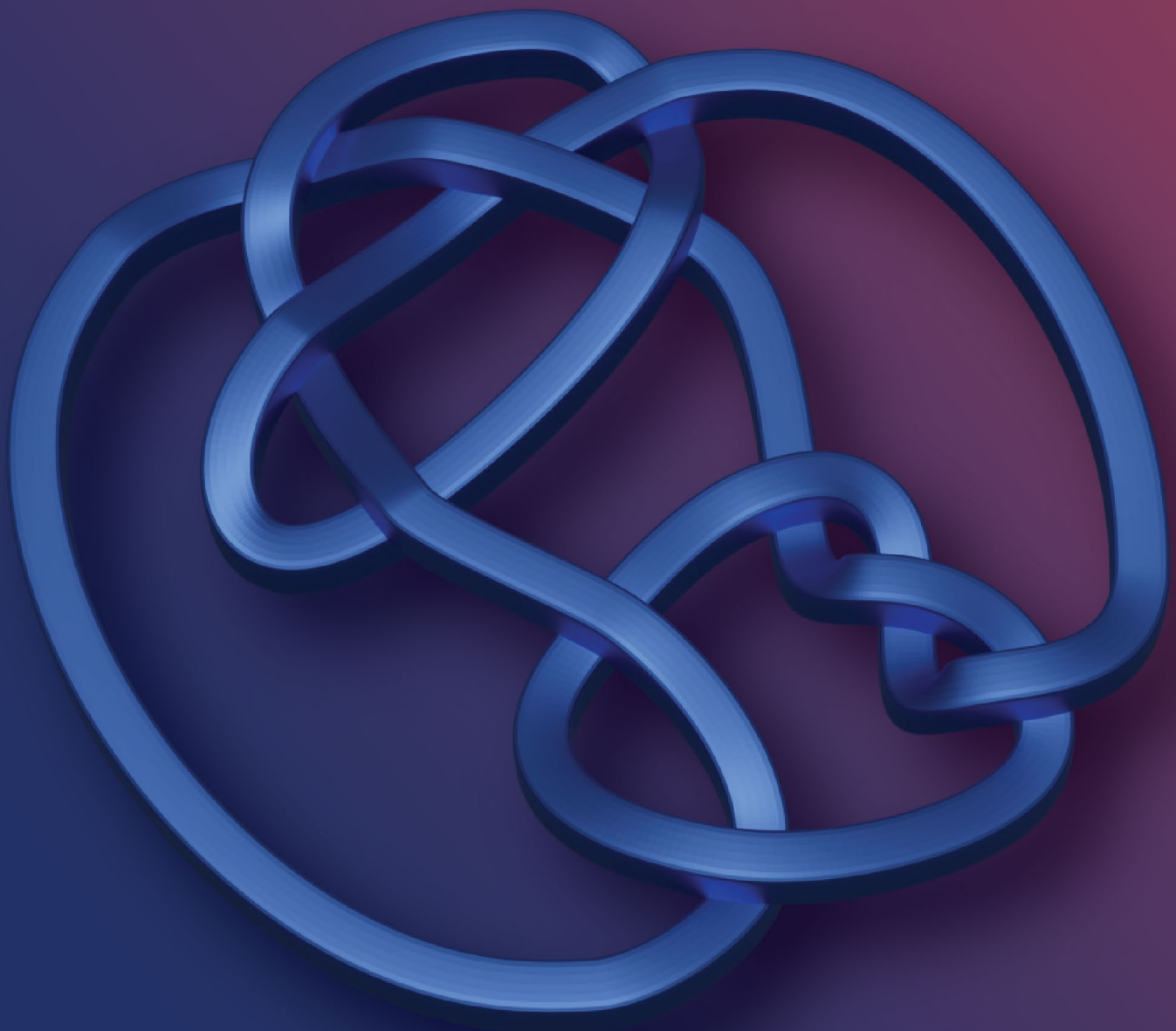
ISSUE 17, WINTER 2024

NEWSLETTER

OF THE INSTITUTE OF MATHEMATICS OF THE POLISH ACADEMY OF SCIENCES



BANACH CENTER UPCOMING EVENTS IN 2025

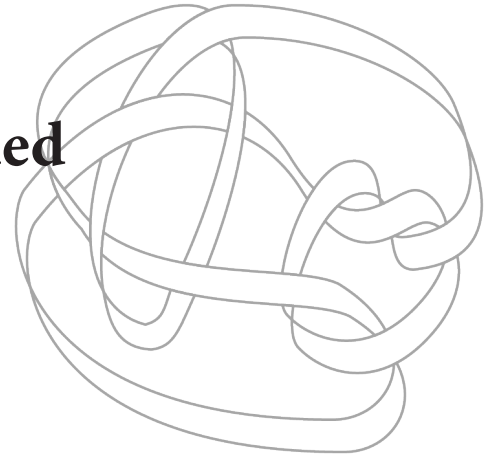
Title	Date	Location
The Navier–Stokes Equations – a Tribute to Wojtek Zajączkowski	28.01-01.02.2025	Warszawa
Workshop on Differential Equations and Their Applications	04-10.05.2025	Będlewo
12th Workshop on GRAph Searching, Theory, and Applications, GRASTA 2025	18-23.05.2025	Będlewo
XVIII Konferencja z Probabilistyki	25-30.05.2025	Będlewo
Torus Action and Characteristic Classes	01-07.06.2025	Warszawa
Invariant Metrics in Complex Analysis	03-07.06.2025	Będlewo
Dynamical Equations on Time Scales	07-14.06.2025	Będlewo
Graded Structures in Geometry and Physics	08-14.06.2025	Warszawa
Ergodic Group Actions and Unitary Representations II	15-19.06.2025	Będlewo
The Yang-Baxter Equations and All That	15-21.06.2025	Będlewo
Perspectives on Ergodic Theory and its Interactions	22-28.06.2025	Warszawa
20th Workshop: Noncommutative Probability, Operator Algebras, and Related Topics, with Application	06-12.07.2025	Będlewo
Symposium of the ALGANT Alumni Network (SYMPAAN 2025)	24-28.07.2025	Będlewo
On Geometric Complexity of Julia Sets VI	03-08.08.2025	Będlewo
Networked MathFlows 2025	07-13.09.2025	Będlewo
21st International Conference on Functional Equations and Inequalities	14-20.09.2025	Będlewo
Approximation, Geometry, and Probability in High Dimensions	21-26.09.2025	Będlewo
Frontiers of Lie Theory: Computational Aspects and Applications	28.09-04.10.2025	Będlewo

For more information, please see: https://www.impan.pl/en/activities/banach-center/conferences?y=2025.

On the cover: Conway's knot. It was introduced by John Conway in 1970. It was a long-standing open question if the Conway knot is slice, i.e., is the boundary of a smoothly embedded disk in the 4-dimensional ball. In 2020, Lisa Piccirillo published a ground-breaking paper, "The Conway knot is not slice," resolving the problem. In 2024, IM PAN hosted the Simons Semester "Knots, Homologies, and Physics" **(see p. 8).**

Photographs of Będlewo on pages 2 and 19. Credit: IM PAN.

MAESTRO grant awarded to Grigor Sargsyan



Interview conducted by Yonatan Gutman.

Grigor Sargsyan from the Gdańsk branch of the Institute of Mathematics of the Polish Academy of Sciences has been awarded the NCN MAESTRO grant entitled "Forcing axioms, inner models, and determinacy" for the period 2024-2029. The NCN MAESTRO grant is a prestigious award given by the National Science Centre of Poland to support experienced researchers in conducting pioneering research.

