN, Dr. Łukasz Szewczyk** completed a 6-month internship at the University of California in San Francisco in a group of Dr. Anna Molofsky, where he conducted research as part of the project "The involvement of LEF1/TCF transcription factors in astrogenesis".

As part of the **Fulbright Senior Award (granted by the Polish-U.S. Fulbright Commission) prof. Joanna Trylska** performs research at University of California San Diego, USA, interacting with the group of prof. J. Andrew McCammon at the department of Chemistry and Biochemistry. Using molecular simulation methods she investigates the toxicity of aminoglycoside antibiotics to human cells and the reasons for development of bacterial resistance to these compounds.

Within the **"Fulbright Junior Research Award" program, Marcin Równicki** participates in research conducted in the Antimicrobial Discovery Center at the Northeastern University (Boston, USA), under the supervision of Professor Kim Lewis. Marcin's research focuses on the molecular mechanisms that lead to formation of persister cells responsible for tolerance to antibiotics in the Gram-negative bacteria Escherichia coli.

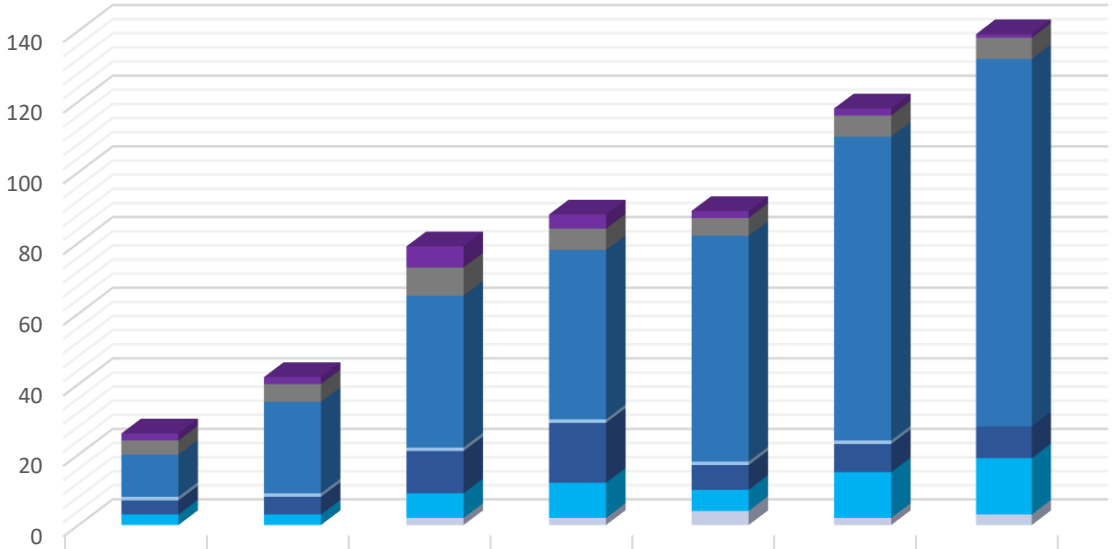
SCIENTIFIC GRANTS

Currently, CeNT UW carries out over 130 research projects involving several people at different stages of their scientific career development. Many of these projects are carried out in cooperation with other national and foreign centres. Projects approved for financing in the competition modes are financed by both domestic and foreign institutions.

The amount of funds transferred in 2018 by grant giving organizations for the implementation of projects amounted to PLN 32.4 million. In 2018 the following changes in the implemented projects took place:

- 22 projects were completed,
- 31 projects were started,
- 4 projects were transferred to CeNT UW from other units,
- 7 projects were transferred from CeNT UW to other units
- 8 projects have been approved for financing - their implementation will start in 2019.

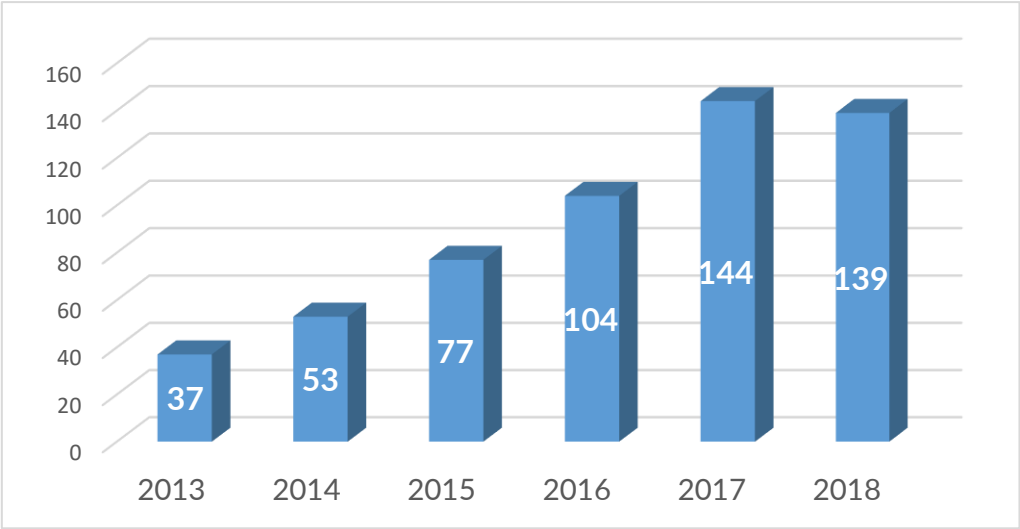
Changes in the numbers of grants in years



	2012	2013	2014	2015	2016	2017	2018
other	2	2	6	4	2	2	1
NCBiR	4	5	8	6	5	6	6
NCN	12	26	43	48	64	86	104
H2020/7PR	1	1	1	1	1	1	0
MNiSW	4	5	12	17	7	8	9
FNP	3	3	7	10	6	13	16
EMBO	0	0	2	2	4	2	3

PUBLICATIONS

In 2018, CeNT UW employees contributed to the publication of such prestigious journals as: Nature Communications, Journal of the American Chemical Society, Proceedings of the National Academy of Sciences. The total number of publications published by CeNT UW researchers is presented in the Figure below.



SCIENTIFIC EVENTS

SEMINARS

Mini-symposium – ReMedy. The meeting of the CeNT UW Council on 4-5.09.2018, was accompanied by an open mini-symposium, where candidates for lab leaders within the ReMedy Agenda and candidates for lab leaders in CeNT UW, had their individual seminars. The following lectures were given as part of the event on 04.09.2018:

- Renata Jurkowska, BioMed X Innovation Center, 'Unravelling the epigenetic regulation of cellular plasticity and repair in the lung
- Piotr Szwedziak, ETH Zurich, 'In situ structure and function of molecular machines'
- Angela Riedel, HI-STEM and DKFZ, 'The role of fibroblasts at the primary tumour site and draining lymph node during tumour progression'
- Tomasz Jurkowski, Universität Stuttgart, 'Probing epigenetic repair mechanisms with synthetic approaches'
- Jakub Godlewski, Harvard Medical School, 'Non-coding RNA and cancer: lessons from glioblastoma'
- Jose Cisneros Trigo, Yale University, 'The medicinal chemistry of agents targeting hydrolytic enzymes, proinflammatory cytokines and viral infections'
- Renata Solarska, CeNT UW, 'Multi-purpose metal oxide materials & interfaces for energy, environmental and health applications'
- Bartosz Różycki, Institute of Physics PAS, 'Membrane protein machineries'
- Krzysztof Pawłowski, Warsaw University of Life Sciences and Lund University, 'Novel enzyme and pseudoenzyme families - bioinformatics predictions and experimental validation'
- Stanisław Dunin-Horkawicz, CeNT UW, 'How often nature reinvents the wheel?'

The Centre for Quantum Optical Technologies lectures. Another scientific initiative was related to the event of launching The Centre for Quantum Optical Technologies. On 21.06.2018, listeners had a chance to participate in the following lectures:

- Paolo Mataloni, Dipartimento di Fisica Sapienza, Università di Roma, 'Integrated photonics devices for quantum communications'
- Artur K. Ekert FRS, University of Oxford, National University of Singapore, 'Privacy for the paranoid ones – the ultimate limits of secrecy'
- Susana Huelga, Universität Ulm, 'Are there non-trivial quantum effects in Biology? A discussion on light harvesting processes'

CeNT UW weekly scientific seminars. The Centre of New Technologies of the University of Warsaw holds weekly scientific seminars. In 2018, Professor Marta Barbara Wiśniewska, leader of the Laboratory of Molecular Neurobiology, and Prof. Joanna Sułkowska, leader of the Interdisciplinary Laboratory of Biological Systems Modelling were the organizers of the seminars.

