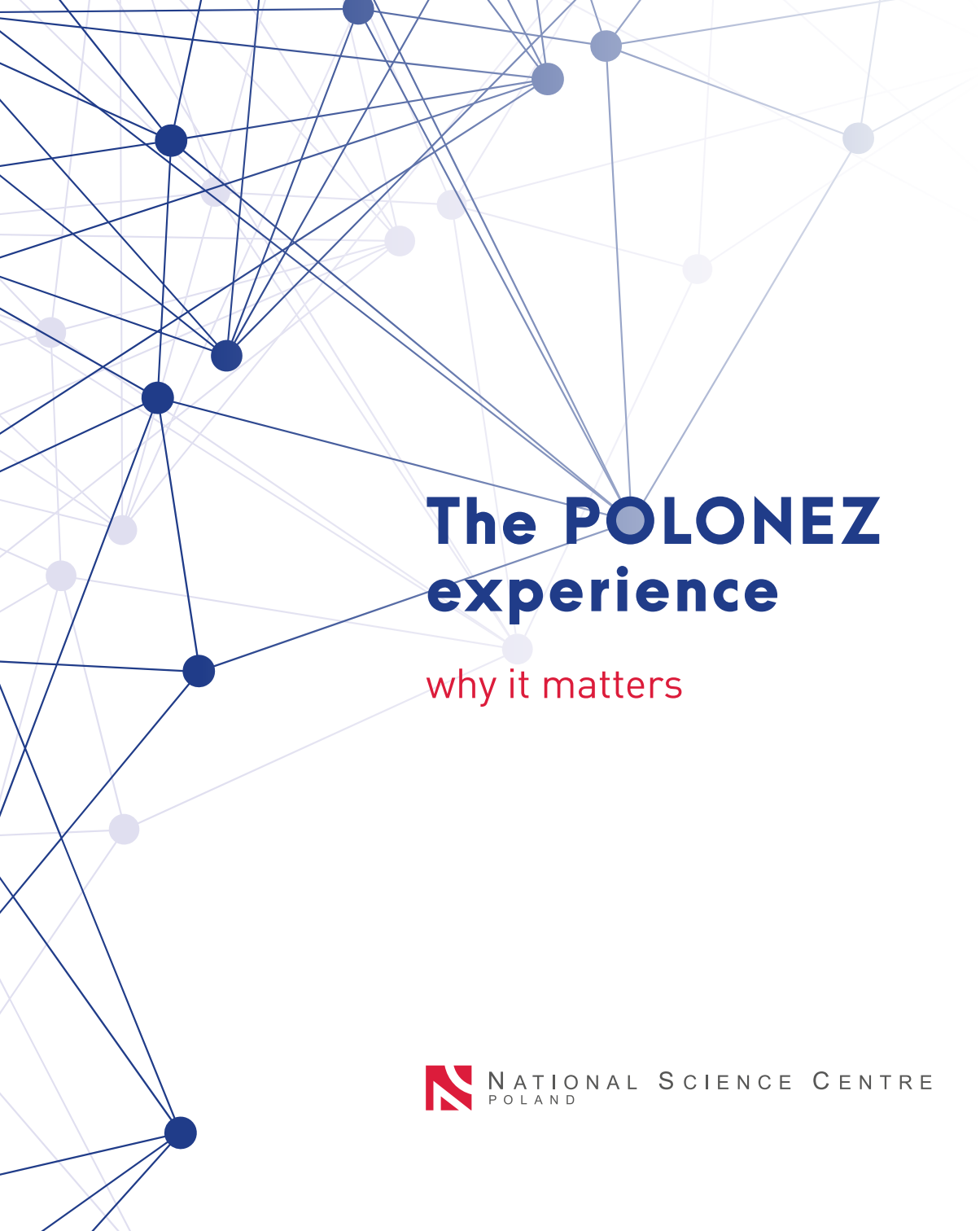
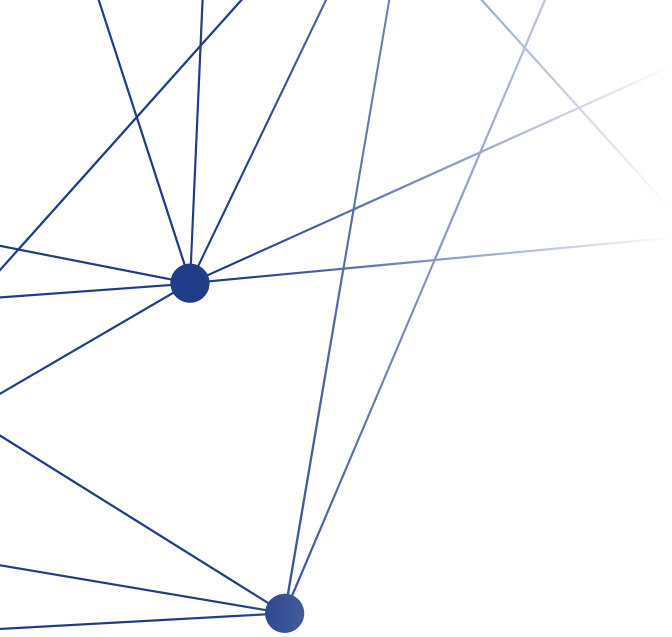


The POLONEZ experience

why it matters

NATIONAL SCIENCE CENTRE
POLAND



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Kraków, February 2021

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Foreword

Prof. Zbigniew Błocki
Director
National Science Centre, Poland

It is my pleasure to introduce to you 24 brilliant scientists who just a couple of years ago chose to pack their research ideas and move to Poland to carry them out.

Their success resulted from the synergy of a number of factors: first and foremost from their individual drive and contributions, but also from the environment provided by the Host Institutions and the combined funding from the European Commission and the National Science Centre under the Marie Skłodowska-Curie Actions Co-fund Project POLONEZ (grant agreement 665778).

The MSCA Cofund Programme is unique in three main ways. First of all, it is a quest for talent and excellence, unlimited by age, nationality or a narrow list of research disciplines.

Second, it produces a huge influx of international Fellows to the host country and thus guarantees a bigger networking impact. Within three POLONEZ calls we have welcomed 109 Fellows from 28 countries all over the world.

Third, it consists of much more than just an individual stipend. POLONEZ offers a considerable research grant to provide Fellows with financial independence and the opportunity to hire a project team. The national funding goes beyond the research box to include capacity building components such as intersectoral study visits and training sessions dedicated to transferable skills.

The National Science Centre shares the MSCA's belief that a successful career in science involves not only high quality individual research and publications but also a great amount of networking and an ability to embrace various research cultures, including those in other countries and outside academia. Taking one's academic career across the globe can be a challenge but there is little doubt that it can also significantly impact one's life – both personal and professional.

In this book, Fellows, their Research Partners and representatives of their Host Institutions explain why participation in POLONEZ fellowships matters to them. Their stories combine to illustrate the colourful and varied nature of the POLONEZ experience.

Polish research institutions already operate according to the highest European research standards. The ambition of the National Science Centre is that they should also grow as vibrant international communities. That is why we were happy to include MSCA Cofund in our portfolio. We are proud of the results the programme has generated so far. We are honoured that, starting from 2021, we will be able to extend a new invitation to Poland to 120 talented researchers under MSCA POLONEZ BIS.

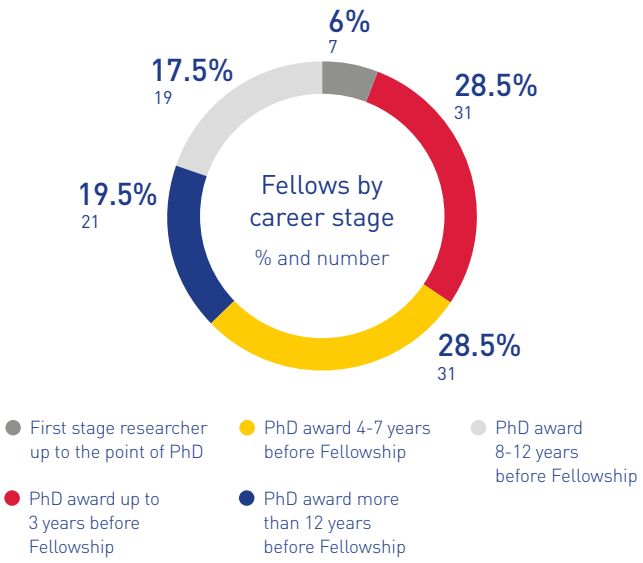
Key figures

Marie Skłodowska-Curie Actions (MSCA) are European Commission's calls for projects which combine research and training with attractive career development opportunities and transfer of knowledge. The basic MSCA requirement is international and intersectoral mobility of researchers.

POLONEZ is an MSCA programme cofunded by the European Commission and the National Science Centre, Poland. It provides an opportunity for experienced, talented scientists interested in moving to Poland to fund their own research projects while working at Polish host institutions of their choice.

The programme follows bottom-up approach to research topic selection and offers career development for researchers at all career stages.

In 3 competitive calls the programme recruited 109 Fellows from 28 countries all over the world and placed them in full-time research positions in 49 Host Institutions throughout Poland.



1151 submitted projects

109 funded projects

10% success rate

24 projects in Arts, Humanities and Social Sciences

30 projects in Life Sciences

55 projects in Physical Sciences and Engineering

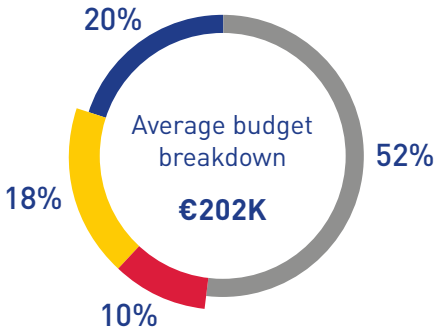
The programme offers generous funding for the Fellow and a substantial research grant to cover relevant costs including the cost of the research team.

total funding **€20.5M**

including **€5.2M** from the European Commission

85 projects employed co-investigators

and funded over **180 new jobs** in research



In addition to training through research, POLONEZ has facilitated the development of Fellows' diverse competences through

336 hours of dedicated training programme

47 individual coaching sessions

217 intersectoral or international study visits

POLONEZ successfully contributed to an increased post-fellowship employability and career prospects. New grants awarded to Fellows:

1 ERC Starting Grant

1 MSCA Individual Fellowship

43 new NCN grants

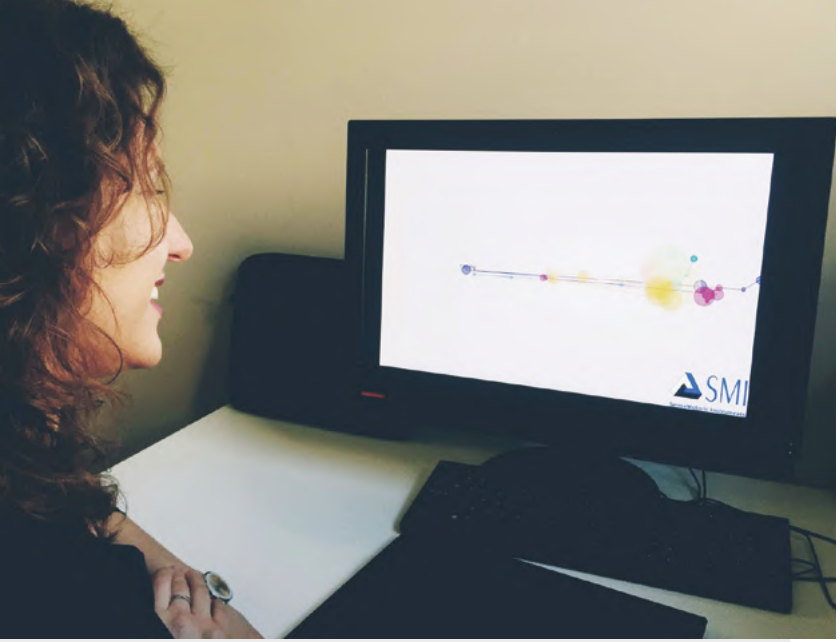
Source: Fellows' final reports and POLONEZ Coordination Team.
Numbers as of December 2020

We carried out independent research, developed new skills and were able to go out of the academic bubble for a while

– say MSCA POLONEZ Fellows, who spent two years working in Polish host institutions.

Watch the interview in which they share insights on their research and training activities and the overall impact the POLONEZ fellowship had on their careers.

Observing people and societies



Rumination, a depression risk factor. Changing the way you think may help fight depression

Monika Kornacka

Each of us sometimes dwells on the same subject: *Why does it always happen to me? What have I done to deserve that?* Repetitive negative thinking is a natural way of regulating our emotions. However, under certain circumstances it might become maladaptive and increase the risk of psychological disorders.

Photo: Monika Kornacka. Author: Zofia Kostrzewa
Portrait photo author: Zofia Kostrzewa

Researchers working on rumination, i.e. repetitive negative thinking that is difficult to control, suggest that rumination may become a habit and we use it by default when we are feeling sad or upset. To stop habitual ruminative response and gain flexibility in emotional regulation, an efficient inhibition and ability to disengage attention from self-referent negative thoughts are necessary. The aim of our project was to examine the role of those processes as potential mechanisms of rumination.

In the first part of the project, we used a daily sampling method to evaluate daily rumination, mood and inhibition. It allowed us to determine dynamic relationships between psychological processes, such as rumination and mood. Depressed patients and healthy controls were provided with an application for their mobile devices. During the first week, five times a day, they answered questions evaluating their rumination and affect, and in the evenings they performed a task evaluating their inhibition. During the second week participants trained their inhibition by playing a simple game. Finally, during the third week, participants repeated evaluation of their daily mood, rumination and inhibition. The results indicate that daily rumination predicts participants' negative mood, but negative affect does not predict prospective rumination. This is an important contribution to the literature, as the previous research results on the link between rumination and mood in daily life were not consensual. Determining this causal relationship is crucial from the clinical perspective in designing effective rumination treatments.

The present study was the first to evaluate the link between inhibition and rumination in ecological settings. Difficulties in inhibiting neutral and negative stimuli were linked to daily rumination and strengthened the impact of daily rumination on daily negative mood. Further analyses will provide a first insight on inhibition training on mobile devices, whether it decreases daily rumination and improves participants' mood.

In the second part of the project we ran experimental studies in the laboratory. Depressed and healthy control participants were randomly allocated to one of three groups. The first group used abstract rumination to dwell on their problems; the second group used concrete rumination to focus on their own emotional feelings; the third group used distraction. Following those instructions, we tested participants' inhibition and attentional processes by using behavioural and eye-tracking measures. Eye-tracking records eye movements and thus, it enables a very precise assessment of inhibition and visual attention. The results indicated that participants after using abstract rumination showed higher emotional reactivity than participants using concrete rumination. The eye-tracking tasks showed that they are also less flexible and fail to adjust their attention to the ongoing task, contrary to the participants using concrete rumination.

Merging ecological and laboratory approaches to study rumination enabled us to identify potential mechanisms of negative repetitive thinking (inhibition and attention flexibility). They should be targeted in future applied research addressing efficient rumination therapy for patients suffering from depression or with a high risk of developing it.

According to the World Health Organization's 2016 statistics, 27% of adults suffered from at least one mental disorder (including 350 million individuals suffering from depression). It is numbers like this that make therapy of rumination and other depression risk factors crucial.

How did you benefit from the POLONEZ fellowship?

Working in a new, dynamic research team and collaborating with more experienced researchers enabled me to learn skills that were previously missing from my portfolio and which are nowadays necessary to conduct research in cognitive psychopathology at an international level. The fellowship also enabled me to develop soft competencies of managing an international research team, dealing with the formal and administrative requirements. The results of this research project were a solid theoretical foundation for my ongoing research project, recently selected for funding by NCN.

Finally, the course of the research project, the skills and collaborations I've developed were undoubtedly a key factor in recruiting me for the position I currently hold at SWPS University.

Dr Monika Kornacka (SWPS University of Social Sciences and Humanities, Interdisciplinary). Psychologist, cognitive-behavioural therapist. Head of Emotion Cognition Lab, Assistant Professor at Katowice Faculty of Psychology and Assistant Director of the Psychology Institute at SWPS University of Social Sciences and Humanities.

POLONEZ project: Dynamic Relation between Repetitive Negative Thinking and Inhibition in Depression – Daily Process Approach
Host institution: SWPS University of Social Sciences and Humanities, Warszawa
Project duration: 01.06.2017 – 31.05.2019

Re-thinking the history of the European family

Mikołaj Paweł Szołtysek

The ways contemporary European families are organised differ markedly, and it is likely that these variations have important consequences for the status of women, intergenerational relations and human capital formation. However, tracing the historical roots of these familial variations has never been successfully concluded. Marred by a lack of large-scale historical data and insufficient methodologies, past research has never culminated in a comprehensive reconstruction of a European historical geography of family patterns.

Photo: The Winnik family by the cradle; Kosów Poleski district, Polesye Voivodeship, Poland. Author: Józef Szymanczyk, 1937. Courtesy of Irena Domanska
Portrait photo: Author's personal collection

This project consists in pioneering analyses of the patterns, causes and implications of European variations in historical family systems, which are tackled via a first systematic comparative approach, using Europe's largest public-use collections of historical census microdata. Drawing on these previously unavailable data, the project addresses the three broad questions of what these major variations were, what caused them and what difference they could make in the European context, from the Atlantic to the Urals, between 1700 and 1918.

Analysis of the nearly pan-European dataset offers a multi-faceted reconstruction of family patterns, seeking to understand how they clustered in space and changed over time. By asking whether these patterns stemmed from differences in socioeconomic, demographic or environmental conditions, or whether they had a deeper 'socio-cultural' basis, the project explores potential links between the historical family geography and Europe's other internal divisions.

Given that families and households constitute fundamental units of economic, demographic and social behaviour, could variations in family patterns contribute to developmental inequalities between the societies of Europe? Overall, this interdisciplinary project elevates the discussion of the geography of European families to entirely new heights by revealing nuanced spatial patterns of family systems, carefully anchoring this variation in historical contexts, and by unravelling its societal implications on a hitherto never attempted scale.

The project is based on a harmonized dataset of historical public-use census microdata from the Mosaic and North Atlantic Population (NAPP) projects, comprising 14 million individuals living in 3.3 million households. These data are analysed with advanced historical demography and geospatial methodologies to provide measures of all crucial attributes

of family systems across multiple settings between 1700 and 1926. Thanks to the georeferenced nature of the Mosaic/NAPP data, a thorough contextualization of the spatio-structural variation in family systems will be carried out by linking family/demographic information at the regional level with various topographical covariates (e.g., soil quality, land-use, terrain ruggedness and population density), as well as with institutional-cum-cultural characteristics (e.g., the presence of serfdom; descent rules; religion, ethnicity and urban-rural distinction), including time-period. Major analytical tasks proceed in three consecutively intertwined stages corresponding to the three major research questions above. The 1st stage – PATTERNS – provides a comprehensive investigation of the variation in family organisation across 300 regions of historic Europe in terms of life course and marriage patterns, household structures and individual living arrangements; it then maps these out in space and time, and strives to establish spatial patterning in their occurrence across the continent and over time. The 2nd stage – CAUSES – links these fine-grained demographic data to geospatially located contextual information and uses spatially-sensitive multivariate regressions to investigate how variations in environmental, cultural and political-economic spheres affected different aspects of regional family systems across different areas. Finally, the 3rd stage – IMPLICATIONS – explores channels through which family variation could produce developmental disparities across European societies. It does so by looking at gender- and age-inequalities in the life course and residential behaviour, and by investigating the relationship between cross-cultural differences in familial organisation and regional disparities in human capital levels in the past.