Yonatan Gutman: In my opinion the MAESTRO grant is the most important grant awarded by NCN. It has been awarded once a year since 2011 and has been won until now by about 15 mathematicians, i.e. on average one per year. You join Janusz Grabowski, Tadeusz Januszkiewicz, Piotr Nowak and Piotr Śniady from our Institute who were awarded MAESTRO in the past. Congratulations!

Grigor Sargsyan: Thank you, it is an honor to be in their company.

Y.G.: I am very curious to hear about your project but first, please tell us about your education.

G.S.: I was born in Armenia but my parents immigrated to the United States where I obtained all of my degrees. I received my PhD in 2009 from UC Berkeley under the supervision of John Steel, with whom I still collaborate very closely.

Y.G.: In 2009 you were awarded the Sacks Prize of the Association for Symbolic Logic for the most outstanding doctoral dissertation in mathematical logic. The committee noted that the thesis contains "uncountably many new ideas" in inner model theory. Please tell us about at least one of those ideas.

G.S.: The subject of my thesis is descriptive inner model theory, which is a deep subject and new ideas tend to be very technical. It is easier to say what the thesis accomplished. It showed that one of the fundamental determinacy theories (such theories isolate classes of two player games and postulate that one of the players has a winning strategy) had a very weak logical or set theoretic strength while up to that point it was believed that this theory was very strong, at the level of supercompact cardinals. In practice, this meant that to carry out certain set theoretic constructions, much less complicated structures were needed than it was previously thought. In some sense it was a paradigm shift, and actually, I was disappointed. I was under the impression that if I get to this theory then I get to stand on the top of the world, but actually it wasn't even close. We got there, and discovered the summit was still far away.

Y.G.: Please tell us about your academic pathway after your PhD.

G.S.: I was lucky to get an NSF postdoc fellowship to go to UCLA to work with Itay Neeman, who has been one of my mentors ever since. Then I moved to Rutgers University, which has a very strong logic group and I have many fond memories from my time there. Around 2018, I got tenured at Rutgers. Then in 2021, I moved to IM PAN and have been here since then. During this time, I mostly continued working on the projects I started in graduate school. Using more technical language, I worked on analyzing the minimal model of the Largest Suslin Axiom (LSA). I finished the manuscript on LSA, which is joint with Nam Trang, at IM PAN. The Gdańsk branch of IM PAN, which is actually in Sopot, is a great, idyllic place for finishing such a manuscript and conducting research in pairs.

Y.G.: From 2021 you are an Institute Professor (the equivalent of Associate Professor) at the Gdańsk branch of the Institute of Mathematics of the Polish Academy of Sciences. What made you seek a position at IM PAN and leave a tenured position at a leading American university?

G.S.: There were not only academic factors, but academic factors also played a very important role. Basically, I really wanted to pursue my research projects without the undergraduate teaching load. Therefore IM PAN as a research institute offered me a great opportunity which I was glad to seize. In addition I heard that both NCN (National Science Centre of Poland) and NAWA (National Agency for Academic Exchange of Poland) offer attractive grants for active researchers. But research only doesn't mean no didactic experience. Here at IM PAN I run two seminars, and one of them, the Baltic Set Theory Seminar, is a learning seminar.

Y.G.: Four years later, how do you summarize your experience up to date at IM PAN?

G.S.: My wife always tells me that I am a pessimist. I think I am a realist. At any rate, take it from a pessimist, I think at the personal level it has mostly been great, and believe it or not, like the American-Polish entrepreneur Dominik Andrzejczuk who is present on YouTube, one of the reasons we moved to Poland was to improve our financial situation. I don't know much about finances, but we both thought we would be better off here, and we have certainly been better off here. Maybe we feel this way because neither of us knows much about finances, but that is how it is. Dominik has some videos explaining why this might be, but perhaps each situation is different. I am more qualified to analyze my professional life than my financial life. I think Poland and IM PAN together provide an incredible environment to carry out big research projects. The tranquil environment of the Gdańsk branch of IM PAN is very motivating for me. To think about mathematics, I sometimes go for long walks in the forest which surrounds the branch or for walks on the beach, which is only 800 meters away. One can also find me in one of the numerous cafes in the old town of Gdańsk, where I often work with colleagues for many hours.

The National Science Center (or as I call it the Polish NSF) is a very impressive organization. They have very interesting grants that can be used to supplement your salary, hire students and postdocs, and travel to conferences. I guess we are discussing the MAESTRO Grant, which as you mentioned is the most important one, but I am very fond of the Weave-UNISONO grants. These are grants joint with other science foundations from around Europe and elsewhere, and they allow you to create new or strengthen old collaborations. I have two such grants, and they have helped me profoundly. I am very grateful for those.

IM PAN has several programs that are very interesting. First and foremost, hosting visitors at IM PAN is just a pleasure. IM PAN branches often have their own internal hotels and the guests can often stay at IM PAN itself. IM PAN also has at least two programs that can be used to organize collaborative meetings. One is financed by IM PAN itself and the other one, the Simons Semesters, are financed by the Simons Foundation. I had a blast organizing one such semester. We had many renowned visitors from around the world who came to Gdańsk and gave tutorials for the local community. I am now going to apply for another such semester.

Not everything is perfect of course. I am having

Prof. Grigor Sargsyan. Credit: private archive.

language problems. I am somewhat lucky that I was already familiar with Russian, which is another Slavic language with many similarities to Polish. But still Polish is hard, very hard. The weather is something to get used to if moving from warmer countries. I love Middle Eastern food and it is hard to find Middle Eastern restaurants in Gdańsk, but fortunately there are many from Georgia. Also, the surrounding Western countries often feel more expansive. However, overall things are better for me here than in the States, and also as far as the weather goes, somehow the Baltic sea is prettier in the winter than in the summer. It is miraculous when it snows, so there is something to look forward to when the cold and dark days come.

As far as work goes, I think the last three years have been the most productive years of my professional life. I was able to finish projects that I started before coming to Poland and pick new ones. One result that I like very much is a joint result with Paul Larson. We proved that a certain combinatorial principle called square can fail at the fourth uncountable cardinal. This then had a surprising consequence that one of the main methods for building canonical models of set theory couldn't succeed beyond a certain large cardinal threshold. Recently, jointly with my NCN postdoc Douglas Blue, Paul and I extended our results further. In technical terms, we introduced and analyzed a new type of determinacy models that we called Nairian Models. Nairi is the name of ancient Armenia, we chose the name because we spent many hours working in the Armenian Center at Mariacka Street in Gdańsk, it is a majestic place, another cozy place in Gdańsk where one can spend hours doing math.

Y.G.: Let us now talk about your MAESTRO project entitled "Forcing axioms, inner models, and determinacy". What is the starting point?

G.S.: The independence phenomenon - namely that the axioms of Zermelo-Fraenkel set theory with the Axiom of Choice (ZFC) do not decide natural statements about infinity (you cannot prove nor disprove them within the theory, equivalently there is a model where the statement is false and another model where the statement is true) - is notoriously difficult to deal with rigorously. The Continuum Hypothesis (CH) is perhaps the most well-known example of such an undecidable statement, but ZFC does not even decide whether all projective sets of reals, the sets obtained from open sets via a finite number of successive applications of complementation and projection, are Lebesgue measurable which is quite surprising.

Y.G.: Yes, this is surprising.

G.S.: Indeed, intuitively, simple set theoretic operations such as complementation and projection should not create pathological sets from non-pathological ones. However, ZFC does not prove this. Therefore, the question remains; is there a non-Lebesgue measurable projective set? The question is so simple that we ought to know the answer.

Y.G.: Is the answer known?

G.S.: We have to get into Gödel's Program, which is the program of removing undecidability from the mathematical study of infinity by adding axioms to ZFC resulting in what is called "natural extensions of ZFC" or more technically, foundational frameworks. The point is whether we can find a natural extension of ZFC which implies that there is a projective non-Lebesgue measurable set. Currently the most successful foundational frameworks are Forcing Axioms and inner models theoretic frameworks like Hugh Woodin's Ultimate-L which are intimately connected with Determinacy Axioms. Since they are intimately connected and mathematically inseparable, I for one usually treat Ultimate-L and Determinacy Axioms as the same (the reason we do not want to use Determinacy itself is that it contradicts the Axiom of Choice). Each of these extensions of ZFC imply that all projective sets are Lebesgue measurable. In fact, Tony Martin, Itay Neeman, John Steel and Hugh Woodin have developed deep universal techniques that can be used within any mathematically rich theory to prove that such theories imply the Lebesgue measurability of all projective sets. So the answer is yes, all projective sets are Lebesgue measurable. However CH and other such statements are of a different nature. Indeed the mentioned extensions of ZFC are unfortunately logically incompatible as Forcing Axioms imply the negation of the CH, while Ultimate-L implies CH. As it stands, we have two very advanced ways of thinking about infinity, one of which leads to not CH, and the other to CH.

Y.G.: So how can we deal with statements like CH?

G.S.: There are several ways to approach this issue, but the one I believe in and the one proposed in the grant is Steel's Program, which basically starts by

asking "in what sense are these theories different?" They are logically incompatible, but arguing by analogy you could certainly consider a manifold where one part of it could look totally different from another but they still co-exist, and they are connected and they are both part of a whole. So the question really is: when one is working within the framework of Forcing Axioms does one use a concept of a set fundamentally different from the concept of a set used by those working within the framework of Determinacy Axioms? Suppose we want to prove that one actually uses the same concept and that disagreements are simply a consequence of standing on different parts of the manifold. Then we could achieve this by showing (for example) that given a model of a Determinacy Axiom we can find inside it a model of Forcing Axioms and vice versa. Continuing the manifold analogy halfway (without the vice versa) this is like finding inside a 3-dimensional manifold a 1 -dimensional manifold, so part of developing the theory of 3-dimensional manifolds is developing the theory of 1-dimensional manifolds. The same way, we want to show that developing one framework necessitates developing the other.

Y.G.: This sounds quite philosophical. Can you please state some concrete problems in your project? In addition please tell us also about the team you will build.

G.S.: Sure, however I will have to use technical language. The first main technical goal of the project is to force Martin's Maximum, a forcing axiom, over a Model of Determinacy. The second goal is to construct, assuming Martin's Maximum, an inner model of a supercompact cardinal, or an inner model of a superstrong cardinal, or an inner model of a Woodin cardinal that is a limit of Woodin cardinals. These are large cardinal axioms, and according to the current wisdom, such models can only be constructed by first constructing really complex models of Determinacy Axioms. What is surprising to me is that the Nairian Models I mentioned before provide a perfect playground for us. It seems that we have identified the determinacy models over which we can force Martin's Maximum. For me, this is a big step forward as ten years ago it was hard to even imagine what such models could look like.

To complete this project, I plan to recruit two postdocs and two PhD students. All of these positions are for three years. The two directions of the project naturally split the team into two groups, each consisting of a postdoc and a PhD student. The project also has a budget to sponsor long term research stays by renowned mathematicians, about 2 months a year. Unfortunately, the organization of conferences cannot be budgeted as direct costs of NCN grants, but IM PAN encourages grant holders to use a portion of the indirect costs to organize conferences, which is what I will do.

Y.G.: This sounds very ambitious yet promising! Finally, what would be your advice for a researcher who would like to obtain the MAESTRO grant at some stage in the future?

G.S.: Since your proposal has to be better than the proposals of the others, some of it is due to luck. If it so happens that everyone who has a better proposal applies with you, then you won't get it. So luck is definitely part of it. I know that there are many very strong mathematicians who have applied for it and didn't get it, so I don't know if there is a formula. Certainly, I am not a better mathematician than the people I know who didn't get it. But judging from my experience, maybe I can say a few things. I think in my case it was a combination of being at the right stage of my career and being part of the development of the subject for considerable time, in my case about two decades. So I belive that the proposed project must be central to the proposal's area and the PI must have already obtained results that show mastery of the techniques involved. The proposal must be ambitious and full of dreams but at the same time it must be grounded, and it must contain precise problems, whose resolution will have a very significant impact, and tested realistic strategies to attack these problems. The project has to have diverse problems appropriate for graduate students, postdocs, and experienced researchers. Finally, having a track record of mentoring younger people will also be helpful, but I do not mean PhD students. In my case, judging from the interview, I could tell that the committee took note of the fact that some of the mathematicians I mentored while they were postdocs are currently tenured at leading institutions. But let me reiterate, I do not think that there is a formula.

Simons semester „Contemporary harmonic analysis and its synergies”

Adam Nowak & Błażej Wróbel

The Semester was held in August and September 2024 in three locations: Wrocław, Będlewo, and Warsaw. The events of the semester allowed fruitful interactions between specialists on various topics within or around harmonic analysis including: local smoothing estimates and restriction estimates, discrete analogues in harmonic analysis, pointwise convergence problems, variation and oscillation estimates, dimension-free estimates, singular integral operators, oscillatory integrals, analysis of differential operators on Lie groups and analysis related to Dunkl operators. An important aspect of the Semester were applications to and relations with other fields such as ergodic theory, PDEs, analytic number theory, and incidence geometry. As a result of this aspect, at least several new projects were initiated and new collaborations started. The Semester consisted of the following three main events.

Lecture series and seminars in Wrocław (Aug-Sep).

Intense lecture series in Wrocław aimed at researchers at all stages of their career. The lecture series covered a variety of topics in modern harmonic analysis and related areas. They were delivered by recognized experts: D. Beltran (University of Valencia), J. Dziubański (University of Wrocław), J. Hickman (University of Edinburgh), M. Kwaśnicki (Wrocław University of Science and Technology), Á. Magyar (University of Georgia), A. Martini (Politecnico di Torino), M. Mirek (Rutgers University), A. Osękowski (University of Warsaw), D. Oliveira e Silva (Instituto Superior Técnico, Lisbon), J.P. Ramos (EPFL), O. Saari (Universitat Politècnica de Catalunya), T.Z. Szarek (University of Georgia) and J. Wright (University of Edinburgh). Furthermore, in 9 seminar talks recent results were presented by participants.

Happy participants of the summer school in Będlewo. Credit: Luz Roncal.

Summer School in Będlewo (19-23 Aug).

One week long summer school for graduate students, PhD students and postdocs. The school consisted of 4 minicourses, each containing 5 one hour long lectures. The lecturers were D. Beltran, J. Hickman, M. Mirek, and J. Wright. The minicourses were a tremendous opportunity for young researchers to learn in depth various topics. Moreover, there were also 6 contributed talks given by participants, presenting their recent research.

Conference in Warsaw (9-13 Sep).

A venue to present recent innovative developments in contemporary harmonic analysis and related areas. There were 14 invited lectures and 9 contributed talks during the conference.

The semester was organized by IM PAN and the Banach Center in cooperation with the University of Wrocław. The summer school was also supported by the Wrocław University of Science and Technology, while the conference in Warsaw was also sponsored by the Nicolaus Copernicus University in Toruń and the University of Warsaw.

The main organizers of the Semester were A. Nowak (IM PAN), L. Roncal (BCAM – Basque Center for Applied Mathematics) and B. Wróbel (IM PAN/University of Wrocław). For further information, see the Semester's website sites.google.com/impan.pl/chas2024. Most of the minicourses were recorded and are available on the Semester's website and on the Banach Center YouTube channel.

Simons semester „Knots, homologies, and physics”

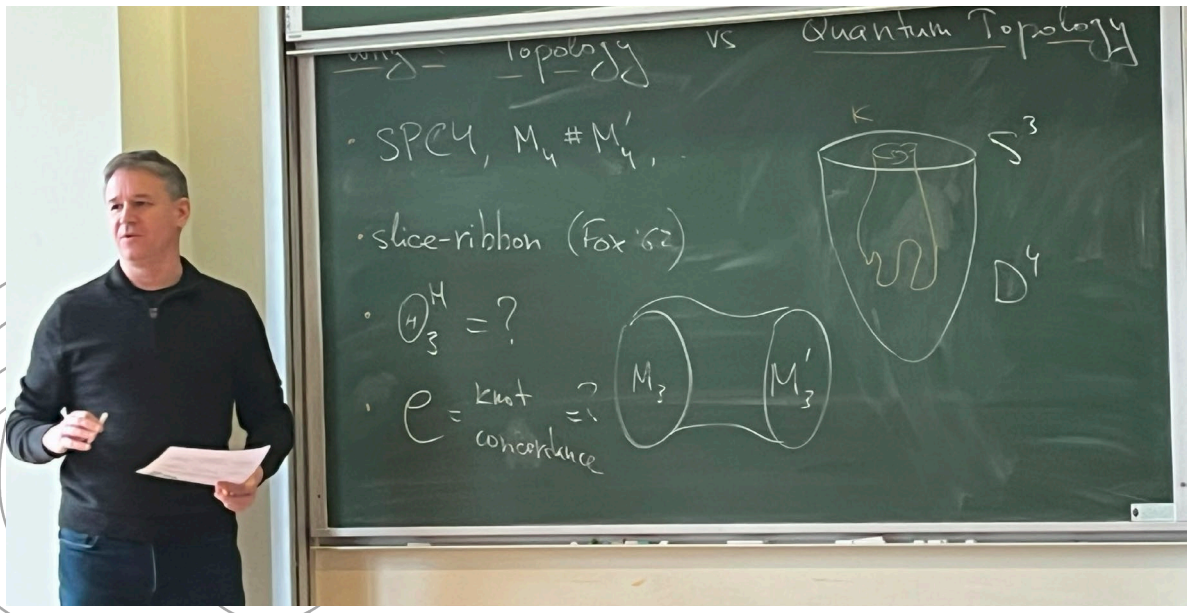
Maciej Borodzik

The Simons Semesters, supported by the Simons Foundation, aim to promote intensive scientific collaboration in specific areas of mathematics. Since 2015, the Institute of Mathematics of the Polish Academy of Sciences (IM PAN) has hosted these semesters, each focusing on a distinct area of modern mathematical research. The 2024 semester continued this tradition by providing the necessary infrastructure, funding for researchers, and a collaborative environment that encouraged the exchange of ideas.

The Simons Semester titled “Knots, Homologies, and Physics” was hosted by the Banach Center at IM PAN from March 1 to June 30, 2024. The main organizers were Maciej Borodzik (IM PAN), Piotr Kucharski, Wojciech Politarczyk, and Piotr Sułkowski (University of Warsaw). A parallel event hosted by the University of Warsaw and supported by the “Excellence Initiative - Research University” program also took place during this period. Many invited guests participated in both programs, fostering mutual collaboration among participants.

This interdisciplinary program brought together mathematicians and physicists to explore the rich connections between knot theory, homological invariants, and their applications in physics. Knot theory, a branch of topology focused on the mathematical study of knots, has deep links to physical theories such as quantum field theory and string theory. The semester emphasized recent developments in these areas, encouraging collaboration among researchers from various backgrounds.

A particularly promising research area discussed was the so-called knot-quiver correspondence. It involves two topological quantum field theories—one derived from quantum representations of the knot group and the other from quiver representations—which are expected to be equivalent. This equivalence leads to a prediction that one can associate a quiver (or a family of quivers) with a knot and vice versa. Research in this field encompasses distinct fields of mathematics and physics; knot invariants derived from representations of quantum groups generalize the so-called Khovanov homology. They can be defined using a combinatorial count of representations, maps into flag varieties, and a variant of Fourier–Mukai transform. In some situations their studies



Prof. Sergei Gukov (Caltech) lecturing during the semester. Credit: Piotr Sułkowski.

involve the homology of Hilbert schemes of points on a curve. Additionally, quiver representations are of interest for algebraic geometers.

The semester featured activities such as workshops, an advanced school, and weekly seminars. These events provided a platform for participants to share new results, discuss open problems, and explore emerging research directions. Notable seminar topics included "Invariant Knot Floer Homology of Satellites" and "Solvability of Concordance Groups and Milnor Invariants," reflecting the breadth of the subject matter. The advanced school was a particularly valuable resource for early-career researchers, exposing them to cutting-edge techniques and tools in the field.

One key outcome of the semester was the establishment of new collaborations and the strengthening of existing ones. The program successfully brought together leading experts and young researchers, creating a vibrant and productive research environment. Participants not only advanced their understanding of specific mathematical structures, but also gained insights into their relevance to physical phenomena, highlighting the importance of interdisciplinary approaches.

In summary, the 2024 Simons Semester "Knots, Homologies, and Physics" was a significant event in the mathematical sciences, promoting interdisciplinary research and advancing the understanding of the intricate interplay between mathematics and physics. The success of the Semester demonstrates the ongoing value of such programs in fostering collaboration, disseminating knowledge and addressing fundamental scientific questions.

The Gdańsk branch of IM PAN

Tomasz Szarek

The Gdańsk branch of the Institute of Mathematics of the Polish Academy of Sciences is situated in Sopot at Antoniego Abrahama Street, in a large, historic villa owned by the Institute.

Sopot is a major health-spa and resort destination in Poland attracting a large numbers of tourists from all over the world.

Established in 1967, the Gdańsk branch owes its location to the efforts of Professor Andrzej Granas, who secured the donation of the building from the Sopot authorities. Except for a brief period from 2012 to 2018, when budget cuts forced a temporary relocation to the University of Gdańsk and the villa was rented out, the branch has been based in Sopot. Currently, the first floor of the three-story villa is leased to a brokerage firm, while the Institute occupies the remaining two floors. The second floor houses five spacious and bright offices for permanent or long-term staff. The third floor features two offices for visitors and short-term staff, two guest rooms, a bathroom, and a kitchen. These facilities are highly valued by guests. Additionally, a seminar room on the third floor can accommodate approximately 15 individuals.

The Gdańsk branch was first led by Professor Zbigniew Ciesielski, a specialist in the approximation theory and probability, and later by Professor Tadeusz Figiel, a specialist in functional analysis. Currently, the Gdańsk branch is being headed by Tomasz Szarek.

The villa at Antoniego Abrahama Street. Credit: IM PAN.

The Gdańsk branch plays a crucial and leading role in the local mathematical community, serving as a hub where mathematicians from the Gdańsk University of Technology and the University of Gdańsk collaborate. The Institute's staff also engage with students from Gdańsk universities and high schools, organizing lectures and activities for them.

The branch currently employs six researchers:
- Anna Kamont (approximation theory and probability),
- Karolina Kropielnicka (numerical analysis),
- Rahman Mohammadpour (logic),
- Grigor Sargsyan (set theory and logic),
- Tomasz Szarek (dynamical systems and probability),
- Adam Śpiewak (dynamical systems).

The number of employees varies annually, depending on research grants secured by the scientific staff. In the coming years, the staff is expected to grow, as Grigor Sargsyan has received the NCN MAESTRO grant entitled "Forcing axioms, inner models, and determinacy" and plans to hire several post-docs (see p. 3 for an interview with Grigor Sargsyan). Additionally, Karolina Kropielnicka and Tomasz Szarek have their own NCN grants.

In 2024, the Gdańsk branch hosted numerous visitors, including Arieh Iserles from Cambridge University, Ewa B. Weinmüller from Technische Universität Wien, Sander Hille from the University of Leiden, Hanna Oppelmayer from the University of Innsbruck and Boban Veličković from Paris Diderot University.

The Gdańsk branch of IM PAN currently hosts several seminars:

- The Approximation Theory and Stochastic Analysis seminar, co-organized by A. Kamont and T. Szarek, is a research seminar uniting scientists from the University of Technology, the University of Gdańsk, and the Institute of Mathematics of the Polish Academy of Sciences.

- The Logic Colloquium, organized by G. Sargsyan, serves the Gdańsk mathematical logic community.

- A seminar for high school students, organized by T. Szarek, offers lectures for talented students from III Liceum Ogólnokształcące in Gdynia and Liceum Autonomiczne in Gdańsk.

- G. Sargsyan also organizes the Baltic Set Theory Seminar, an online seminar that began in 2021 and has attracted many prominent participants.

In 2024, the Gdańsk branch of the Institute of Mathematics of the Polish Academy of Sciences hosted a mini-workshop entitled "Markov Processes and Limit Theorems," which brought together over 10 researchers from Poland, Australia, and the Netherlands.

New permanent faculty members at IM PAN

Adam Skalski

As a result of an open competition which took place in the first half of 2024, following the recommendation of the Hiring Committee, the decision of the Director and the approval of the Scientific Council, two applicants were offered and subsequently accepted permanent full time positions at IM PAN. We offer our sincere congratulations!

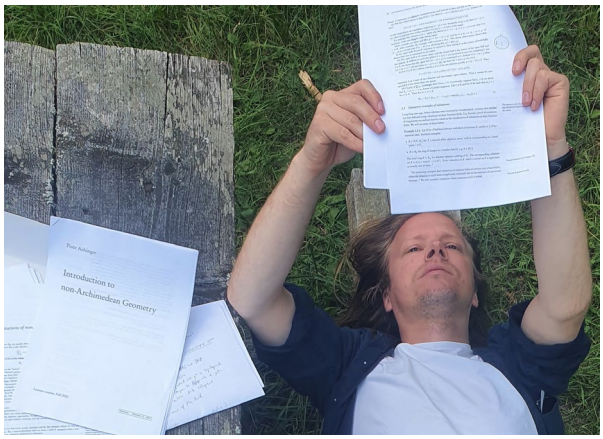
Piotr Achinger works in algebraic geometry, leading a research group at IM PAN's headquarters in Warsaw. He is interested in the homotopy theory of algebraic varieties and other algebraically defined geometric objects: algebraically defined theories of cohomology, fundamental groups, higher homotopy groups, etc.

In his research, among other things, he has shown that every affine algebraic variety over a field of positive characteristic is aspherical. This result was published in 2017 in Inventiones Mathematicae.

His recent work focuses on different kinds of fundamental groups of p-adic analytic spaces.

Piotr Achinger joined IM PAN in 2015 right after finishing his PhD at the University of California, Berkeley. A year later he left for a short EPDI postdoc at IHÉS. In 2016 he won the Kuratowski Prize and in 2022 the Sierpiński Prize. Since 2019, his research at IM PAN has been funded by an ERC Starting Grant. He is an active member of the IM PAN Scientific Council.

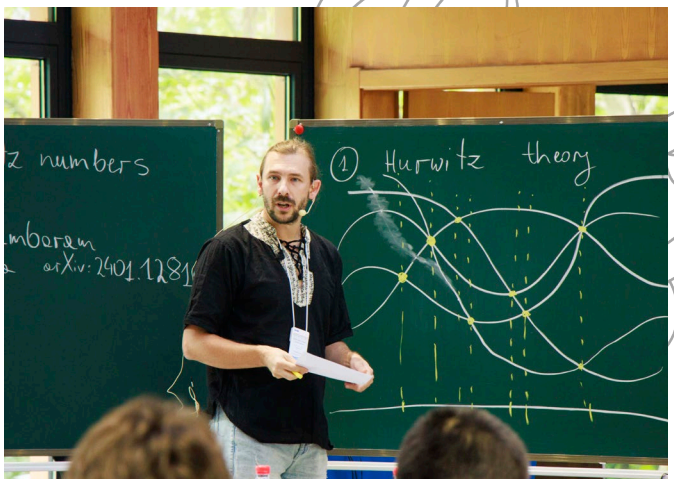
According to Piotr, he values IM PAN for the freedom it gives to mathematicians, in particular for the possibility of focusing almost entirely on research. In the coming years he hopes to write a graduate-level textbook on non-archimedean geometry.



Prof. Piotr Achinger. Credit: private archive.

Maciej Dołęga works at the Kraków branch of IM PAN, where he leads a research group in discrete mathematics. His main research interests lie in algebraic and enumerative combinatorics, with a particular focus on the interactions between combinatorics and other fields, such as representation theory, probability, mathematical physics and enumerative geometry.

His most recent studies explore various deformation theories appearing in probability, enumerative geometry, and mathematical physics through combinatorial models. In these studies, Maciej and his collaborators discovered a combinatorial model that describes a certain deformation between classical (complex) and non-oriented (real) branched coverings, which led to the development of the theory of b-Hurwitz numbers. This new theory provides a combinatorial and topological interpretation of previously studied models in random matrix theory and has significant implications in both mathematics and physics.



Prof. Maciej Dołęga. Credit: Banff International Research Station.

These developments turned out to be very useful in answering several open problems in the field, such as Lassalle's conjecture or the description of the global asymptotic behavior of a large class of random partitions. Nevertheless, what makes them most fascinating, according to Maciej, is that they opened the door to asking many more intriguing questions about possible connections between seemingly unrelated fields.

Maciej Dołęga completed his master's thesis and doctorate under the guidance of Piotr Śniady at the University of Wrocław. Subsequently, he worked at Paris Diderot University and the Adam Mickiewicz University in Poznań. He also conducted research as a visiting scholar at the University of California, San Diego, through the Fulbright STEM Impact Award program. In 2018, he began working at the Kraków branch of the Institute of Mathematics of the Polish Academy of Sciences (IM PAN), where, with the support of the NCN SONATA BIS grant awarded in 2022, he started to form his research group.

According to Maciej, he decided to apply for a permanent position at IM PAN due to the Institute's strong reputation in mathematical research and the possibility of leading and developing a research group. Maciej expects to continue his research in a stimulating and supportive setting, mentoring the next generation of mathematicians and popularizing the emerging fields of algebraic and enumerative combinatorics, which are still largely absent in Poland.

Rafał Latała awarded the FNP Prize

Krzysztof Oleszkiewicz

Rafał Latała was awarded the 2023 FNP Prize in the field of mathematics, physics, and engineering sciences for developing mathematical tools that led to the proof of Talagrand's Bernoulli Conjecture. This prestigious prize, presented annually since 1992 by the Foundation for Polish Science (FNP), is one of the most esteemed scientific awards in Poland, with only a few mathematicians having received it thus far.

Born in 1971, Rafał Latała studied mathematics at the Faculty of Mathematics, Informatics, and Mechanics of the University of Warsaw. He completed his PhD thesis in 1997 under the guidance of Prof. Stanisław Kwapień at the same university and obtained his habilitation in 2002. In 2009, he was granted the title of professor. Since 2016, he has been a corresponding member of the Polish Academy of Sciences. While the University of Warsaw has always been his primary affiliation, Rafał Latała has developed strong connections with IM PAN in Warsaw over the years, particularly valuing the scientific influence of Prof. Aleksander Pełczyński.

Rafał Latała's scientific interests revolve around probability theory and its intersections with other branches of mathematics. He has explored properties of probabilistic objects as diverse as sums of independent random variables, random chaoses, U-statistics, logarithmically concave measures, and random matrices, achieving important results in each area. His most notable accomplishment, recognized by the FNP Prize, stems from his extensive research on suprema of stochastic processes.

The significance of estimating the size of such suprema was initially recognized by Andrey Kolmogorov. In the realm of Gaussian processes, Michel Talagrand refined the methods of Richard Dudley and Xavier Fernique, proving his famous majorizing measure theorem. Motivated by this result, