PASIFIC

PAN

POLSKA AKADEMIA NAUK

PASIFIC

Polish Academy of Sciences
Individual Fellowship
Innovation & Creativity

The PASIFIC is a postdoctoral fellowship Programme of the Polish Academy of Sciences, offering researchers a unique opportunity to undertake state-of-the-art research in a dynamic scientific environment. It enabled scholars of all nationalities and across all scientific disciplines to establish their scientific independence and conduct ground-breaking research.

This project has been cofounded from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement and from the Polish Ministry of Science and Higher Education.

PASIFIC Programme details

The Programme recruited 48 excellent researchers from a pool of 550 candidates in two Calls announced in 2021. Fellows were selected through a merit-based evaluation process carried out by international experts. Selected candidates came to Polish Academy of Sciences, one of the country's most prestigious scientific institutions, for 24 months to conduct the research at their chosen Institutes.

The laureates have been provided with excellent conditions for their research projects. Fellows have been entitled to a monthly salary of about EUR 2,500 net and, in justified cases, a family allowance. In addition, the PASIFIC Programme have provided researchers with a research budget of up to €93,000 per project (including 20% of indirect costs). They also have the possibility to spend six months on secondment outside academia in institutions implementing the research results.

The PASIFIC Programme offered, among other things: funding to carry out an individual research project; support in the preparation of a long-term career development plan; the opportunity to participate in scientific and supplementary training courses at the host institutes of the Polish Academy of Sciences; a wide range of training courses and seminars on topics such as research funding opportunities in Poland and Europe, writing research grant applications, intellectual property rights and project management; etc.

PASIFIC Fellows

PASIFIC Programme fellowships were intended for postdoctoral researchers of any nationality and representing all areas of research.

Applicants had to comply with the MSCA mobility rule: they could not have lived or performed their main activity (work, studies, etc.) in Poland for more than 12 months in the three years immediately preceding the application deadline.

The PASIFIC fellows came from 19 different countries from around the world, including India, the United States, Australia, Italy, Ukraine, and others.

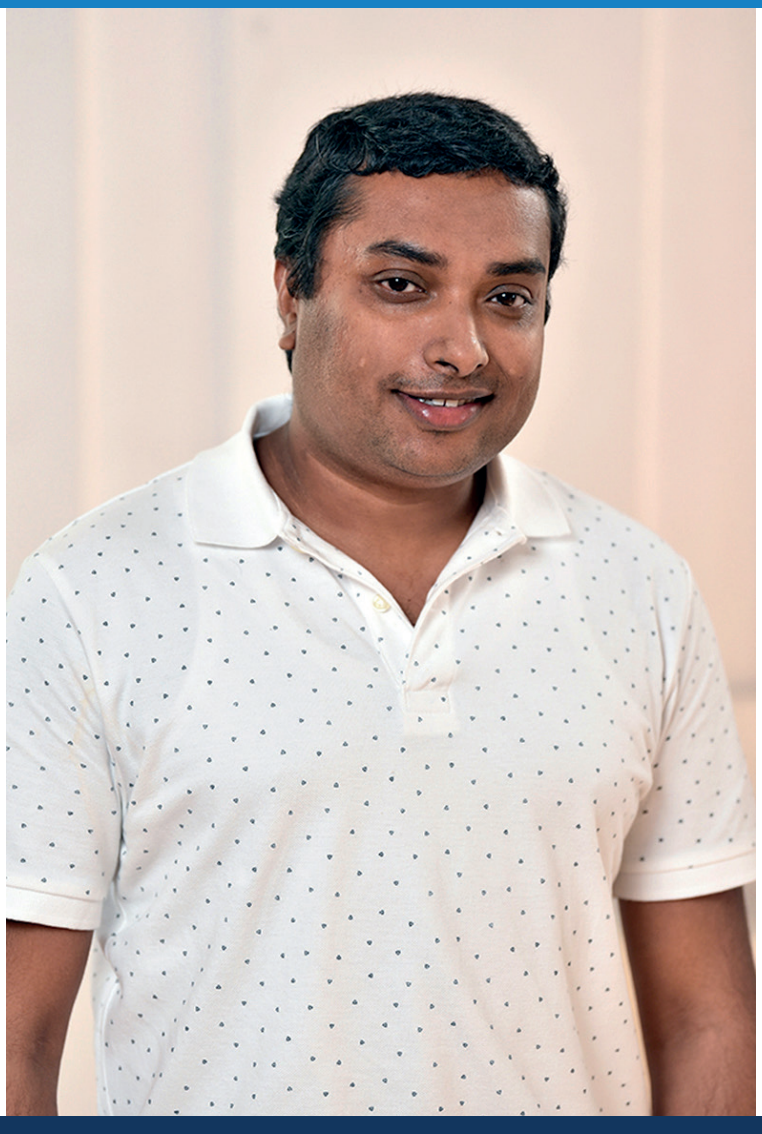
They conducted their research in three areas – Physical Sciences and Engineering (22 fellows), Life Sciences (11 fellows), and Social Sciences and Humanities (15 fellows). The projects covered a wide range of disciplines, including, Space Science, Materials Engineering, Computer Science and Informatics, Cultures and Cultural Production, Environmental Biology, and Ecology and Evolution.

LIST OF FELLOWS

Mitrajit	**GHOSH**
Piotr	**CHUDZIŃSKI**
Souvik Priyam	**ADHYA**
Richard	**RUIZ**
Sunita	**RANOTE**
Rugmani	**MEENAMBAL**
Ghulam	**NABI**
Juris	**BURLAKOVS**
Ajitanshu	**VEDRTNAM**
Arun Kumar	**AWASTHI**
Maciej	**BARTOSIEWICZ**
Ilyas	**DJAFER-CHERIF**
Christopher	**HALE**
Angelo Castrorao	**BARBA**
Josefina	**RODRIGUES-ARRIBAS**
Olha	**TIKHONOVA**
Matthias	**ROICK**
Mikhail	**KHORKOV**
Francesco	**LATTERINI**
Fabricio	**CARRIJO**
Mariia	**DEKALIUK**
Monika	**CHWALCZUK**
Li	**CHEN**
Jędrzej	**NIKLAS**
Abdel Aziz	**GAD**
Taina	**ROCHA DE ALMEIDA**
Vineeta	**KAUSHIK**
Vishal	**SHRIVASTAV**
Marcin	**BIAŁEK**
Kseniya	**MEDVEDEVA**
Narayan	**SOM**
Nilesh	**MANWAR**
Pallavi	**KUMARI**
Imran	**SARIHASAN**
Kinga	**POLYNCZUK-ALENIUS**
Oksana	**POCHAPSKA**
Monika	**HEJNA**
Navjotpal	**KAUR**
Shumaila	**RAZZAQUE**
Sazim	**SHEIKH**
Syed Ahmed	**SHAH**
Ewa	**PONIECKA**

Mitrajit **GHOSH**

began his scientific career at Indian Institute of Technology Kanpur, earned his doctorate from RWTH Aachen University in 2013, and continued his studies as a postdoctoral researcher at Harvard Medical School. In 2017 he joined Indian Institute of Engineering Science and Technology, Shibpur, and was appointed assistant professor. In 2022–2023 M. Ghosh carried out a PASIFIC project at Nencki Institute of Experimental Biology of the Polish Academy of Sciences.



HOST INSTITUTE: Nencki Institute of Experimental Biology, PAS

PASIFIC PROJECT

OverGBM. **Overcoming resistance to immunotherapy in Glioblastoma**
Life Sciences

RESEARCH PROBLEM

What are the differences in immune cell infiltration and functionality in gliomas with distinct genetic alterations and how would that impact immunotherapy?

PROJECT RESULTS

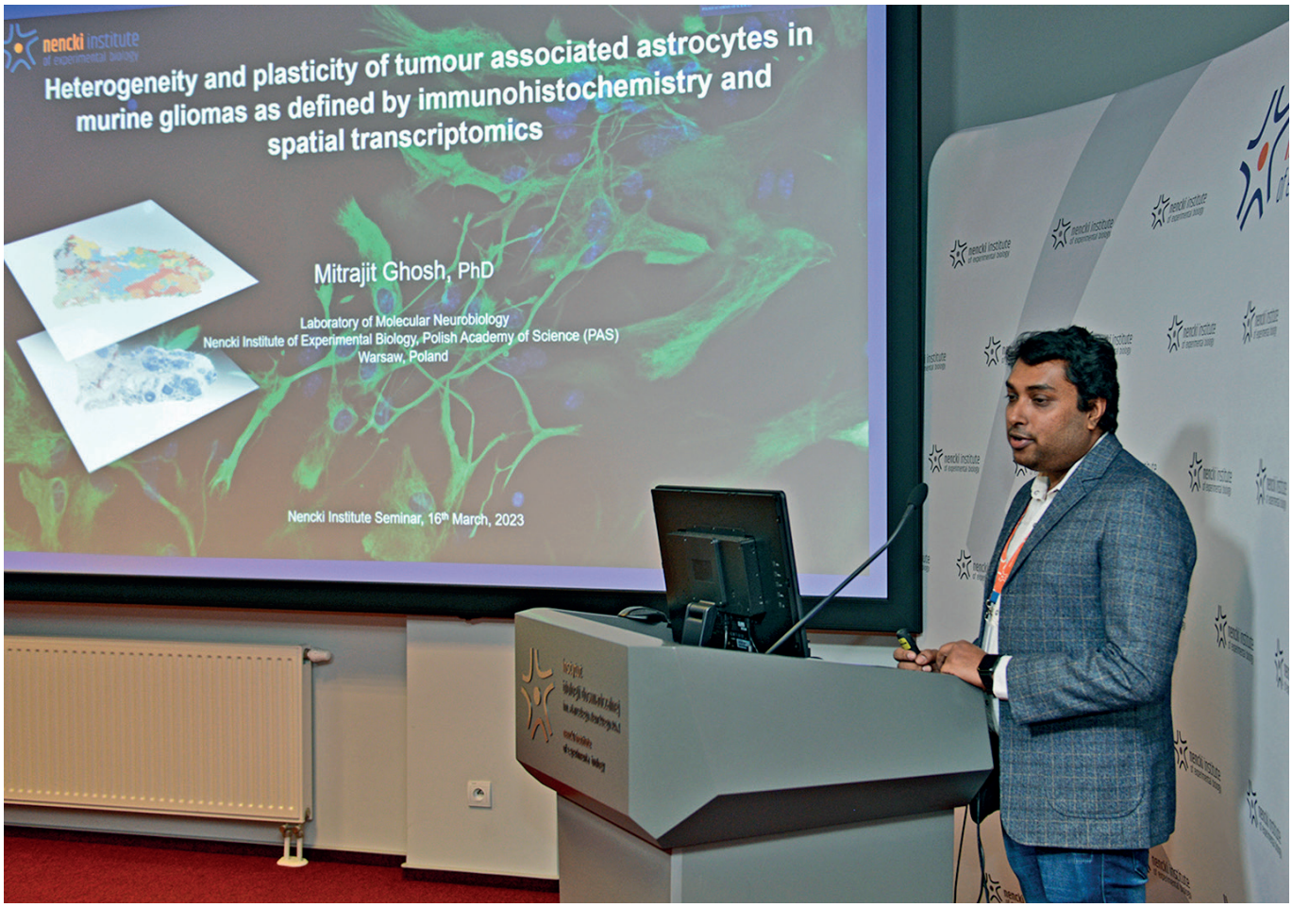
1. Subtypes of tumor associated astrocytes with distinct localization and implication of specialized functionalities within the tumor microenvironment of Glioblastoma or brain tumor have been identified with the use of spatial transcriptomics and immunohistochemistry.
2. The spatial distribution of tumour-associated astrocytes in murine glioblastoma is remarkably modulated by the use of a customised RGD peptide aimed at transforming the ‘cold’ into a ‘hot’ tumour microenvironment. The RGD peptide with integrin blockade enhances the innate and adaptive immune response via vascular normalisation.
3. Spatial transcriptomics, CITEseq and FACS analysis revealed the role of genetic background on the glioblastoma microenvironment and its susceptibility to anti-tumor immunotherapy, providing evidence for specific alterations that shape the immunosuppressive tumor microenvironment of various gliomas and affect tumor progression.

IMPACT

The most aggressive malignant adult primary brain tumor is glioblastoma (GBM) which is also called glioblastoma multiforme. The median survival of glioblastoma patients treated with available multimodal therapy including neurosurgery, radiation therapy and chemotherapy remains only in the range of 15–16 months. GBM is also one of the most immunosuppressed and heterogeneous tumors. The lack of information about the composition of the tumor microenvironment (TME) and reciprocal cell-cell interactions is a major hurdle to successful immunotherapy in this tumor.

In response to the unmet need for studying this devastating disease to understand and combat resistance and improve patient survival, we have investigated specific genetic changes in brain tumors that lead to context-specific immune responses. To this end, multi-omics technologies have been combined with traditional immunohistochemistry and intravital imaging to provide a holistic view of the disease progression.

The implementation of spatial transcriptomics, brain tumor heterogeneity and tumor response to therapy will advance the novel understanding of cell-cell interactions, and might become instrumental in developing new paradigms in the scientific discipline of brain tumors. The latest insights into the complex tumor microenvironment might help to improve therapeutic targeting and overcome resistance to therapy.



Piotr
CHUDZIŃSKI

After obtaining his PhD at Paris-Sud University (Orsay, France) in 2008 where Piotr Chudzinski was working on cuprates, he became a postdoctoral fellow at the University of Geneva (Switzerland) carrying out the research on collective modes in semimetals (Bi1-xSbx family). He continued his postdoctoral research at the University of Regensburg (Germany) working on carbon nanotubes, at Utrecht University (Netherlands) studying columnar tri-chalcogenides and at the Queen's University of Belfast (the United Kingdom) conducting the study of incipient ferroelectrics. From 2022 to 2024, P. Chudziński was a PASIFIC Fellow at the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Fundamental Technological Research, PAS

PASIFIC PROJECT

NanoCollective. **A new pathway for future electronic devices: collective electron-lattice states in nanostructures**
Physical Engineering

RESEARCH PROBLEM

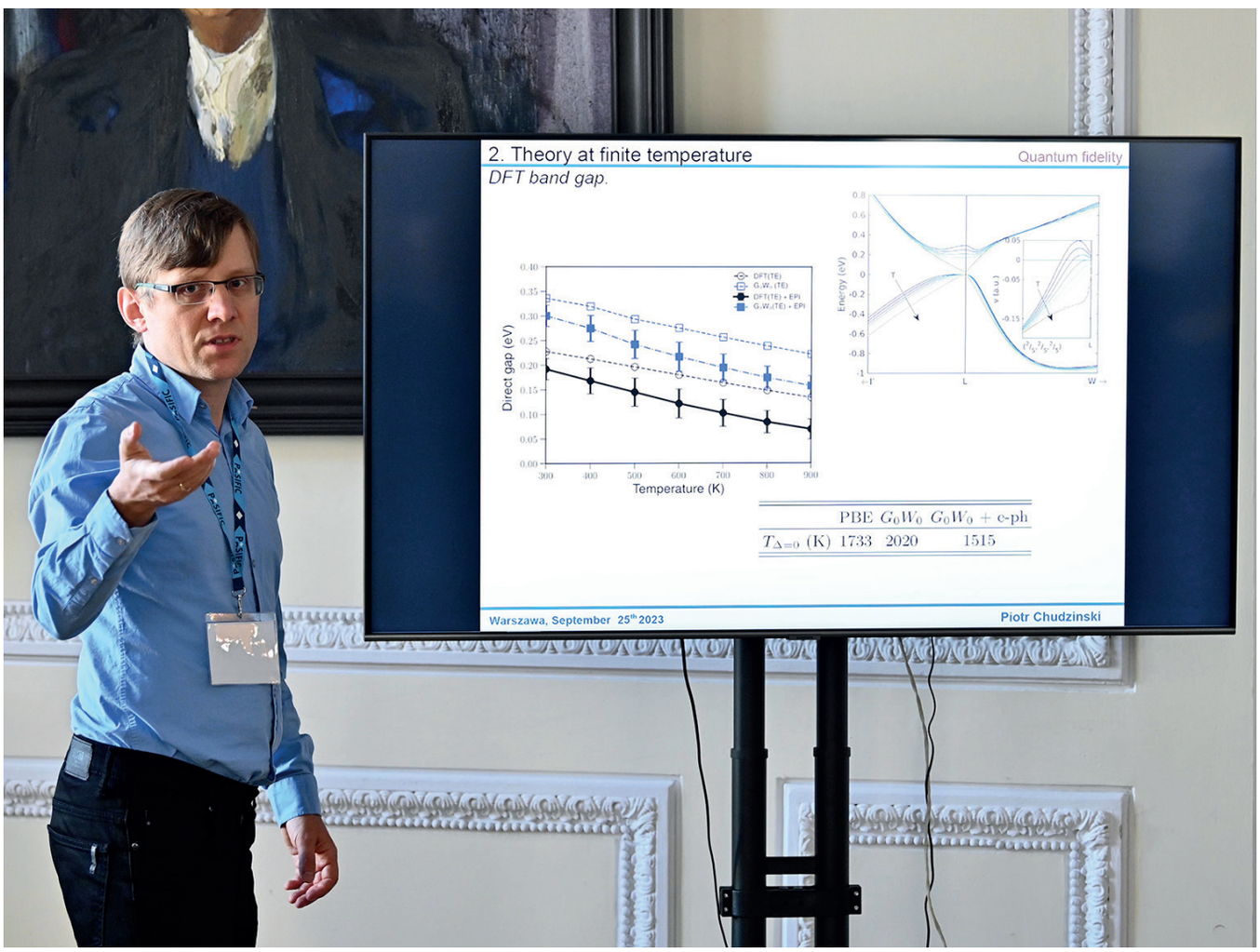
Can the couplling of electrons in a low dimensional system with a topological state of a lattice lead to new exotic orderings?

PROJECT RESULTS

1. Development of theoretical tools that are going to be useful to describe classical quasi-2D systems (or quantum quasi-ID) consisting of multiple collective modes. This includes theoretical framework to describe their dynamics and possible phases (and instabilities) within (but not limited to) a new variant of functional renormalization group. Also a generalized formulas for transport coefficients has been obtained. A new formalism was derived, a double geometric re-summation of the electron-phonon influence of fermionic density of states was stated. This last formalism is unavoidable when the system departs from adiabatic approximation.
2. Investigation and determination of the influence of topological vortex states in the situation when vortexes have energy approaching zero, that is in the vicinity of Kosterlitz-Thouless transition. Calculation of selected transport properties (field emission, resistivity, Hall coefficient) and, most importantly, comparing them with experiment was carried out. The methods to fit numerically obtained distortions were received also in the case of an anharmonic lattice (where the concept of a solitonic wave has been generalized) and applied to DFT results and experimental results.