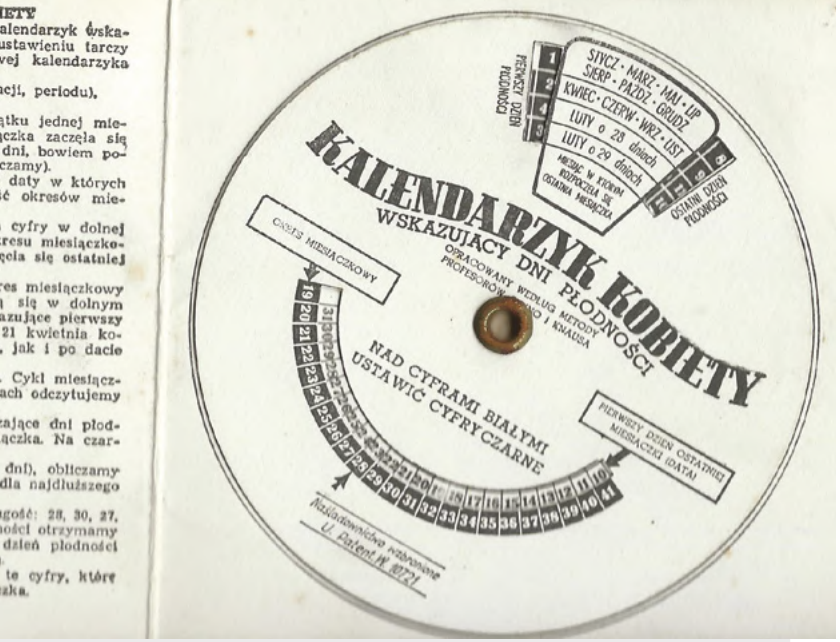
The project fills the evidentiary gaps for many previously under-researched areas and yields key breakthroughs leading to a radical re-thinking of previous mainstream 'family histories'. The new detailed geography of family patterns will become a comprehensive reference study for social and family historians, as well as for demographers, sociologists and economists alike, providing a fresh reservoir of policy-relevant insights into the persistence of and changes in basic patterns of human organisation and their causal factors. It will also form a crucial building block for future comparative studies covering the whole of Eurasia.

How did you benefit from the POLONEZ fellowship?

The Polonez fellowship allowed me to build an excellent research team, bringing together people of very diverse skills and competencies. With such human resources I was able to target the top scientific journals in the world. The Fellowship made it possible to popularize my research widely in Europe and beyond by attending conferences, workshops and seminars in my research field.

Before coming to Warsaw **Dr hab. Mikołaj Szołtysek** worked as a Senior Research Fellow at the Max Planck Institute for Social Anthropology in Halle/Saale and as the Deputy Head of the Laboratory of Historical Demography at the Max Planck Institute for Demographic Research in Rostock. He is interested in researching historical family systems, in which he combines demographic methods with those of economic history, social anthropology and cross-cultural studies. Szołtysek's recent research, at the Hungarian Demographic Research Institute in Budapest, focuses on spatially contingent relationships between different aspects of family systems and environmental characteristics.

POLONEZ project: Family variation in historic Europe: patterns, causes, and implications for European developmental inequalities, 1700-1918
Host institution: University of Warsaw
Project duration: 01.01.2018 – 31.12.2019



Reproductive practices under state socialism

AGATA IGNACIUK

Contraception and abortion are highly contentious topics in contemporary Poland. A close examination of how these issues were dealt with in the recent past sheds new light on the history of Polish state-socialism, the democratic transition and current debates on reproductive rights in Poland.

Photo: A woman's calendar from the brochure *What is a fertility calendar*, dr Rafał Pumpiański (Państwowy Zakład Wydawnictw Lekarskich, 1957)
Portrait photo: Author's personal collection

Birth control cultures in Poland, 1945-1989 is the first systematic study of the history of contraception and abortion in Poland during the whole state-socialist period. It adds to the dynamically developing scholarship examining the history of the 1956 Polish abortion law, family planning activism and its international entanglements, biopolitics and population policies and sexual expertise in post-War Poland. It also broadens the incipient field of social history of medicine and health in Poland and East Central Europe.

We studied ways in which the Party-State, on one hand, and the Roman Catholic Church on the other, were trying to convince people — directly or through specific organisations funded for that purpose — to have more or fewer children. We examined how the population policies these institutions promoted were communicated and how they changed over time, looking for discrepancies and meeting points between them. We also explored the ways in which expert knowledge on contraception and abortion was created and popularized, and how it inserted itself in international scientific debates. Finally, we investigated Polish men's and women's knowledge and experiences related to birth control.

In our research, we used a wide range of sources. We examined the archives of the Society for Family Development, the state-sponsored family planning organisation, as well as archival material from the Department of the Chaplaincy of Families of the Metropolitan Curia in Krakow. We carried out a systematic study of popular medical literature in Poland published between the late 1950s and late 1980s, and analysed the coverage on abortion and contraception in the leading professional journal for gynaecology, *Ginekologia Polska*, during this period. We also studied magazines for women and the general press as well as documentaries on contraception and health produced by the Educational Film Studio in Łódź. Furthermore, we

conducted oral history interviews with Polish women and men in which we enquired about their experiences with planning their families before 1989.

We showed how popular medical publications on contraception put forward a particular vision of what were women's and men's roles in family planning. We explained the transnational influences in the campaign of production and dissemination of diaphragms and spermicides in Poland during the late 1950s and the 1960s, and how their availability and quality fluctuated in the centrally planned economy. We demonstrated how expert discussion on abortion in Poland shifted from framing it as a public health solution to a public health problem, and analysed ways in which state-sponsored and Catholic family planning 'systems' were implemented and how they engaged in dialogue with each other.

Finally, we put the stigmatisation of abortion, disseminated through both state-sponsored and Catholic discourses between the late 1950s and late 1980s, in dialogue with women's narratives of abortion to conclude that for many women, abortion was a pragmatic birth control option.

Our research has advanced the study of population policies, expert and popular knowledge about contraception and 'ordinary' people's reproductive practices under state socialism, contributing to a more nuanced history of this period in Polish history.

How did you benefit from the POLONEZ fellowship?

The POLONEZ fellowship has been fundamental for the development of my professional career. I was awarded the fellowship in 2017, less than two years after completing my PhD. In addition to having the opportunity to carry out my first independent research project — a dream project indeed — I was able to strengthen and expand my professional networks. Thanks to the POLONEZ fellowship, I was able to secure a tenure-track position in history of medicine at my target institution. I also benefited from the project personally. Being able to conduct a 2-year research project in Poland, where I am from, after almost a decade spent abroad, has enabled me to reconnect with my family and friends. My daughter, who moved with me for the duration of the grant, has highly improved her command of Polish, which is great too!

Dr Agata Ignaciuk holds an MA degree in international studies (University of Łódź) and an Erasmus Mundus Joint European MA in Women's and Gender Studies (University of Granada/ University of Bologna). She completed her PhD in women's studies and history of medicine in 2015 at the University of Granada. Since 2010, her research has revolved around the transnational history of reproduction and contraception, and the history of women and gender in Spain and Poland.

POLONEZ project: Agata Ignaciuk, Birth control cultures in Poland (1945-1989)
Host institution: University of Warsaw
Project duration: 01.10.2017 – 30.09.2019

The smellscapes of Lublin

Stephanie Weismann

Sniffing out everyday life in interwar Poland. An attempt at narrating the city's history on the basis of its smells.

Collage: The Smellscapes of Lublin. Author: Stephanie Weismann
Portrait photo author: Annette Tesarek

The smell of horse dung and bakeries, of *rynsztok* (*street gutter*) and herring marinade were dominant topics in everyday debates in Lublin between the first and second World Wars. Smells are ubiquitous and strongly determine the atmosphere of a given place. In this project, historical smell experiences and smell perceptions are used as a tool for cultural analysis. 'Nosing around' the city of Lublin is meant to explore certain olfactory sensitivities that were emerging at that time. With a focus on the Polish interwar period, the project asks which smells have affected the citizens of Lublin, their everyday lives and how these smells have reflected infrastructural, socio-cultural and political conditions and transformations.

The city of Lublin serves as a case study, representing the troubled, yet in many respects 'ordinary' history and socio-cultural landscape of a medium-sized city in East Central Europe at the time. The *smellscapes* of interwar Lublin were shaped by forms of habitation, by sanitary practices, cooking customs, seasonal cycles, by the level of industrialization and, last but not least, by the people inhabiting the city. By asking who smelled and what smelled, the project reflects upon changing notions of hygiene, socio-political struggles as well as interethnic sensitivities. Case studies on selected urban micro-spaces (e.g. courtyard, staircase, neighbourhood) do not only give insight into local *smellscapes*, but also into the emotions and feelings provoked by these smells.

The project implements approaches from sensory history, everyday life history and historical anthropology to study urban life in interwar Poland, thereby expanding the field of sensory (urban) studies to the social and cultural history of East Central Europe. Sniffing out what was in the air provides insights not only into cultural practices of everyday life, but also into the motions of modernisation and the emotions of nation-building.

In this context, archival sources reveal patterns of social surveillance and civil (dis)obedience and reflect problems of hygiene and living conditions. Discourses in selected newspapers provide useful insight into fears, public concerns and national sensitivities. In addition, personal recollections elucidate moral and cultural ideas and reveal what people think about odours.

How did you benefit from the POLONEZ fellowship?

I applied for a 12-month POLONEZ grant to do in-situ research on my 'olfactory history' of Lublin. When working on an urban history, especially with a sensory approach, it is of special relevance to actually live in this city. Being 'in the field' for me has rendered multiple possibilities to actually get a sense for the city and to make sense of the city – not only from inside the archive and with a view to its historical sources, but also on the everyday level.

Moving from Vienna to Lublin with the support of POLONEZ was a great possibility as well as a great challenge: as a non-native of Poland without a basic social network and as a single mother of a three-year-old, choosing a medium-sized city has turned out to be an advantage in many ways: smaller local networks for academic as well as non-academic cooperation, being exposed to Polish language on an everyday basis, and the pleasure of communicating scientific findings to an interested local audience via various non-academic activities. My POLONEZ stay in Lublin has allowed me to really get in touch with the city, the subject of my research, it facilitated fruitful exchange with local experts (both academic and non-academic). Furthermore, it has paved the way to broaden my individual academic network, to improve my language (and therefore also cross-cultural) skills and to get acquainted with the facets of Polish histories and mentalities.

Dr Stephanie Weismann studied Comparative Literature, German Philology and Slavic Studies (Russian) at the Universities of Vienna and St. Petersburg. She earned her PhD within the research programme 'Habsburg Galicia and Its Multicultural Heritage' at the University of Vienna. After her MSCA POLONEZ Fellowship 2017-2018, she has continued to work on her project as Hertha-Firnberg-Fellow (Austrian Science Fund) at the Institute for Eastern European History at the University of Vienna. Her research interests are: sensory history, the history of everyday life in East Central Europe and Russia in the 19th and 20th century, the history of emotions, popular culture under Socialism and after.

POLONEZ project: The Smellscapes of Lublin. An Olfactory Urban History of Interwar Poland
Host institution: Maria Curie-Skłodowska University in Lublin
Project duration: 01.04.2017 – 31.03.2018

Europeanisation from a Central European perspective

James Wesley Scott

The development of the European Union is often linked to ideas of 'Europeanisation', which sometimes suggests a one-sided exportation of values and rules from West to East. At the same time, the notion of an East-West gap within the EU emphasises economic, political and cultural differences. However, is this an accurate reading of the situation?

Photo: Wola apartments in new development area. Author: James Wesley Scott
Portrait photo author: Klaudia Nowicka

What does Europeanisation actually mean? If we abandon the idea that somehow all EU member states are becoming – or should become – more similar or should follow a certain set of rules defined by Brussels, we can understand Europeanisation as something taking place locally, from the bottom up. And cities are perhaps the best places to see how this actually happens.

The project has studied Polish positionality with regard to Europeanisation by using three URBAN perspectives: understandings of national roles within European construction, interpretation of cross-border co-operation and European Neighbourhood, and understandings of European identity as they relate to socio-cultural questions, diversity and uses of history.

We have achieved:

1. Most importantly, comparative analysis of governance innovations and the use of urban cultures in local development policies of Polish cities. Two specific examples we have elaborated are the 2016 European Capitals of Culture programme and Smart City initiatives undertaken by major Polish cities such as Gdańsk, Gdynia, Lublin, Warszawa and Wrocław.
2. Background research on Cohesion Policy and Europeanisation focusing on cross-border cooperation.
3. Background research on Polish positionality with regard to European Neighbourhood Policy and Eastern Partnership, with a specific reference to Polish-Ukrainian urban partnerships.
4. A comparative perspective with regard to other Central European perspectives, Hungary in particular, regarding the positionality of local actors in terms of the urban perspectives mentioned above.

As the project shows, urban culture can refer to the various ways of living in a city; it derives meaning from the urban environment and everyday uses of urban spaces. Cities reflect in concrete terms (e.g. through narratives, architecture, social media, literature and neighbourhood change) tensions that are present at the more general national level. At the level of cities we find not just elite ideas of what culture means, but also the bottom-up creation of cultural spaces in terms of urban stories, events, uses of public spaces, gastronomy, urban civil society activism and participation. As part of our work we have also made a documentary video that shows how Polish cities on the River Vistula are using their waterfronts as part of local development strategies that blend tourism, culture and local identity with improvements to the townscape.

What is the wider social significance of our research? Polish cities are undergoing rapid social and economic change. There is no national-level urban policy and locally available resources are scarce. Still, more than the national level, it is Poland's cities that are at the vanguard of influencing Europeanisation, for example, through creative governance partnerships with civil society and with cities outside Poland's borders. Polish cities are also innovation leaders in comparison with Central Europe, and have developed much more dynamic governance practices than their Hungarian counterparts, for example. With or without EU support they have been dealing with this change in highly innovative ways. The project shows, therefore, that in order to better understand European integration we need to have a closer and more careful look at local situations.

We think that East-West differences are overstated as something cultural but that they exist as historical experiences and ways of seeing the world.

Dr James W. Scott is a Researcher in Regional and Border Studies at the Karelian Institute of the University of Eastern Finland. He obtained his PhD at the Free University of Berlin and his B.Sc. at the University of California, Berkeley. His principal fields of research include: urban and regional geography, borders, border regions, geopolitics, regional and urban governance. Since 2003 he has coordinated several medium-sized and large research consortia focusing on border studies and supported by the EU's Framework Programmes, the European Science Foundation, the Finnish Academy and other sources. Presently he is coordinator of the GLASE project (Multi-layered Borders of Global Security), funded by the Academy of Finland and is scientific coordinator of the Horizons 2020 project RELOCAL, which investigates the role of the local level and local strategies in Cohesion and Territorial Development.

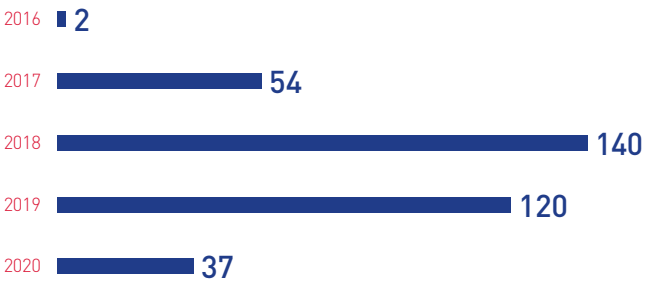
POLONEZ project: Beyond Core-Periphery Debates: New Member States in the Constructionof European Union
Host institution: University of Gdańsk
Project duration: 01.01.2017 – 31.12.2018

Impact – Publications

Thanks to numerous publications in peer-reviewed journals POLONEZ Fellows have gained recognition and acknowledgement as experts in their respective fields at national and international levels. Their efforts to disseminate scientific evidence have also built international recognition for departments, universities and institutions that hosted them.

Open Access publication policy has helped Host Institutions advance their mission to build a knowledge-based society. Immediate and unrestricted access to Fellows' research results also boosted their visibility as demonstrated by a growing number of citations.

Number of Open Access publications

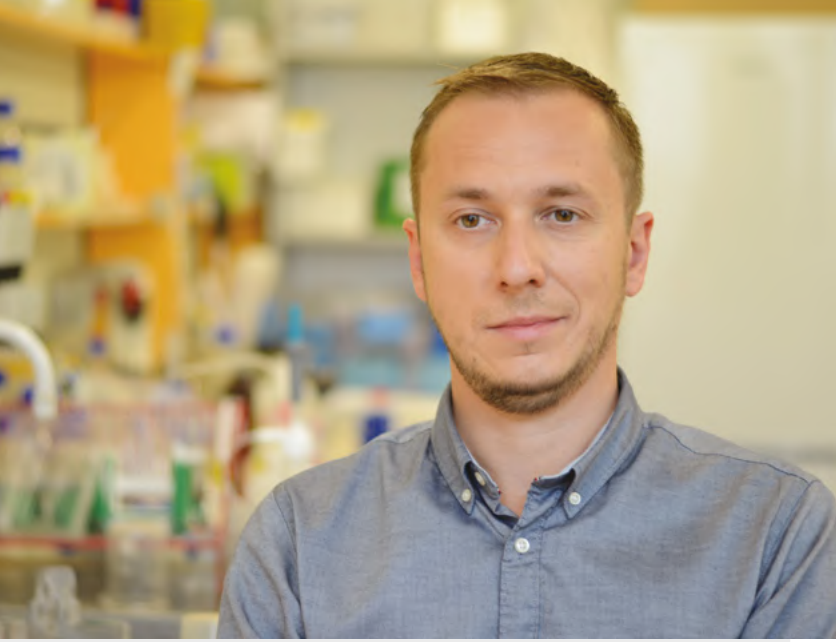


353
OA publications
and counting

2056
citations
since 2016

Source: Fellows' final reports
and POLONEZ Coordination Team.
Numbers as of December 2020

Explaining the molecular basis of health



How gum bacteria manipulate our genes and how we can stop them

ALEKSANDER GRABIEC

Periodontitis, or gum disease, is one of the most common chronic inflammatory diseases known to mankind. It affects the tissues which support the teeth and, if left untreated, it can last for years causing gum recession and tooth loss.

Photo: Aleksander Grabiec. Author: Piotr Malinowski

The disease is initiated by bacteria in dental plaque, especially *Porphyromonas gingivalis*, which accumulate on the surface of the teeth below the gum line. Although nearly 30% of adults suffer from periodontitis, in many countries it is a neglected disease, both by people in general and by health-care personnel, who often consider tooth-loss due to periodontitis to be an inevitable event associated with aging. However, the true impact of periodontitis on human health is immense as it is strongly associated with increased risk for other diseases, including rheumatoid arthritis, atherosclerosis and cancer. That is why it is necessary to better understand the causes of the disease and develop new strategies for its prevention and treatment.

In periodontitis, the damage of the periodontal tissue is a consequence of an ineffective host immune response to microbial invaders. However, little is still known about how these microorganisms affect biological processes inside host cells in order to avoid elimination by the immune system. One such process is epigenetic regulation of gene expression.