Within those series of lectures, the following were presented:

- 11.01.2018, Przemysław Malinowski, CeNT UW, 'Exotic, highly reactive and useful: weakly coordinating anions and extremely reactive cations', host – Prof. Joanna Sułkowska
- 01.02.2018, Duncan Smith, New York University, 'Eukaryotic replication: learning from the lagging strand', host - Prof. Magda Konarska
- 08.02.2018, Steffen Scholpp, University of Exeter, 'Towards deciphering the molecular mechanism regulating Wnt ligand trafficking', host - Prof. Marta Barbara Wiśniewska
- 15.02.2018, Bożena Kamińska, Nencki Institute, PAS, 'Targeting tumor-microenvironment interactions as a new therapeutic approach', host – Prof. Marta Barbara Wiśniewska
- 22.02.2018, Joanna Niedziółka, Institute of Physical Chemistry, PAS, 'Synthesis and surface modification of plasmonic nanostructures for (bio) molecular interaction', host – Prof. Joanna Kargul
- 08.03.2018, Katarzyna Tych, Technical University of Munich, 'Unfolding a Molecular Chaperone', host – Prof. Joanna Sułkowska
- 22.03.2018, Urszula Wojda, Nencki Institute, PAS, 'Presymptomatic AD: development of novel biomarkers and therapies', host – Prof. Marta Barbara Wiśniewska
- 29.03.2018 - Jeff Noel, AG Daumke, Max Delbruck Center, Berlin, 'Toward understanding the dynamin molecular motor: a molecular python', host – Prof. Joanna Sułkowska
- 5.04.2018, Agata Starosta, Maria Curie-Skłodowska University, Lublin, 'Undercover translation Hidden secrets of the ribosomes', host – Dr. Urszula Nowicka
- 12.04.2018, Remigiusz Serwa, Imperial College London, 'Chemoproteomic methods for studying protein behaviour', host – Prof. Agnieszka Chacińska
- 19.04.2018, Mariusz R. Więckowski, Nencki Institute, PAS, 'What can we foretell from mitochondrial parameters?', host – Prof. Marta Barbara Wiśniewska
- 26.04.2018, Maria Górna, BCRC UW/Faculty of Chemistry UW, 'Proteins recognizing atypical RNA in mitochondrial and viral RNA metabolism', host – Prof. Joanna Kargul
- 10.05.2018, Victor Tybulewicz, The Francis Crick Institute, UK, 'Novel signalling pathways controlling T cell adhesion and migration', host – Prof. Agnieszka Chacińska
- 17.05.2018, Bartosz Wilczyński, Institute of Informatics, University of Warsaw, 'Looking at chromosomal contacts at different scales', host – Prof. Joanna Sułkowska

- 24.05.2018, Michał K. Stachowiak, State University of New York & Buffalo, 'Evidence-based theory for integrated genome programing ofontogeny –unravelling and combating developmental disorders', host – Prof. Marta Barbara Wiśniewska
- 28.05.2018, Edward H. Egelman, University of Virginia, 'Cryo-EM of Helical Protein and Nucleoprotein Polymers at Near-Atomic Resolution', host – Prof. Joanna Trylska
- 7.06.2018, Ewa K. Stachowiak, State University, New York, 'Neurodevelopmental origins of schizophrenia – new lessons from induced Pluripotent Stem Cells', host – Prof. Marta Barbara Wiśniewska
- 14.06.2018, Matthias Bochtler, International Institute of Molecular and Cell Biology, 'The vocabulary of protein-DNA interactions: Symmetry, degeneracy, modifications', host – Prof. Joanna Sułkowska
- 05.07.2018, Yoshihisa Yamamoto, Japan Science and Technology Agency/Stanford University, 'Physics of quantum-to-classical crossover and coherent Ising machines', host – Prof. Konrad Banaszek
- 28.09.2018, Tomasz J. Nowakowski, University of California, San Francisco, 'Area-Specific Excitatory Neuron Development in the Human Cerebral Cortex', host – Dr. Łukasz Szewczyk
- 5.10.2018, Jacek A. Majewski, Faculty of Physics University of Warsaw, 'New Opportunities in the Flat World', host – Prof. Joanna Sułkowska
- 12.10.2018, Jose Luis Ferran, University of Murcia, 'Brain induced changes in motor responses and fat tissue content during a forced exercise program in rodents', host – Prof. Marta Barbara Wiśniewska
- 15.10.2018, Wladek Minor, University of Virginia, Charlottesville, 'The Impact of Reproducibility on Structure Based Drug Discovery', host – Prof. Joanna Sułkowska
- 18.10.2018, Marek Tchórzewski, Uniwersytet Marii Curie-Skłodowskiej, 'The ribosomal GTPase-associated center as regulatory element modulating ribosomal modus operandi', host – Prof. Agnieszka Chacińska
- 24.10.2018, Ian Collinson, University of Bristol, UK, Mechanism of protein translocation through the bacterial Sec machinery', host – Prof. Agnieszka Chacińska
- 9.11.2018, Peter Virnau, Johannes-Gutenberg Universität Mainz, Germany, 'Knots in DNA, Chromosomes and Polymer Melts', host – Prof. Joanna Sułkowska
- 15.11.2018, Alexander Schug, Karlsruher Institut für Technologie, 'Simulating the molecular machinery of life', host – Prof. Joanna Sułkowska
- 23.11.2018, Magdalena Winiarska, Medical University of Warsaw, 'Tumor microenvironment – a key barrier to effective anti-tumor immune response', host – Prof. Marta Barbara Wiśniewska
- 30.11.2018, Remigiusz Serwa, CeNT UW, 'Proteomics Core Facility @CeNT', host – Prof. Agnieszka Chacińska
- 04.12.2018, Pavel Jungwirth, Academy of Sciences of the Czech Republic, 'Biological Water or Rather Water in Biology?', host – Dr. Piotr Setny

The Wild Urban Evolution and Ecology Lab seminars. CeNT UW was also the host of seminars organised by Prof. Marta Szulkin from the Wild Urban Evolution and Ecology Lab, together with the Mammal Research Institute PAS Białowieża. As part of this initiative, the following lectures were given throughout 2018:

- 10.01.2018, Joanna Bagniewska, University of Reading, 'The bittersweet story of an invasive mammal'
- 07.02.2018, Marta Maziarz, University of Wrocław, 'The value of ornithological research in the Białowieża primeval forest'
- 14.03.2018, Piotr Tryjanowski, Poznan University of Life Sciences, 'Long-term changes in the quantity and quality of supplementary feeding of wildlife'
- 11.04.2018, Marketa Zarybnicka, Czech University of Life Sciences, 'The Smart Nestbox as a tool for video trapping and live streaming of cavity-dwelling animals'
- 09.05.2018, Joanna Sudyka, CeNT UW, 'Age-related trade-offs and telomere dynamics in passerines'
- 13.06.2018, Cleve Hicks, Max Planck Institute for Evolutionary Anthropology Leipzig, Germany, 'Specialized chimpanzee technology in Northern DR Congo'
- 10.10.2018, Piotr Dawidowicz, University of Warsaw, 'Trade-offs in life-against-all-odds-history of Daphnia'
- 14.11.2018, Tomasz Podgórski, Mammal Research Institute Białowieża PAS, 'African swine fever virus (ASFV) in wild boar populations – modus operandi'
- 12.12.2018, Elena Buzan, University of Primorska, Slovenia), 'The impact of landscape management on genetic structure: a review and case studies from small mammals and ungulates'

Other. In 2018, CeNT UW organized the 1st CeNT UW Students and Postdocs Scientific Session, which took place 28.02.-01.03.2018. Thirty-six speakers representing a spectre of disciplines held short presentations on topics of their scientific specialisation.

POPULARIZATION OF SCIENCE

Scientists and doctoral students of CeNT UW are committed to making science more popular, trying to reach the broadest possible audience. They do so by engaging in various activities and cooperating with a number of institutions and entities. The activities range from shows, lectures, exhibitions, and workshops designed for children and school students.

Activities for gymnasium and secondary school students:

Open Day of the University of Warsaw 'Ochota' Campus

A number of CeNT UW scientists were involved in the Open Day of the University of Warsaw 'Ochota' Campus, which took place on 14 April 2018. Key activities included the following:

- The Laboratory of Bioinformatics and Systems Biology prepared a workshop 'DNA – a molecule of Life', prepared for gymnasium and secondary school pupils. The event was attended by about 20 participants;
- The Solar Fuels Laboratory held an event on the topic of 'the artificial leaf' and photosynthesis, attended by about 30 participants;
- The Chemical and Biological Systems Simulation Laboratory organized two group workshops on molecular modelling, attended by 8 participants;
- The Interdisciplinary Laboratory of Biological Systems Modelling presented a workshop on programming a biological molecular machine, with about 20 participants attending;
- The Laboratory of Molecular Neurobiology organized an event called 'The Transparent Brain', during which several participants viewed brain specimens, e.g. prepared using the clarity method, and carried out elements of preparing specimens for further histologic examinations.