IMPACT

Nanostructures are currently one of the most intensely developed areas of technology, offering the hope of solving engineering problems at the smallest possible scale, the scale of atoms. However, a theoretical description of such systems is often inadequate. The research will fill this gap in our knowledge, paving the way for yet unknown technologies. For example, the study of nanoscopic thermoelectric transport will hopefully allow heat to be removed from computer processors at the highest possible resolution, while the study of inhomogeneous superconductors should bring us closer to controllable quantum computing platforms.



Souvik Priyam **ADHYA**

obtained his doctoral degree from Saha Institute of Nuclear Physics, Kolkata, in 2016. As a member of ALICE and CERN collaborations, he continued the postdoctoral research at the Variable Energy Cyclotron Centre in Kolkata and later on at Charles University in Prague. Besides mainstream research, Souvik Priyam is also interested in the management of science and innovation and loves teaching graduate level physics courses. During 2022–2023, he worked as a postdoctoral fellow at Henryk Niewodniczanski Institute of Nuclear Physics of the Polish Academy of Sciences in Krakow.

HOST INSTITUTE: Henryk Niewodniczanski Institute of Nuclear Physics, PAS

PASIFIC PROJECT

QGPAnatomy. **Space time structure of Quark Gluon Plasma**
Physical Engineering

RESEARCH PROBLEM

How powerful are Jets for Quark Gluon Plasma (QGP) tomography? Exploring the physics of quenching of highly energetic quarks and gluons as “jets” traversing through the hot and dense QGP formed in heavy ion collisions.

PROJECT RESULTS

1. Gluonic cascades, both in static and Bjorken-expanding Quark-Gluon Plasma (QGP) mediums, have been investigated by solving full evolution equations taking into account transverse momentum broadening. Using the Monte Carlo event generator Medium Induced Cascade (MINCAS), the in-medium parton shower was solved numerically. While medium dilution due to expansion significantly impacts leading jet fragment broadening, angular distributions remain similar in the low-energy regime across different medium profiles at equivalent effective in-medium path lengths. This enhanced a theoretical understanding of momentum broadening for soft versus hard gluons within jet cones in expanding mediums, offering valuable insights for phenomenological jet shape measurements.
2. A thorough study of jet quenching within realistic mediums, the influence of equilibration time and the effects of gluon saturation paved the way for testing the results at current and future colliders. A unified theoretical framework for computing transport coefficients applicable to extreme temperature conditions in heavy ion collisions and extreme density scenarios in neutron stars has been developed.

IMPACT

The implementation of the Opacity Expansion, Improved Opacity Expansion, and the Resumed Opacity Expansion with finite length corrections for expanding media holds potential benefits for studies involving heavy ion jet Monte Carlo in-medium parton showers. These advancements introduce newer kinematical scales and increase sensitivity to equilibration time, paving the way for precision studies in phenomenological models or jet quenching within the quark-gluon plasma physics community.

The significance of finite size corrections and coherence in jet evolution, in particular with respect to the Sudakov form factor and saturation physics, has been explored for the first time, focusing on understanding the implications of medium expansion, coherence, and variations in quenching between quarks and gluons. Notably, the integration of small-x gluon saturation physics as initial conditions for the jet-medium interaction has been central, with tailor-made predictions for Focal, ALICE, and CERN.

Investigation of the influence of magnetic fields on heavy quarkonium states in heavy ion collision (HIC) experiments, analysis of modifications in binding energies and ionization potentials for different quarkonia species within a thermal medium, gave the insights of transitions between bound-to-bound and bound-to-unbound states for various charmonium and bottomonium states, offering drifts into the presence and persistence of magnetic fields generated during high-energy nucleus-nucleus collisions.

Richard **RUIZ**

obtained his PhD in Physics from the University of Pittsburgh in the USA in 2015. He joined Durham University in the UK in 2016 and carried out his postdoctoral research there until 2018. As a research fellow at the University of Louvain, Richard Ruiz continued his investigations in the area of theoretical high energy physics / particle physics until 2020. During 2022–2024, he was a PASIFIC Fellow at Henryk Niewodniczanski Institute of Nuclear Physics of the Polish Academy of Sciences.

HOST INSTITUTE: Henryk Niewodniczanski Institute of Nuclear Physics, PAS

PASIFIC PROJECT

POPSICLE. **Polarization of precision scattering in colliders with large energies**
Physical Engineering

RESEARCH PROBLEM

Is it possible to improve the description (accuracy) of polarized particles in high-energy scattering processes at the Large Hadron Collider?

PROJECT RESULTS

When investigating the theoretical formalism underlying the lepton-nucleus deep-inelastic scattering (DIS) was studied, it was found that DIS inherently involves an interplay between helicity polarizations and chiral couplings in the scattering of high-energy particles. “Target mass corrections” to the structure functions in DIS were derived in their entirety in the framework of the operator product expansion at the leading twist. For large momentum fractions ($x > 0.5$) and small virtualities ($Q^2 < 10$ GeV), the corrections could exceed 50%. Nevertheless, a class of uncertainties for predictions in charged-lepton and neutrino DIS at moderate-to-large momentum fractions ($x > 0.1$) were reduced to the percent level, thereby facilitating future precision studies of lepton nucleus DIS at high energies and low virtualities.

IMPACT

At sufficiently high scattering energies, the scattering of W and Z bosons in proton collisions, i.e., vector boson scattering, can be modelled as if the proton itself contained a small number of W and Z bosons. That is to say, that the proton is composed of W and Z bosons at a tiny level. The underlying formalism was implemented in the simulation package MadGraph5_ aMC@NLO, automating calculations of the so called Effective W Approximation at lowest order in perturbation theory for high-energy lepton collisions. These results solved a puzzle that first emerged in the literature nearly 30 years ago.

Polarized ZZ pairs in gluon fusion and vector boson fusion at the LHC present novel means for predicting polarized cross sections for processes at the Large Hadron Collider.

Sunita **RANOTE**

started her scientific career as a PhD research fellow at HNBG University, Uttarakhand and Himachal Pradesh University (co-centre), Himachal Pradesh, India, in 2013. She continued her research as a senior research fellow under CSIR-Emeritus Scientist Scheme at Himachal Pradesh University. From 2022 to 2024, S. Ranote was a postdoctoral Fellow at the Centre of Polymer and Carbon Materials of the Polish Academy of Sciences under the PASIFIC Call 1 Progamme.

HOST INSTITUTE: Centre of Polymer and Carbon Materials, PAS

PASIFIC PROJECT

TMOG-PHB BIOPLASTIC. **Green synthesis of functionalized Moringa oleifera gum-based bioplastic film as packaging material and adsorbent with antimicrobial properties**
Physical Engineering

RESEARCH PROBLEM

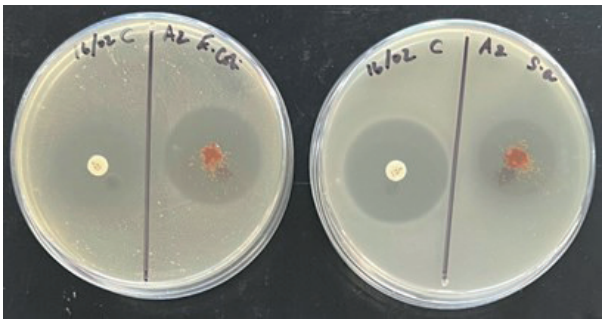
Synthesis of cost-effective and biodegradable multifunctional bioplastic film from the plant gum and poly(hydroxyalkanoates) and its application as packaging material as well as an adsorbent with antimicrobial properties.

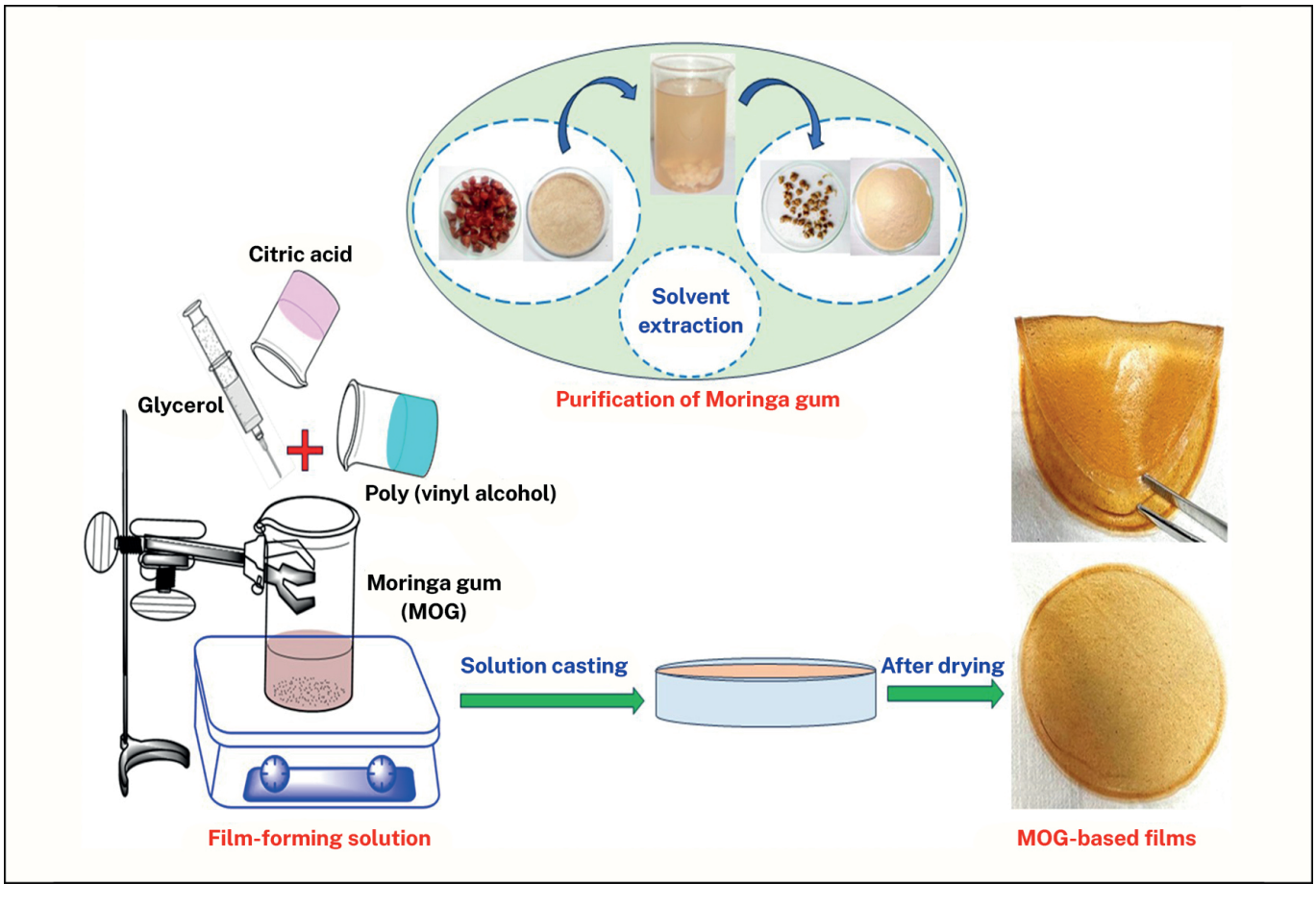
PROJECT RESULTS

1. A series of new, green, cost-effective, non-toxic, and degradable bioplastic films (13) was prepared using Moringa oleifera gum (MOG) and polyvinyl alcohol by varying the amounts of plasticizer and crosslinker.
2. Synthesized MOG bioplastic films showed better barrier properties with switchable behavior from being hydrophilic to hydrophobic, rigid to elastic, and elastic to plastic, which will expand its application range across various areas.
3. Fabrication of novel, cost-effective, and degradable multifunctional bioplastic films from modified MOG and polyhydroxyalkanoates with antimicrobial and adsorbent properties.

IMPACT

Globally, the augmented demand for plastic products requires an immediate alternative in the form of biodegradable bioplastic materials that reduce the accumulation of non-degradable plastic waste in our environment. In addition, it has been reported that plastic waste imparts $13 billion every year of economic damage to the world's marine ecosystem. In recent years, bioplastics have proven to be an excellent alternative to synthetic plastics. However, one of the major challenges that bioplastics face today is the high cost of production. The research focused on the synthesis of cost-effective, and degradable bioplastics from bioresources to realize the twin objectives of economic and environmental concern, i.e. the e2 concept. Through this project, a new, economic, and non-toxic resource of polysaccharide, i.e. plant gum, has been progressed to synthesize bioplastics, thus dipping dependence on the consumption of reduced non-renewable resources, reducing the carbon footprint and supporting the circular economy. Biodegradability is one of the main advantages of the synthesized bioplastic films. They are designed to be 100% biodegradable or compostable under certain conditions, unlike conventional plastics that remain in our environment for centuries.





Rugmani **MEENAMBAL**

earned her Ph.D. from Pondicherry University, India, on the thesis “Synthesis and structural insights of Ln3+ doped β-Ca3(PO4)2 and LnPO4 contrast agents for multimodal imaging applications” in 2018. She was employed at the Department of Science and Technology funded by the INSPIRE project at NIMHANS during 2018–2022. During the years 2022–2024, she worked under the PASIFIC Programme at the Institute of Pharmacology of the PAS.

HOST INSTITUTE: Maj Institute of Pharmacology, PAS
Jerzy Haber Institute of Catalysis and Surface Chemistry, PAS

PASIFIC PROJECT

TheraLanOx. **Neuroprotective properties of theranostic lanthanide oxide nanoparticles against neurotoxin-induced cellular models of Parkinson’s disease**
Life Sciences

RESEARCH PROBLEM

Need for multifunctional neuroprotective agent for Parkinson’s disease and its early detection and therapy using imaging contrast agents.

PROJECT RESULTS

1. Creation of nanoparticles with antioxidant properties from cerium oxide to potentially aid diagnosis and treatment of Parkinson’s disease.
2. Changing the composition of cerium oxide by adding elements such as europium and gadolinium to enhance neuroprotective properties and multi-functionality for use as a probe for fluorescence imaging and magnetic resonance imaging.

IMPACT

The outcomes of this research: the successful synthesis of polyacrylic acid conjugated cerium oxide nanoparticles and the application of Gd3+ and Eu3+ doping in polyacrylic acid conjugated cerium oxide nanoparticles as well as the establishment of their neuroprotective properties against neurotoxin-induced oxidative stress in neuroblastoma cells, together with their imaging efficacy, thus developing theranostic nanoparticles, will have far-reaching consequences in various aspects.

The findings will contribute to the development of novel therapeutic interventions for neurodegenerative diseases. For example, the discovery of effective neuroprotective agents will lead to breakthroughs in medical treatment and could result in the development of new drugs or therapies that can slow down or even halt the progression of neurodegenerative diseases, giving hope to millions of people worldwide. Reducing the prevalence and severity of neurodegenerative diseases could have a positive economic impact. By mitigating the effects of these diseases through early diagnosis, people may be able to remain active in the workforce for longer, reducing the economic burden associated with healthcare costs and lost productivity.

Ghulam **NABI**

joined the Polish Academy of Sciences in 2022 and was a PASIFIC Fellow until 2024. His research focused on the ecophysiology of mammals. He completed his master's degree in Endocrinology in Pakistan and earned a PhD degree in Hydrobiology from the University of the Chinese Academy of Sciences. Afterwards, he continued his postdoctoral research in avian endocrinology and physiology at Hebei Normal University in China and was appointed associate professor there.

HOST INSTITUTE: Institute of Nature Conservation, PAS

PASIFIC PROJECT

ANTHROBEAR. **Assessing population-level consequences of anthropogenic pressure: long-term stress and reproduction indices in brown bear populations in a gradient of human disturbances**
Life Sciences

RESEARCH PROBLEM

How does the histophysiology of adrenal glands and gonads relate to hormone levels in wild brown bears? How do anthropogenic activities affect stress and reproductive hormones in wild brown bears?

PROJECT RESULTS

Brown bear reproductive and stress biology in different seasons, effects of urbanization and habitat change.

1. Reproduction: The brown bear is a highly seasonal species. In male bears, spring is marked by greater testicular mass and volume, larger seminiferous tubules, and higher stages of spermatogenesis. In-depth histological (diameter of seminiferous tubule and graafian follicles, generation of follicles), immunohistochemical (expression of androgen receptor, 11Beta-hydroxysteroid dehydrogenase enzyme II) and the reproductive hormone (testosterone, dihydrotestosterone, dehydroepiandrosterone, androstenedione, estradiol, estrone, 17-hydroxyprogesterone, progesterone) analyses deepened the understanding of the extrinsic and intrinsic factors affecting brown bear reproductive physiology.
2. Stress: The adrenal glands secrete glucocorticoids (so-called stress hormones) to cope with challenges, and, initially, the physiological changes induced by stress, are adaptive and aimed at maintaining homeostasis. However, when prolonged, they have negative effects on overall health, reproductive success, and survival.
3. Anthropogenic effects on stress and reproduction: Human activities, such as outdoor recreation, tourism, hunting, or habitat fragmentation affect the stress levels of wildlife, which can affect not only individual health, but also population performance.

IMPACT

With this project a comprehensive understanding of species responses in a human-shaped environment was provided. It also developed a complementary approach to assessing fundamental physiological phenomena and physiological responses to escalating human activities. Insights were gained into the long-term implications of altered physiological responses for management and conservation strategies. The results were of great importance to policy makers and conservation practitioners, particularly in an era of rapid biodiversity loss, climate change and habitat degradation.

Juris
BURLAKOVS

earned his PhD in Geography from the University of Latvia. His scientific interests focus on heavy metal contamination remediation technologies and applications of those in different geo-ecological conditions. He is experienced in Applied Geology, conducted his research in Sweden, Estonia and Latvia. He has received national and international recognition as a member of EAGE, EAG, CMS and various panels of experts. From 2022 to 2024, J. Burlakovs was a PASIFIC Fellow at the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences.

HOST INSTITUTE: Mineral and Energy Economy Research Institute, PAS

PASIFIC PROJECT

GeoReco. **Towards 'beyond the zero waste' concept: innovative solutions for valorization of fine residual waste fraction from landfills**
Physical Engineering

RESEARCH PROBLEM

Identification of the potential for sustainable resource recovery of a fine residual fraction of landfill waste in order to value waste as a secondary resource and reduce greenhouse gas emissions.

PROJECT RESULTS

1. Inert landfill waste can be used to cover landfills as a bioactive layer. Amended with compost waste, it serves as a functional material that significantly reduces greenhouse gas fluxes as much as 80-90%.
2. Closed landfills have an undisclosed value from a real estate and ecosystem revitalization point of view, which far exceeds the value of landfill material recycling; in the project the estimated annual real estate tax benefit alone is 30 to 50 kEUR /ha yr.
3. The roadmap for future revitalization projects of former waste disposal sites requires first of all taking the right political decisions based on sustainable development goals. The improvement of economic, social and ecosystem cohesion brings indirect benefits in terms of potential use in urban planning of industrial parks, recreational areas or waste recycling facilities with the option of adapting to renewable energy installations.

IMPACT

Landfills can be recycled, transformed, or left as a resource for future generations. As economic conditions change and technologies advance, existing and previously buried waste will need to be used as secondary raw materials. Landfills can be considered as a „resource bank" for future materials, providing metals, high quality recycled aggregates and recovered fuels. It is estimated that there are between 150,000 and 500,000 historic and still active landfills in the European Union, holding between 30 and 50 billion cubic metres of waste. The huge amount of waste going to landfill demonstrates the huge untapped potential for secondary materials and energy recovery.

Once the materials have been recovered, the former landfill sites must be used for various territorial development purposes, both for the creation of industrial areas and for the creation of green areas that are important for society. The greater the negative impact of the degraded area in the past, the more important it is to transform such an area by extracting new materials, energy, cleaning the area, developing a new industrial or green area, restoring ecosystem services, improving the landscape. Sustainable landfill remediation gives the green light to put into practice the "zero waste" and "zero emissions" strategies proclaimed in the Grean Deal by changing the concept of landfill as a value for the future.

Ajitanshu
VEDRTNAM

published more than 100 articles, including 50 articles in high-impact journals, 2 patents, and 2 authored books. He was awarded prestigious fellowships such as the Marie Skłodowska-Curie fellowship, fellowships from the University of California, Israel Institute of Technology, and from the Ministry of HRD, Govt. of India. In 2022–2024, he joined the Polish Academy of Sciences as a PASIFIC Fellow.

HOST INSTITUTE: Mineral and Energy Economy Research Institute, PAS

PASIFIC PROJECT

ZIF-X-CARBON. **Development of cellulose fiber-ZIF-8 based exhaust air filter with CO2 selectivity**
Physical Engineering

RESEARCH PROBLEM

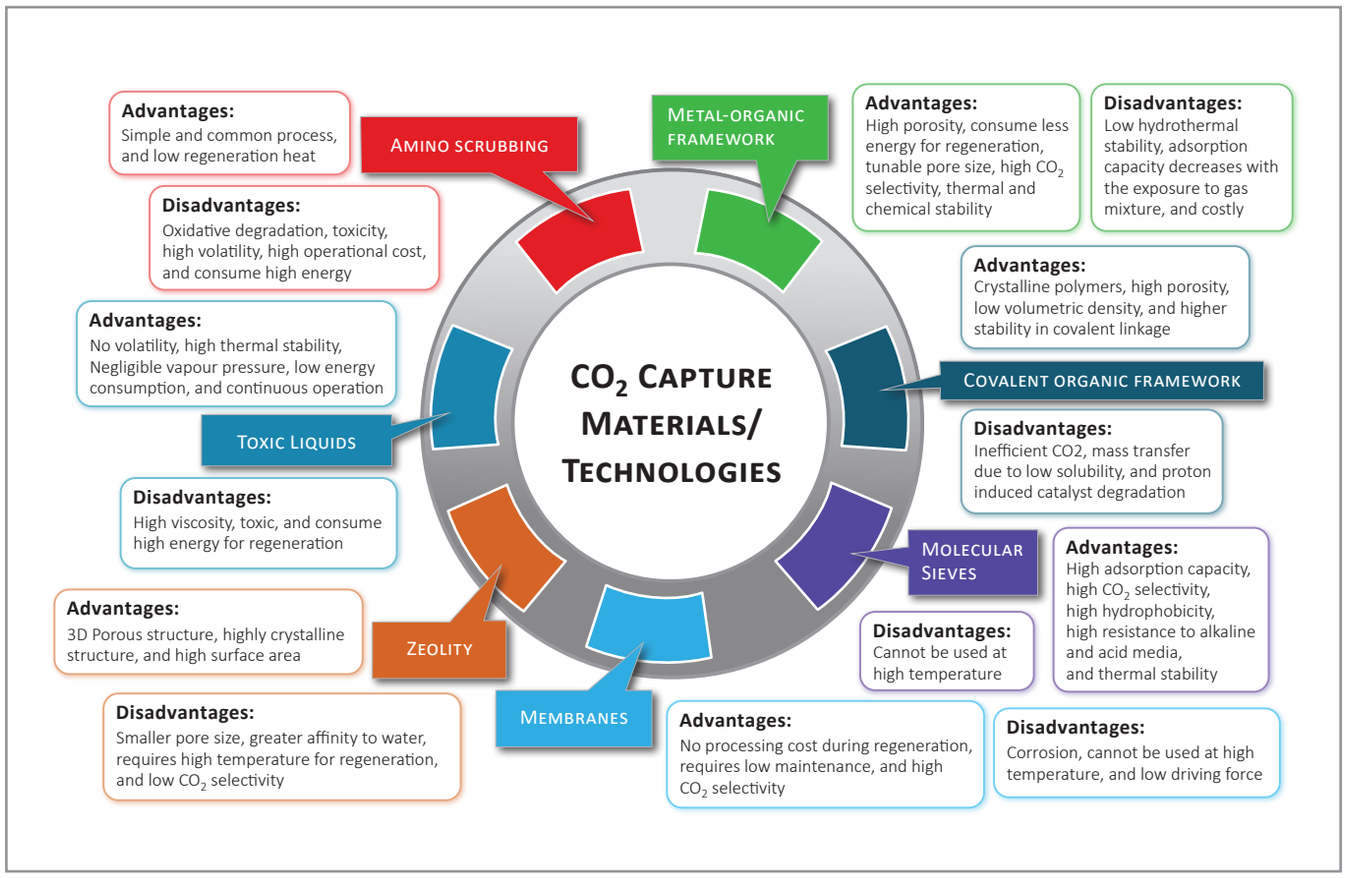
Development of filter with the carbon capture ability.

PROJECT RESULTS

1. **Enhanced CO_2 Absorption Capacity:**
   The synthesized materials, specifically the combination of ZCAF and ZIF-8, demonstrated a significant improvement in CO_2 absorption capacity. The results showed a remarkable 21.47% higher capacity compared to previously used nanomaterials (ZIF configurations, MEA) for CO_2 capture. This suggests a promising advancement in filter materials for more efficient carbon capture.
2. **Optimized Synthesis Process:**
   The project successfully streamlined the synthesis of ZIF-8, resulting in a highly efficient and controllable material. By tailoring the synthesis of both ZIF-8 and ZCAF, specific properties such as particle size and molar ratio could be achieved. This optimization is crucial for the production of materials with enhanced performance in CO_2 capture applications.
3. **Improved CO_2 Loading Capacity of MEA:**
   By incorporating various samples such as a slurry, the project achieved a remarkable increase in the CO_2 loading capacity of MEA (Monoethanolamine). The incorporation of different samples resulted in a remarkable improvement, demonstrating the potential for improving the efficiency of MEA in capturing carbon dioxide. This could have implications for the development of more effective carbon capture technologies.

IMPACT

The PASIFIC project's development of ZCAF and ZCAF+TSMAIL materials aims to significantly enhance carbon capture technology, contributing to global efforts in mitigating climate change. Optimized synthesis processes, such as ZIF-8 nanoparticles, demonstrate technological advancements with potential applications beyond carbon capture, fostering broader innovation. Interest from companies such as Zenith Filter and Balaji Industries indicates the potential for commercial applications, creating economic opportunities and stimulating growth in related industries. Dissemination of project results through journal articles, conferences, workshops and educational materials will educate both the scientific community and the public, raising awareness of the challenges of carbon capture and potential solutions. The focus on carbon capture and sustainable construction materials is in line with the broader goal of long-term environmental sustainability, promoting green solutions for infrastructure development. The project outcomes highlight responsible practices in addressing global challenges.



Arun Kumar **AWASTHI**

received his Ph.D. from the Physical Research Laboratory, a unit of Indian Space Research Organisation, in 2014. To continue the postdoctoral research he moved to the Institute of Astronomy of the PAS and afterwards, to the University of Science and Technology of China. He joined the Space Research Center of the Polish Academy of Sciences in 2022 and continued his research under the PASIFIC Programme until 2024.

HOST INSTITUTE: Space Research Centre, PAS

RESEARCH PROBLEM

Investigation of plasma heating and particle acceleration during microflares and flare-precursors.

PASIFIC PROJECT

MicroFlareHeating. **Investigation of plasma heating and particle acceleration during microflares and flare-precursors**
Physical Engineering

PROJECT RESULTS

1. By quantifying the productivity of high-energy X-ray emission (HXR) relative to low-energy X-ray emission (SXR), a standalone quick method for determining energetically important flares has been derived. This will enable solar astronomers to identify and investigate cases of importance from a large list of observed flares, e.g., more than 30,000 flares already observed by the European X-ray instrument STIX onboard the Solar Orbiter mission in less than 3 years of observations.
2. The combined study of the multi-wavelength emission (in microwave and X-ray wavebands) from the flare provides a unique opportunity to comprehensively assess the physical processes taking place in the solar atmosphere. It has been found that the multi-wavelength emission during weak flares has the potential to unravel the magnetic connectivity of the active region responsible for such flares. Furthermore, the analysis of X-ray emission in the 1–150 keV energy band from the XSM and STIX instruments with EOVSA observations helped to identify the role of the magnetic field and thermal-nonthermal plasma properties in the partitioning of the energy budget.
3. Statistical investigations helped to establish scaling laws of plasma parameters corresponding to the weak flares.
4. The project used a two-fold approach of multi-wavelength diagnostics and hydrodynamical modelling to obtain an unparalleled insight into the thermal-nonthermal energy partition and its role in producing energetic particles.

IMPACT

Studying the unique nature of flares has two advantages, namely 1) unravelling the physics of reconnection (often exhibit unusually strong non-thermal emission), and 2) brightening the magnetic connectivity in the solar corona without disrupting the overall structure. The research carried out under MicroFLareHeating exploited these capabilities of flares to answer two long-standing questions in solar astrophysics: 1) the heating mechanism of the plasma producing weak flares and how it differs from that operating during the large eruptive flares, and, 2) the role of the weak flare in the onset of the imminent eruption. Further, unique datasets (1. X-ray emission in the ~2 keV energy band from the SphinX and XSM instruments, and 2. 4–150 keV X-ray emission from STIX) provided a comprehensive thermal characterization of the flare plasma. Unprecedented legacy data sets from SMM/BCS and RESIK will also be utilized that will help unravel obscured plasma processes mainly due to the low signal-to-noise ratio of the observed flux during weak flares. The future mode of operation of the X-ray missions is therefore planned to enhance the interpretative capabilities of the scientific community involved in the interpretation of solar X-ray emission and the physics of line and continuum emission.

Maciej **BARTOSIEWICZ**

graduated from the University of Warsaw in 2009 after successful defense of the thesis on plankton ecology. He then moved to Quebec (Canada) for a PhD project focusing on greenhouse gas fluxes in lakes. In 2015 he earned his doctorate degree in Biogeochemistry from the National Institute of Scientific Research and continued the postdoctoral research on the project “Methane Paradox” at the University of Basel. Since 2020, he had worked as a co-PI on projects supported by the Swiss National Science Foundation. From 2022 to 2024, M. Bartosiewicz was a PASIFIC Fellow at the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Geophysics, PAS

PASIFIC PROJECT

METVISARC. **Visualization of methane fluxes along coastal boundaries of Arctic permafrost and glaciers**
Life Sciences

RESEARCH PROBLEM

Hypothesis: CH4 fluxes during coastal erosion of glaciers and permafrost represent an important source of CH4 in the Arctic.

PROJECT RESULTS

1. Comparisons of methane saturation patterns between an average wet summer (2022) and an extremely hot and dry summer (2023) revealed striking differences between ecosystems across the CBZ. For example, methane saturations in the groundwater-fed permafrost wetland were an order of magnitude higher in the hot summer than in the average summer. In fact, groundwater contained almost twice as much methane during the hot summer (i.e., 4.5 µM vs 2.3 µM). These differences support the climatic dependance of methane emissions in SW Svalbard and show that extreme weather events can strongly stimulate CH4 fluxes within the CBZ.
2. Using satellite data and a state-of-the-art-model, it was possible to estimate freshwater lake changes across the cryosphere boundary zone in Svalbard. The process-based model was coupled with a hydrological modelling dataset and allowed the relationship between hydrological connectivity and freshwater lake volume to be established in this region. We estimate that the overall volume of freshwater proglacial lakes in Svalbard increased by approximately 2.6 km^3 between 1936 and 2020. Considering the average methane oversaturation in proglacial lakes measured during the MetVisArc project (26nM±17nM, n=120), and assuming that these values are representative of the general population of proglacial lakes in Svalbard, the size of this emerging methane reservoir was estimated to be at 1.083 Gg (gigagrams) of CH_4.

IMPACT

Efforts to conduct highly spatially resolved methane sampling along the cryosphere boundary zone, including a space-for-time simulations in glaciated High Arctic catchments, have shown that while relatively young proglacial lakes are not a major source of methane to the atmosphere, increased deposition of nutrients and organic matter from the declining glaciers and permafrost stimulates biological productivity that contributes to sediment accumulation and methane production.

Using a tunable diode laser sensor, the project team has developed and optimized an innovative system to map dissolved CH_4 concentrations that will allow rapid assessment and real-time recording of CH_4 saturation levels. The system itself is a highly novel design that will be of interest not only for scientists working to characterize methane emissions, but also for industry wishing to better understand and potentially reduce their methane footprint.

Ilyas
DJAFER-CHERIF

is a physicist interested in biological questions: how cells evolve and colonize organisms in the broad context of active matter, i.e. the physics of objects which harness their surroundings energy to generate motion. Ilyas Djafer-Cherif started his scientific career in 2013 and earned his master's degree in Theoretical Physics of complex systems at Pierre et Marie Curie University, France. He continued his research on Neisseria Meningitidis colonies rheology and a generic model of active nematic particles at the SPEC laboratory, CEA, Saclay, France, where he received his PhD in 2017. From 2022 to 2024, he was a PASIFIC Fellow at the Institute of Physical Chemistry of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Physical Chemistry, PAS

PASIFIC PROJECT

COLONAIZE. **Predictive models of bacterial colonization from machine-learning aided image processing**
Physical Engineering

RESEARCH PROBLEM

The role of mechanical forces in the growth of bacterial colonies, which is an important issue for physics, biology and medicine as it might pilot the development of an alternative to antibiotics.

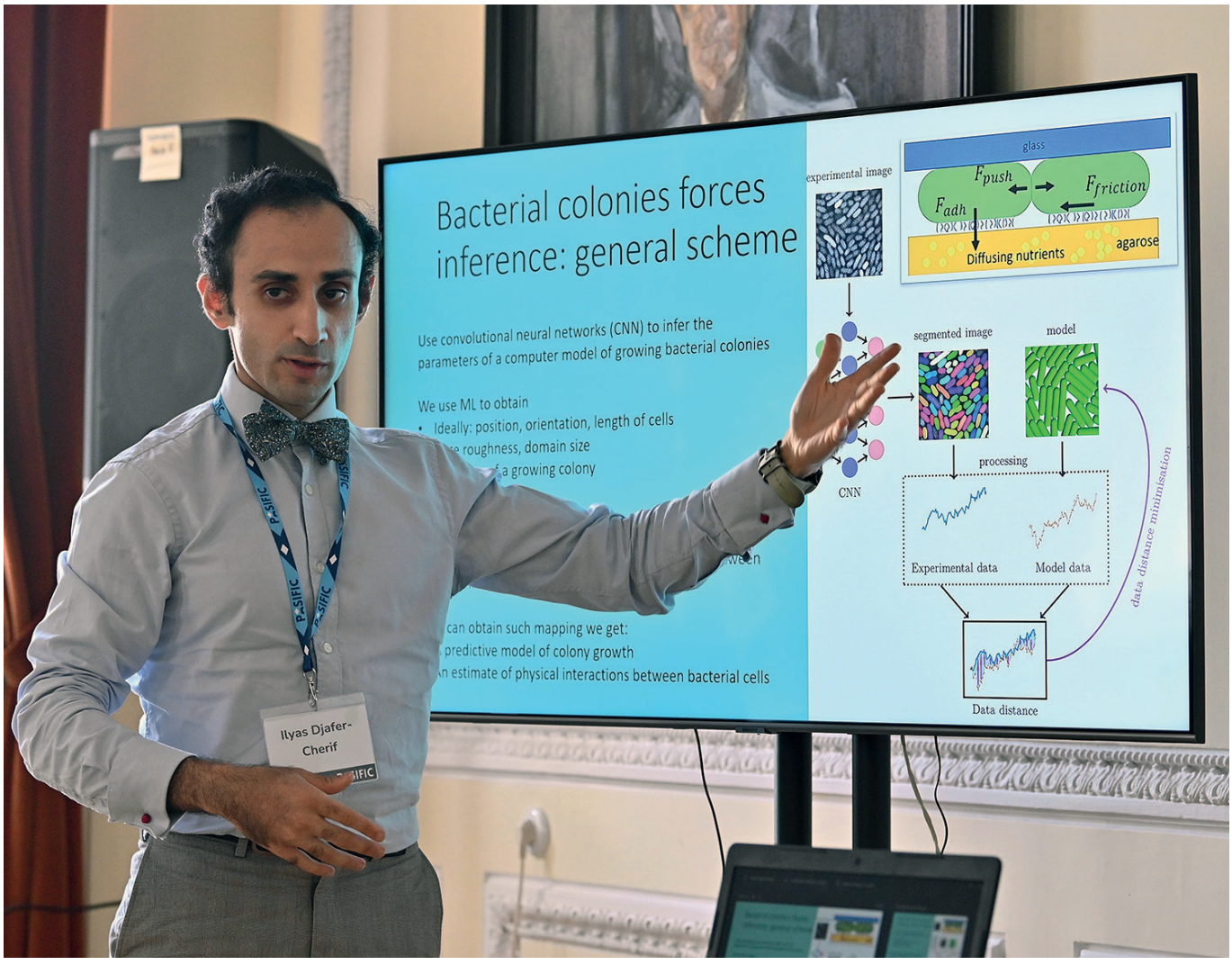
PROJECT RESULTS

1. Statistics of cell divisions in small to medium-sized colonies, and (to a lesser extent) in the growing layer of large colonies.
2. Data ralating to the movement (tracks) of cells in small to medium-sized colonies.
3. Bacterial adhesion data on micro channels.
4. Generation of several datasets of bacteria under different conditions (magnification, temporal resolution, in microfluidic chips or on agar).
5. Development of a code that uses machine learning (using Segment Anything) to segment objects of any type within an image, and that can be used for rapid segmentation without specific training of a network.

IMPACT

An established collaboration with the Cambridge research group on associating colony simulation, artificial image generation and machine learning allowed the simulations to be used to train neural networks capable of upscaling or denoising. An efficient C++ code that runs the simulation can easily be executed in a simpler language (Python) and linked to the numerous ML libraries that exist in the former.

The creation of a Python library will enable Python users to use the CNN to detect bacteria and cells in images. The code has been published at https://github.com/Dioscuri-Centre/MLtools.



Christopher **HALE**

holds a PhD in Archaeology from the University of Melbourne and has worked on archaeological projects in Greece and Israel since 2008. Previously, he was Assistant Professor of archaeology at O.P. Jindal Global University, a Glassman Holland Fellow at the W. F. Albright Institute of Archaeological Research in Jerusalem, and a Knossos Curatorial Assistant with the British School in Athens. From 2022 to 2024, Ch. Hale carried out his research within the PASIFIC Programme at the Institute of Archeology and Ethnology of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Archeology and Ethnology, PAS

PASIFIC PROJECT

RENLORC. **Regional networks and local recipes for complexity**
Social Sciences and Humanities

RESEARCH PROBLEM

Which pottery communities were active in central Greece during the Middle Bronze Age? How were their products and techniques distributed? How does this region interact with the rest of the Aegean?

PROJECT RESULTS

1. The most common tableware pottery class in central Greek MBA assemblages is known as “Grey Minyan”. Around 70% of this pottery was made from clays from the Lelantine plain in central Euboea. For the first two to three centuries of the MBA, this appears to have been the only clay source used for the production of this class. The same clay source was used to produce other pottery types, including Dull Painted, Matt Painted, and Bichrome Painted pottery, as well as rare examples of Fine Unpainted Pale pottery. This indicates the presence of an intensive wheel throwing production community operating throughout the MBA in central Euboea.
2. Another common pottery type is known as Dark Burnished. It is similar to Grey Minyan in many respects, but was made from slightly coarser clays and with reduced firing practices.
3. Bichrome Painted pottery comes in several varieties. The main variety, known as Magnesian Polychrome, is strongly associated with samples from the site of Pefkakia in Magnesia. Other varieties of Bichrome Painted pottery can be associated with both central Euboean and Boeotian sources.
4. Distinctive varieties of Red Slipped and Burnished pottery, originally thought to be imports perhaps from the southern Aegean, have revealed a fabric compatible with eastern Boeotian lithology. These results point to a pottery community in eastern Boeotia that produced a wide variety of goods, but at a lower intensity and with less specialization than the central Euboean production community.

IMPACT

RENLORC's results have revealed unprecedented insight into intra-regional MBA central Greek networks through the distribution of pottery products. Pottery from central Euboea appears to be the most widely distributed throughout the region, appearing in large quantities in every assemblage analyzed thus far. In particular, if RENLORC's results are extrapolated to the whole assemblage, more than 20% of all pottery from Mitrou on the northern Euboean Gulf was from central Euboea, suggesting intensive interaction throughout the period along a maritime trans-Euboean Gulf corridor route. This network appears to have operated in a predominantly south-east to north-west direction, at least in terms of pottery exchange, as central Euboean products were far more common in the north than northern products in central Euboea.

Central Euboean pottery also made its way to Boeotia, but almost no Boeotian pottery appears in the central Euboean sample set. Rather, Boeotian pottery appears in significant quantities at Mitrou, where more than 10% of the assemblage may have originated from western or eastern Boeotian sources. One explanation for this distribution pattern may be that predominantly overland routes were responsible for the distribution of Boeotian products, whereas maritime routes – for the distribution of central Euboean products. Specialized, high-quality central Euboean products may have been distributed by central Euboean maritime agents and exchanged for non-pottery goods.

Angelo Castrorao **BARBA**

received his PhD in Medieval Archaeology from the University of Siena in 2013. Between 2016 and 2021, he was a researcher and postdoctoral fellow at the Royal Netherlands Institute in Rome, the University of Palermo, the University of Tübingen, and the Spanish National Research Council. In the years 2022–2024, he was a PASIFIC Fellow at the Institute of Archaeology and Ethnology of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Archaeology and Ethnology, PAS

PASIFIC PROJECT

IS_LANDAS. **Islamicate landscapes in southern Andalusia and western Sicily: patterns of change in settlements and rural communities between Late Antiquity and the Islamic age**
Social Sciences and Humanities

RESEARCH PROBLEM

Change and resilience in rural landscapes of Western Sicily and Southern Andalusia during the transition between Late Antiquity and Islamic age.

PROJECT RESULTS

1. Important archaeological discoveries have been made in the areas of Málaga and Palermo.
2. At the Cortijo de Las Mezquitas site (Campillos, Málaga), a medieval Islamic mosque dating from the early 10th century was found. It was previously a Roman villa, in use until the 6th century, which was converted into the mosque in the late 9th or early 10th century. The excavation found no evidence of a mihrab, minaret or settlement associated with the mosque, leaving questions about its relationship to the Cordovan Caliphate.
3. In the outskirts of Palermo, the analysis of ceramics provided insights into the daily life of Islamic societies: different types of cooking, table and storage vessels dating from the 9th to the 11th century CE as well as animal bones, provided information on the dietary and economic practices of the time.
4. New archaeological sites have been discovered and mapped in the Corleone area. Among the most important finds were fortification walls and materials from the Islamic period at Casale di Sopra, as well as mills that confirmed the economic activities mentioned in medieval records.
5. Surprisingly, the archaeobotanical record from the Byzantine-Islamic layers at Contrada Castro showed no evidence of fruit or oil-producing species, which were important in this period. However, the archaeobotanical remains did show the continuation of major cereal and legume crops, suggesting a rich and diversified agriculture.
6. The study of the ceramics found during the excavation of the rural and suburban site has revealed the complex dynamics of continuity and change that affected Sicilian society during the Byzantine and Islamic transitions, and their importance for understanding cultural and socio-economic dynamics.

IMPACT

The IS_LANDAS project, which focuses on Islamic landscapes in Andalusia and Sicily, has a significant impact on society's understanding of historical human-environment interactions, particularly during the Roman-Islamic transition. Archaeological fieldwork in Andalusia (province of Malaga) and Sicily (province of Palermo) has had an impact on local communities, potentially fostering a sense of connection to their historical roots and heritage. By shedding light on Andalusia and Sicily under Islamic rule, the project offers a counter-narrative to prevailing prejudices and new insights into the multifaceted history of Islamic cultures in Europe. This promotes social harmony and acknowledges the complexity of our shared history, underlining the importance of historical and archaeological research in understanding our past and shaping cultural heritage relations.

Josefina
RODRIGUES-ARRIBAS

has been a research fellow in the USA, Israel, the UK, and Germany. The core of her research is the intellectual history of Jews with a focus on medieval scientific manuscripts, science, and technology (including astronomical instruments and divination). She is a co-editor of Unveiling the Hidden–Anticipating the Future: Divinatory Practices among Jews (Brill 2021) and Astrolabes in Medieval Cultures (Brill 2017 and 2019). From 2022 to 2024, she carried out her research at L. & A. Birkenmajer Institute for the History of Science of the Polish Academy of Sciences.

HOST INSTITUTE: L. & A. Birkenmajer Institute for the History of Science, PAS

PASIFIC PROJECT

PERIPHERIES. **Minority cultures on the periphery of science: the Jews and the circulation of scientific goods (13th–17th c.)**
Social Sciences and Humanities

RESEARCH PROBLEM

The role of Jewish culture in the circulation of astronomical knowledge and tools by exploring the traces of inter-religious use/circulation of mathematical instruments and their textual/visual sources.

PROJECT RESULTS

The main outcomes of the project include

1. Cataloguing and analysis of the Hebrew manuscripts on the roba Israel (34).

2. Cataloguing and analysis of the Latin manuscripts on the quadrans novus (83). Analysis of the circulation of this instrument and its text in Europe between the 13th and the 17th centuries.

3. Micro-histories of this reception, which account for the uniqueness of some case studies (e.g. the reception of the mathematical object in vernacular languages by converso writers (i.e. Jews who converted to Christianity).

4. Analysis of the visual corpus relating to the new quadrant in Hebrew and Latin sources.

5. New findings on the material culture of the object relating to the quadrant in the collections of the Museum of Rouen.

IMPACT

The struggle for the future, including cultural and intellectual progress, is intimately linked to the past. Our interpretation and communication of the past and our attitude to its legacy already shape our future. In this context, the new quadrant stands as a cultural product that speaks of skill and ingenuity and points to Jewish culture as a minority whose legacy, role and impact have been undervalued in historical narratives and, consequently, in the media and among non-specialists.

By giving visibility to the roles and contributions of this minority, the project has ensured a more comprehensive understanding of our past. The outputs of the project provide a platform for discussion of the dominant historical narrative and ensure that all voices are heard.

Olha **TIKHONOVA**

began her scientific career at Lviv Polytechnic University where she got her master's degree in 2013. She received a doctor cum laude with an international mention from Lisbon School of Architecture in 2020. Olha has already been a granted research fellow in 3 countries: Portugal, Austria, and Poland. From 2020 to 2022, she worked at a postdoctoral position at the University of Porto. In 2022 she joined the Polish Academy of Sciences and was a PASIFIC Fellow until 2024.

HOST INSTITUTE: Tadeusz Manteuffel Institute of History, PAS

PASIFIC PROJECT

PERRET&POLAND. **Jacques Perret's influence on defensive Polish architecture in the 17th century.**
Social Sciences and Humanities

RESEARCH PROBLEM

How did Jacques Perret's treatise influence the theory and practice of defensive architecture of the Polish Crown?

PROJECT RESULTS

1. The scientific results obtained during the PASIFIC fellowship include various findings that significantly contribute to the understanding of the 17th century defensive heritage in the Polish and Lithuanian lands and beyond.
2. The project highlighted an overlooked French architect, Jacques Perret, and shed light on his life, his contributions, and the lasting impact he left behind. While the focus was on Perret's influence in the former Polish lands, numerous traces of his influence in other countries were identified. In particular, sixty well-preserved original copies of Perret's 17th-century treatise have been found in libraries around the world, nine of them located in Polish archives.
3. Perret's designs were found to have been incorporated into the first treatise on defensive architecture written in Polish by Naronowicz-Naroński in 1659. This pioneering work within the PASIFIC project involved textual analysis and English translation of the descriptions of the duplicate drawings between Perret and Naronowicz-Naroński. Such a detailed comparative analysis has never before been carried out for either Naronowicz-Naroński or Perret. Through meticulous examination of the texts and drawing characteristics, it has been determined that Naronowicz-Naroński used the first edition of Perret.
4. It has been found out that two of Perret's projects, with minor modifications, served as blueprints for the designs of two bastioned castles in Ukraine – Pidhirtsi and Zbarazh – both located on the former territory of Poland.

IMPACT

The results of the project can serve as a basis for international transcultural studies aimed at establishing Cultural Routes linking bastion castles in different countries, illustrating their common heritage shaped by the influence of the overlooked architect Perret. Cultural Routes not only increase the visibility of sites in different countries, but also promote increased tourism in the regions linked to these routes, thereby contributing positively to the economic growth and overall development of these areas.

Matthias **ROICK**

received his PhD in Philosophy and Literature from the European University Institute in 2009. He continued his postdoctoral research at the University of Göttingen, at the Warburg Institute in London and at the Herzog August Bibliothek in Wolfenbüttel. In the years 2022–2024, he was a PASIFIC Fellow at the Institute of Philosophy and Sociology of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Philosophy and Sociology, PAS

PASIFIC PROJECT

FRIENDS4EVER. **Virtue and sociability. Teaching friendship in early modern schools and universities, 1518–1648**
Social Sciences and Humanities

RESEARCH PROBLEM

How did early modern schools and universities in post-Reformation Germany and Poland discuss the notion of friendship in Aristotle and Cicero?

PROJECT RESULTS

1. The academic writings under study have a much greater philosophical potential than has hitherto been appreciated. They provide us with a sophisticated vocabulary for rethinking fractured social relations.
2. The project has shown that it is precisely those parts of the discussions that we tend to regard as old-fashioned, such as virtue, that are of particular interest in current debates about the redefinition of social relations.
3. It has been found out that academic discussions of friendship were much more present in early modern culture than previously thought.

IMPACT

The PASIFIC project explored friendship in the early modern period. Using the writings of the Greek philosopher Aristotle and the Roman statesman Cicero, university teachers discussed the concept of friendship. They wrote commentaries, disputations and dissertations on the subject. This material has been largely overlooked, and the project seeks to fill this gap. The research will impact on the understanding of friendship in early modern and contemporary society in three ways. First, early modern notions of friendship are closely linked to notions of true or virtuous friendship. Modern philosophers such as Jacques Derrida and Alexander Nehamas have criticized this focus as outdated and inapplicable to contemporary society. The project has shown that, on the contrary, it is possible to use the concept of friendship based on virtue for contemporary purposes, for example by reflecting the renewed interest in the moral culture of corporations. Secondly, early modern discussions of friendship clearly demonstrate the urgent need to redefine our own notions of friendship as a purely private phenomenon. The texts discussed are very clear about the public nature of friendship relationships as an integral part of a wide range of our social interactions, for example in the workplace. Third, there is an early modern imaginary of friendship, represented in emblems and other text-image combinations, which can help us to reassess the complicated relationship between friendship, sociability and truth. This is particularly relevant in our contemporary society, divided by media echo chambers and partisan politics.

Mikhail **KHORKOV**

studied history and philosophy at the Universities of Moscow and Karlsruhe, and worked as an associate professor of the history of philosophy and a researcher at the Universities in Moscow, Cologne, Erfurt and Salzburg. He was a fellow at the Institute for Human Sciences in Vienna (2006), Max-Weber-Kolleg in Erfurt (2016–2017), the Polish Institute for Advanced Studies (2017–2018) and the Swedish Collegium for Advanced Studies in Uppsala (2019–2020). From 2022 to 2024, prof. Khorkov was employed at L. & A. Birkenmajer Institute for the History of Science of the PAS under the PASIFIC Programme.

HOST INSTITUTE: L. & A. Birkenmajer Institute for the History of Science, PAS

PASIFIC PROJECT

TRANSLIBHUB. **Transmission of texts and individualization of knowledge at the end of the 15th century: Carthusian libraries as transregional hubs for accumulation of ideas and practices of their reception**
Social Sciences and Humanities

RESEARCH PROBLEM

What was the role of late medieval libraries in the transmission of texts and ideas, and in the emergence of new scientific knowledge in the late 15th and early 16th centuries?

PROJECT RESULTS:

1. Despite today's common perception of old manuscripts as museum objects, in the Middle Ages manuscripts were not usually fixed and unchangeable objects. They were often divided up and then reassembled in a new order. Writing in the margins of a manuscript and compiling or even rewriting the works of other authors was considered good practice for any scholarly reader.
2. The actual form of existence of the medieval manuscripts from the monastic libraries of Poland and Germany, investigated within the PASIFIC project, allowed to trace the process of individualization of scientific knowledge, which became the basis of the scientific revolution of the 16th century.
3. The Carthusian libraries are the clearest example of this development. Organised by monks of a religious order of reclusive contemplatives and hermits, they formed a communication network through which there was a deliberate and not at all accidental dissemination of intensively copied texts from the largest central Carthusian libraries (in Erfurt, Legnica, Frankfurt on the Oder; the Augustinian Abbey of Sagan in Silesia).
4. Of greatest importance was the study of the commentaries and notes in the margins of the manuscript copies of Nicholas of Cusa's works, written by the Carthusians. Thanks to the methodology developed in the course of the project for studying individual manuscripts as part of their production, copying and distribution groups, previously unknown treatises, sermons and a chronicle written by the prominent 15th-century Carthusian author John Hagen de Indagine have been found.

IMPACT:

A new methodology has been developed for the study of closely related groups of late medieval manuscripts. Thanks to this methodology, it has been possible to discover and identify new manuscripts containing previously unknown texts. This applies in particular to John Hagen's Chronicle and his other writings, to reception of the texts and ideas of Nicholas of Cusa in the Erfurt Charterhouse, and to the newly discovered fragments of John Tauler's and Henry Suso's sermons. In addition, some Carthusian libraries and authors such as John Hagen de Indagine were used to show how the history of ideas and scientific theories in the 15th century was closely linked to the practice of manuscript production and dissemination.

Francesco **LATTERINI**

began his research in the field of forestry at Tuscia University in Italy, where he received his Master's degree with honors. He continued his research activity at Tuscia University for several years, focusing on sustainable forest management and reduced-impact logging. He has participated in 5 national and 6 international research projects. He is co-author of 55 scientific papers indexed in Web of Sciences and co-advisor of 31 Master's theses. In the years 2022–2024, F. Latterini was a PASIFIC Fellow at the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Dendrology, PAS

PASIFIC PROJECT

AImSusFor. **Extending assessment of the environmental impacts to the forest ecosystem due to forest management: a comprehensive approach to enhance sustainable forestry in the context of climate change**
Life Sciences

RESEARCH PROBLEM

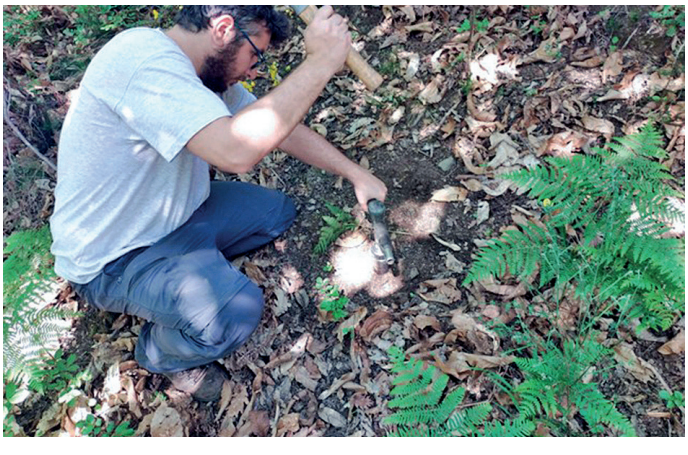
What are the disturbances caused by current forest management and harvesting techniques in European beech forests?

PROJECT RESULTS

1. A novel set of silvicultural guidelines has been developed for the proper planning of the forest interventions to increase or maintain the target level of tree biodiversity.
2. Fine roots in forest soils are very sensitive to machine-induced soil compaction associated with forest operations. The natural recovery process to restore fine roots to pre-harvest levels can take decades. Good practices to reduce the negative impact of forest harvesting on fine roots have been systematized.
3. The effects of forest interventions on litter decomposition have been investigated. It has been found out that the greatest disturbance occurs when clear cutting is followed by soil preparation activities to artificially restore the forest stand. The complexity of the issue and the need to improve the overall knowledge of the relationships between forest interventions and litter decomposition has been highlighted.

IMPACT

AIMSUSFOR aimed to investigate the complex relationships between active forest management and the health of forest ecosystems. The project has produced a compendium of knowledge on these difficult but fundamental issues, which form the basis for the proper sustainable management of European broadleaved forests, with particular reference to beech forests. The results of AIMSUSFOR show that there is an urgent need to shape active forest management in line with recent European policies and the Sustainable Development Goals. A holistic approach to the research problem, i.e. studying forests in different bioclimatic zones – Central Europe and the Mediterranean – has provided a broad perspective on the issue, allowing different stakeholders to benefit from the research results. Forest policy makers and practitioners in the sector will be able to identify the most sensitive aspects of the forest ecosystem, the specific human behaviour that causes disturbance and ways to mitigate disturbance. The results of the project will provide a solid knowledge base and can be a truly effective starting point to respond to the needs of the European forest sector, both in terms of management and conservation.



Fabricio **CARRIJO**

graduated from the State University of Sao Paulo, Brazil, and holds a master degree in Peace, Conflict and Development Studies from Jaume I University, Spain. In 2016, he earned a PhD degree in International Relations from the Autonomous University of Barcelona. The researcher's scientific interests encompass refugee studies, peace studies, decolonial/ post-colonial approaches and photography. From 2018 to 2022, Fabricio Carrijo worked as a professor of International Relations at the Federal University of Roraima, Brazil. In 2022, he joined the Institute of Archeology and Ethnology of the Polish Academy of Sciences, where he continued his research on refugees' experiences of peace and conflict in shelters until 2024.

HOST INSTITUTE: Institute of Archaelogy and Ethnology, PAS

PASIFIC PROJECT

PCRS. **Peace and conflict dynamics in refugee shelters**
Social Sciences and Humanities

RESEARCH PROBLEM

Peace and conflict dynamics in refugee shelters.

PROJECT RESULTS

1. The results of the project show that residents of two of the three shelters studied, Modlińska (Warsaw, Poland) and Rondon 1 (Boa Vista, Brazil), large shelters hosting over 1000 people, are often exposed to conflict, either as witnesses or parties. Residents of Kolejarz (Muszyna, Poland), a hotel hosting fewer refugees, experience conflict to a much lesser extent.
2. Most of the residents of the Warsaw shelter (87.6%) and the Boa Vista site (97%) have experienced at least one conflict since their arrival. The most common type of violence they suffer is verbal, followed by psychological and physical.
3. A novel theoretical framework, conceptualizing shelters as 'spaces of (de)coloniality', has been developed to typologize structural factors influencing the occurrence of conflict in refugee shelters. Beyond conflict episodes, in the sense of the most visible aspect of conflict, such as shouting at another person in a queue, the research findings also allowed the identification of a number of intertwined underlying elements at the root of conflict in refugee shelters, such as materiality, gender and mental health.
4. It has been found that refugees in three shelters used a range of everyday peace strategies and mostly tried to resolve their conflicts themselves, seeking support from the shelter administration only as a last resort. A proposed typology of everyday peace practices in refugee shelters is an analytical tool that can be used to study how refugees respond to conflict and pursue peace in refugee shelters in different parts of the world, and to make recommendations for the use of refugee shelters as a humanitarian response.

IMPACT

The PCRS project, carried out within the PASIFIC Programme, highlighted the forms of conflict and violence that refugees experience in their everyday lives in shelters, as well as the causes and strategies that shelter residents use to respond to conflict and violence in the site and to pursue peaceful coexistence. Extensive ethnographic research in three shelters, using participant observation, interviews, surveys and photography, fostered the development of new theoretical frameworks of everyday conflict and peace practices in shelters, which can be seen as a humanitarian response to improve mechanisms for violence prevention, conflict transformation and peacebuilding in shelters.

Mariia **DEKALIUK**

received her PhD in Biotechnology from O.V. Palladin Institute of Biochemistry, Ukraine, in 2017. She worked as a postdoctoral researcher at Paris-Sud University and Université de Rouen Normandie in France. From 2022 to 2024, she was a PASIFIC Fellow at the Institute of Bioorganic Chemistry of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Bioorganic Chemistry, PAS

PASIFIC PROJECT

EXAM. **Ultra-sensitive multiplexed screening for cancer biomarkers: exponential signal amplification combined with Förster resonance energy transfer**
Life Sciences

RESEARCH PROBLEM

New advancements are needed to increase the reliability of protein detection and to improve sensitivity by minimizing the background signal and miniaturizing the assays.

PROJECT RESULTS

1. Successful development and optimization of fluorescent probes for a combined immuno-amplification assay targeting protein biomarkers.
2. Adaptation and optimization of experimental conditions for a single-target protein sensor (e.g., prostate-specific antigen).
3. Optimization of the amplification approach through the adoption of rolling circle amplification (RCA) for protein biomarker detection.
4. Determination of the limit of detection for the designed sensors at extremely low concentration ranges (pg/mL).
5. A successfully validated assay for PSA detection from complex liquid matrices, including serum-based mediums.
6. Adaptation and optimization of the simultaneous detection of two protein biomarkers from liquid samples (2fold spectral multiplexing) and development of the protocol for the amplification-FRET assay application.

IMPACT

The project focused on optimizing the detection of single protein targets, with a particular emphasis on prostate-specific antigen (PSA), a key marker of prostate cancer. Key achievements included the development of specialized fluorescent probes for immuno-amplification assays, refinement of experimental conditions, and the adoption of rolling circle amplification (RCA). This shift in methodology enabled the project to reach extremely low detection limits in the pg/mL range, significantly enhancing the sensitivity and reliability of the assays.

The amplification-FRET assay for PSA detection was optimized and its application extended to other key cancer markers, including a-fetoprotein (AFP) and carcinoembryonic antigen (CEA). The final part of the project focused on improving the assay's multiplexing capabilities, enabling the simultaneous detection of multiple cancer markers. This multiplexing approach used different fluorescent dyes that emit light at specific wavelengths, allowing for the measurement of two to three protein markers in a single sample. This advancement increased the efficiency and versatility of the assay, broadening its potential applications in clinical and research settings.

The EXAM research project revolutionized cancer diagnostics by integrating DNA amplification and Förster resonance energy transfer (FRET) technology. This innovative approach was designed to achieve highly sensitive and specific detection of protein biomarkers associated with different types of cancer. Significant progress has been made in enhancing the sensitivity and accuracy of cancer diagnostics compared to traditional methods.

Monika **CHWALCZUK**

After graduating summa cum laude from the Institute of Applied Linguistics of the University of Warsaw, Monika Chwalczuk received a PhD degree in Translation Studies from Université Paris Cité. From 2017 to 2022, she lectured at Université de Paris, France, and the University of Warwick, UK. In the years 2022–2024, M. Chwalczuk implemented her project combining corpus linguistics, gesture studies and cognitive psychology at the Institute of Psychology of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Psychology, PAS

PASIFIC PROJECT

CoGCIn. **Cognitive processes behind the use of gestures in consecutive interpreting**
Social Sciences and Humanities

RESEARCH PROBLEM

What are the grounds and the implications of the use of co-speech gestures in consecutive dialogue interpreting? Does gestural production help decrease the interpreter's cognitive load?

PROJECT RESULTS

1. The study of the behaviour of future interpreters (57 Master's degree students from the Interpreting and Translation Departments of the University of Warsaw, Poland, Université Paris Cité, France, and Universitat Autònoma de Barcelona, Spain) showed that trainee interpreters had longer reaction times and higher scores in the self-assessment of cognitive load when they could not use their hands to perform spontaneous gestures, meaning that this artificial constraint made their task more strenuous and time-consuming.
2. To corroborate these findings, video recordings of the experimental interpreting sessions were collected. These were used to further study the gestures used by different interpreters in the language combinations English – Polish, French – Spanish. Qualitative analysis of this multimodal corpus showed that interpreter trainees mirrored the gestures of the speakers even when these speakers were presented only in video recordings and could not benefit from this additional embodied information.
3. Electroencephalograms (EEGs) and electrocardiograms (ECGs) were taken from the participants to examine the electrical activity of their brains and hearts during the interpreting tasks. These data showed that the interpreter's body showed increased mental effort and stress when the participants were instructed to refrain from gesture production during interpreting.
4. The findings shed light on an inherent incoherence between the pedagogy and practice of dialogue interpreting.

IMPACT

The results of the project will contribute to the popularization of the emerging field of multimodal interpreting studies. Until 2023, scholarship on gestures in interpreted interactions was scattered across the fields of interpreting studies, gesture studies and multimodal conversation analysis. The International Pragmatics Association Conference (IPra 18) held in Brussels in 2023, where the project results were presented, marked a milestone in the creation of a new field, consolidating the existing independent research projects through the first-ever panel dedicated exclusively to gestures in Spoken and Signed Language Interpreting.

The outcomes of the project will promote multimodal and cognitive interpreting research and contribute to the fields of interpreting studies in general, focusing on pragmatic and pedagogical aspects of interpreting and exploring experimental research in cognitive interpreting studies.

Li
CHEN

obtained her PhD from Ehime University, Japan, in 2013. Afterwards, she lectured at several universities in China. In 2022, L. Chen joined the Institute of Genetics and Animal Biotechnology of the Polish Academy of Sciences, where she carried out her postdoctoral research on goat milk protein until 2024.

HOST INSTITUTE: Institute of Genetics and Animal Biotechnology, PAS

PASIFIC PROJECT

STAR. **Synthesis action and regulation of milk protein in dairy goat mammary cells**
Life Sciences

RESEARCH PROBLEM

Which genes have an effect on milk protein quality and how do these genes regulate milk protein synthesis?

PROJECT RESULTS

Microproteomic analysis proved that insulin and LKB1/AMPK/TSC pathways were involved in the goat milk protein synthesis network. The gene of Insulin Receptor Substrate 1 (IRS1) plays a central role in insulin signal transduction. The gene expression of IRS1 was silenced by RNA interference (RNAi) in goat mammary epithelial cells (GMECs) and evaluated by RT-qPCR. The content of casein was determined by ELISA. Microproteomic analysis identified more than 2253 proteins, with 323 pathways annotated from goat mammary epithelial cells (GMECs). A total of 12 differential expression proteins (DEPs) were characterized as up- or down-regulated in the IRS1-silenced sample. It is worth mentioning that transcriptomics analysis harvested more information on up- or downregulated genes, some of which were not significant at protein expression level but were active on transcription level. GO annotation and KEGG analysis from micro-proteomics depicted the enrichment and signal pathways of genes in GMECs as well as the transcriptomics analysis.

IMPACT

This is a multidisciplinary project combining biotechnology, animal science, and food science. It aims to explore the intriguing biochemical functions of IRS1 in GMECs and steer pathways of milk protein synthesis. In this frame, the successful implementation of this project would strengthen the interdisciplinary nature of biochemistry, animal science, and dairy science. Representative studies include (i) quality control and traceability of casein in dairy goats; (ii) exploring the mechanism of the functional gene IRS1 in the milk synthesis network at a molecular level; (iii) improving knowledge of microproteomics and transcriptomics analysis technique. This will foster the development of dairy goat breeding and thus the progress of animal science and dairy science.

Jędrzej **NIKLAS**

is a socio-legal scholar whose research focuses on the role of emerging digital technologies in the functioning of state and public institutions and their implications for social justice. He holds a PhD in Law (International Public Law) from the University of Warsaw, and has previously worked as a postdoctoral researcher at the London School of Economics, the University of Leeds, and Cardiff University. From 2022 to 2024, he was a PASIFIC Fellow at the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Philosophy and Sociology, PAS

PASIFIC PROJECT

DATAFORESTS. **Public forest governance in a datafied society**
Social Sciences and Humanities

RESEARCH PROBLEM

How does the process of datafication transform public governance of forests? How does the presence of data technologies reformulate goals, operations and imaginations of the environmental state?

PROJECT RESULTS

1. The project has revealed important insights into how digital technologies are reshaping the governance of Polish forests, with implications for both policy and practice.
2. A key outcome is the development of responsiveness as a framework for integrating AI and other data-driven technologies into environmental governance. This concept emphasizes the need for institutions to actively engage with diverse societal voices.
3. Civil society organizations are increasingly challenging state-controlled narratives by developing alternative platforms and tools for visualizing and interpreting forest data. These efforts reveal a growing divide between foresters focused on resource management and activists advocating for biodiversity and conservation. This tension underscores how data is not just a technical tool but a battleground for competing visions of what forests should represent.
4. Technologies such as AI, satellite imaging, and drones are shifting forest management from monitoring broad areas to tracking individual trees. This shift requires substantial institutional changes such as updating key documents like Forest Management Plans and acquiring new technical skills among foresters.
5. Finally, the research has identified the growing role of data ecopolitics, where data practices not only inform governance but also act as a form of activism. Polish environmental groups are leveraging data to demand transparency, influence policy, and protect ecologically valuable areas, reframing data as a central element of democratic environmental governance.

IMPACT

The outcomes of the project have contributed significantly to advancing discussions on the integration of AI and data technologies into environmental governance. The concept of responsiveness, which emphasizes empathetic perception and resolute engagement, is emerging as an important framework for understanding and addressing the governance of AI. In addition, the project has contributed to ongoing discussions in critical data studies by helping to define data ecopolitics as a practice focused on challenging dominant narratives and power structures in environmental governance through alternative data framings and public engagement. The research has been recognised as a valuable addition to debates on data governance and environmental politics, particularly in its focus on under-researched regions such as Poland. The project has resulted in significant outputs, including journal submissions, public lectures and conference presentations, further embedding these ideas in academic discourse.

Abdel Aziz GAD

started his career in 2005 at the National Research Center in Egypt. He received his MSc and PhD degrees from Tanta University, Egypt, in 2008 and 2014 respectively. From 2014 to 2022, he continued his career in a research position at the National Research Center. After a short scientific stay at the Institute of Biochemistry and Biophysics of the Polish Academy of Sciences in 2019, A.A. Gad returned to Egypt to continue his research at the National Research Center. From 2022 to 2024, he carried out his project at the Institute of Biochemistry and Biophysics of the PAS under the PASIFIC Programme.

HOST INSTITUTE: Institute of Biochemistry and Biophysics, PAS

PASIFIC PROJECT

HELP-GULO. **Heterologous production of L-gulono lactone oxidase fused with human elastin like-polypeptide**
Life Sciences

RESEARCH PROBLEM

Production of enzymatically active recombinant rat L-gulono-lactone oxidase fused with synthetic elastin-like polypeptide in bacterial and plant cells to obtain biologically active matrix to facilitate wounds healing.

PROJECT RESULTS

1. First successful overproduction of rat gulono-lactone oxidase (GULO) in bacteria and purification of active recombinant GULO protein (both full GULO and C-terminal GULO).
2. The enzymatic activity of cGULO was confirmed by its ability to produce ascorbic acid from L-gulono-lactone in the presence of the FAD co-factor. Comparative analysis revealed that cGULO is more efficiently produced in bacteria than in fGULO. Native-PAGE confirmed the presence of His-tagged GULO variants, while SDS-PAGE estimated their molecular weights to be approximately 50 kDa for fGULO and 20 kDa for cGULO. Enzymatic assays showed that fGULO and cGULO exhibited peak activity at pH 7.0 and 6.5, and temperatures of 40°C and 30°C, respectively. Stability tests indicated optimal enzyme performance at pH 6.5–8.5 and temperatures between 20°C and 40°C. Additionally, cGULO demonstrated greater acidic pH tolerance, thermal stability, and efficacy at low substrate concentrations compared to fGULO. In terms of the substrate affinity and kinetic parameters, the recombinant enzymes fGULO and cGULO were found to have Km and Vmax values of 53.5±5 and 42±6.3 PIM, 780±45 and 374±20 U/mg protein, respectively.

IMPACT

In the longer term, the approach proposed in the project will enable the cost-effective production of the matrix that provides the missing enzymatic activity in human tissues, which could be applied topically to the wounded skin.

It is anticipated that the externally delivered active GULO will increase local levels of vitamin C, while elastin will act as a source of replacement tissue at the wound site.

The production of recombinant GULO in fusion with HELP will facilitate purification of the product and its use in preclinical testing. The preclinical tests will be used as proof of concept for the feasibility of such an approach in the future.

Treating patients with ascorbic acid leads to a rapid improvement in the wound healing process after surgery, reducing the costs of extensive wound treatment and prolonged hospital stays. Vitamin C supplementation improves the rate of wound healing in children with extensive burns.

Taina
ROCHA DE ALMEIDA

graduated from the Federal University of Bahia, Brazil, with a master degree in Animal Production. She continued her research on fish populations and egg quality at Université de Lorraine in France where she obtained a PhD degree in Agronomic Sciences in 2019. Prior to the research fellowship at the Polish Academy of Sciences (2022–2024), T. Rocha de Almeida worked on the position of a postdoctoral fellow of USM, the USA, investigating fish genetics, spent a year as an assistant professor at Université de Lorraine and another year as an assistant professor at Université de Reims Champagne-Ardenne in France.

HOST INSTITUTE: Institute of Animal Reproduction and Food Research, PAS

PASIFIC PROJECT

MOMSINCHARGE. **Strain-specific maternal non-genetic inheritance and its effect on progeny performance in rainbow trout (Oncorhynchus mykiss)**
Life Sciences

RESEARCH PROBLEM

Investigation of how maternal non-genetic inheritance is involved in different offspring performance by studying embryos and juveniles from three strains of rainbow trout (Oncorhynchus mykiss) farmed in Poland.

PROJECT RESULTS

1. Two strains of rainbow trout were studied from egg fertilization to 6g juveniles when the bacterial challenge was performed. Unfertilized eggs were snap frozen after collection for transcriptomic analysis. Additionally, gills, liver and spleen were collected during the challenge for gene expression analysis. High quality eggs were obtained from both strains and no difference between them was observed up to hatching. However, a difference in growth performance was observed between the strains from the fifth week. At the end of the growth period, strains A and B produced 6.0±1.2 g and 9.4±2.0 g. respectively. No difference in mortality was observed between the strains during this period.
2. During the bacterial challenge, the mortality of strain B started earlier and was three times higher (66.7±0%) than that of strain A (13.6±0.6%). In the control group, no mortality was observed for either strain. Expression differences between control and infected juveniles showed that all genes tested responded to the experimental infection by changing their expression level in at least one of the organs. Notably, three genes (spi1, ctss and itgb2) responded to infection in all three organs and also differed between strains. Our data suggest that maternal effects go beyond the classical direct transfer of maternal Ig, although this is largely erased during early embryonic development. Therefore, we suggest that differences in maternal transcriptomic cargo may have further consequences, potentially shaping physiological status, including the immune system, in a cascade-like manner.

IMPACT

Selection based on offspring performance is a valid option for fish selection programmes once sufficient information on the progeny is available. Our results will help to provide this knowledge in terms of early survival, growth, late mortality and disease resistance. Egg molecular content has the potential to alter offspring gene expression and consequently offspring phenotype and its interaction with environmental challenges. From this perspective, it is of paramount importance to identify the molecular mechanisms that contribute to the occurrence of certain traits in different populations. Our next step is to look at some of these molecules: mRNA, miRNA and proteins in unfertilized eggs, with the aim of finding out how offspring cope with this non-genetic molecular inheritance.

Vineeta **KAUSHIK**

obtained her PhD in Biophysics from the University of Delhi South Campus, India, in 2020. She joined the ISB lab at ICTER in March 2021 as a postdoctoral fellow to work on the proteins involved in the visual cycle. From 2022 to 2024, she carried out her research under the PASIFIC Fellowship Programme at the Institute of Physical Chemistry of the Polish Academy of Sciences in Warsaw.

HOST INSTITUTE: Institute of Physical Chemistry, PAS

PASIFIC PROJECT

RBP3 Imaging. **Development of a non-invasive diagnostic method for early detection of changes in the level of retinol binding protein 3 (RBP3) linked to Diabetic Retinopathy**
Life Sciences

RESEARCH PROBLEM

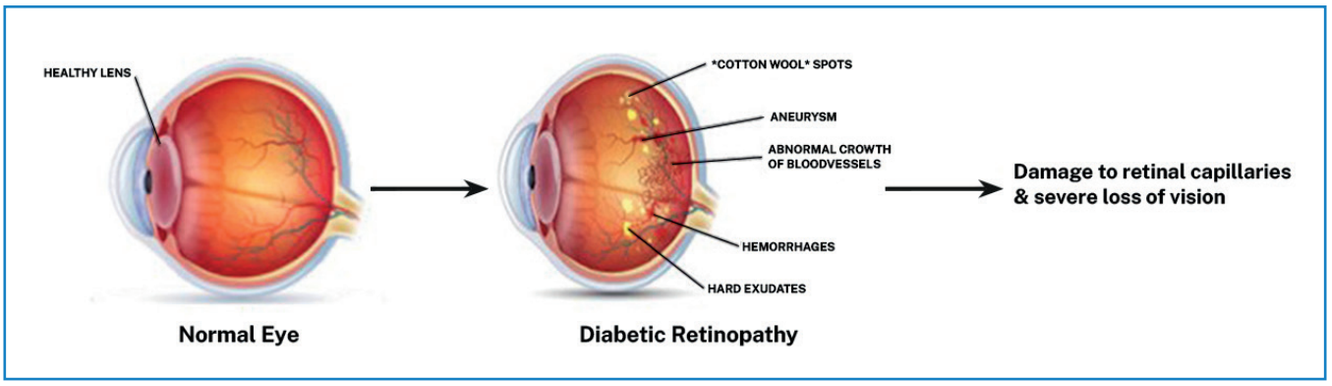
A non-invasive diagnostic method for early detection of changes on the level of retinol binding protein 3 (RBP3) linked to Diabetic Retinopathy.

PROJECT RESULTS

The project focused on imaging and in-situ detection of RBP3 protein levels in diabetic retinopathy (DR). After establishing the protocol for isolating the protein from a biological source to optimize the lattice preparation for the protein, the apo structure of RBP3 was submitted to the RCSB PDB database and was successfully determined to a resolution of 3.67 Å, meaning that it became possible to see the atomic details of its architecture. This detailed structure provides valuable insights into predictive retinoid binding sites within the protein and which parts of the protein are flexible or rigid. To target this protein for early detection of diabetic retinopathy, the complex with mice RBP3 with specified antibodies was made, that were labelled with molecular flags to later easier visualization. The signal from RBP3 was detected using fluorescent microscopy. The microscopy sessions showed a signal from the precise location where RBP3 was present, confirming that the antibody was functioning correctly. However, the intensity of the signal from the labelled antibody was lower than expected, possibly due to the protein's surrounding environment and free-floating nature. The control data set validated effectiveness of the technique, showing a strong, intense signal from the control protein.

IMPACT

The project focused on the role of developing a non-invasive diagnostic method for the early detection of changes in RBP3 levels associated with diabetic retinopathy and the limitations of current detection methods. RBP3 plays an essential role in the visual cycle. The outcomes of the project have significantly contributed to the scientific discipline, particularly in exploring the protein structure that has the highest impact value on the visual cycle. Previously, only a low-resolution structure of this protein in complex with an antibody was available, leaving several questions unanswered. Troubleshooting led to a high-resolution structure at 3.67Å in its native state. This structural information allowed us to explore the binding affinities of this protein towards various retinoids and fatty acids. Tagging or marking a protein that is not receptor bound is a difficult task, and this protein is located in between the RPE and the photoreceptor cells, which makes it even more challenging. Labelling of this protein with Alexa Flour 488-taged polyclonal antibodies has been successful. The structure and location of this essential protein will help us to precisely control the disease state of diabetes. In summary, the research under the PASIFIC Programme has not only advanced scientific knowledge, but also opened up a new way of tackling a challenging disease. It has also fostered the introduction of innovative techniques that have the potential to reshape the landscape of diagnostics and innovative approaches to disease detection.



Vishal **SHRIVASTAV**

earned his PhD in Material Science from the Academy of Scientific and Innovative Research, India, in February 2022. Thereafter, he joined the Regional Centre of Advanced Technologies and Materials, Czech Republic, for his postdoctoral research until July 2022. In October 2022, he was awarded the Green talent Award 2022. From 2022 to 2024, he worked as an assistant professor under the PASIFIC Programme at the Institute of Physical Chemistry of the Polish Academy of Sciences in Warsaw.

HOST INSTITUTE: Institute of Physical Chemistry, PAS

PASIFIC PROJECT

BMOF. **Biowaste derived activated carbon and metal organic framework structures for printable microsupercapacitors**
Physical Engineering

RESEARCH PROBLEM

Research on how synthesis of highly interfacial conductive and redox-active composite structures can resolve the low power density of batteries.

PROJECT RESULTS

1. Waste office paper, bamboo leaves, beetroot peel waste, etc. have been successfully transformed into highly efficient, porous carbon materials whose porous structure is further tuned using metal-organic frameworks (MOFs) to make them compatible with storing high levels of electrochemical energy such as batteries.
   These porous carbon materials enhanced with MOFs, not only contribute to high-performance supercapacitors, but also have a positive impact on the environment. It's a double win, turning waste into a valuable resource for energy storage while reducing our carbon footprint.
2. The innovative combination of MOFs with eco-friendly porous carbon materials has resulted in remarkable improvements in energy storage capabilities, as measured by performance metrics such as capacitance and stability. This has created a large surface area to accommodate the charged ions, i.e., supercapacitors, that not only last longer but are also in line with sustainable practices. This advancement paves the way for a greener future where energy storage is both powerful and environmentally conscious.
3. A pioneering method has been applied to print cutting-edge MOFs such as ZIF-8, HKUST-1, Cu-BDC, and others directly onto flexible surfaces such as plastic and paper, opening up new possibilities for large-scale production of thin, lightweight supercapacitors.
   Porous carbon, derived from waste and infused with MOFs, is at the heart of the future of energy storage. This means accessible, thin-film supercapacitors that not only perform exceptionally well, but also contribute to a sustainable energy landscape. It's a tangible step towards making efficient energy storage a reality for everyone.

IMPACT

The research carried out under the PASIFIC Programme has made significant contributions to the advancement of scientific knowledge, particularly in the realm of sustainable materials and energy storage technologies. The innovative research conducted under the Fellowship has led to notable breakthroughs, including the successful synthesis and characterization of biowaste-derived activated carbon (BWAC) and its composites with Metal-Organic Frameworks. This work has pushed the boundaries of how biowaste resources can be effectively utilized for high performance energy storage applications, paving the way for more sustainable and eco-friendly materials. One of the key achievements has been the development of a novel approach to in-situ MOF printing, which involves incorporating MOF precursors directly into ink cartridges for precise control over MOF characteristics. This technique represents a significant advance over existing methods and offers new opportunities to create customizable and efficient materials for a variety of applications. The successful optimization of BWAC@MOF inks for printable electrodes has further demonstrated the potential for integrating sustainable materials into flexible electronics.

Marcin **BIAŁEK**

obtained his PhD in Physics from the University of Warsaw, Poland, in 2016. His thesis dealt with magnetoplasmon resonances in high electron mobility two-dimension electron gas in GaAs/AlGaAs heterostructures. Until July 2022, he had a postdoctoral fellow position at Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland. From 2022 to 2024, he implemented his PASIFIC project at the Institute of High Pressure Physics of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of High Pressure Physics, PAS

PASIFIC PROJECT

TeraMag. **Towards terahertz cavity magnonics**
Physical Engineering

RESEARCH PROBLEM

Electrical detection of magnon-polariton modes might give new insight into the field of spintronics and result with new types of terahertz radiation detectors and sources.

PROJECT RESULTS

1. Magnon polaritons were detected in the classical three-dimensional antiferromagnet nickel oxide (NiO). Such modes are hybrids of electromagnetic radiation modes and spin waves, where energy is periodically exchanged between the cavity mode and oscillations of the magnetic system. When the natural frequencies of the magnon and the cavity mode are close, this periodic exchange of energy is enhanced and it leads to the formation of two different states called polaritons. This hybridization gives these new states mixed properties, simultaneously those of the electromagnetic modes and those of the magnons. Such mixed states can be used to show two interesting developments.
2. Coupling of excitations of crystal lattice (magnons) with spin lattice (magnons) in exclusively excited different and spatially separated crystals forming a common optical cavity has been achieved. Such modes are hybrids of magnons, phonons, and photons, and it is the cavity photons that mediate this interaction as they pass through both crystals.
3. The electrical control of magnon-polariton states is common because magnons are excitations of magnetic crystals and they generally do not depend on an electric field which remains the most practical tool to manipulate matter. Here, liquid crystal cells based on molecules rotating in electric field were used to achieve a control over magnon-polariton modes by exploring their partially photonic character. The project resulted in shifting the magnon-polaritons modes frequencies, and increasing the light-matter coupling strength when applying the bias to the liquid crystal cell. The benefit of this solution is that it works at room temperature and the liquid crystal cell does not need to be in direct contact with the magnetic crystal.

IMPACT

New technologies became indispensable very fast and it appears that our lives will be even more intertwined with their use. However, there are two fundamental issues in this development. Firstly, information technologies rely on a constant, exponential growth of computing possibilities of electronic devices. For example, future artificial intelligence would require much more computing and storage capacity than is available now. The development of silicon-based technologies allowed to fulfill this need for growth but the current level of miniaturization of electronic technologies will finally approach their physical limits and then growth in computer possibilities will slow down. Secondly, traditional silicon-based electronics rely on electron currents causing huge energy losses.

Moving from transistors based on silicon to much faster devices based on antiferromagnetic materials might solve both issues at the same time. Spintronic devices can be more energy efficient because they rely on spin current, which does not cause Joule heating like a flow of electrical currents in traditional electronic devices. Devices based on antiferromagnets have smaller physical limits for their size than traditional transistors. Moreover, they have spin dynamics faster than electrons in silicon by orders of magnitude. Thus, these materials might constitute a basis for a sustainable and efficient future of computers and wireless communications.

Kseniya **MEDVEDEVA**

worked at the Higher School of Economics in the Russian Federation, the University of Toronto in Canada, the Free University of Berlin in Germany, and the University of Warsaw in Poland. Her research interests cover intentional communities such as monasteries and eco-villages. Being deeply interested in religion, she focuses on different aspects of Eastern Orthodox Christianity. Ksenia Medvedeva conducted her fieldwork in Russia, the USA, Canada, Poland. In 2022–2024, she continued her research under the PASIFIC Programme and carried out fieldwork in Greece and the USA.

HOST INSTITUTE: Institute of Philosophy and Sociology, PAS

PASIFIC PROJECT

ECOCO. **Green Orthodoxy: ecological conversion of Eastern Orthodox churches**
Social Sciences and Humanities

RESEARCH PROBLEM

Orthodox churches in the USA and Greece. How and why do religious actors become engaged with environmentalism? How does the “ecological conversion” work?

PROJECT RESULTS

1. Based on data collected during fieldwork in the USA and Greece, several eco-narratives used by Orthodox actors were elicited: environmental (per se), ascetic, “traditional” and agrarian.
2. The “environmental” narrative (“direct ecological action”) refers to those actors who are straightforward about calling their activities ecological. For example, in the United States, “How-to Green Your Parish” Initiative of the Greek Orthodox Archdiocese released a series of videos about how to bring environmental thinking to the parish level and prepared a resource page with various materials on environment. Similar initiatives openly declare their involvement in the environmental topic and use the eco-language familiar to everyone from secular eco-initiatives.
3. Many Orthodox communities carry out activities related to the environment but avoid “green” labels. The sisters of two monasteries in Greece, for example, educate their visitors about the environment, but rather in terms of the “traditional” monastic eco-living style.
4. Other communities have very rustic lifestyles. Their simplicity, which is consistent with spiritual discipline, also happens to be environmentally sustainable, and they see it as part of their ascetic tradition.
5. Some initiatives in Orthodox communities focus on food sovereignty and soil cultivation, running community garden projects and producing a so-called “rural” eco-narrative rather than modern environmental activism.
6. The actions presented in the above narratives are ecological in effect, but their framing avoids modern “green” terminology. Orthodox eco-narratives exemplify a “soft” approach to talking about the controversial, politicized issue of environmentalism.

IMPACT

On a theoretical and methodological level, the research conducted within the fellowship helped to bridge ecology, sociology and religious studies. It addressed a specific gap in the current literature on how Eastern Orthodox churches are responding to the ecological crisis as one of the pressing issues of our time. On a practical level, this research informs policy-making by presenting good environmental practices of religious communities.

Narayan **SOM**

started his scientific career as a research fellow at the Maharaja Sayajirao University of Baroda, India, in 2015 and graduated with a PhD degree in 2020. In 2021, to progress his research N. Som joined the BIOG-NET project at the Faculty of Materials Science and Engineering of Warsaw University of Technology in Poland. From 2022 to 2024, he conducted research at the Institute of High Pressure Physics of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of High Pressure Physics, PAS

PASIFIC PROJECT

NanoHER. **Development of the new PCN-nanocomposites for photocatalysis. Experimental and computational approach**
Physical Engineering

RESEARCH PROBLEM

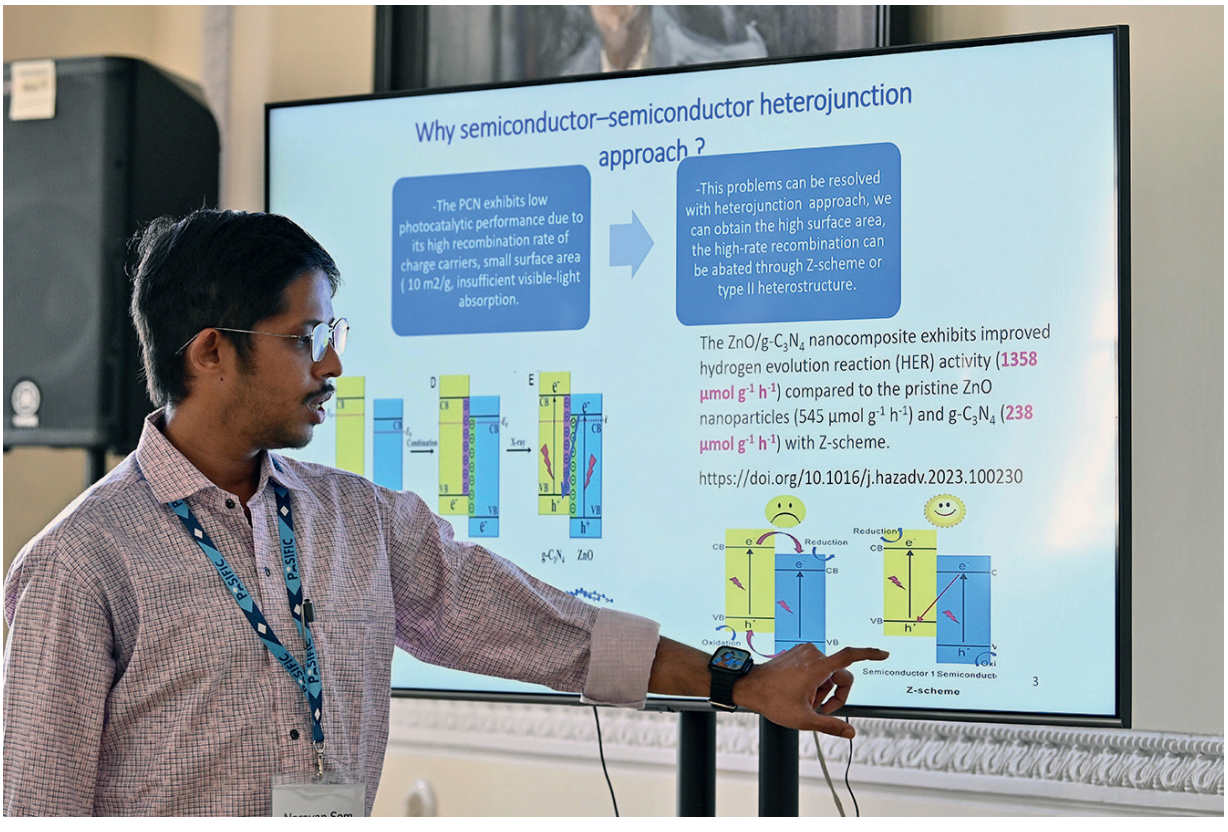
The main objectives of nanoHER are to produce highly efficient photocatalysts based on PCN-nanocomposites and narrowing the band gap of PCN-nanocomposite, and obtaining heterostructures of PCN with nano metal oxide.

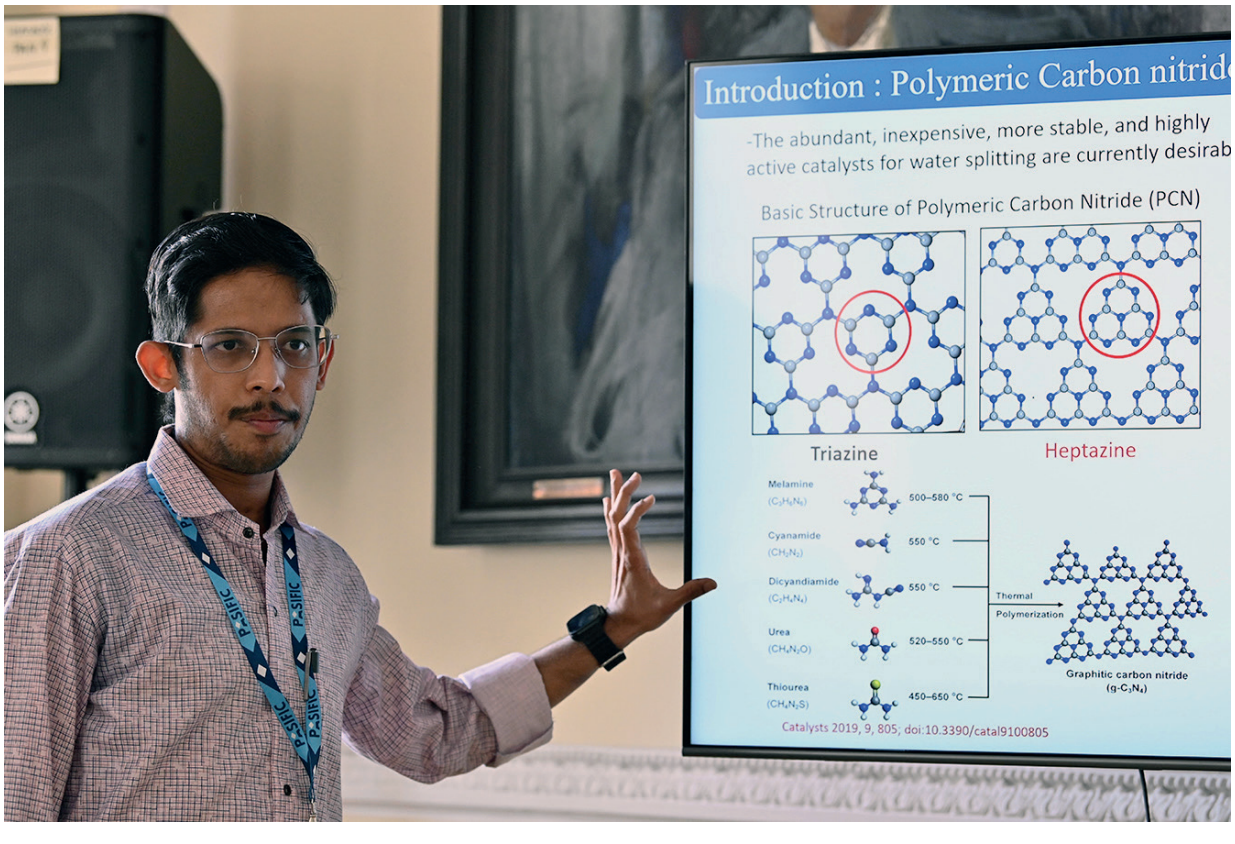
PROJECT RESULTS

1. The nanocomposite with a higher surface area compared to the pristine PCN and a lower band gap after the formation of the nanocomposite with two different synthesis routes was successfully synthesized. The research showed that the properties of the PCN nanocomposite varied with the synthesis route.
2. The catalytic activity of the complex nanocomposite was computed. It was validated with photocatalytic activity properties such as Solar to hydrogen efficiency (STH). A higher STH of around ~29 % was observed, whereas for the pristine PCN it was around 5% which was also in good agreement with the previous report.
3. A major milestone has been reached in the synthesis of the Polymeric Carbon nitride-ZnO nanocomposite using melamine. Future work will explore different precursors such as urea and thiourea. Additionally, two other nanocomposites, PCN-AlOOH-ZrO_2 and PCN-Ag-doped ZnO, were successfully synthesized.

IMPACT

Given the focus on hydrogen production, the impact of the Fellowship extends to the broader field of sustainable energy research. Understanding and optimizing photocatalytic processes for hydrogen production is in line with global efforts to develop clean and renewable energy sources.





Nilesh **MANWAR**

obtained his BSc and MSc degrees from Sant Gadge Baba Amravati University, India, in 2009 and 2011 respectively. In 2012, he joined the CSIR-National Environmental Engineering Research Institute, Nagpur. After submission his PhD in 2016, he continued the postdoctoral research at Indian Institute of Petroleum, Dehradun (2017–2020), Indian Association for the Cultivation of Science, Kolkata (2020–2021), and the Institute of Chemical Technology, Mumbai (2021–2022). From 2022 to 2024, he was an assistant professor at the Institute of Physical Chemistry of the Polish Academy of Sciences under the PASIFIC Programme.

HOST INSTITUTE: Institute of Physical Chemistry, PAS

PASIFIC PROJECT

Plasmonic-2D-SACs. **Integration of plasmon-induced 2D supported atomic site catalysts for thermo-photocatalytic CO_2 utilization / valorization of organic waste into useful chemicals**

RESEARCH PROBLEM

What is the research rationale of Plasmonic-2D-SACs? Why does plasmon induce 2D materials? Sustainable energy resources and their utilization methodologies: opportunities and challenges.

PROJECT RESULTS:

1. A key focus of the PASIFIC project has been on designing, synthesizing, and characterizing innovative carbon nitride-supported metal catalysts (Cu, Co, Ni). These catalysts exhibit remarkable stability and broad light absorption, making them ideal for sustainable photocatalysis. Ongoing optimization experiments target photocatalytic hydrogen generation, $C0_2$ reduction, and the selective oxidation of compounds such as 5hydroxymethylfurfural (HMF), furfural (FUR), and benzyl alcohol, along with E1202 production. Initial findings highlight the significant potential of these catalysts for $C0_2$ conversion into affordable hydrocarbons, such as methanol. Additionally, the selective oxidative dehydrogenation and hydrogenation of HMF and FUR have yielded valuable chemicals, further underscoring the versatility of the developed catalytic systems.
2. This research has achieved significant progress in photocatalytic material design, contributing to renewable energy and sustainable chemistry. Optimized methodologies and innovative catalysts developed during the project are poised for broader adoption in photocatalysis. Moving beyond laboratory experiments, the work aligns with sustainable and environmentally conscious approaches, offering valuable insights for future advancements. The outcomes not only enhance scientific understanding but also promise tangible societal and environmental benefits. Ongoing developments are focused on sustainable catalysis, further driving innovation in energy conversion and green chemical processes, emphasizing the project's potential for transformative impact in addressing global energy and sustainability challenges.

IMPACT:

The PASIFIC project has significantly advanced the scientific discipline of photocatalysis, particularly in plasmon-induced catalysis for renewable energy and environmental sustainability. By developing innovative 2D-supported catalysts and dual-function photocatalytic systems, the fellowship addressed critical challenges in energy conversion and chemical transformations. Key advancements include scalable synthesis of polyheptazine imide (PHIM) catalysts with superior visible-light activity, enabling sustainable energy conversion and biomass valorization.

This interdisciplinary research integrated materials science, chemistry, and engineering, resulting in breakthroughs in selective oxidation reactions, $C0_2$ reduction, and hydrogen production, pushing the boundaries of catalytic efficiency and selectivity.

The project has introduced novel methodologies and applications in photocatalysis and green chemistry, influencing future research directions and promoting sustainable technologies. The PASIFIC project results serve as a foundation for lasting progress in sustainable chemistry.

Pallavi **KUMARI**

started her scientific career with the investigation of block copolymers and earned a doctoral degree from the Central University of Jharkhand, India, in 2017. To continue her postdoctoral research on the polymer and block copolymer based materials she moved to Indian Institute of Technology, and afterwards, to the Agricultural Research Organization, Volcani Center in Israel. In 2021, P. Kumari joined the Norwegian company capture bank as a researcher. From 2022 to 2024, she was a postdoctoral fellow at the Centre of Polymer and Carbon Materials of the Polish Academy of Sciences under the PASIFIC Programme.

HOST INSTITUTE: Centre of Polymer and Carbon Materials, PAS

PASIFIC PROJECT

NFMTMB. **Nanostructured functional materials with tailored morphology from block copolymer induced self-assembly of small organic molecules for electronic and optoelectronic applications**
Physical Engineering

RESEARCH PROBLEM

Exploration towards understanding and controlling the processes of developing idealized morphologies for enhancing the performance of devices.

PROJECT RESULTS

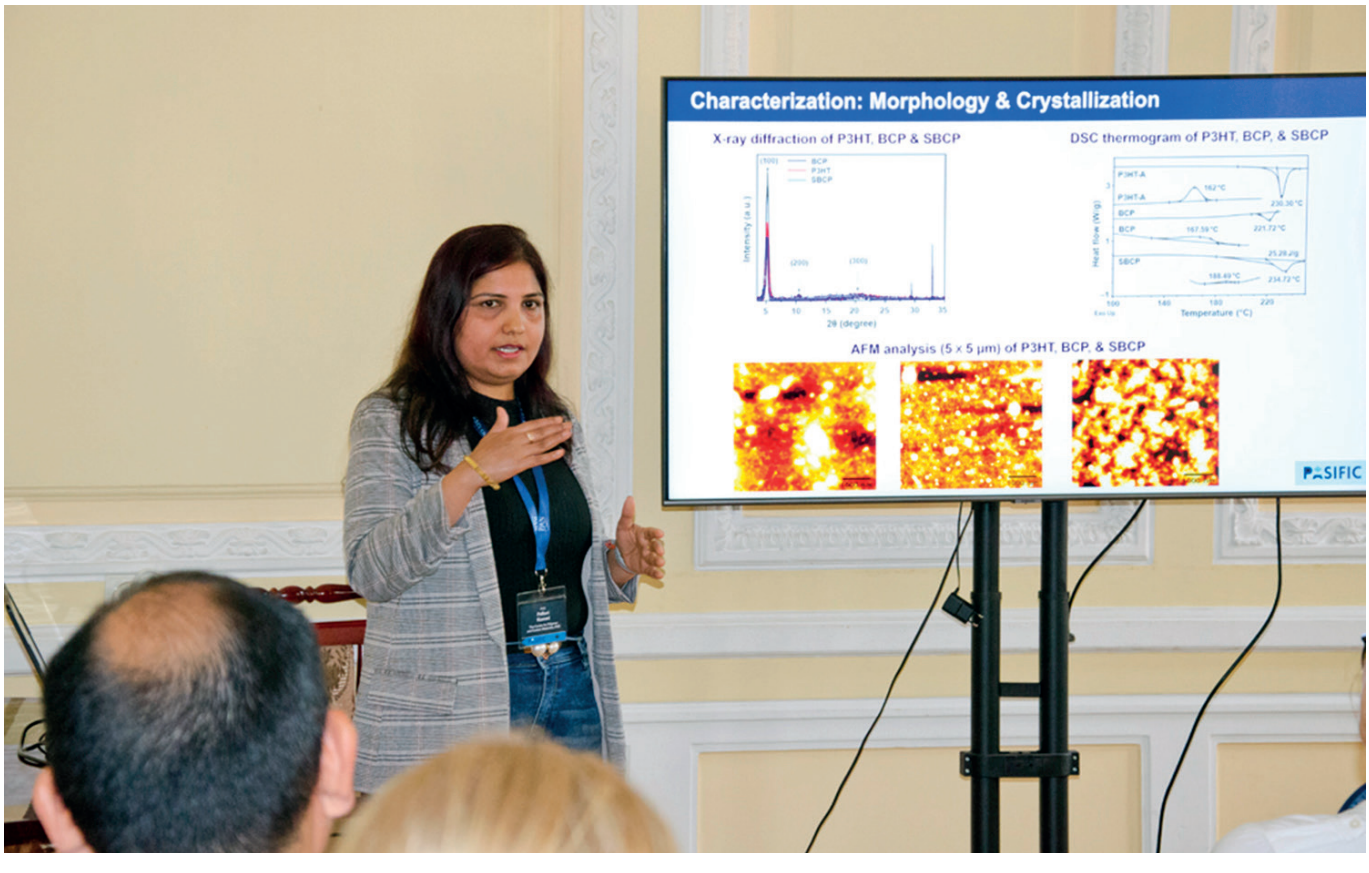
1. The novel aim of the NFMTMB project under the PACIFIC Programme was to develop nanostructured functional materials using block copolymer induced self-assembly with small organic semiconducting molecules (SMBC), which exhibit significantly enhanced properties compared to their pure material form. Notably, significant improvements in thermal stability, crystalline structure, and surface microstructural characteristics were observed. The improved crystallinity and morphology of SMBC showed a remarkable correlation with charge transfer in OFET devices. In this context, they demonstrated improved charge transfer characteristics and consistent performance compared to the pristine pure material.
2. The ability of the block copolymer self-assembly technique to effectively tailor these properties shows its promise for advanced applications in a wide range of industries. The synthesised nanomaterials will hopefully address the need for innovative materials with high performance, low cost and ease of device fabrication on a global scale.

IMPACT

The research carried out under the PASIFIC Programme has the potential to significantly impact society by focusing on the development of nanostructured functional materials with tailored morphology. Utilizing block copolymer-induced self-assembly alongside small organic semiconducting molecules, it is possible to enhance the performance of optoelectronic devices. The self-assembly process involving block copolymers and small molecules enables precise control over material structure and function. This innovation directly addresses the global demand for novel, efficient materials that offer high performance, are cost-effective, and facilitate easy fabrication of devices.

In the current era of the electronic-centric world, where the demand for flexible, wearable, and implantable electronic goods is ever increasing, there is a crucial need for a simple and effective approach to patterning nanostructured functional materials. The proposed self-assembly method emerges as a promising solution to meet these requirements for desirable electronic goods.

Furthermore, the self-assembly approach not only fulfils practical needs, but also provides valuable insights into the design-structure property relationships. By delving into the physical principles operating at the nanometer length scale, this research provides a deeper understanding of the intricate interplay between structure and function. Overall, the proposed effort represents a significant step foward in the advancement of semiconductor device patterning, with the potential to provide new insights and innovations that can positively impact various aspects of society, from technology and manufacturing to healthcare and everyday life.



Imran
SARIHASAN

graduated summa cum laude from the University of Debrecen, Hungary, in 2020 with a PhD in Labour Migration. From 2022 to 2024, she carried out her research on human mobility, labour markets, migration statistics, immigrant entrepreneurship, and gender studies at the Institute of Philosophy and Sociology of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Philosophy and Sociology, PAS

PASIFIC PROJECT

IMGEEUC19. **Persisting immigrant entrepreneurship in European Union member states during the economic downturn due to covid-19 pandemic**
Social Sciences and Humanities

RESEARCH PROBLEM

How did immigrants' socio-demographic differences influence the sustainability of immigrant enterprises during the Covid-19 pandemic in the EU member states?

PROJECT RESULTS

1. Immigrant entrepreneurs in Poland demonstrated remarkable resilience in the face of economic challenges during the COVID-19 pandemic. Despite limited support schemes, many entrepreneurs showed adaptability and perseverance in maintaining their businesses. However, the lack of integration programs, language barriers, and difficulties in legalizing their status were some of the hassles they continued to face in sustaining their businesses during the pandemic.
2. In Hungary, immigrant entrepreneurs used various coping mechanisms to deal with financial uncertainty. These tactics included using digital technologies, exploring untapped market niches, and diversifying business structures during the COVID-19 pandemic.
3. In the case of Germany, an integration programme for migrants has been launched, but it's only a language programme. Most of the participants could speak the language, but were not eligible for the necessary financial support and other facilities to improve the sustainability of their businesses during the COVID-19 pandemic.

IMPACT

As well as demonstrating perseverance in the face of adversity, immigrant-owned businesses have continued to thrive during the economic crisis caused by the COVID-19 pandemic. This is a testament to the long-lasting benefits that these endeavors bring to society. In addition to their positive economic impact, these business ventures are essential for community development, social integration, and cultural enrichment in their areas. The diverse fabric of immigrant entrepreneurship is enriched by the inventiveness, flexibility, and distinctive perspective that immigrant entrepreneurs bring to their destination countries.

Kinga **POLYNCZUK-**
-ALENIUS

is a media and communication scholar with an empirical focus on Poland. Her research deals with ethical trade, mediated racism and nationalism, conspiracy theories and illiberalism, and most recently, journalism and democracy. Kinga received her doctorate from the University of Helsinki in 2018, after which she became a Core fellow of the Helsinki Collegium for Advanced Studies. From 2022 to 2024, she continued her research under the PASIFIC Programme at the Institute of Philosophy and Sociology of the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Philosophy and Sociology, PAS

PASIFIC PROJECT

MEREDEI. **Mediated re/making of democratic imagination in Poland**
Social Sciences and Humanities

RESEARCH PROBLEM

How do news media across the political spectrum exacerbate the crisis of democracy in Poland? How can they contribute to its amelioration?

PROJECT RESULTS

1. MEREDEI offers a conceptualization of ‘identity journalism’, as practiced by Polish right-wing media engaged in ‘culture wars’, as a distinct genre of journalism that employs a peculiar subjectivist epistemology.
2. MEREDEI conceptualizes a new role that journalism can play in a democracy and proposes a framework for assessing legacy media’s performance in this respect.

IMPACT

Beyond academia, MEREDEI's findings may be particularly useful to two groups of stakeholders. First, its careful analysis of media representations of anti-racist, pro-LGBTQ+ rights and pro-choice activism might be of interest to minoritized activists themselves. It can inform their understanding of how to navigate relationships with the media to their advantage, and how to defend themselves against symbolic violence inflicted on them by journalists. Secondly, the normative propositions offered by MEREDEI regarding the role of legacy media in a democracy might help journalists committed to the democratic principles of equality, justice, and pluralism to better represent and more effectively support minoritized groups.

Oksana **POCHAPSKA**

started her research career at Kamianets-Podilskyi Ivan Ohiienko National University, Ukraine, where she received her BA and MA. She earned her PhD in Social Communication from Ivan Franko National University of Lviv, Ukraine, in 2009. To continue her research and implement the fellowship, O. Pochapska moved to the College of Journalism and Communications of the University of Florida, the USA. From 2018 to 2022 she held a position of an associate professor of Journalism Department at Kamianets-Podilskyi Ivan Ohiienko National University. From 2022 to 2024, O. Pochapska implemented her project under the PASIFIC Programme at the Polish Academy of Sciences.

HOST INSTITUTE: Institute of Philosophy and Sociology, PAS

PASIFIC PROJECT

UETransCap
Transformation of the consciousness of the audience under the influence of the printed media in Post-Soviet and European countries
Social Sciences and Humanities

RESEARCH PROBLEM

Transformation of the consciousness of the audience under the influence of the printed media in Post-Soviet and European countries.

PROJECT RESULTS

The project focused on analyzing various aspects of propaganda, media manipulation, and their practical application. It examined the features of Nazi and Soviet propaganda in Polish printed periodicals, compared the methods of Nazi propaganda with those of modern Russian propaganda, and examined how the war was framed in the Ukrainian and Polish media.
Main research findings:

1. Citizen journalism expands access to news but also spreads misinformation due to a lack of editorial oversight. Social media algorithms amplify sensationalist content, reinforcing echo chambers and pseudo-expertise.
2. Media framing shapes public opinion by using emotional language and selective terminology. Polish media (Gazeta Wyborcza) frame refugee stories differently, while social media intensifies emotional responses. Historical associations, such as the Volyn tragedy, contribute to negative perceptions of Ukrainian refugees, leading to a decline in public support.
3. Refugee stories are weaponized to manipulate public sentiment. Russian propaganda distorts the portrayal of Ukrainian refugees in Polish media, fueling xenophobia and weakening Polish-Ukrainian solidarity. These narratives balance between local support and disinformation campaigns.
4. Traditional media prioritize engagement over depth, while social media algorithms create echo chambers. False narratives spread faster than fact-checks, though media literacy and fact-checking initiatives help counter misinformation.
5. Modern framing techniques resemble WWII propaganda, necessitating further research. Strengthening media literacy, expanding fact-checking, and studying audience reactions are key to improving information hygiene and critical thinking.

IMPACT

The fellowship allowed to develop and expand two key disciplines:

1. **Digital Media and Communication Strategies:** This new course focuses on the role of digital media in shaping public discourse and communication strategies. Drawing from the latest research and my own findings, it provides students with the skills to analyze and design communication strategies within the digital landscape. The course emphasizes the use of digital tools in social movements, conflict resolution, and political mobilization, and examines how media can either support or undermine democratic processes.

2. **Media Ethics and Social Responsibility:** This course has been expanded to address the ethical challenges media professionals face today, especially in the context of disinformation, propaganda, and media responsibility in conflict situations. Through international case studies, including the Russian-Ukrainian war, it explores how journalists navigate ethical dilemmas in reporting sensitive issues and uphold their social responsibility. The course also focuses on the role of media in promoting social justice, human rights, and public accountability.

Monika **HEJNA**

worked as a visiting scholar at the University of California, Davis, where she carried out the research on plant-based strategies of controlling antibiotics input in swine farming. She received a PhD degree in Veterinary and Animal Science from the University of Milan, Italy, in 2021. To continue her postdoctoral research, M. Hejna moved to the University of Gdańsk, Poland. In 2022, she joined the PASIFIC Programme at the Institute of Genetics and Animal Biotechnology of the Polish Academy of Sciences, where she carried out her research until 2024.

HOST INSTITUTE: Institute of Genetics and Animal Biotechnology, PAS

PASIFIC PROJECT

ADVISE. **Algal-based alternatives: their ability to perform anti-inflammatory, antioxidant and antimicrobial activities in swine farming system**
Life Sciences

RESEARCH PROBLEM

Do the algae-based extracts have molecules to perform anti-inflammatory activity able to ameliorate inflammatory response, antioxidant activity to reduce oxidative stress and antimicrobial activity to diminish infection?

PROJECT RESULTS

1. The research under the PASIFIC Programme has produced the following results.
2. Three different algal species (Ascophyllum nodosum, Palmaria palmata and Ulva lactuca) showed strong antioxidant and antibacterial properties, demonstrating the ability to reduce infections.
3. Within the same algal extracts and their mixtures, further research is being conducted on anti-inflammatory and oxidative stress reducing effects.

IMPACT

Future farmers will need to breed pigs while reducing the use of antibiotics for various infections, ensuring health and well-being of animals, while producing fresh and cured pork products at a reasonable price. Therefore, tested algal-based extracts can help prevent infections and could be further applied as functional additives in intensive farming.

The project research results will identify algal species able to meet the specifications in terms of functionality and/or bioactivity for novel treatment of pathogens and for their counteraction in oxidation processes and further improvement of the meat quality due to the growing interest in functional meat products. The results will also be used to scale up production on an industrial level, bringing to market a new class of well-defined eco-friendly and functional algal products to reduce inflammation and oxidative stress.

The ability of algal additives to counteract bacterial infections will further contribute to the reduction of antibiotics in pig infections and may be part of future guidelines for improving agroeconomics. The identification of functional additives for antimicrobial, anti-inflammatory and antioxidant activity will contribute to scholarship in the field and application of antibiotic substitutes to prevent pathogen infections.

Navjotpal **KAUR**

earned her PhD from Memorial University of Newfoundland, Canada, in 2022. In the years 2022–2024, as a PASIFIC fellow, she continued her research at the Institute of Sociology and Philosophy of the Polish Academy of Sciences, exploring the relations between rural hegemonic masculinities, contextual gender relations, agrarian practices, and environmental degradation.

HOST INSTITUTE: Institute of Philosophy and Sociology, PAS

PASIFIC PROJECT

MMAGS. **Men, masculinities, and agriculture: a gendered approach to environmental degradation in the global South**
Social Sciences and Humanities

RESEARCH PROBLEM

Do particular cultural values (e.g., notions of masculinities, femininities or gender relations) become barriers or facilitators to pro-environmental knowledge and action?

PROJECT RESULTS

1. Due to the escalating effects of anthropogenic global warming and other types of global environmental change in the Anthropocene era, the connections between individuals (male farmers in Punjab) and their surrounding are becoming more susceptible to disruption. Currently, farmers in Punjab, who live in ecologically vulnerable areas or who depend on their local environment and seasonal patterns for their way of life, income, and cultural practices are at the forefront of the hazards posed by climate change to their attachment to their surroundings and mental well-being.
2. The environmental degradation resulting from the Green Revolution in Punjab, which encompasses soil and water pollution, soil erosion, is now evident, affecting not only farmers but also the rural population in general. The impact has been worsened by the increase in severe weather phenomena in recent decades, including floods, heat waves, cyclones, and droughts.
3. Agricultural productivity is affected by environmental degradation, including but not limited to soil erosion, water scarcity and climate change. The livelihoods of rural people, including farmers, are threatened by reduced yields or failed harvests, undermining the sense of purpose and achievement they derive from working the land.

IMPACT

In agrarian societies such as Punjab, men's work on the land often instils in them a sense of pride, identity and purpose. Their obligations as guardians of the family and community, providers, cultivators, and custodians of the land are inextricably linked, and the environment/land serves as a backdrop that establishes the parameters of their masculine duties and obligations. There is a link between their ability to preserve and cultivate the environment for future generations and their sense of pride.

The examination of solastalgia and sense of place in the context of gender carries implications for mental health and well-being that can be used to shape policy, and will further delineate the boundaries of their respective disciplines such as ecological anxiety, eco-grief.

Shumaila **RAZZAQUE**

received her PhD in 2017 from the Huazhong University of Science and Technology. She furthered her postdoctoral research at UK-Nano Energy Materials Research Centre from 2018 to 2021. Her main research interests cover the development of polymeric materials, microporous polymers, nanocomposites, fabrication of metal nanoparticles for the adsorption, catalysis, and drug carrier perspective. From 2022 to 2024, Sh. Razzaque worked on the preparation of multi-site microporous polymers for CO_2 mitigation at the Institute of Physical Chemistry of the Polish Academy of Sciences under the PASIFIC Programme.

HOST INSTITUTE: Institute of Physical Chemistry, PAS

PASIFIC PROJECT

MICPOLCO2. **Fabrication of multiple sites microporous polymers for mitigating CO_2 and its utilization**
Physical Engineering

RESEARCH PROBLEM

The root cause of global warming is anthropogenic carbon-dioxide emission. The only solution to scale is clean energy and CO_2 neutral fuel production.

PROJECT RESULTS

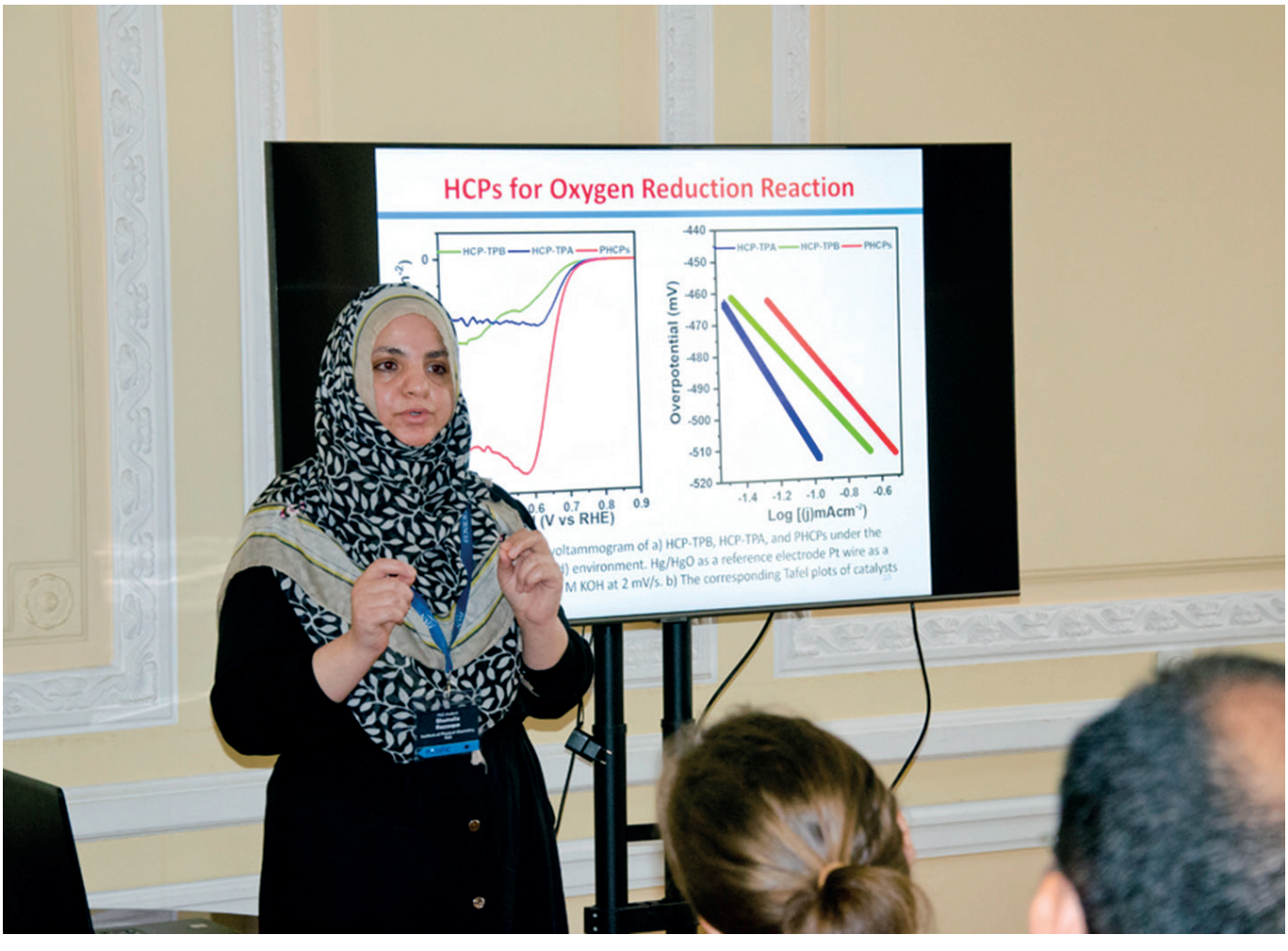
Successful synthesis of the high surface area material that

1. holds a promising application in the storage of greenhouse gases such as carbon dioxide;
2. has a very good capacity to adsorb carbon dioxide;
3. possess high potential for the electrocatalytic conversion of carbon dioxide into value-added chemicals (CO and HCOOH).

IMPACT

The development of a porous framework for carbon dioxide catalysis is at the forefront of research. As rising carbon dioxide is the main cause of global warming, the storage of carbon dioxide offers significant economic and environmental benefits. The results of the research would have a positive impact on the reduction of greenhouse gases through integrated storage and catalysis.

The successful development of the porous catalyst is also an innovation for the energy sector. Products derived from the catalysis of carbon dioxide are important in the chemical and pharmaceutical industries. Together with the protection of biodiversity, it also contributes to the promotion of a clean and sustainable environment.



Sazim **SHEIKH**

earned his PhD from the Institute of Physics, Bhubaneswar, India, on the thesis “Quantum correlations in multi-particle systems and their application” in 2016. Previous work experience includes the positions of a postdoctoral fellow at the Harish-Chandra Research Institute, India (2016–2019), and Stefan Schwarz fellow at the Research Center for Quantum Information, Slovakia (2019–2022). In the years 2022–2024, he worked under the PASIFIC Programme at the Center for Theoretical Physics of the Polish Academy of Sciences.

HOST INSTITUTE: Center for Theoretical Physics, PAS

RESEARCH PROBLEM

Higher order maps and their implications in quantum networks. Understanding facets of quantum correlations induced by networks.

PASIFIC PROJECT

HO(Q)NC
Higher-order maps and (quantum) network communication
Physical Engineering

PROJECT RESULTS

1. Incompatible testing procedures (a feature only available in quantum theory) is a crucial resource for distinguishing quantum networks. This result has profound implications in the fabrication of useful testing quantum devices which have a better outlook over its classical counterpart.
2. Perfect labelling is not possible most of the time when quantum observable is not projective, i.e., its effects are orthogonal. However, one can do minimum error labelling though success probability decreases exponentially with the number of effects in a single shot scenario.
3. A certification scheme has been devised using temporal inequalities exploiting sequential correlations, where it is possible to self-test quantum objects (states and measurements) without entanglement and spatial distance between the parties.

As far as the device independent certification of quantum devices in linear chain networks is concerned, it is possible to self-test all the Bell basis measurements for the N (greater than and equal to 1) number of middle parties.

IMPACT

The results of the PASIFIC project have significant implications for higher-order quantum maps and networks, as well as for the field of quantum information. The revelation about the labelling of quantum measurement devices comes as a surprise to the community, as this avenue has not been previously considered essential.

The research has shed light on the behaviour of quantum systems within more realistic scenarios of quantum networks. This knowledge will facilitate the construction of scalable quantum networks and provide insights into the inner workings of communication networks based on quantum principles. Given the fragility of quantum devices to environmental influences, the project results may contribute to the development of more robust devices. In the field of quantum computing, the results will advance the understanding of how to process large systems under environmental conditions and design reliable repeater-based quantum networks, including those commissioned for terrestrial and satellite quantum communications worldwide.

It will be possible to apply the mathematical tools developed in various branches of quantum information science and other disciplines of physics. In quantum engineering, the use of the above framework and techniques will facilitate the understanding of information processing in circuits. Furthermore, the project results will enhance comprehension of quantum codes and enable the development of operating principles for thermal devices based on our research.

Syed Ahmed **SHAH**

started his research career dealing with the development, characterization, and in vivo evaluation of stimuli-responsive hydrogels in diversified biomedical and clinical applications. In 2022, he obtained a PhD in Pharmacy and Pharmaceutics from COMSATS University Islamabad, Pakistan. S.A. Shah has been awarded Research Excellence Award 2022 by Superior University, Pakistan, considering his passion for increasing the translation of fresh ideas and concepts in the field of biomedical sciences from bench to bedside through research and innovations. From 2022 to 2024, S.A. Shah's research under the PASIFIC Programme focused on enzyme-mediated and pH-responsive hydrogels for accelerated bone regeneration and repair, controlled drug delivery, bone tissue engineering (BTE), and bio-based polymeric systems for de novo bone formation and the assembly of functional constructs that synergistically promote the healing of damaged bone tissue.

HOST INSTITUTE: Center for Theoretical Physics, PAS

RESEARCH PROBLEM

Bone tissue owns an intrinsic regenerative capability to make up deformations but severe fractures interrupt this ability. Severe bone defects are conventionally managed and treated by allografts and autografts that still face several shortcomings such as high cost, donor limitation, donor site morbidity, and postoperative complications.

PASIFIC PROJECT

Hydrobonereg. Biopolymer based Enzyme-mediated fast in situ injectable hydrogels laden with curcumin nanocrystals for bone tissue engineering
Physical Engineering

PROJECT RESULTS

1. The main outcome of the project was a creation of curcumin nanocrystals, or Cur-NCs for short. These microscopic marvels, made from a compound found in turmeric called curcumin, a natural spice, hold immense promise for bone regeneration. Why? Curcumin has natural anti-inflammatory, antioxidant, and bone-strengthening properties. Even more exciting is that these Cur-NCs can carry curcumin with unparalleled efficiency, with over 95% of the curcumin tightly folded inside them. Most of the Cur-NCs stayed strong and clear for over 120 hours. But a few of them started to wobble after a few days.
2. Under the microscope, Cur-NCs revealed their crystalline shapes and wave patterns, hinting at their magical ability to dissolve in water and release their healing powers where they're needed most. These curcumin nanocrystals are like tiny, stable, and super-efficient delivery vehicles for bone-healing magic. They're the future of bone health. These Cur-NCs aren't just tiny, they're beautifully structured, with shapes resembling intricate crystals. The curcumin nanocrystals aren't just stable and efficient, they're also incredibly well-designed for the future of bone health.

IMPACT

The global incidence of bone diseases and conditions has risen steeply and is expected to double, especially in populations where ageing is associated with increased obesity and physical inactivity. The development of curcumin nanocrystals and their potential use in bone healing therapy can be seen as a possible alternative to the conventional use of bone grafts. It will be an effective, fast and cost-effective therapy. The results of the PASIFIC project will advance the development of biomaterials science worldwide.

Ewa
PONIECKA

is a molecular biologist with a background in microbiology of extreme environments. She holds a PhD degree in Microbial Ecology from Cardiff University, the UK. From 2021 to 2022, she worked as a postdoctoral fellow at the University of Warsaw, Poland, focusing on single-cell techniques in microbiology. From August 2022 to February 2025, she was a fellow at the International Institute of Molecular and Cell Biology of the Polish Academy of Sciences, investigating novel applications of droplet microfluidic and single-cell techniques in RNA biology research.

HOST INSTITUTE: International Institute of Molecular and Cell Biology, PAS

RESEARCH PROBLEM

What is the response for mRNA vaccines in mice at the single-cell level? Are there any differences in gene expression between the cell types? What is the localization and longevity of the vaccine mRNA in vivo?

PASIFIC PROJECT

mRNA VacRes. **Targeted single-cell gene expression analysis of mRNA vaccine response**
Life Sciences

PROJECT RESULTS

The main objective of the project was to understand the fate of therapeutic mRNA under physiological conditions and the organism's response to it.

Key findings include:

1. Vaccine mRNA reads were confidently detected without dedicated targeting primers, facilitating future experiments and reducing potential bias.
2. Immune cells in muscle tissue rapidly take up the vaccine, with a large proportion of cells containing vaccine mRNA after just 6 hours post-injection. This proportion decreases over time.
3. In-depth analysis identified cell clusters and discerned details of each vaccine's uptake and turnover. The distribution of immune cells followed expected patterns, with macrophage proportions increasing over time while neutrophils and monocytes decreased.
4. Macrophages, particularly those resembling Lipid-Associated Macrophages, contained the most mRNA vaccine reads, especially from Moderna's vaccine. This suggests the importance of lipid nanoparticles in shaping the immune response to mRNA vaccines.
5. Some differences between Pfizer and Moderna vaccines were observed, requiring further bioinformatic analysis.

IMPACT

The COVID-19 pandemic accelerated the development of mRNAs-based treatments, including vaccines administered to billions of people worldwide. Using advanced single-cell analysis techniques, several surprising discoveries were made. Vaccine mRNA can be detected in muscle tissue within just six hours of injection, present in over 40% of cells. As time progresses, more immune cells gather at the injection site, leading to a decrease in the percentage of cells containing the vaccine. The vaccine remains detectable up to 48 hours after injection.

Differences were observed in how Moderna and Pfizer vaccines break down in cells and which genes they activate. Analysis revealed that immune cells form specific clusters, with macrophages becoming more prominent over time, while neutrophils decrease. This shift is crucial for understanding the immune response to mRNA vaccines. Macrophages, particularly those resembling Lipid-Associated Macrophages (LAMs), took up the most mRNA vaccine, especially from Moderna's vaccine. LAMs, known for their role in lipid metabolism, may play a significant role in shaping the immune response to mRNA vaccines. Their involvement in the response to lipid nanoparticles used in vaccine delivery is an interesting avenue for future research.
These findings are significant because they show how different cell types interact with mRNA vaccines influencing the overall immune response.
By uncovering details about where the vaccine goes, how long it lasts in the body, and how different types of cells respond, researchers can improve understanding of how vaccines work and develop them further for future applications.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 847639 and from the Ministry of Science and Higher Education