Genes provide instructions for cells on how to produce a variety of proteins which trigger biological processes to carry out life functions. Epigenetics influences how cells 'read' genes or how specific types of cells 'know' which genes to switch on to produce certain proteins and which to switch off. If we understood how to keep the good combinations of genes activated and how to eliminate the harmful ones we could, for example, influence the way cells respond to bacterial infection and determine the right treatment for many diseases.

The focus of this project was one of such epigenetic processes – acetylation of proteins that interact with DNA. We studied how oral bacteria manipulate protein acetylation

in gingival cells and whether targeting this process could be beneficial in patients with periodontitis. First, we discovered a new mechanism of host cell manipulation by P. gingivalis – degradation of enzymes that regulate protein acetylation, histone deacetylases, which may significantly impact cell responses to infection with this pathogen. Second, we found that compounds which block the activity of acetylation regulators – histone deacetylases and BET proteins – reduce excessive production of mediators of inflammation and bone destruction by gingival cells from patients with periodontal disease. Since currently available therapies focus predominantly on reducing bacterial challenge, the anti-inflammatory activity of epigenetic drugs targeting acetylation could be considered a potential strategy for additional therapy that would support standard periodontitis treatment. These results not only improve our understanding of the pathogenesis of periodontal disease, but may also be important from the clinical perspective. Because some epigenetic drugs (histone deacetylase inhibitors) are already successfully used in the clinic to treat other diseases, these observations provide a rationale for future tests of drugs targeting histone acetylation in patients with gum disease.

How did you benefit from the POLONEZ fellowship?

The POLONEZ fellowship was the essential first step towards developing an independent scientific career and helped me secure funding for setting up my own research group in Poland. During the fellowship, I gained invaluable experience in project management and student supervision, which are essential parts of the scientific career as a group leader. At the personal level, the fellowship gave me a unique opportunity to return to my home town after 10 years of international work.

Dr Aleksander Grabiec is a cell biologist with a keen interest in epigenetic and transcriptional regulation in chronic inflammatory diseases. His research focuses on understanding how altered expression of epigenetic regulators, transcription factors and signalling molecules contributes to chronic inflammation, and on identification of novel therapeutic strategies targeting these alterations.

After obtaining an MSc in biotechnology at the Jagiellonian University in Kraków, Poland in 2007, he worked at the Academic Medical Center, University of Amsterdam, The Netherlands, where he earned his PhD in 2012. He continued as a postdoctoral researcher at the Manchester Collaborative Centre for Inflammation Research (MCCIR), University of Manchester, UK. In October 2016, having received the POLONEZ fellowship, he joined the Department of Microbiology at the Faculty of Biochemistry, Biophysics and Biotechnology, Jagiellonian University. Together with the research group that he established within the Department of Microbiology, he now continues the research initiated during the POLONEZ project, with the support from grants from the Foundation for Polish Science (FIRST TEAM) and NCN (OPUS 18). He is the recipient of a 3-year scholarship from the Polish Ministry of Science and Higher Education for outstanding young scientists (2018) and the Polish Intelligent Development Award 2020 in the category: Researcher of the Future for his research on epigenetic mechanisms of gum disease.

POLONEZ project: Epigenetics of periodontitis: alterations in the host protein acetylation system as a potentially fundamental mechanism for disease development
Host institution: Jagiellonian University in Kraków
Project duration: 01.10.2016 – 30.09.2018

DNA damage recognition and processing in mitochondria

Michał Roman Szymański

Mitochondria are cellular power plants. We have hundreds to thousands of them in each cell. It is inside of mitochondria that the sugar and fat we eat are burned and generate energy used to create a compound – ATP. ATP can be thought of as a universal battery that powers most biological processes in our cells.

Photo: Michal Roman Szymanski in his lab. Author: FNP ONE HD
Portrait photo author: FNP ONE HD

Mitochondria are unique in the way that they have their own DNA, in which the information on how to build the key components of electron transport chain, the ATP production sites, is encoded. However, free radicals generated during the process of ATP production tend to escape from these cellular power plants. At low concentration, free radicals are thought of as signalling molecules but at high concentrations they damage mitochondrial DNA. DNA in mitochondria, just like in the nucleus, must be faithfully copied and mistakes lead to formation of DNA lesions. Persistence of these DNA lesions may lead to genomic instability and different disorders with a wide range of clinical symptoms, and has been connected to cancer and premature aging, as well as cardiovascular, skeletal muscular and neurological disorders. It has been shown that mitochondrial DNA can be efficiently repaired but our understanding of this process is rather limited.

The goal of this project was to provide fundamental mechanistic information on how two proteins (hEXOG and Polγ), thought to be involved in the process of DNA repair in mitochondria, work and cooperate with each other to process damaged DNA substrates. We have shown that both proteins cooperate in removing DNA lesions. This cooperation is dynamic and dependent on the type and the size of the damage. Our findings have also shown that there are probably other, additional proteins, that would facilitate DNA damage repair and this possibility is being examined further in my group.

What's the biggest success of your project?

We have had several scientific achievements in the project. Research-wise, not only were we able to uncover the mechanism of DNA damage removal in human mitochondrial DNA but also identified additional factors that could modulate this process. In addition, we continued old collaborations and

extended our scientific network. However, probably the biggest success of the project is the development of my scientific programme and the setting up of my independent research group supported by external research funding from the Foundation for Polish Science, EMBO and ERC.

Why are the results of your research important?

Strict preservation of genetic information is critical for maintenance of species and faithful inheritance of genetic material through generations. DNA replication, recombination and repair are tightly regulated fundamental processes coordinated by multiple protein complexes. Understanding how these enzymes cooperate to perform their function is indispensable for understanding why such processes dysfunction in various diseases such as cancer and human genetic disorders.

Understanding how DNA replication, recombination and repair enzymes perform their function may inform us on how to regulate and control these processes and, thereby, design efficient disease therapies.

How did you benefit from the POLONEZ fellowship?

POLONEZ helped me in the transition stage from postdoc to the PI and from USA to Poland. Thanks to the fellowship I was able to build a small research team and expand my scientific network through collaborations. In addition, thanks to the support of the POLONEZ fellowship I could commit more time to research and additional activities. For instance, I filed my habilitation and I applied for additional funding (EMBO Installation Grant). With the support of the POLONEZ fellowship I was able to generate ideas and preliminary data to support my application for the ERC Starting Grant which I received in 2019.

Dr hab. Michał Roman Szymański, prof. UG completed his studies in Biochemistry and Biophysics at the University of Houston, USA (2007) and earned his PhD in Biochemistry and Molecular Biology from the University of Texas, USA (2011). He was awarded the prestigious Jeane B. Kempner Postdoctoral Fellowship and continued his research at the Department of Biochemistry and Molecular Biology and later Department of Pharmacology at the University of Texas Medical Branch (USA). In 2017, as winner of POLONEZ (National Science Centre, Poland) and FIRST TEAM (Foundation for Polish Science) grants, he joined the Intercollegiate Faculty of Biotechnology UG & MUG Gdańsk, Poland. Apart from Polish and American fellowships and grants, he won the prestigious European Research Council Starting Grant and the EMBO Installation Grant. Since 2019, he has headed an independent Structural Biology Laboratory at the Intercollegiate Faculty of Biotechnology UG & MUG Gdansk, Poland.

POLONEZ project: Unraveling the molecular basis of DNA damage recognition and processing in human mitochondria
Host institution: University of Gdańsk
Project duration: 01.10.2017 – 30.09.2019

Tackling mitochondrial diseases through in vivo studies of zebrafish

Barbara Uszczyńska-Ratajczak

Mitochondrial dysfunctions can affect almost any part of our body, including the brain, nerves, muscles, heart, kidneys, eyes and pancreas. Many human diseases are related to their dysfunctions, including muscular dystrophy, cancer and neurodegenerative diseases such as Alzheimer's disease or Parkinson's disease.

Photo: Zebrafish (Danio rerio) in aquarium. AdobeStock_172717225
Portrait photo author: Silvia Carbonell Sala

Eukaryotic cells can be compared to mobile phones. Both of them are small and powerful and can work as a stand-alone system or easily interact with others. Each mobile phone consists of subassemblies that have well-defined functions and efficiently co-operate with each other. In eukaryotic cells these subassemblies are called organelles and are essential for their proper functioning. Of these, mitochondria are the most unusual. They act as a self-charging battery that provides energy for the cell. To maximize their productivity, mitochondria have a specific structure. They consist of two membranes: outer and inner. The outer membrane fully surrounds the inner membrane like a rubber bumper that completely covers the mobile phone from all sides. Contrary to the smooth outside of the mobile phone that is fitted around by the bumper, the mitochondrial inner membrane folds many times and creates layered structures. As a result, the two membranes are not in direct, physical contact and a small intermembrane space is formed between them. The inner membrane surrounds the mitochondrial matrix and those two components act together to produce the energy for the cell.

Another feature that makes mitochondria special is the presence of their own DNA. Although the size of mitochondrial DNA is not as large as the nuclear one, it encodes 13 components that are crucial for energy production. However, for mitochondria to be fully active requires more than 1000 proteins. The remaining 99% of mitochondrial proteins are encoded by nuclear DNA and need to be imported into mitochondria. This process is not easy due to the complex mitochondrial structure and requires special machinery that helps proteins to get to their final destinations in mitochondria. Mitochondrial dysfunctions caused by an imbalance in protein import have serious consequences for the cell and are associated with different diseases. The majority of mitochondria-related diseases affect the brain and muscles, due to their high energy requirements. Alzheimer's disease

is currently the most common form of dementia, affecting 46 million people worldwide and it is estimated that by 2050, the number of cases will triple.

We know a lot about the system that helps to transport mitochondrial proteins, but it is not clear what is happening at the cytosolic stage of the mitochondrial transport. The main question was to understand whether all mitochondrial proteins are transported after completing their production in the cytosol or for some of them the production is coupled with the import into the mitochondria. We addressed this question using zebrafish as a model organism. Zebrafish is a small tropical fish that shares many similarities with humans. Moreover, humans and zebrafish share 70% of genes, and 84% of genes known to be associated with human pathologies have a counterpart in zebrafish. These features ensure that information acquired through zebrafish is more accurate than obtained by in vitro studies, thus easier to extrapolate to human biology.

Altogether the results of the project indicate that the post-translational import, where the proteins are first synthetized in the cytosol and then imported into mitochondria is the main route for mitochondrial proteins. Whereas coupling the protein synthesis with the mitochondrial import seems to be a specialized route taken by some proteins with special properties that would be difficult to get imported in a post-translational manner. Interestingly, it seems that cells can use other organelles to facilitate the mitochondrial protein import, e.g. endoplasmic reticulum, which is like a stand-alone centre for the synthesis and folding of special types of proteins. Moreover, we also indicated that the impairment of the import of the intermembrane space proteins triggers abnormalities in the development and physiology of the liver and pancreas. We also identified the acinar cells that produce and transport enzymes, assisting in the digestion of food, to be severely affected by the disorders in mitochondrial biogenesis. Our data contribute to a better understanding of the molecular, cellular and organismal effects of mitochondrial deficiency, important for the accurate diagnosis and future treatment strategies of mitochondrial diseases.

How did you benefit from the POLONEZ fellowship?

The POLONEZ fellowship encourages women's advancement. It is particularly important for me, as I am aiming to reach a leading position in research, while fulfilling maternity responsibilities at the same time. The broad spectrum of courses helped me to improve my personal effectiveness, project management and presentation skills. I simply started to feel more confident in the fast-moving and highly competitive field of my research.

Dr Barbara Uszczyńska-Ratajczak received her PhD in Biochemistry from the Institute of Bioorganic Chemistry, PAS in Poznań in 2013. After completion of her degree, she joined the group of Prof. Roderic Guigo at the Centre for Genomic Regulation in Barcelona, where she worked on the identification of full-length long noncoding RNAs (lncRNAs) in human and mouse genomes. She joined the International Institute of Molecular and Cell Biology in 2019 and her current focus is on studying the evolutionary conservation of lncRNAs across and beyond mammals.

POLONEZ project: Principles of mitochondrial protein compartmentalization in vertebrates
Host institution: University of Warsaw
Project duration: 01.09.2017 – 31.08.2019

Investigating the role of mitochondrial proteins in cancer

CARLO VASCOTTO

Cancer is a complex disease caused by interactions of multiple factors, such as genetic predisposition, environmental and lifestyle influences, infectious agents and ageing. Due to the complexity of this pathology, cancer research includes basic research, strategies for prevention, development of early diagnostic tools, and translational approaches for treatment and cure.

Photo: Carlo Vascotto – outreach activities in the kindergarten.
Author: Edyta Nowotka

In basic cancer research 'knowledge' is the key word because if you want to interfere with a biological system you must know how it works. For this reason, the main purpose of this project is to gain information about the mitochondrial form of a DNA repair protein.

Radiation therapy and chemotherapy are the mainstream options available for cancer treatment. Many chemotherapeutic drugs act by damaging DNA, leading to an accumulation of lesions that ultimately cause cell death. However, human cells have the ability to repair damages induced by chemotherapeutics drugs therefore vinifying their effects. Base excision repair (BER) is a cellular pathway able to repair the damage generated at nuclear and mitochondrial DNA. An essential protein for the correct functioning of this pathway is APE1. This protein is present both in the nucleus and the mitochondria, represents a key enzyme of the BER pathway and elevated expression levels have been reported in several carcinomas contributing to resistance to chemotherapy.

Current approaches to cancer treatment report more effective results when specific DNA repair inhibitors are used in combination with DNA damaging drugs. The foremost rationale of the combined therapy is that the repair of DNA is likely to sensitize cancer cells to chemotherapeutic agents. For this reason APE1 inhibitors are currently in use in therapy as adjuvants to chemotherapeutic drugs. However, an alternative approach to inhibit APE1's DNA repair function consists in blocking its mitochondrial translocation to alter the ability of the cell to repair DNA damage induced by chemotherapeutic agents.

Research activities in this project allowed us to demonstrate, for the first time, the role of the TIM23 channel and the PAM motor complex in the translocation of APE1 into the mitochondrial matrix where the mitochondrial DNA is located.

Moreover, we measured the kinetics of translocation, or in other words, how fast the protein is imported after induction of DNA damage. Our data proved that it takes less than 30 minutes for APE1 to be efficiently imported into the mitochondrial matrix to repair damaged DNA.

This study significantly contributes to filling the knowledge gap about the mitochondrial nature of APE1 protein therefore opening the possibility for further translational approaches to cancer treatment that rely on APE1 protein as a target.

How did you benefit from the POLONEZ fellowship?

Polonez has been a life-changing experience. The fellowship gave me the possibility to work for two years in an internationally renowned Polish research institute while pursuing my scientific interests through a basic research project. During this period I had the possibility to improve my knowledge of mitochondrial biology, strengthen my collaboration with my host, Prof. Chacińska, and establish new collaborations with Polish scientists. I was the recipient of the fellowship but not the only beneficiary of the project – four of my Italian collaborators also had an opportunity to spend some months with me at the Centre of New Technologies of the University of Warsaw.

But the fellowship impacted not only my profession, but also my family. Indeed, I came to Poland with my wife Elena and our five-year-old daughter Alice. She attended the International Preschool of Warsaw where I organised a laboratory experience to show the kids that bacteria are on our hands and why it is important to wash our hands before eating to remove bacteria.

POLONEZ was an unforgettable life experience: we fell in love with Warsaw and I really hope to be able to come back to Poland!

Dr Carlo Vascotto is Assistant Professor of Molecular Biology at the University of Udine in Italy. His research interests are focused on the understanding of some basic molecular mechanisms of cancer, in particular the mechanisms responsible for repairing damaged nuclear and mitochondrial DNA, and the role of mitochondria in tumorigenesis, tumour progression and resistance. He also positively contributes to students' and junior faculty's careers by mentoring and teaching Molecular Biology.

His scientific collaboration with Poland dates back to 2015 when he was a guest of the Mitochondrial Biogenesis laboratory headed by Prof. Agnieszka Chacińska at the International Institute for Molecular and Cell Biology. POLONEZ allowed him to work for two years at the Centre of New Technologies of the University of Warsaw. He continues to collaborate in different research projects with other Polish scientists.

POLONEZ project: Mitochondrial translocation of the DNA repair protein APE1
Host institution: University of Warsaw
Project duration: 01.09.2017 – 31.08.2019

Shedding light on HIV latency

Anna Kula-Pacurar

There are almost 40 million people throughout the world living with HIV. 35 years after its discovery there is a good anti-HIV therapy; however, this treatment cannot fully eliminate the virus.

Photo: Anna Kula-Pacurar. Author's personal collection.

The major reason for this is that HIV hides away in cells by switching off its genome (its so-called latent state), becoming invisible to drugs and the immune system. When the antiretroviral therapy attacks HIV, it is not able to eliminate the hidden/dormant virus, which eludes the therapy. Whenever a patient stops the antiretroviral regimen, the latent virus reappears. Therefore, the HIV-infected patient has to take the antiviral medications for the rest of their life.

Consequently, latency persists, cannot be eliminated and represents a major hurdle in finding a cure. New strategies aimed at eliminating the latent virus are absolutely necessary in order to reach a cure. By unlocking the secrets of latency it may become possible to cure – not just control – HIV.

With no vaccine on the horizon, several strategies are currently proposed in order to fight latent HIV. One of them is 'shock-and-kill'. This strategy involves waking up the sleeping virus ('shock') using so-called latency-reversing agents while keeping the anti-HIV therapy ('kill') so that the reactivated virus can be eliminated. This kind of strategy would allow the latently infected cells to die from viral cytopathic effect or host immune response. However, scientists are now aware that this strategy for some reason is not potent enough to reactivate the virus and to eliminate the latent reservoir. Therefore, development of additional tactics is necessary.

The goal of the research was to discover if MATR3 and PSF cellular proteins matter for HIV latency. Researchers found out that these two factors are poorly expressed in latent cells from patients and further demonstrated that lack of these factors blocked the latent virus from full reactivation using existing drugs. They therefore identified a novel block related to MATR3 and PSF that impedes the action of drugs.

This demonstration at least partially answers the question as to why the current shock-and-kill therapy is insufficient and highlights that further studies are urgently needed to understand the blocks.

How did you benefit from the POLONEZ fellowship?

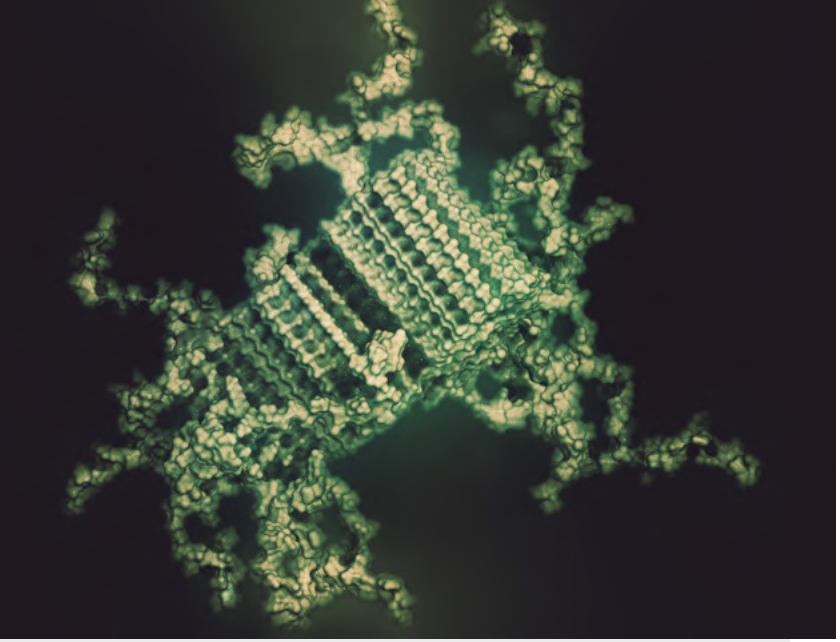
The POLONEZ grant allowed me to come back to Poland after 12-years of doing research in Italian and Belgian laboratories to establish pioneering HIV research in my country from scratch. This project bridges the gap between ongoing HIV epidemiological and clinical studies as well as broadens the virology research in Poland to a new area of high impact.

Moreover, thanks to the grant I could carry on already established and initiate new multidisciplinary collaborations with clinicians, chemists and other virologists from Poland and abroad. Realization of this grant in collaboration with international laboratories allowed to demonstrate a novel block of latency that needs to be relieved to potently awake the virus from latency. This discovery directly impacts on the development of the HIV field with implications for therapy.

Importantly, I could say that without the POLONEZ grant I would not have been able to establish myself as an independent researcher in Poland with solid and recognized research program. Realization of this grant helped me to be successful in obtaining SONATA BIS grant from NCN that aims at continuing the research initiated during POLONEZ

Dr Anna Kula-Pacurar is a molecular virologist focused on the HIV-host interactions. After she graduated from the University of Gdańsk, Poland (MSc in 2005), she moved to Italy, where she undertook research training at the International Centre for Genetic Engineering and Biotechnology, investigating novel pathways controlling HIV gene expression (PhD in 2009). In 2013 she began her post-doctoral training at the Institute of Molecular Biology and Medicine, Université Libre de Bruxelles, Belgium focusing on aspects of an HIV cure. With the help of the POLONEZ grant from the National Science Centre she moved back to Poland in 2017 to initiate an independent research focused on molecular mechanisms leading to HIV latency/reactivation and the implication for therapy at the Malopolska Centre of Biotechnology, Jagiellonian University in Kraków.

POLONEZ project: Molecular dissection of the MATR3/PSF complex in the regulation of HIV-1 posttranscriptional latency: implications for therapy (MATR3PSFHIV)
Host institution: Jagiellonian University in Kraków
Project duration: 01.04.2017 – 31.03.2019



Protein aggregation models to find a cure for viral and neurodegenerative diseases

PANAGIOTIS THEODORAKIS

Proteins are biomolecules consisting of one or more amino acids that carry out a vast array of functions within organisms. However, proteins can also be the cause of various diseases when, for example, they aggregate into particular structures.

Photo: Alpha-synuclein fibril structure, determined by solid-state NMR. Thought to play a role in diseases including Parkinson's disease. AdobeStock 153243838
Portrait photo author: Izabela Pałygiewicz

Characteristic examples of such aggregates are virus capsids, which can lead to many infectious diseases, and fibrils or oligomers, which can lead to neurodegenerative diseases such as the well-known Alzheimer's and Parkinson's diseases. Hence, if we would like to prevent or cure diseases caused by such protein aggregates, we need to understand how they self-assemble into these structures and study their properties. Given that these processes occur at molecular scales and depend on the way proteins interact with each other under different conditions (e.g. temperature), our method of choice is molecular-level computer simulation.

This project succeeded in building such models, which can be used by researchers to study protein aggregation phenomena. Two of these models are currently known in the literature as the GoMARTINI and the GEN (Generalised Elastic Network) models and provide us with new capabilities in this research area of biophysics. In particular, by using these novel models in our studies, we were able to describe the self-assembly of small virus capsids with or without the presence of their genome at the molecular level by identifying the conditions that favour the formation of initial and intermediate key structures (transition states) that will eventually lead to well-formed capsids, that is, capsids that have been identified experimentally. Moreover, we were able to study various properties of these capsids, including their mechanical and thermodynamic stability.

Given that our models are suitable for the study of any system consisting of proteins, our methodology was easily applied in the case of fibrils and oligomers of α-synuclein, which are considered responsible for Parkinson's disease. In this case, we have conducted a series of computer simulation studies that involved the formation and dissociation of different structures (e.g. fibrils or oligomers that are considered particularly toxic) under different thermodynamic (e.g. temperature) and physicochemical conditions

(e.g. pH) or the presence of other neurotoxic molecules such as amyloid-ß. As in the case of virus capsids, we were able to unravel the key underlying molecular mechanisms that favour the formation/dissociation of aggregates and identify crucial intermediate structures in these processes. Moreover, we were able to characterize the mechanical properties of α-synuclein fibrils and enable the comparison with neurotoxic amyloid fibrils by using our simulation models, which goes beyond the capabilities of any currently existing experimental setup.

Our studies provide new insights in the formation processes and properties of harmful aggregates anticipating that the acquired knowledge will assist experimentalists in the design of relevant treatments for viral and neurodegenerative diseases.

Our studies also have broader implications in the research area of biophysics and drug design due to the nature of our models, which are able to describe the fundamental physics of many key processes in protein systems. Hence, the acquired knowledge is readily applicable to other research areas including the design of biomaterials for industrial applications.

How did you benefit from the POLONEZ fellowship?

The POLONEZ fellowship has been a great opportunity to start my scientific career in Poland, lead my group, share my experience gained in other countries, meet other POLONEZ fellows, expand my cultural background and benefit from a comprehensive skills programme.

Dr Panagiotis (Panos) Theodorakis is Assistant Professor at the Institute of Physics of the Polish Academy of Sciences. He received his Ph.D. from the University of Ioannina (Greece) and carried out postdoctoral research in Germany (Max Planck Institute for Polymer Research), Austria (University of Vienna), and the United Kingdom (Imperial College London). He has also been a Marie Skłodowska-Curie and Max Planck Fellow. His expertise lies within computer simulation in the areas of soft matter, polymer and statistical physics, fluid physics, and biophysics.

POLONEZ project: Self-aggregation of protein complexes: virus capsids and amyloids
Host institution: Institute of Physics of the Polish Academy of Sciences, Warszawa
Project duration: 01.10.2016 – 30.09.2018

Zooming in on molecules communicating with each other

SERGEY SAMSONOV

Despite the tremendous successes of contemporary medicine in the last decades, there are still many diseases, such as cancer, diabetes, Parkinson's and Alzheimer's diseases, which are far from being not only cured or well described in terms of the characteristic symptoms but also from being understood in detail.

Photo: Sergey Samsonov with his research team. Author: Adam Sieradzan

One of the most important objectives on the road to improving life quality in general is solving the actual health problems. Only through knowing the origin and comprehending the process of a pathology, can one effectively fight against it. That is why the value of the interdisciplinary research conducted by scientists ranging from physicists, chemists, biologists to medical clinical researchers focused on clarifying all the diverse aspects underlying these and other illnesses is difficult to overestimate. What is the role of molecular modelling in such big long-term and ambitious research? Why are the experiments not enough to understand the pathologies and to answer the questions on how to treat them? There are several reasons: theoretical studies are in general faster and cheaper than experiments. However, these reasons are not crucial. What really distinguishes modelling from experiments is that modelling is not only able to provide the deepest details, which are not accessible by the experiments, but also complements the experiment, explains its outcome and contributes to the rational planning of the next experiments. In this sense, modelling and experimental studies work together very effectively in an iterative manner.

In our project, we model a special class of molecules, glycosaminoglycans (GAGs), which are key participants in a number of biological processes, disruption of which could lead to severe diseases. Depending of the type of GAG, its addition to a wound can, for example, dramatically speed up the healing or, vice versa, slow it down. Although such facts have already been known for many years, the challenge is to understand why and how this happens. Why certain GAGs would work in tissue regeneration therapies and others not; why this effect is observed in some tissues but not in others. To answer these complex questions, we really need to go deep into the tissues and zoom the picture until we can observe the behaviour of individual molecules. The way in which numerous diverse molecules communicate with

each other (interact) predetermines what is happening when the participants of the interactions are lacking or are in excess, and what happens if they slightly or dramatically change their properties. In our project, we in particular characterize the interactions between GAGs and other biologically relevant molecules such as proteins. This allows us to propose the mechanisms of action of these molecules and so to better understand their function. We also describe the potential consequences of the use of a novel synthetic class of GAG molecules, which undergo artificial chemical modification, in particular, phosphorylation. Our data show how attractive such class of molecules could potentially be for clinical applications in the future. Finally, because the molecules we study are not similar to other biological objects, there are no computational methodologies that are particularly developed to work with them effectively. Therefore, an essential part of our project was devoted to such development and testing approaches that could be more useful for the work with these objects we are studying. As computational tools we use, first of all, molecular dynamics, which is a technique allowing for observations on how atoms and molecules are moving and 'communicating' between each other in a course of time. It helps us to understand a substantial amount of the properties of the studied molecular systems. All parts of the project are tightly connected with the experimental data which we use to compare our models with. These data were obtained by our collaborators from experimental laboratories in Germany, Hungary, France, Japan, Sweden and Russia.

Our results will contribute to the better understanding of many biologically important processes where GAGs are involved, which can have a striking potential significance for the development of various therapeutic applications in the future.

How did you benefit from the POLONEZ fellowship?

I am very happy that I was able to join the MSCA Polonez programme. It allowed me to start my independent research and face principally different challenges than I used to experience as a postdoc before. Thanks to the grant, I was able to establish a research team which, in turn, assisted me in successful applications for subsequent grants. As a consequence, I extended my project team and the scope of my studies. Personally, my transfer to Poland definitely broadened my international experience, helped me to see many things in everyday life differently, and my first child was also born here in Gdańsk.

Dr hab. Sergey Samsonov graduated in Biophysics at Saint-Petersburg State Polytechnic University (2006), received two PhDs: in Structural Bioinformatics at the Dresden University of Technology (2009) and in Biochemistry at Saint-Petersburg State University (2010). In 2009 he started working on modelling glycosaminoglycans at the Dresden University of Technology as a Postdoctoral Researcher (2009-2017) and then at the University of Gdańsk as a Principal Investigator. In 2018 he was awarded habilitation at the University of Tours. At the moment, he is a Project Leader of two NCN projects (SONATA BIS and BEETHOVEN CLASSIC).

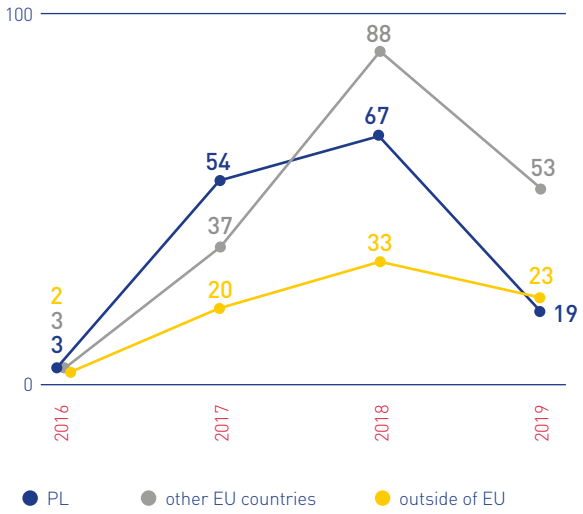
POLONEZ project: Computational approaches to study protein-glycosaminoglycan interactions
Host institution: University of Gdańsk
Project duration: 01.05.2017 – 30.04.2019

Impact – Conferences

Scientific conferences and symposia provide a platform for face-to-face interaction with peers, experts in the field, R&D practitioners and often stakeholders as well. In that way they are not only a way of getting feedback on new research, but may also help scientists gain novel ideas, stimulate interdisciplinary approaches and establish collaboration contacts which can lead to grant proposals, publications and funding.

POLONEZ Fellows have used all these opportunities by participating in over 400 scientific events all over the world.

Number and locations of conferences



Since 2016 Fellows contributed

51 invited talks

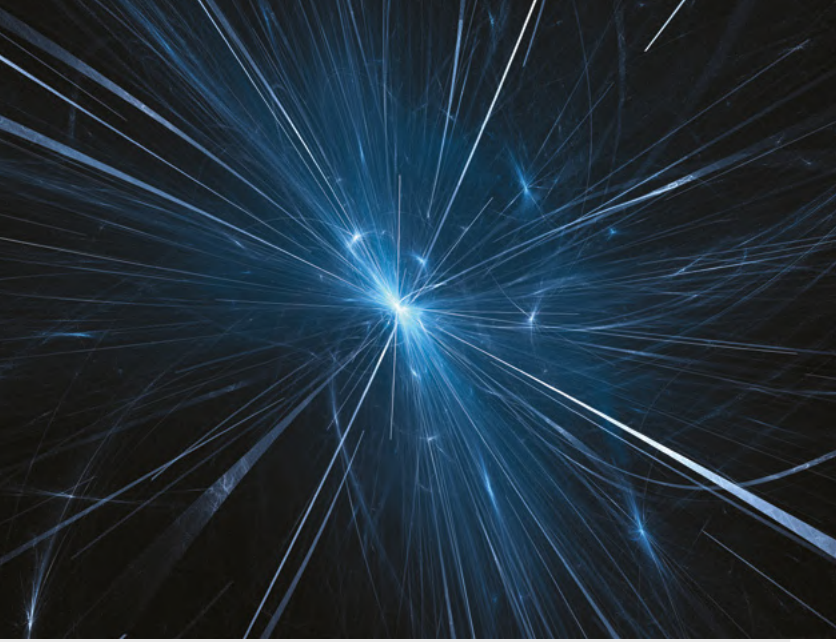
250 oral presentations

100 posters

often involving their Research Partners and other members of project teams.

Source: Fellows' final reports, numbers as of December 2020

Understanding the universe



How do the tiniest constituents of matter behave?

PASI HUOVINEN

We always say that the universe has its origin in the Big Bang, when everything was compressed into a point. But a universe-sized amount of matter compressed into a pinprick – what kind of stuff is that?

Photo: Particle fission in large hadron collider – AdobeStock 214676381
Portrait photo: Author's personal collection

As we know, ordinary matter around us consists of atoms. They are made of electrons and nuclei, and the latter of protons and neutrons. Protons and neutrons have a structure too, and consist of quarks and gluons. When matter is heated, the connections between its constituents get weaker – ice melts, water boils. Eventually the atoms break up into electrons and nuclei – so-called plasma is formed. If we continue to heat the plasma, we reach a stage where even protons and neutrons do not hold together, but are broken into quarks and gluons. This state of matter is called quark-gluon plasma, and since quarks and gluons are point-like, without any structure, this is the stuff of the Big Bang.

The temperature required to form quark-gluon plasma is humongous, and the only way to form it here on Earth is by the collisions of heavy nuclei – like gold or lead – at velocities close to the speed of light. We cannot observe the quark-gluon plasma formed in these collisions, since its huge pressure blows the tiny plasma droplet apart immediately. Instead we have to deduce its formation and properties by studying protons, neutrons and other particles coming from it.

The first part of my project was to improve our understanding of the properties of these conventional particles at the late stages of the evolution of the droplet of plasma. We especially studied the class of particles called resonances and showed how their description should be improved to draw reliable conclusions about the properties of the formed droplet of matter. In addition, we studied how the repulsive interactions affect the properties of the cloud of particles emitted from plasma.

The second part of my project was to analyse the properties of particles coming out of the plasma: their momenta, i.e. velocities, the directions where particles fly, how the amount of particles flying to a particular direction correlates with particles flying to another direction, and how all this varies from one collision to another. All this allows us to eventually

deduce what the properties of the plasma are. Such an analysis is very time-consuming. During my fellowship we were able to take only the first steps towards that goal, and the first results of this analysis are being published now, more than a year after the end of my fellowship.

In this way we improved our understanding, not only about how the tiniest constituents of the matter around us behave, but also about the early universe and the origin of us all.

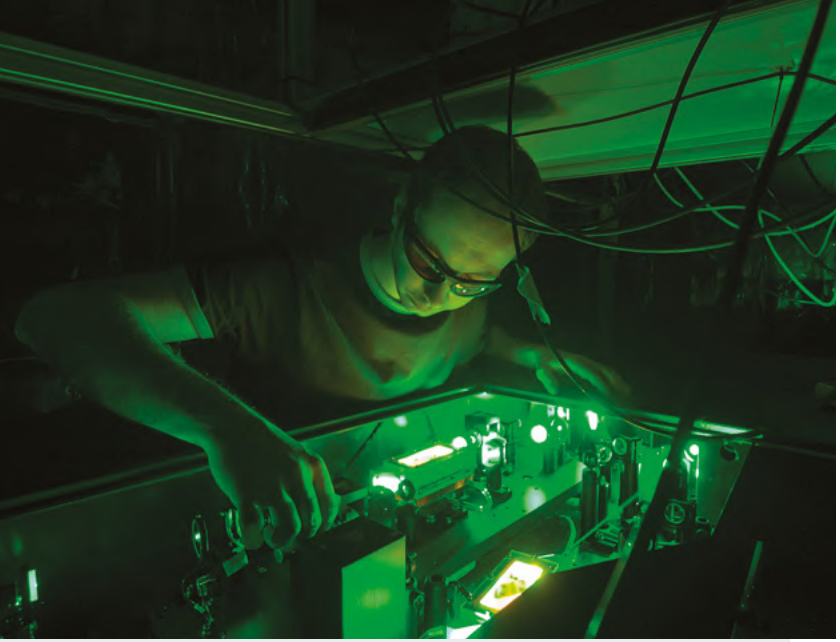
How did you benefit from the POLONEZ fellowship?

During the POLONEZ fellowship I benefited from the Wrocław group's expertise in hadrons and resonances. Knowing of their interactions is essential when modelling the heavy-ion collisions. I formed new connections with my Polish colleagues and initiated new collaborations. As an academic nomad, I should not downplay the very practical benefit of someone paying my salary for two full years either.

Last but not least, the POLONEZ fellowship allowed me to learn to know and appreciate Poland much better than previously. I enjoyed my two years in Wrocław.

Dr Pasi Huovinen was born in Varkaus, Finland in 1967. He gained a Ph.D. in theoretical physics at the University of Jyväskylä, Finland in 1999. Since then he has worked as researcher at various universities and research institutes both in the U.S. and Europe; his last position before the POLONEZ fellowship was at Goethe University in Frankfurt, Germany. Presently he is Research Professor (3-year position) at the Institute of Physics Belgrade, in Serbia. His main field of interest is nuclear matter in extremely hot and dense environments, its transition to quark matter, observation in heavy-ion collisions, and consequences to the Big Bang and neutron stars.

POLONEZ project: Dissipative properties of strongly interacting matter formed in heavy-ion collisions
Host institution: University of Wrocław
Project duration: 01.10.2016 – 30.09.2018



Shedding light on the nature of the tautomerization

ŁUKASZ PIĄTKOWSKI

Porphyrins form an important, naturally occurring, yet not well-explored family of molecules. Various kinds of porphyrins take part in a multitude of biochemical processes, including those taking place in our body.

Photo: Łukasz Piątkowski in his lab. Author's personal collection
Portrait photo author: Izabela Piechocka

They are found in our blood stream, as the main building block of haemoglobin and a part of the vitamin D12 complex. The significance of porphyrins and the role they play is strongly connected to their structure and dynamics, in particular to the mobile hydrogen atoms that constantly change their position within the molecule. This makes the molecule switch continuously between two chemical structures, a process known in chemistry as tautomerization. The goal of the project was to elucidate the nature of the tautomerization reaction: how fast it is in individual molecules, how sensitive it is to the local environment and how it relates to the structure of the molecule itself.

To this end we used a set of sophisticated experimental techniques that combine specially polarized laser excitation with fluorescence detection from individual molecules. The obtained fluorescence patterns provided direct information about the speed of tautomerization. For some specific porphyrins it was possible to determine the presence of two tautomeric forms by monitoring fluctuations of the emission spectra of individual molecules in time. Moreover, together with our collaborators from the Institute of Photonic Sciences in Barcelona (ICFO) we developed a special experimental approach, termed stimulated emission microscopy. We demonstrated its capabilities by studying ultrafast charge dynamics in individual quantum dots and set up a solid basis for studying chemical reactions at a single molecule level.

The experiments revealed that the speed of the double proton transfer spans many orders of magnitude – the reaction can be extremely fast (occurs millions of times per second) and it can be very slow (timescale of seconds). Intriguingly, the tautomerization rate is not constant for a particular molecule, but changes dramatically in time. It can be very fast in one moment and extremely slow just a moment later. These observations are a consequence

of the interactions between the porphycene molecule and other molecules in the direct surroundings. Tautomerization is very sensitive to the local environment – small movements, translations, changes of conformation of the surrounding molecules may slightly change the state of the porphycene in a way that it speeds up or slows down the proton transfer. Consequently, porphycenes can be used as probes of the local nanoscale dynamics of the surrounding medium. Porphycenes are considered as potential building blocks for complex artificial molecular structures capable of performing certain operations using light or charge. From this technological point of view our results indicate that we can design and shape the local environment in order to induce specific tautomerization dynamics in a particular porphycene molecule. Finally, we learned that tautomerization is not very sensitive to the structure of the molecule itself – for porphycenes with different structures these are still interactions with the local nano-environment, which determine tautomerization dynamics, and not the exact structure of the molecule.

This project gave us much needed insights into tautomerization, one of the most fundamental chemical processes. We now better understand the mechanism behind the hydrogen transfer and hydrogen bond rearrangement, with quantum tunnelling being one of the key factors. Moreover, the proposed experiments form a solid basis for studying hydrogen transfer and hydrogen bonding dynamics in complex biomacromolecules.

How did you benefit from the POLONEZ fellowship?

The POLONEZ fellowship had an important impact on my career and future plans. Apart from expanding my transferable skills, the successful realization of the project and, in particular, my participation in a number of conferences and symposia improved my visibility as a researcher on a national and international level and gave me the opportunity to set up new collaborations. Importantly – full financial and research independence provided me with the opportunity to test my skills towards the perspective of leading my own research team. Furthermore, the recent outcomes of the fellowship definitely contributed to the successful application for other national and international research grants.

Dr hab. Eng. Łukasz Piątkowski – graduated from the Faculty of Technical Physics at the Poznan University of Technology. He received his PhD in physics at the University of Amsterdam in 2012. In the years 2012-2016 he completed a postdoctoral internship at the ICFO Institute of Photonic Sciences in Barcelona, where he used microscopic methods to deal with ultrafast processes in single molecules of biological importance. Since 2019, he has been running his own research team at the Institute of Physics at Poznan University of Technology. Author of over 30 scientific papers, including in Nature Chemistry and Science.

POLONEZ project: Intramolecular hydrogen transfer dynamics in single molecules studied with femtosecond microscopy
Host institution: Institute of Physical Chemistry of the Polish Academy of Sciences, Warszawa
Project duration: 01.11.2016 – 31.10.2018

VIBRANT communication in ants

Luca Pietro Casacci

Efficient communication to coordinate the actions of up to a million specialised nestmates is fundamental to the success of social insects, especially ants, which represent some of the most sophisticated animal societies.

Photo: Messor barbarus ant. Author: Daniel Sanchez Garcia
Portrait photo author: Daniel Sánchez García

Communication in social insects has fascinated scientists for centuries. One of the most famous examples is the dance language of honeybees, a breakthrough for which Karl von Frisch was granted the Nobel Prize in 1973. Various modalities of signalling have been identified in ants, including the predominant release of chemical substances, visual behavioural displays, tactile interactions and the emission of sounds and vibrations. Vibratory messages can be generated by using unspecialised morphological features, but at least five ant subfamilies have evolved a specialised stridulatory organ made of a 'plectrum' rasping across a 'file' ('pars stridens').

Until now, it was thought that acoustic cues constitute a minor part in ant communication, representing simple signals conveying alarm or used for orientation, but it has recently become clear that they can also contain additional and significant information. Furthermore, recent studies have demonstrated the ability of several social parasites to imitate ants' language to live for long periods in close contact with their host ants.

During the project, we characterised the variation in ant acoustic signals and emission organs, disentangling the factors that have shaped the evolution of acoustic communication in ant societies. Ants were recorded by using a device that amplifies their sounds, and stridulatory organs were visualised using a Scanning Electron Microscope which allows pictures of very tiny structures to be obtained.

First, we verified if sounds vary at multiple scales, i.e. among colonies and populations, and between species or genera. We evaluated the entity of variation at colony and population levels along a latitudinal gradient (from northern to southern Europe) using *Myrmica scabrinodis*, a common red ant, as the model. We found that sounds are slightly different between colonies belonging to the same popu-

lation but mostly differ among populations for certain sound characteristics. Second, to evaluate the acoustic differences among species and genera, we recorded and compared the sounds of 40 European ant species.

We found an enormous variability of sounds that was not explained by the weaker variability in stridulatory organs, suggesting that ants can 'play' very diverse signals using an 'instrument' which is constant in its structure across species.

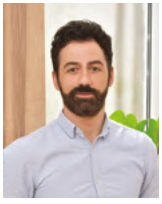
In addition, the ants' acoustic patterns do not seem to have evolved across species and genera following phylogenetic trajectories. Interestingly, our data suggested that some acoustical signal characteristics could be explained by the substrate used to build ant nests (e.g. soil, wood) or the temperature and humidity of the environments they colonise.

Finally, we investigated how vibroacoustic signals have evolved in socially parasitic ants using two model systems, the inquiline ant *Myrmica karavajevi* and its host ant *M. scabrinodis*, and the slave-making *Myrmoxenus ravouxi* and its host ants belonging to the genus *Temnothorax*. We discovered that the parasite sound has evolved towards an imitation of the host signals produced by the host queen and workers. This imitation strategy was confirmed in playback trials where the host workers reacted in a similar way when we reproduced the sound of the parasite and host queens.

Our results have shown that an enormous variability of acoustic signals exists across ant colonies, populations and species, overtaking the concept that sounds are little used in ants. Thus, the project VIBRANT has brought to light the idea that there are still many aspects to be discovered in this insect communication channel.

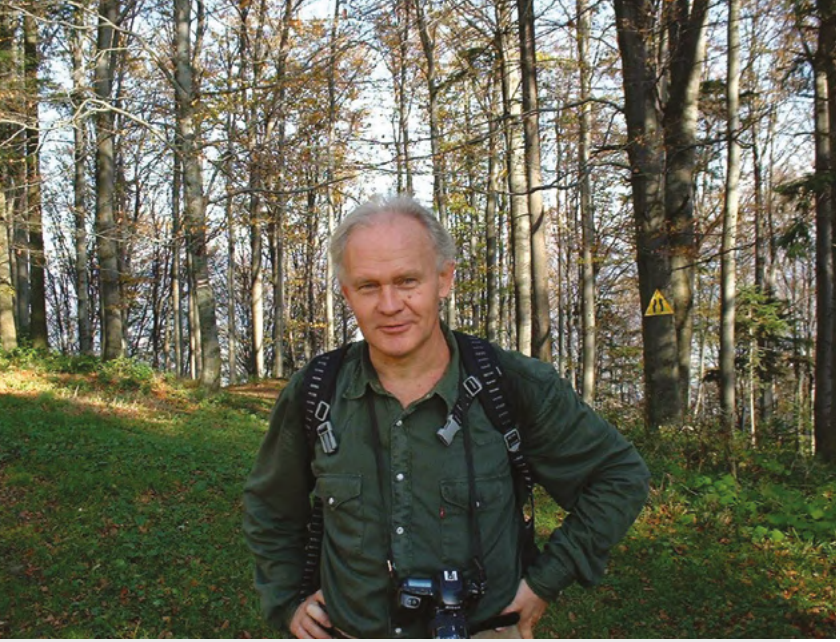
How did you benefit from the POLONEZ fellowship?

The POLONEZ fellowship allowed me to implement a project, conceived over years, that I particularly cared about. I had the opportunity to deepen knowledge on ant taxonomy and ecology and learn new genetic methodologies. Also, the participation in several international congresses allowed me to establish numerous collaborations with researchers to strengthen some aspects of the project VIBRANT. Finally, the countless amount of data collected during the project has paved the way for carrying out new studies and explore further perspectives on the bioacoustics of social insects.



Dr Luca Pietro Casacci obtained his PhD in Evolutionary Biology and Biodiversity Conservation at the University of Turin. Currently, he is a researcher at the Museum and Institute of Zoology in Warsaw, Polish Academy of Sciences, where he pursues several pieces of research on the investigation of vibroacoustic and chemical signals involved in ant communication. His research activities are also focused on the study of biology, ecology and conservation of diurnal Lepidoptera, with particular reference to the butterflies of the genus *Maculinea*, on which he studies as co-investigator in an OPUS project.

POLONEZ project: VIBRANT – Evolution of VIBRoacoustic communication in ANTs
Host institution: Museum and Institute of Zoology of the Polish Academy of Sciences, Warszawa
Project duration: 01.01.2018 – 31.12.2019



How the 'humanisation' of the environment affects brown bears

DJURO HUBER

As with all wildlife, and perhaps even more so, brown bears are affected by loss of living space and changes to the remaining parts of habitat. This has led to the extinction of bears in most parts of Western Europe. Poland, Croatia and Sweden still have bears in parts of the countries.

Photo: Djuro Huber in his natural habitat. Author: Eladio Fernandez Galiano

Bears have to cope with an environment that is being changed by human activities. Some examples include the development of buildings and transport infrastructure into bear habitats, the growing number of tourists in natural areas, the increased supply of human foods that are accessible to bears (e.g. garbage), corn fields or food provided in the forest to feed wildlife for hunting, as well as higher levels of pollution. All these might have an effect on bears and their health. In this project, we investigate how the 'humanisation' of the environment affects the health of brown bear populations. In order to do this, we are measuring several parameters indicative of health condition in the hair, scats, bones and tissue of brown bears from Poland, Croatia and Sweden. These samples have been obtained from data banks and scientific collections in the research institutions of the three countries collaborating in this project. They are complemented with samples collected in the field in a non-invasive way.

The COVID-19 pandemic affected our project considerably: field work was not possible and, even more importantly, the laboratories in 4 countries that were conducting various analyses of our samples all closed in March 2020, so the final project results will also be delayed. On the other hand, the rise in importance of the coronavirus drew additional attention to what we have been doing already for three years before the COVID-19 outbreak. Dr Vladimir Stevanovic at the Faculty of Veterinary Medicine in Zagreb and other Croatian collaborators have been routinely checking the exposure of brown bears in Croatia to a longer list of viral (and other) pathogens. This included alfa-coronavirus, which affects the intestinal tract. Around 300 bear samples were tested, and all were negative. We intend to test recent bear samples for beta-coronavirus also (where SARS-CoV-2 belongs). However, that will be possible only after the pandemic stops.

This study is paving the way for additional standards in brown bear and other wildlife research. When tracking stress, food

assimilation and flow of pathogens become the routine procedure, risky changes in the environment could be detected early enough to apply proper conservation measures. Science will have a powerful and standardized tool for monitoring ecosystem stability. The results of this research will represent a contribution in that direction and may reveal brown bears as sentinels of detrimental changes in the environment.

How did you benefit from the POLONEZ fellowship?

The study of brown bear ecology and, in particular, the status and health of bear populations has been my main research line for 40 years, and here it has been merged with the work of the Polish research team. We have established a unique research network in order to develop a wildlife health index to assess population status in a novel way. My daily joint work and scientific discussions with researchers at the Institute of Nature Conservation in Kraków has been a continuous bi-directional flow of knowledge transfer plus the real pleasure of being part of that. Now we have trained teams in both laboratory and field techniques, established standards for long-term data collection and analyses, as well as international cooperation through consolidated research network.

I will personally continue to work on the promotion of the approaches designed here to monitor brown bear populations and to implement such methods in conservation and management plans in other countries. The integrative character of this research is to also apply those results in further education at all levels: the general public, wildlife managers, university students. All of this I see as a significant personal benefit.

Prof. Djuro Huber was born in Zagreb, Croatia, in 1950. After graduating in veterinary medicine in 1975, he specialized in ecology (Master's degree) and in wildlife parasitology (PhD in 1979). He has worked for 45 years at the Biology Department of the Faculty of Veterinary Medicine, University of Zagreb. In 1979/80 he attended the Wild Animal Disease Centre in Fort Collins, Colorado, USA on a Fulbright grant. Since 1981 he has been conducting a brown bear study in Croatia, which in 1996 expanded to the Study of large carnivores in Croatia (including bear, wolf and lynx). The research included radio-telemetry, with many morphological, physiological, nutritional and genetic aspects all supported by over 20 international projects and published in about 200 scientific papers. Djuro Huber is currently professor emeritus at the Department of Biology at the Veterinary Faculty in Zagreb.

POLONEZ project: Wildlife health in human-shaped environment: integrating multiple indicators to assess the status of brown bear populations (BearHealth)
Host institution: Institute of Nature Conservation of the Polish Academy of Sciences, Kraków
Project duration: 01.12.2018 – 30.11.2020

Fire, and then the ice: the core of supercontinent Rodinia in the Neoproterozoic

Ashley Paul Gumsley

It is now emerging that our wandering continents came together and diverged throughout Earth's history, a process known as the Supercontinent Cycle. The last known supercontinent was Pangea, which began to break apart in the time of the dinosaurs. However, this has been shown as just one of many supercontinents back in time, with the supercontinent before Pangea known as Rodinia existing up to one billion years ago, and which was the focus of this project.

Photo: The scenic landscape in our field study area in Zimbabwe.
Author: Ashley Gumsley
Portrait photo: Author's personal collection

This supercontinent occurred at a critical juncture in Earth's history, when the hostile environments of the ancient Earth changed into the habitable world we know today. It is an exciting avenue of research to understand how the world we know today came to be. Supercontinents, driven by forces deep within the Earth, have a dramatic effect on the Earth's environmental system. As the supercontinent Rodinia came together and began to break up approximately 700 million years ago, large and extensive volcanism erupted and covered the surface of the Earth's continents in lava, sometimes up to kilometres thick. Such volcanic events are unlike anything humans have ever witnessed; but they are now known to have occurred sporadically throughout Earth's history, with many large ones even causing mass extinctions. Therefore, these large igneous provinces as they are known, are an important temporal marker.

Such catastrophic volcanism on Rodinia led to massive amounts of volcanic gases escaping into the Earth's atmosphere and the weathering and erosion of the lavas into the oceans, which likely triggered a global glaciation, a 'Snowball Earth' encasing the world in ice. This volcanism formed the focus of this study. Largely undocumented fragments of this large igneous province were identified and studied in this project. We found these fragments in Zimbabwe in southern Africa, as well as in Dronning Maud Land in Eastern Antarctica. These fragments were preserved as mafic dykes, a black rock which is the magmatic feeder to the lavas above, which have mostly long since been removed through weathering and erosion. These fragments were shown to be 700 million years old through age dating on the mineral baddeleyite, and the mineral assemblages showed that they were unaltered by subsequent events, which can change the mineral assemblages of these rocks, destroying the primary information that is preserved. Age dating using apatite also showed they cooled quickly. Chemically, they can be seen to have formed in an intra-continental tectonic setting.

With this information, we completed a controversial, but fundamental puzzle piece in our understanding of the paleogeography of the supercontinent Rodinia.

This enabled us to show that we can place southern Africa and Dronning Maud Land of Eastern Antarctica against North America and Siberia in a new Rodinia paleogeography through high-precision geochronology and geochemistry on a large igneous province, which shows that the dykes occurred at the same time and with similar chemistry. In addition, paleomagnetic and rock magnetic evidence shows that the dykes may be connected, although at this time, these results remain preliminary. Although provenance studies on the host rocks could also have allowed us to match up the surrounding continental basement, this study instead showed us that this basement is much younger than previously thought, opening up exciting new possibilities for the future, although this is now beyond the scope of this project.

With all these results, we will now model our understanding better about how volcanism led to global glaciation. This is important, as when the world emerged from global glaciation, the nutrients trapped in the oceans led to a boom in biological production and ultimately drove photosynthesis, producing increasing oxygen concentrations in the Earth's atmosphere. This positive-feedback loop led to the evolution of multi-cellular life, and the planet we know today began to emerge.

How did you benefit from the POLONEZ fellowship?

During my fellowship, I was lucky to be awarded two further grants funded by the National Science Centre to the University of Silesia in Katowice, which is where I work now. Additionally, my Polish partner recently had our first baby. So, I am really happy! I aim to settle here in Poland, as it has many opportunities. My fellowship enabled me to learn more about rock magnetic investigations, which directly complement my own age dating experience towards studying paleogeography. The fellowship taught me a lot about Poland. I look forward to collaborating with researchers here on projects in Svalbard, Poland, Ukraine and Bulgaria, as well as continue my older investigations in southern Africa, Antarctica and Australia. Hopefully I will have my own world-class geochronological facility in Poland one day!

Dr Ashley Paul Gumsley, geologist and a U-Pb geochronologist. He is interested in Earth's history in deep time, i.e. many millions of years ago. He uses his skills in geochronology to get precise ages using magmatic events to provide constraints on critical events in deep time, such as the rise of oxygen on the planet, or global glaciations. His interests also include paleogeography. He grew up in South Africa and was educated there. He did doctoral studies at Lund University in Sweden.

POLONEZ project: Fire, and then the ice: calibrating southern Africa's position within the Neoproterozoic supercontinent Rodinia
Host institution: Institute of Geophysics, Polish Academy of Sciences, Warszawa
Project duration: 01.01.2018 – 30.11.2019

Cosmic dust and dying galaxies

Michał Jerzy Michałowski

Gas in galaxies can exist in two forms: atomic and molecular. Atomic gas is composed of hydrogen atoms separated from each other, whereas molecular gas is composed of hydrogen atoms forming a molecule (two atoms bound together).

Photo: Michał Michałowski. Author: Adrian Wykrota, Życie Uniwersyteckie

Gamma-ray bursts (GRBs) are the explosions of the most massive stars, 20-30 times more massive than the Sun. There were previous claims that galaxies hosting such explosions have very little molecular gas, which would be surprising, because this gas is the fuel for making new stars (including those exploding as GRBs). However, those claims were based on a small number of galaxies. I studied a dozen of such galaxies and concluded that on average their molecular gas properties are as expected, given their star formation activity. This has important consequences on our understanding of the explosion mechanism and on using GRBs as a tool in galaxy evolution.

I discovered large amounts of atomic gas in the environment of an explosion of a relativistic supernova 2009bb type Ic. These supernovae explode when the most massive stars in the Universe die (several dozen times more massive than the Sun). This is the first time when atomic gas in the environment of a supernova explosion has been studied. This discovery brings us closer to the full understanding of stellar explosions because the concentration of gas in this case suggests that stars exploding as this kind of supernovae are formed when gas flows into a galaxy from the space between galaxies. This will also allow us to study gas inflows into galaxies using supernovae.

I characterised the atomic gas in the host galaxy of an unusual and poorly-understood explosion called AT 2018cow. Its nature is still being discussed by scientists. I have found typical gas distribution unlike those of GRB and supernova host galaxies. Therefore, the environment of AT 2018cow suggests that its progenitor may not have been a massive star. This brings us closer to the understanding of this unusual explosion.

I reported the discovery of the second-closest GRB (number 111005A). I found that this GRB was surprisingly not accompanied by a supernova so it likely represents a rare class of GRBs that is different from typical explosions of massive stars.

I have measured for the first time how quickly galaxies which are 'dying' (shutting down their star formation activity) are getting rid of dust. This is a key aspect of galaxy evolution.

Dust affects the optical light of a galaxy in a complex way, so that dusty galaxies appear redder than in reality (in the same way as the setting Sun appears red). It is important to measure the details of this effect in order to understand the properties of distant galaxies. I am a member of an international team, which measured this effect for very distant galaxies using the best telescopes in the world: James Clerk Maxwell Telescope (JCMT) in Hawaii and the Atacama Large Millimeter Array (ALMA) in Chile. We found that the standard parametrisation of this effect derived for nearby galaxies also applies for distant ones.

I led the Poznań team, a part of a larger collaboration, in observations of a gamma-ray burst number 171205A. This allowed us for the first time to confirm the existence of a hot gas cocoon ripped from the centre of an exploding star. Our observations were executed using the Roman Baranowski Telescope. This is a robotic telescope owned by the Adam Mickiewicz University, located in Arizona (USA) and operated from Poznań via the internet.

Gravitational waves, travelling disturbances of space-time predicted by the theory of general relativity, were discovered 4 years ago by LIGO (Laser Interferometer Gravitational Wave Observatory). On the 17 August 2017 an international team of astronomers, of which I was a member, for the first time detected radiation from colliding neutron stars – the sources of gravitational waves. Neutron stars are extremely dense objects with sizes of around ten kilometres and a few times more massive than the Sun. The discovery of this radiation provided the confirmation that gravitational waves can also be emitted by colliding neutron stars. Moreover, the observation of gamma-rays provided the proof that so-called short gamma-ray bursts result from the collisions of such stars. This discovery opens new ways of using gravitational waves to study very massive stars

The results of your research were published as 42 papers in top astronomical journals, including one in Nature and one in Nature Astronomy. You also found time for public lectures, press releases and TV interviews. Why are such outreach activities important?

For me outreach activities are a chance to connect with the wider public to talk about the exciting results we obtain. This is needed in order to inform non-specialists about the importance of our work and to inspire people to study physics and astronomy. Finally, the interaction with the audience attending outreach events can simply be fun!

Dr Michał J. Michałowski is an astronomer at the Astronomical Observatory Institute at the Adam Mickiewicz University in Poznań. He did his PhD in the Dark Cosmology Centre at the University of Copenhagen under the supervision of Jens Hjorth and Darach Watson. He was a postdoc at the Institute for Astronomy, University of Edinburgh and at the University of Gent. His research concentrates on exploding stars and the so-called interstellar medium in distant galaxies, i.e. gas and dust between stars.

POLONEZ project: PanDust: everything you always wanted to know about cosmic dust
Host institution: Adam Mickiewicz University in Poznań
Project duration: 01.05.2017 – 30.04.2019

Impact – Study visits

Following the philosophy of Marie Skłodowska-Curie Actions, POLONEZ sees mobility as indispensable in fostering professional skills and increasing employability of Fellows. Each individual fellowship involved two study visits whose main goal was to promote two-way transfer of knowledge and development of research networks.

Fellows were free to choose the institutions to visit according to their professional interests and career development goals. The study visit destinations were not limited to businesses in Poland, and included NGOs, local authorities, museums or institutions with a mission to promote science, to name just a few.

217 study visits

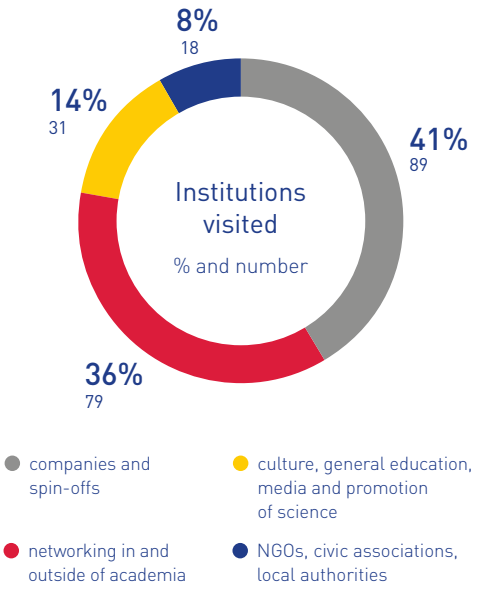
5 days average duration

Geographical reach

105 **(48%)** Poland

90 **(42%)** other EU countries

22 **(10%)** outside the EU



Source: Fellows' final reports, numbers as of December 2020

Designing innovations

Algebraic effects in a programming language

Maciej Adam Piróg

Nowadays, computer systems control almost every aspect of our lives. There is a constantly increasing demand for safety-critical software of growing complexity. To meet this demand, one needs appropriate tools, and at the very heart of software-development toolchain lays a programming language in which one can describe the logic of the system. The better the design of the language, the more flexible, reliable, and scalable the system can be.

Photo: Maciej Piróg. Author: Uniwersytet Wrocławski

One of the goals of computer science as an academic discipline is to provide insights and ideas both for programming languages and tools to analyse programmes. For example, one of the most desirable features of a well-designed system is modularity: parts of the system are loosely coupled, and we strive for each component to be easy to understand on its own, with little knowledge about the details of the rest of the system. This makes the development process easier (since the programmer does not have to think about the entire system all the time, only about one particular part), and each component can be modified and tested in isolation. A well-designed programming language can make modularity more effortless to achieve. Moreover, new technologies, such as parallel and distributed computing, render some widely used programming techniques (such as imperative programming) obsolete. This creates new challenges for computer science to come up with new methodologies and tools.

One such methodology, which is not new, but gaining a lot of attention recently, is functional programming. Its strength lies in strong modularity features and precise, mathematical semantics, which makes functional programmes much easier to understand and reason about. Within the area of functional programming, a recent advancement has been made by the introduction of algebraic effects and their handlers. They allow the programmer to precisely control the behaviour of each part of the programme (both locally, in a small piece of code, and globally, specifying the relations between big components), giving the programmer both strong tools of expression, and a way to maintain modularity.

Algebraic effects and handlers are quite a recent addition to the area of programming and programming language research. They are very promising, and seem to be able to solve many practical and theoretical problems, but some aspects are still to be investigated, which was the topic of this project.

Specifically, the first task was to establish a precise relationship of algebraic effects with other features that allow structuring of programmes, that is, other approaches to computational effects. The goal of this task was to better understand which features are well-suited to be included in programming languages – we strive for languages that are simple and yet expressive. The obtained result was that algebraic effects are no less expressive than other features studied before, but have more practical, programmer-friendly angle.

Another task of the project was to come up with new programming constructs that allow the programmer to strengthen modularity and reason about programming with algebraic effects. One tangible result of this task is an implementation of an experimental programming language that provides the new modular features, and which has a novel formal calculus as its basis.

Finally, the project was concerned with algebraic specification of effects: giving the programmer and language designer some mathematical tools to specify and reason about programmes that use algebraic effects. We developed some new mathematical foundations for understanding the connection between the practice of defining algebraic effects in a programming language and their mathematical underpinning. One additional result is a system for automatic generation of correct-by-construction implementations of effects and their related algebraic specifications.

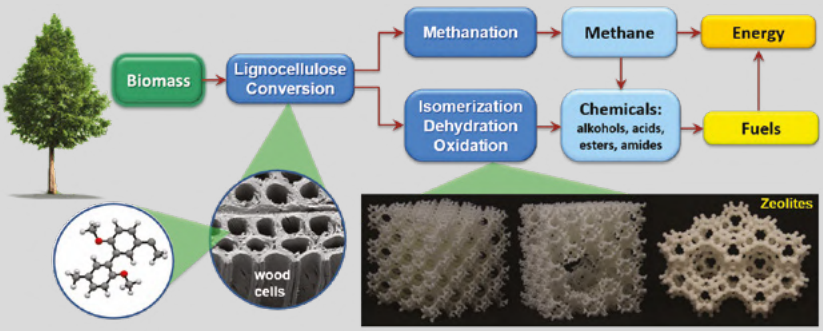
In general, the most attractive quality of algebraic effects is that the combine precise mathematical foundations with practical tools for programming and reasoning about programmes. The results of this project allowed to better understand algebraic effects, and solved some problems that had barred the way to their popular adoption in programming practice.

How did you benefit from the POLONEZ fellowship?

The greatest benefit by far was the means and opportunity to collaborate with people, both at Wrocław University and elsewhere. This allowed me to learn and expand my research area, leading to some quite exciting results. This was also quite an exciting period for me personally. In between the moment I applied for the scholarship and the conclusion of the project, my two children were born, and in that time I really did appreciate the support and flexibility I had thanks to the fellowship.

Dr Maciej Piróg graduated in computer science at the University of Wrocław. He obtained his PhD at the University of Oxford, where he also completed a postdoctoral training. He works on the theory and practice of programming languages. To learn more about Dr Piróg and his research interests, visit http://www.ii.uni.wroc.pl/~mpirog/

POLONEZ project: Algebraic Effects and Continuations
Host institution: University of Wrocław
Project duration: 01.10.2017 – 30.09.2019



From wood biomass to sustainable chemicals – how can zeolites help?

Izabela Czekaj

Nowadays, crude oil and natural gas are the main sources for the production of fuels and feedstock chemicals. These resources are limited and mankind urgently needs alternatives for a more sustainable production of chemicals from renewable feedstock (e.g. wood biomass). This is why I decided to join the search for novel porous nano-materials such as zeolites.

Different routes of biomass conversion and 3D models of zeolites. Author's illustration.
Portrait photo: Author's personal collection

Zeolites are minerals and chemical compounds within the group of silicates. Thanks to their specific crystalline structure, zeolites have water-binding capacities and can act like a mineral sponge or sieve. Zeolites have been successfully used as catalysts to facilitate many chemical reactions, but their properties can be improved with a better understanding of their molecular structure and complexity of active centres. The main goal of the project was to design – at nano-scale – zeolites with enhanced catalytic performance, optimized for biomass transformation to dedicated chemicals. The research was focused on zeolites with different pore sizes. Zeolites are available commercially in purely microporous form but for the purposes of our experiments we also synthesized zeolites in mesoporous shape and with the addition of selected metals. The structure of zeolites is very complicated; therefore, realistic three dimensional models of their crystallographic structure were also designed. The project used new insights from both molecular modelling and experimental methods to obtain knowledge about zeolite topology and catalytic properties.

The integration of both paths, experimental and theoretical, in the same research team was a novel approach. It guaranteed rapid progress in new catalysts and processes development in the very difficult subject of wood biomass catalytic transformation as well as exceptional training for students on the subject of nano-design of zeolite-based catalysts for selective conversion of biomass into chemicals.

The team designed experiments to study the development of catalytic routes for the conversion of bio-renewable feedstocks to selected key chemicals: acrylic acid and its derivatives used for the preparation of a variety of materials such as fabrics, paints, varnishes, adhesives, acrylic rubbers, detergents or water-absorbent polymers used in diapers. Examination of

the effect of the zeolites as support for the nanostructure and reactivity of the metal nanoparticles was carried out in detail. We designed modifications of zeolite which could be used in the process of biomass (wood and corn waste) conversion reactions into valuable chemicals. The processes have been successfully tested in different phases, including in the gaseous liquid phase, which is important in industrial applications. Such processes were not possible without such effective catalysts as modified zeolites. Additionally, we found out that a clinoptilolite – a natural and inexpensive zeolite – can also be successfully used for biomass conversion reaction, which is important for economic reasons.

We used a density functional theory method to explore active sites and the electronic structure of zeolite catalysts during reactions, which led us to the development of a new class of catalysts with a declared molecular structure. We also performed theoretical modelling of different components derived from wood biomass (lignin dimers, selected sugars from cellulose and hemicellulose), which allowed us to obtain a theoretical Vibrations Basis Database for experimental spectra interpretation.

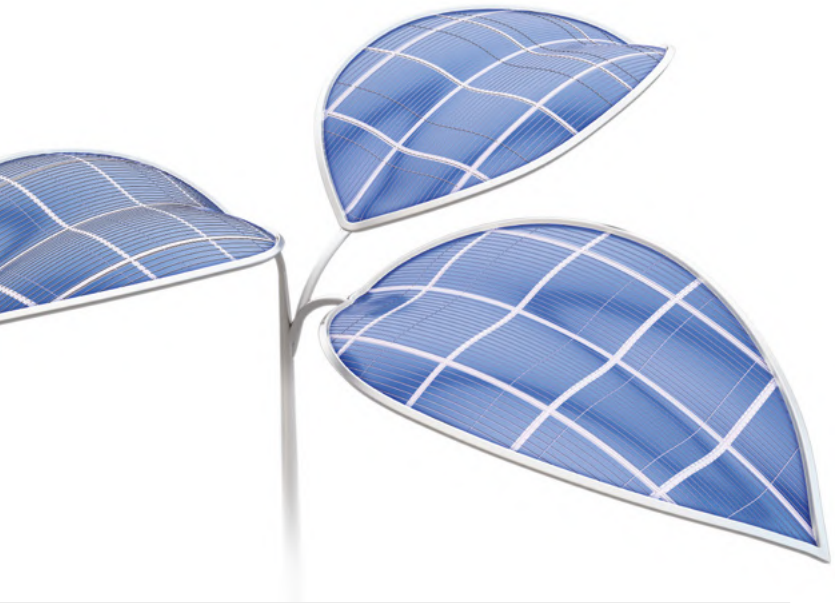
A number of uncertainties still remain in relation to biomass transformation into valuable chemicals. One such problem is the production of a large number of by-products. Another is the existence of many phases during these processes, which makes them very difficult to apply at an industrial scale. Solving these problems would have a significant impact on the development of science and the economy of zeolite catalysts as well as on the environmentally friendly production of important chemicals.

How did you benefit from the POLONEZ fellowship?

The POLONEZ grant gave me an exceptional perspective to return to academic work after a maternity break at the previous level as well as a move to a university in Poland after ten years of working and living in Switzerland. I was able to develop new skills (e.g. catalyst synthesis and nanoarchitecture, a new modelling approach, business contacts in Poland, negotiations skills), which gave me new perspectives to create the independent research group that I now direct. The Catalytic and Nanostructured Materials Design Group was officially established in 2017. Theoretical modelling combined with experimental knowledge gave me the opportunity to create databases that are actually used to explain many complex catalytic reactions, which constitute a basis for obtaining a virtual image of more efficient industrial catalysts. The fellowship helped me to increase my pedagogical skills and leadership abilities.

Dr hab. Eng. Izabela Czekaj prof. PK obtained a Master's degree in engineering in 1999 at the Faculty of Technology and Chemical Engineering, Cracow University of Technology (CUT). She defended her doctoral thesis in the field of heterogeneous catalysis and theoretical modelling in 2004 under the supervision of Prof. Małgorzata Witko. Between 2005 and 2015 she worked in the Paul Scherrer Institute and Institute of Chemistry and Biochemistry Eidgenössische Technische Hochschule Zürich, continuing her interests in heterogeneous catalysis, theoretical modelling and modern spectroscopy. Since 2015 she has led the independent research group 'Catalytic and Nanostructured Materials Design' in the Institute of Organic Chemistry and Technology at CUT, working on a variety of subjects including the design of materials and processes of biomass valorisation, deodorization, deNOx, electro- and photochemistry.

POLONEZ project: Nano-design of zeolite-based catalysts for selective conversion of biomass into chemicals
Host institution: Tadeusz Kościuszko Cracow University of Technology
Project duration: 01.09.2016 – 31.08.2018



Protein-graphene system for bio-organic photovoltaics

Silvio Osella

The goal of this project was to expand the knowledge of hybrid, protein-graphene systems by assembling a team of computational chemists and physicists. We focused on the theoretical study of a new hybrid protein-graphene system, as a candidate for bio-electronic devices, such as biosensors and bio-organic photovoltaic cells (bio-OPV).

Photo: Artificial photosynthesis concept. AdobeStock 43006057
Portrait photo: Author's personal collection

The considered protein is the reaction centre (RC) of the photosystem I (PS-I) protein, responsible for absorption of light and conversion into energy in bacteria, while graphene (SLG) is a monolayer of carbon atoms bonded together in a two dimensional honeycomb structure. The study focused on the interaction between these two fragments as conducting and charge carrier material. The way the protein and SLG interact is crucial to ensure the efficiency of the final device and thus the investigation of the nature of the interface is essential. A more complex interface presents the addition of a monolayer of molecules forming a Self-Assembled Monolayer (SAM), such as pyrene derivatives, in between SLG and the RC, which improve the stability of the system, direct charge transport mechanism and at the same time suppress the recombination of charges at the interface.

In this project, we resorted to a multiscale computational approach for the description of chemical and physical properties of the systems of interest. Due to the huge size of the PS-I, a smaller model system was considered, namely the Cytochrome C533 (Cyt), with the same characteristic of PS-I but at a feasible computational cost. First, we modelled the time-evolution of Cyt and SLG with a classical molecular dynamic method, which consists in considering the atoms bonded together in a spring-like way, without explicitly considering the electronic attractive forces. This allowed us to consider realistic model systems (thousands of atoms) and physically meaningful time-scales (hundreds of nanoseconds), for the investigation of the time-evolution of the Cyt/SLG interaction with and without SAM.

In the second step of the project we focused on a smaller portion of the system (the haem group of Cyt/SLG or SAM/SLG interaction) using more accurate ab initio methods that account explicitly for the electrons, to describe and understand the electron transfer mechanism occurring in between the Cyt-SLG, Cyt-SAM and SAM-SLG interfaces. Here, we ana-

lysed the electronic wavefunction and the change in electronic properties of the interface, by means of energy level alignment (for the charge transport mechanism) and bandgap opening (for electronic properties).

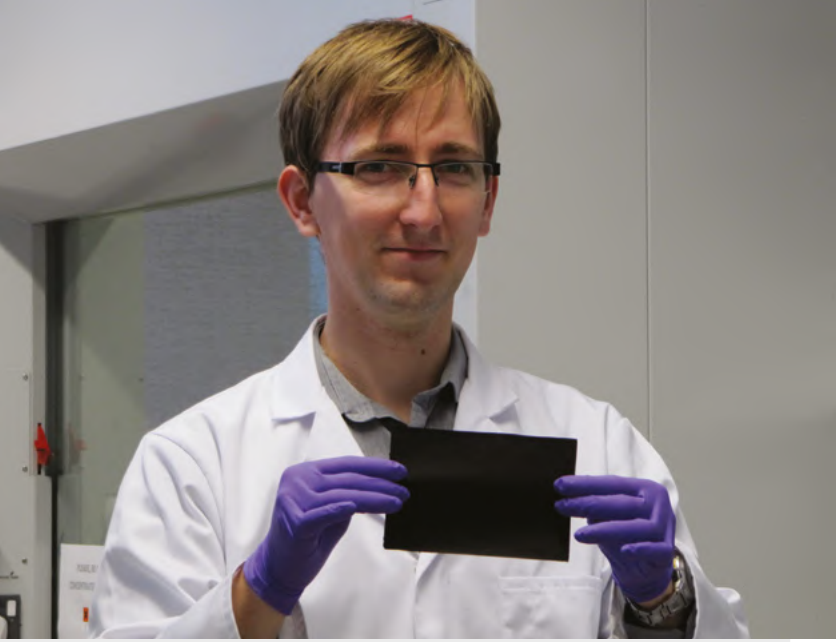
Our project offered a rational design for novel complex systems composed of proteins and organic surfaces, with the possible use of such interfaces in the future as bio--organic photovoltaic cells and transistors, which may solve the problem of rapidly growing world energy consumption.

The project contributed to a better understanding of the impact of graphene on the stability and physical and chemical properties of the light harvesting protein and vice versa, and it offered answers to pressing questions such as how to avoid the recombination of charges at the interface, which is the most common problem observed in working devices.

As part of the project, I arranged an intersectoral study visit to a small company based in Warsaw, whose team members are experts in nuclear magnetic resonance (NMR) data acquisition and processing, with years of experience in developing new methods for better description of molecular systems. The main achievement from the visit was gaining a practical knowledge of how a small company is run on both the administrative and legal level. Moreover, they recently started to produce end-user products, and their strategy and process was of valuable importance since it gave me ideas on possible commercialization of our own research. I believe that the research conducted within the POLONEZ project is at a stage that is too early to be commercialized. Yet, the continuing collaborations and the development of novel methodologies are closing the gap between pure basic research and I envision possible commercialization of our findings in the near future.

Dr Silvio Osella received his PhD in Science at the University of Mons (Belgium) in 2014. He is currently an assistant professor at the Centre of New Technologies, University of Warsaw. His research focuses on the computational study of the opto-electronical properties of graphene and its derivatives (i.e. Nanoribbons, Nanoclusters) and of photoswitchable and fluorophore molecules when (but not limited to) inserted into biological environments. Two main research lines are followed. The first concerns the study of fluorophores embedded in lipid membranes and proteins, while the second is on the formation and study of hybrid organic-biological materials of interest for bio-organic electronics.

POLONEZ project: Towards an efficient design of biosensors: an investigation of the interplay between light harvesting proteins and graphene
Host institution: University of Warsaw
Project duration: 01.01.2017 – 31.12.2018



Carbon nanostructures for sustainability

DAWID WITOLD JANAS

We are living in times when energy demand is growing at such a fast pace that it will not be long before we encounter a huge crisis unless discoveries come to light to avert it. What we need is a new generation of electrical conductors, more efficient, ecologically--friendly and sustainable. A recently discovered form of carbon called carbon nanotubes seems like one of the most viable candidates to accomplish this goal.

Photo: Dawid Janas holding a self-made sample of a carbon nanotube film.
Author: Monika Rdest

Carbon nanotubes are a new form of carbon, in which carbon atoms form cylindrical nanostructures. These tiny carbon tubules are assembled uniquely, and hence the material can transport thermal and electrical energy with unprecedented ease. As a consequence, carbon nanotubes can outperform the best classical conductors such as silver, copper and aluminium on the nanoscale. Moreover, they are very strong, light and are relatively easy to make into networks such as wires or tapes from renewable resources.

The project aimed to gain a thorough understanding of their electrical properties to offer new innovative solutions for modern power engineering. Traditional materials are close to operational limits thus we need alternatives which will facilitate further progress of civilisation.

For that to happen, we developed a method of formation of free-standing carbon nanotube sheets of any size, composition and microstructure. Moreover, to study the influence of material structure on the electrical properties, we devised a range of highly precise sorting methods. We developed a method of separating semiconducting carbon nanotubes from metallic ones to provide promising materials for microelectronics and power transmission, respectively. Interestingly, these species showed vivid colours although they are entirely made of carbon, which everyone associates with blackness. Even more, we were also able to differentiate between carbon nanotubes of various types with up to 10^{-11} m precision in just one step to study how minute changes in the material structure influence the properties.

Besides considerable insight into science gained during the project, the findings laid the foundation for a spectrum of promising applications. First, the electrical properties of

carbon nanotube materials produced in-house showed remarkable electrical conductivity. Besides potential applications as light-weight high-performance wires, the produced nanocarbon was also found useful for biomedical engineering. We noticed that our carbon nanotube films had appreciable electrical properties to be considered as neural interfaces, and can be used for recording and processing neural activity or treating neurological disorders. They also facilitated neuron growth and demonstrated biocompatibility. Second, we observed that these films (although free of defects) are surprisingly hydrophilic, which makes them much more compatible with various polymer matrices. As a consequence, they can be transformed into high-performance electrically-conductive composites. Finally, our novel process of carbon nanotube sorting produced a spectrum of nanomaterials of highly defined structure and interesting light emission characteristics. These nanocarbon species, when combined with DNA, can sense diseases such as HIV or ovarian cancer, so we are currently investigating the opportunities that our material offers for medical diagnostics.

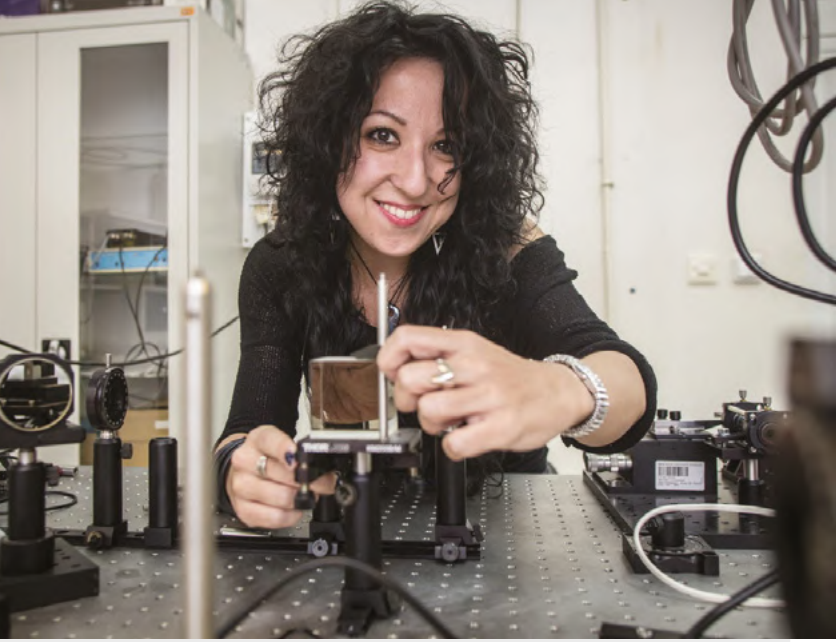
We hope that it will not be long before such devices based on carbon nanostructures will surround us to make the world a more sustainable place.

How did you benefit from the POLONEZ fellowship?

The award of the POLONEZ Fellowship was a turning point in my personal and professional life. I decided to come back to Poland for good and establish my scientific presence here. From the first days of the fellowship, I felt that Poland is a very fertile environment for doing science, thus it was an immense pleasure to become a part of it. I considered myself lucky since the project also helped me to establish my team, with whom I can now realise my scientific dreams. I am very grateful to the National Science Centre and the European Commission that enabled me to unleash a stream of creativity, which keeps growing as time goes by. I have to admit that two years on the project were a very steep learning curve, but only now can I see how much I have grown because of it.

Dr hab. Dawid Janas is a graduate of the University of Cambridge with a PhD degree in Materials Science. Thanks to the POLONEZ programme, he came back to Poland in 2016. He is currently an Associate Professor and Head of the Functional Nanomaterials Group at the Silesian University of Technology in Gliwice. Dr Janas has received several prestigious awards and grants. He also participated in fellowships funded by the Fulbright Commission and the National Agency for Academic Exchange. He has co-authored more than 50 publications in peer-reviewed journals.

POLONEZ project: Fundamentals of electrical properties of chirality-defined carbon nanotube macroassemblies
Host institution: The Silesian University of Technology, Gliwice
Project duration: 01.10.2016 – 30.09.2018



Developing self-assembled materials for photonic devices

EVA OTÓN

Photonic devices are present in everyday life: from TV screens, holograms, phones, PC displays and fibre optical communications to avionics. All these are examples of photonic devices – devices that are able to manipulate light with an external control. The general objective of this project was to develop new families of photonic devices to manipulate guided and unguided light beams using novel materials.

Photo: Eva Oton in the lab. Author: Michał Niwicz

Our approach to creating new photonic structures is based on self-assembled materials (SAM). The molecules of SAMs are able to assemble with each other *like Lego bricks*, creating complex structures. A good example of SAMs is liquid crystals (LCs), whose optical properties can be modulated by external stimuli and thus they are excellent candidates to be implemented in photonic devices.

A crucial key task in the material development of the project involved the stabilization of the so-called Blue Phase LCs. Blue phases are a very particular LC type. Unlike other LC phases that organise with a 1D or 2D order degree, *Blue Phases can self-assemble into 3D cubic structures.* In previous research Blue Phase cubes were shown to appear disorganised at micrometre size. However, we developed a new technique and obtained perfectly organised large Blue Phase monocrystals. This is a remarkable and completely above expectations achievement, because these materials were not stable as a unique structure outside small temperature ranges. Besides, a 3D Blue Phase monocrystal, being a periodic nanostructure, can be regarded as a photonic crystal; these have become exceptionally popular materials in the last few years due to their unusual optical properties.

One of the most significant and critical tasks of the project was creating photonic devices for unguided light beams. The devices that were fabricated are called beam steerers, which are devices capable of moving light beams (laser beams) towards one direction. Three tuneable beam steerers based on LCs were manufactured: a grating, a prism and a grating-prism. The grating can deviate laser beams to fixed positions; they are not tuned continuously. The prism produces a continuous angular deviation of laser beams but with limited deviation angles. Finally the grating-prism combines both optical functions, it can work as a prism and as a grating at the same time. This combination of refrac-

tive and diffractive effects was achieved by the development of a novel multilayer electrode matrix configuration in a liquid crystal device. The grating-prism effectively deviates a light beam to a large fixed angle by diffraction, and then fine-tunes the beam over small angle ranges by refraction. Tuneable photonic devices based on materials like liquid crystals are opening new alternatives for photonic applications, and they become highly coveted when several optical functions can be implemented into one device.

Because of the nature of this project, any progress in these technologies has an impact in Material Sciences and Photonics, as well as societal benefits. Since it is a transversal technology, new developments benefit many areas, like electronics, photonics, space and optical communications. An important feature of these photonic devices is that their tuneability does not require movable parts. This fact is welcomed in many applications, especially in space technologies. Optical non-movable elements are preferred over mechanical ones, specifically during launching or landing stages, when there are high chances of equipment damage. Potential photonic devices, with reduced size, could become an inspiration for new commercial devices. It is expected that the generated experience and know-how will improve other procedures and contribute to a better understanding of the underlying phenomena in self-assembled optical materials and structures.

How did you benefit from the POLONEZ fellowship?

During the project, I achieved significant progress, especially when the tasks required synergy of different areas, since the proposal relied on a multidisciplinary approach. As a result, my learning curve was greatly increased in this respect. I had to learn how to manage many different tasks in parallel and make progress with every task. I also learnt a number of new techniques and know-how which I consider priceless sets of skills both for personal growth and for future career endeavours.

Dr Eva Otón received a B.Sc. degree in chemistry and an M.Sc. degree in material engineering from the Universidad Autónoma de Madrid and Universidad Complutense de Madrid in 2005 and 2008 respectively. She has a background in Material Engineering and Chemistry and her field of expertise since her PhD is Liquid Crystals and Liquid Crystal Devices. She has 5 years of postdoctoral experience, two of these were spent in a research company in Tokyo. Her work has focused mainly in research of SAM structures. After the POLONEZ project she is working at the same research institution at the Military University of Technology, in Poland, continuing the exciting research derived from the project.

POLONEZ project: Tunable self-assembled micro- and nanostructures for photonic devices and circuits
Host institution: Military University of Technology
Project duration: 01.10.2017 – 01.01.2020

Towards ecological nanolubricants

AGNIESZKA MARIA TOMALA

The two main constituents of tribology are friction and wear, the control and reduction of both parameters is critical to proper functionality of machine elements.

Photo: AgnieszkaTomala. Author's personal collection

High friction will lead to energy losses, while extensive wear can lead to catastrophic failure of the mechanical systems. The performance of current mechanical components made of steel is limited by the tribological properties of the surfaces. Steel components require stricter high-quality lubricants, very often containing toxic additives to enable them to withstand high contact pressures and temperatures. The stringent requirements from environmental legislation on reducing harmful elements is constantly forcing lubricant manufacturers to produce and implement greener additives. In the same way, equipment manufacturers are encouraged to develop and implement novel materials in machine elements' contacts, with better mechanical, wear and frictional properties.

Diamond-like carbon (DLC) coatings in conjunction with nanolubricants are considered to hold great promise for such objectives and are of paramount interest to researchers. Nowadays, however, a major challenge involved in using coated materials is ensuring satisfactory tribological performance with conventional lubricant additives. This is because existing lubricant additives (e.g. AW/EP, friction modifiers, detergents, dispersants, etc.) were designed to work with ferrous surfaces (e.g. steel on steel) and no adequate confidence exists as to whether they can work and effectively reduce friction and wear with non-ferrous surfaces (e.g. DLC coatings).

The TriNoIS NovA (Tribology of Non-ferrous Interacting Surfaces Lubricated with Fluids Containing Novel Additives) project approach addresses grid issues by focusing on novel types of lubrication additives in the form of inorganic fullerene-like (IF) and nano-tubular structures as nanolubricants suitable for both ferrous and non-ferrous materials. Using lamellar nanoparticles such as IF-MoS_2 as novel additives in the nanolubricants, a superior lubrication ability can be achieved due to their low-shear resistance to any applied shear stress. Multiwall IF-MoS_2 nanotubes (NTs) are eas-

ily exfoliated and deposited on the interacting surfaces. Such a physically-based mechanism can be used for the lubrication of materials with lower chemical reactivity, e.g. DLC coatings.

Accordingly, the TriNoIS NovA project's main achievement is the design of nanolubricants which are suitable for steel coated and uncoated surfaces combining modern machine components interacting with ecological nanolubricants.

In the following steps, newly developed nanolubricants based on fully-formulated gear and engine oils with incorporated MoS_2 and MoO_3 NTs are evaluated using an FZG gear test rig and engine component test. Further, when the nanoparticles are added to coolants/lubricants (nanofluids), they show better heat dissipation ability at the machining zone, which enables substantial enhancement of the machining process.

The outcomes of these implementations will be mutually benefited by reduced emissions (e.g. social, environmental, ecological societies), optimised savings (e.g. economic body) and will facilitate sustainable development of energy-efficient and greener products. The expected impact on civilisation and society involves improved fuel economy and, importantly, with an environmental/ecological interest to reduce harmful emissions.

How did you benefit from the POLONEZ fellowship?

The POLONEZ fellowship has served as a continuation of my career and an extension of the research excellence in tribology and lubrication. The fellowship has helped me to increase my interdisciplinary renown, leading in future to my achieving a doctor habilitatus degree. In addition to the scientific work, I have developed my skills in management, personal effectiveness, scientific writing and preparation of European Commission (EC) project proposals.

Dr Eng. Agnieszka Tomala received her PhD in Physics from the Vienna University of Technology in 2010. She participated in EC Marie Skłodowska-Curie Actions PhD exchange programmes at SKF Engineering and Research Centre and Imperial College London. She published over 20 peer-reviewed papers in the field of tribology while working at Austrian Excellence Center for Tribology. Experience gained during the POLONEZ fellowship evolved into funding awarded from the M ERA.NET Call 2018: HOTselflub project at Łukasiewicz Research Network – The Institute for Sustainable Technologies in collaboration with teams from Austria and Estonia. She is currently working on bioengineering and biomaterials at Cracow University of Technology, Faculty of Materials Engineering and Physics.

POLONEZ project: Tribology of Non-ferrous Interacting Surfaces Lubricated with Fluids Containing Novel Additives (TriNoIS NovA)
Host institution: The Institute for Sustainable Technologies – National Research Institute, Radom
Project duration: 01.06.2017 – 31.05.2019

Host Institutions

49 research-centred institutions in Poland have hosted POLONEZ Fellows and provided them with a stimulating research environment. They delegated outstanding experienced scientists as Research Partners to facilitate each Fellow's integration into the local research community and to act in an advisory capacity as academic mentors throughout the project period.

The Host Institutions also committed time and funds to organise outreach activities as well as provide Fellows with additional training opportunities in both research and non-research oriented skills.

The POLONEZ experience helped Host Institutions further align their human resources policies with the *European Charter for Researchers and Code of Conduct for the Recruitment of Researchers*. 27 POLONEZ Host Institutions have been awarded the European HR Excellence in Research Logo by the European Commission.

HR EXCELLENCE IN RESEARCH

20 Institutes of Polish Academy of Sciences

15 Universities

8 Universities of Technology

6 Other Research Institutes

Top 5 Host Institutions hosting 5 or more Fellows

Host Institution	Number of Fellows hosted	POLONEZ funds granted
University of Warsaw	22	16 776 782 zł
Jagiellonian University in Kraków	10	8 579 809 zł
Gdańsk University	6	5 002 484 zł
Wrocław University of Science and Technology	5	4 045 873 zł
Adam Mickiewicz University Poznań	5	4 435 930 zł

Source: POLONEZ Coordination Team, amounts as in funding decisions

The bigger picture

It is not just about research

ANNA KOTARBA

POLONEZ equips Fellows with the skills necessary to further their careers – emphasizes Anna Kotarba, the NCN's International Cooperation Officer in charge of the Fellows' training programme. The programme made it possible for foreign researchers to conduct basic research in Poland. How did NCN come up with the idea to invite them to undertake soft skills training as well?

Photo: POLONEZ Fellows during a workshop on Personal Effectivenes.
Author: Cityevents
Portrait photo author: Paweł Pałka, Arteffea

The objective of the Marie Skłodowska-Curie Cofund, which provides the funding for POLONEZ, is not only to enable scientists to conduct individual research projects, but also to help them develop skills not directly related to research work. Doing research requires a number of different skills, and within the framework of POLONEZ we wanted to provide researchers with the best possible environment for personal growth. Our training programme included soft skills workshops, but also meetings with business people; it was an opportunity to step out of the academia and forge new contacts.

The POLONEZ Fellows represented a variety of academic disciplines. Was it difficult to design a training agenda that would appeal to everyone?

Choosing the themes was quite a challenge, so we enlisted the help of an experienced British company, CRAC/Vitae. Their training experts invited the Fellows to fill in a survey to adapt the training to their needs and expectations. In the end, we selected five main themes: personal effectiveness, working with others, communication, management and intellectual property. Managing research teams, coordinating the project process, pitching ideas and presenting research results are issues encountered daily by all researchers, no matter their discipline. In addition, ten Fellows, who stood out for their skills and experience, were invited to participate in individual coaching sessions. We were aware that researchers are extremely busy, so we wanted to make their participation in the workshops as convenient as possible. The training sessions were held in Warsaw at weekends, so that they would not interfere with the daily obligations at host institutions and to optimise the time spent travelling. All technical arrangements, such as booking tickets and accommodation, were handled by a company we hired specifically for the purpose.

What teaching methods were used?

The training, led by experienced facilitators from CRAC/Vitae, followed the principles of experiential learning and involved the participants in their own development to the maximum. The workshops created a space for the Fellows to reflect on their work thus far and analyse what they could change or improve. We helped them set apart the time to analyse each problem on the agenda, to place themselves in the context of the matter at hand, to spark discussion and encourage trainees to share their experiences. We covered a lot of issues; some of which only came up during follow-up group discussions. Importantly, over the period of 2 years, the feedback from the participants helped to modify and improve the course contents.

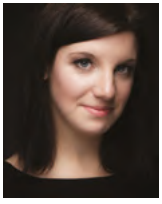
All these elements combined to develop a set of transferable skills. The coaches wanted to 'equip' our fellows with tools that would help them further their careers.

What specific skills were enhanced?

The composition of each resulting set of skills was a very individual matter, of course, because each researcher had slightly different needs and expectations to begin with. I hope everyone took something away from the workshops. Many trainees particularly appreciated the chance to develop their presentation skills and the ability to involve others in their activities. Many indicated that they also enjoyed practical tips on time management and keeping the right balance between personal life and work.

An equally important aspect, which most participants mentioned as a very enriching experience, was the opportunity for networking, the chance to get to know other POLONEZ Fellows, to step out of their own environment and forge contacts with other researchers, often representing other disciplines, which frequently proved to be a very enriching experience.

The networking opportunities were not limited to POLONEZ grantees. We organised three special events to accompany the workshops, to which we invited entrepreneurs who started their careers in the world of science but later decided to become involved in the world of business. This was an excellent chance for the Fellows to meet people active in the R&D sector outside the academia.



Anna Kotarba graduated from the Jagiellonian University in Kraków with a Master's degree in Geography, specialization: Hydrology, Meteorology and Climatology. Since 2017 she has been working at NCN's International Cooperation Office, where she takes care of the POLONEZ Training Programme and other initiatives, including co-funded joint calls for proposals under the Horizon 2020 ERA-NET scheme.

From ‘fast-food’ bears to shaping nature conservation policies in Europe

How did you establish your cooperation with Professor Djuro Huber?

Prof. Huber has been collaborating with our team for more than a decade now. He supported us during the preparation of the management plan for the brown bear in Poland, unfortunately not yet implemented, and during the field work of the GLOBE project, focused on the effects of climate change on brown bear populations. We have always been in touch; however, POLONEZ provided the opportunity for the first time to conduct a research project together.

Photo: BearHealth project crew in Bieszczady, from left to right: Agnieszka Sergiel, Djuro Huber and Nuria Selva. Author: Anna Maziuk

What are the main aims of the Carpathian Brown Bear Project?

We started this initiative 10 years ago, when the scientific knowledge of brown bears in Poland was very limited, with the aim of disseminating science-based information related to bear ecology and management, mostly from our research activities. Brown bears are intelligent animals, very plastic behaviourally and amazing from a physiological point of view. The species is present across the northern hemisphere (North America, Europe, and northern and central Asia), and many of the regions inhabited by bears are experiencing rapid climate change and are increasingly affected by human activities, such as road construction, tourism development, forest degradation or hunting. Thus, brown bears are a good model species to investigate the effects of global change from a wider perspective.

Brown bears are present both in the Carpathians and the Dinarides. Is their situation similar in both locations?

In some aspects the situation is similar. For instance, bears from both populations are artificially and intensively fed, which is changing the ecology and behaviour of bears – their hibernation patterns, movements and diet are greatly altered. While bears in Croatia are fed at feeding sites to facilitate bear hunting, in Poland they are not the target of feeding, but they intensively use the food provided for ungulates, such as corn or beetroots. In both cases, they are becoming ‘fast-food’ bears, and this may have consequences for their health as well. We gathered information about the practice of artificial feeding and other large carnivores in Europe and led the approval of a statement on this practice by the IUCN/SSC Large Carnivore Initiative for Europe. This initiative translated into the Recommendation no. 198 of the Council of Europe – Standing Committee of the Bern Convention. Thus, this international cooperation will

allow us to tackle research questions at larger scales across populations and assess how 'healthy' are bears in populations with different human pressures and human footprint levels in the environment.

What is the biggest benefit for the Carpathian Brown Bear Project from being Prof. Huber's Research Partner?

For the entire team it is a privilege to have Prof. Huber integrated on a daily basis. His deep knowledge on bears and practical experience is unique and learning from an experienced researcher like him is a luxury. Prof. Huber, being both a vet and a biologist, has complemented our research lines well by adding the health perspective. Thanks to his project we can now integrate data from pathogens and toxicants with data on physiological stress levels, immune response or nutritional status of individual bears across populations with different human pressures. By integrating all these measures we aim to provide a health index for bear populations. This will be an innovative tool to assess the conservation status of populations, currently based only on the numbers of bears or the area occupied by them.

How about the greatest challenge?

The COVID-19 pandemic has interrupted the normal progress of the project. Now, our main challenge is to finalize all the laboratory analyses planned in BearHealth on time. On the other hand, the pandemic has made us more aware of the risks of artificially concentrating wildlife in Chinese markets, but also at artificial feeding sites in Europe, which may become a hotspot for disease transmission. The closure of Tatra National Park was an unplanned experiment that we used to collect samples to study the level of physiological stress in different species without visitors and compare with levels after the lockdown. Unfortunately, the closure was too short (1 month) to investigate other potential effects of tourism on wildlife.

What have been the highlights of the POLONEZ programme?

The POLONEZ programme has offered a unique opportunity to consolidate collaborations with foreign research teams. Another main highlight is that funding offers the possibility to conduct a research project in Poland led by recognised foreign researchers. By promoting knowledge transfer and broadening of existing research lines, POLONEZ has contributed to improving the research capacity of the Institute of Nature Conservation of Polish Academy of Sciences, as well as to its excellence and competitiveness.

Prof. Nuria Selva, Institute of Nature Conservation, Polish Academy of Sciences, Kraków

Prof. Nuria Selva is a conservation biologist specialized in trophic and community ecology, with a special focus on large carnivore ecology and conservation. She is also interested in global change effects on ecosystems and species and in conservation policies and management backed by science. She lives in Białowieża Forest, at the Polish-Belarusian border, the last primeval temperate forest in Europe. She is a Research Partner to MSCA POLONEZ Fellow, Prof. Djuro Huber.

POLONEZ helps to internationalize science

Where did the idea to invite Dr Samsonov to Gdańsk come from in the first place?

The initiative to come to Gdańsk was his; he asked me if I would agree to be his supervisor in the POLONEZ grant he was applying for at the time and whether I would accept him into my research team. But I had met him earlier than that, back in 2014, during a conference entitled From Computational Biology to System Biology 2014 (CBSB2014), which I organised in Gdańsk together with Prof. Ulrich Hansmann (now working at the University of Oklahoma). Based on his outstanding abstract, Sergei was selected to present his paper as an invited speaker and he won an Outstanding Early Stage Researcher Award.

Photo: Adam Liwo. Author: Krzysztof Witecki

Your research interests are a bit different. What is your cooperation like?

The difference in the scope of our research is a matter of quantity rather than quality: Sergei looks for solutions to specific biological problems, while I focus on developing the methodology. Our research interests also overlap to a large extent because we both deal with molecular modelling. Also, despite our slightly different backgrounds (Sergei is a physicist, while I'm a chemist), we both put a great deal of emphasis on explaining the physics of the phenomena we study rather than just their possible applications.

How did the presence of a foreign researcher change the daily work in your Laboratory of Molecular Modelling?

The scope of the lab expanded to include a new research area: interactions between proteins and glycosaminoglycans. These interactions are of key importance to processes that occur in the extracellular matrix, especially the processes of regeneration. In addition, Sergei has a real flair for scientific networking and cooperation. This means that apart from his own team, which consisted of Dr Urszula Uciechowska and Krzysztof Bojarski, MSc, his research work involved practically everyone in my lab, as well as the staff employed at the Laboratory of the Simulation of Polymers, headed by Prof. Cezary Czaplewski. Thanks to Sergei's contacts with groups in Germany, France and Hungary, we received visits from early stage researchers and senior researchers from foreign centres, who delivered seminars and conducted research in our lab. Our cooperation also had a more tangible product, i.e. publications, which contributed to the scientific record of the lab. The greatest proof of our mutual benefits, and the high quality of work done by Sergei, is his decision to stay in Poland and continue to work with my team for the next 5 years. Sergei also won a SONATA grant awarded by the NCN.

What were the greatest challenges of welcoming a new member of staff?

Administrative and financial matters, which in Poland are traditionally the responsibility of the principal investigator and which usually require a lot of time. We received a lot of support from the university administration, but even so it was a challenge, mainly because it was Sergei's first independent grant and he had to learn how to manage it from scratch. A good solution would probably be to follow the American model, where the financial reports are the responsibility of the host institution's grant office. But this is a general remark, not one that only applies to POLONEZ projects[1].

And what do you think are the strongest assets of the POLONEZ programme?

The greatest advantage is that we can attract motivated foreign researchers, which helps internationalizing Polish science and, in particular, it allows young Polish researchers and PhD students to enjoy greater access to global science. If we have an appropriate candidate we will definitely participate in POLONEZ BIS. But it may prove very difficult to find anyone as talented as Sergei Samsonov.

[1] In POLONEZ BIS, to be launched in 2021, a portion of project's overheads will be set aside for the host institutions to hire a part time administrative assistant to help each Fellow adjust to a new research environment.

Prof. dr hab. Józef Adam Liwo, Laboratory of Molecular Modelling, Department of Theoretical Chemistry, Faculty of Chemistry, University of Gdańsk

Prof. Liwo's field of research is molecular modelling. He has worked at the University of Gdańsk since 1983. He won an individual award of the Ministry of Science and Higher Education in 1998 and, in 2013, a Mistrz/Master grant awarded by the Foundation for Polish Science. His academic and research track record includes ca. 300 scientific publications, which have been cited more than 5000 times. In his free time, he enjoys learning foreign languages, such as Korean or Mandarin Chinese. Prof. Liwo is the head of the Laboratory of Molecular Modelling, which hosted Sergei Samsonov during his 2-year MSCA POLONEZ fellowship.

POLONEZ Fellowships boost the research potential of the University of Warsaw

As many as 22 out of more than one hundred POLONEZ Fellows have joined research teams at various faculties and independent research units of the University of Warsaw, which makes it the programme's largest institutional partner. What kind of impact have they had on the University?

Prof. Agata Górny from the Centre of Migration Research, Dr Michał Pilipczuk from the Institute of Informatics and Dr hab. Marta Szulkin, Head of the Wild Urban Evolution & Ecology Lab at the Centre of New Technologies shared their insights with us.

Photo: University Library. Author: Mirosław Kaźmierczak

The projects carried out under the MSCA POLONEZ programme have definitely increased the University's research potential. Among other things, the Fellows have helped create new thematic research groups, many of which are unique in Poland. On many occasions they have contributed to the expansion of earlier research perspectives.

POLONEZ helped to shape new mind-sets and prepared groups of young ambitious researchers to become leaders in subsequent scientific projects. Their involvement in the dissemination and communication activities of project results – in scientific publications, at conferences, seminars or debates in the media – has increased the visibility of the University of Warsaw as an important research centre in a number of disciplines.

What was the biggest organisational challenge?

There were two such challenges we had to address even before the start of individual research fellowships – the relocation of the POLONEZ Fellows to Poland and the on-boarding process with the new employer. For many researchers, participation in mobility programmes means changing country and institution every two or three years. So they have to adapt to the new context and at the same time maintain contacts with their home institutions, which can be rather difficult. Our experience shows that projects achieve better results if they become the common ground for scientific cooperation between the Fellow's home institution and the new host institution in Poland. We are happy to say that many fellowships successfully established long-term international cooperation and its continuation beyond the project end date has proved beneficial to all interested parties, regardless of whether the Fellow decides to move on, return to his/her previous employer or stay at the University of Warsaw to continue his/her career here.

MSCA POLONEZ is one of many HORIZON 2020 initiatives in which the University takes part. Does it stand out from the others?

POLONEZ goes beyond the classic concept of individual mobility programmes by combining their advantages with the possibility for the establishment of new research groups – aside from individual remuneration, the Fellows receive funds to set up their own research team at the host institution for the duration of the project. This gives them two important advantages in terms of career development: they gain research experience outside their home institutions and act as heads of scientific teams. In this way, they gain hands-on experience in guiding less experienced researchers; often for the first time in their lives they take on the role of scientific leaders of the groups they set up, and become mentors for co-investigators on their way to the position of principal investigators in the future. Therefore the positive impact of an individual POLONEZ fellowship goes way beyond the Fellow's career development only.

Thanks to the European Commission's funding, the Fellow's remuneration in the project is relatively high, which is an important financial incentive for promising scientists from abroad with valuable scientific achievements to apply for POLONEZ grants.

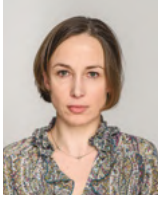
Why is it important for the University to attract international mobility?

It is one of the sources of innovation in research thanks to the exchange of knowledge and scientific ideas between a foreign scientist and scientists from the host institution. It also provides an opportunity to compare the organisational cultures of scientific institutions from Poland and abroad and to implement good practices at the institution hosting the foreign scientist. International mobility contributes to increasing the research potential of the host institution, to establishing international, interdisciplinary research teams, and creates opportunities for

Photo: University buildings and Warsaw skyline. Author: Miron Bogacki

the preparation of joint scientific publications and joint long-term research grants to further expand newly established scientific teams and research activities.

International mobility is one of the sources of innovation in research. We are happy to invite more international researchers to join the University of Warsaw research community for the benefit of all parties and for the further development of science.



Prof. Agata Górny is the Head of the Department of Population Economics and Demography at the Faculty of Economic Sciences of the University of Warsaw and Deputy Director of the Centre of Migration Research, University of Warsaw. She is also the deputy president of the Committee for Migration Research of the Polish Academy of Sciences.

An economist and sociologist by education, she was awarded a PhD in 2002 at the School of Slavonic and East European Studies, University College London. Her PhD thesis was devoted to the role of social, economic and political networks in settlement migration to Poland using the example of Ukrainian migrants.

Her research interests include the methodology of migration research, contemporary migration processes, primarily patterns of immigration to Poland and Central and Eastern Europe, and the integration of migrants in the host society.

Dr hab. Marta Szulkin is a group leader of Wild Urban Evolution and Ecology Lab in Centre of New Technologies of the University of Warsaw. In 2008, she defended her doctoral thesis at the University of Oxford under the supervision of Prof. Ben Sheldon. Her doctoral thesis was devoted to an analysis of inbreeding and dispersal in birds.

Her research interests include urban biology (ecology and evolution). One of her latest achievements is the publication of a book entitled Urban Evolutionary Biology (Oxford University Press), where Dr hab. Szulkin is the co-author and chief editor.

Dr Michał Pilipczuk is an assistant professor at the Institute of Informatics, Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw. In 2013, he defended his doctoral thesis in Theoretical Computer Science *Tournaments and Optimality: New Results in Parameterized Complexity* at the University of Bergen, Norway, under supervision of Prof. Fedor V. Fomin.

His research interests include algorithms on discrete structures (particularly, parameterized algorithms), structural graph theory and logic in computer science.

In 2020 the European Research Council awarded him a Starting Grant for his BOBR project, in which together with his team, he will try to solve discrete problems in networks using their structural and decomposition properties.

Portrait photos: Authors' personal collections

Dear POLONEZ Fellows,

we couldn't have done it without all of you. Thank you!

Photo: POLONEZ Fellows' Forum. Author: Izabela Doniec

Looking forward to

POLONEZ BIS

Following the success of MSCA POLONEZ Cofund programme, the National Science Centre will launch three more calls in 2021 and 2022 to recruit 120 experienced scientists from all over the world. We invite them to move to Poland for 24 months to carry out basic research projects at Polish institutions. POLONEZ BIS guarantees successful Fellows a full time employment and an additional grant for the implementation of their own projects in a research field of their choice. The research component will be complemented by a series of attractive workshops on transferable skills, and an opportunity to cooperate with startups and non-governmental organisations during short-term secondments.

Follow the project webpage **www.polonezbis.eu** and **LinkedIn account**.

Mail the POLONEZ BIS Team **polonez@ncn.gov.pl**

Who is it for?

- Talented scientists with excellent research ideas.
- Citizens of any country, regardless of nationality, age and gender.
- Holders of PhD or at least four years of full-time documented research experience.
- Researchers who have not lived or worked in Poland for more than 12 months within the 3 years before the date of the call launch (researchers applying for refugee status are eligible for extensions).
- Researchers prepared to move to Poland for 2 years – for the duration of their research project.

What does it offer?

- Full time employment contract with full health and Social Security coverage under the Polish Labour Code.
- Attractive annual salary including:
  - Living and Mobility allowance: € 53 580 gross
  - Family allowance: € 3 600 gross (if eligible)
  - Special needs allowance: € 2 400 gross (if eligible).
- A research grant up to € 100 000 to cover salaries of the research team, purchase of equipment, costs of field research, scientific conferences, intersectoral secondments (fees, travel and subsistence).

What competences will you develop?

The POLONEZ BIS training programme will be conducted in cooperation with programme's institutional partners. It will enable you to:

- develop an action plan for your further career with The Careers Research and Advisory Centre – Vitae,
- promote your research with the Polish Women Scientists Network
- develop cooperation with business with the Startup HUB Poland Foundation
- more effectively implement Open Access and Open Data policy with the Interdisciplinary Centre for Mathematical and Computer Modelling of the University of Warsaw.

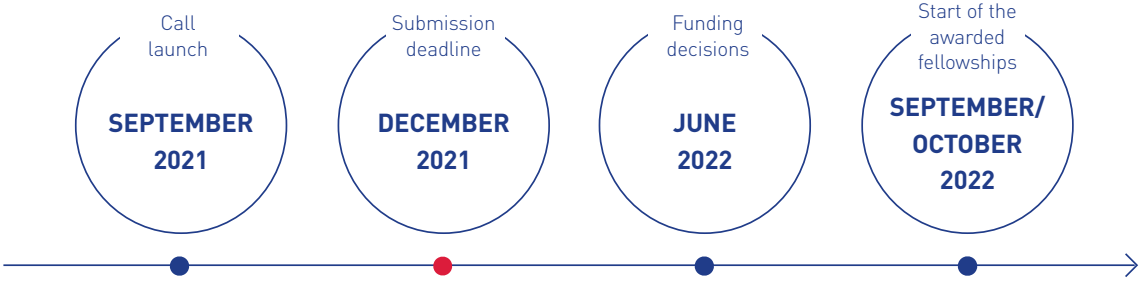
Where will you work?

You can choose any organisation registered in Poland, such as a research centre, university, museum, non-governmental organisation, hospital, company – whichever is most suitable for your research project. Please note that an institution which granted you your doctoral degree or which employed you in the 3 years immediately before the date of the call announcement is not eligible as your POLONEZ BIS host.

The host institution will provide you with the support of a supervisor/mentor in your field of research and will employ an administrative assistant to help you successfully manage your project.

When can you apply?

The first call will open in September 2021, two more calls will follow in March and September 2022.



POLONEZ BIS has received funding from the European Union's Horizon 2020 research and innovation programme under Marie Skłodowska-Curie grant agreement No 945339

POLONEZ

- Curiosity-driven research
- Financial independence
- Team building
- Transferable skills
- Intersectoral experience
- Developing networks

POLONEZ has received funding from the European Union's Horizon 2020 research and innovation programme under Marie Skłodowska-Curie grant agreement No 665778