National Fund for Children

A series of activities organized in cooperation with the National Fund for Children, which supports talented primary and secondary school students:

- Workshop with the participation of the Laboratory of Bioorganic Chemistry, aimed at popularizing biological and chemical sciences among school students;
- Research workshop with the participation of the Laboratory of Biological Systems Modelling, which focused on teaching students about the design of selective inhibitors using bioinformatic and biophysical methods;
- Workshop by the Laboratory of NMR Spectroscopy (27.02.18.-05.03.18) during which three secondary school pupils became acquainted with the latest techniques of NMR spectroscopy;
- Workshop by the Laboratory of Molecular Neurobiology, during which a group of students got acquainted with sophisticated techniques of molecular and cellular biology and the realities of research work
- Lecture by Prof. Marta Szulkin from the Wild Urban Evolution and Ecology Lab, with approximately 30 participants

- Another initiative was organized by the scientists from Laboratory of Stem Cells, Tissue Development and Regeneration and Laboratory of the Molecular Biology of Cancer;

Other activities:

- Workshop 'Profession – scientist' for primary school students in Legionowo, comprising a theoretical part and a laboratory presentation part. The event was organized by The Laboratory of Bioinformatics and Systems Biology and attended by 20 pupils.
- Contribution to the Children's University, during which about 500 schoolchildren had an opportunity to attend a lecture by Prof. Joanna Sułkowska who introduced basic biophysical concepts and encouraged the participants to carry out some simple research;
- Contribution to the work of the Main Committee of the Chemical Competition by preparing tasks and reviewing contestants' work by Professor Stępiński from the Interdisciplinary Laboratory of Molecular Biology and Biophysics
- Lecture on bird biology in the La Fontaine primary school and setting up a bird house with a camera by the Wild Urban Evolution and Ecology Lab;

Activities addressed to students and young scientists:

- Co-organization (with Prof. Agnieszka Chacińska as chairwoman) the event 'Woman in Science' at the 3rd congress of the Polish Biochemical Society in Gdańsk called Bio 2018. The aim of the initiative is the popularization of women's scientific careers;
- Chemical and Biological Systems Simulation Laboratory organized a week-long workshop on molecular modelling for a group of 3 participants;
- The first edition of the Young Chemist University (30-31 August 2018) selected 20 students who had a chance to share the results of their projects by poster or presentations. The conference also included plenary lectures, presentations, and poster sessions, as well as lab tours of the Biological and Chemical Research Centre and the Centre of New Technologies. Approximately 60 students attended;
- Involvement of the Chemical and Biological Systems Simulation Laboratory in the Summer School of Molecular Biophysics and Systems Biology in Nove Hrady, South Bohemia, Czech Republic. This initiative gives Czech and foreign students an opportunity to cooperate with specialists, lecturers, and enables participation in excellent lectures and new to gain insight into the methodology of research. The event was attended by about 20 people.

For all

- Exhibition of urban nature photography at Pole Mokotowskie in Warsaw, which featured selected photographs
- 'Zero Waste' Fair (Gdynia, 18.08.2018) – The Solar Fuels Laboratory had a lecture on 'Phytoplankton as a basis for trophic networks in water reservoirs and micro-plastic pollution'.

FINANCES

Financial Management

		PLN	EUR*
I	**Sources of Funding**	43 168 403	10 039 163
1	Statutory and Budgetary Subvention	9 759 850	2 269 732
2	Domestic and Foreign Grants	32 418 835	7 539 264
3	other, including commercialization	989 718	230 167
II	**Expenditures**	44 186 518	10 275 934
1	Personnel cost	21 563 936	5 014 869
2	Scientific instruments and equipment	3 647 232	848 193
3	Consumables, including research materials	8 769 343	2 039 382
4	Cost of building maintenance	6 583 270	1 530 993
5	Subcontracting	1 117 642	259 917
6	Other	2 505 095	582 580
OUTCOME		**- 1 018 115**	**-236 771**

**1 EUR = PLN 4.3000, exchange rate of the National Bank of Poland as of 31 Dec, 2018*

In 2018, the costs of maintaining CeNT UW's new building at ul. Banacha 2C exceeded the amount of PLN 6,6 mln (EUR 1.5 mln), including personnel costs, out of which operating costs were covered by a subsidy in the amount of PLN 3 080 049 (EUR 716 290). 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.

INVESTMENTS

In 2018 we focused on the efficiency and effectiveness of existing infrastructure. Additional equipment is planned to be purchased in 2019. We have secured funds to finance obtaining the Glacios Cryo-TEM for structural studies, as well as the Q Exactive HF-X mass spectrometer for proteomic analyses.

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.

CONTENTS: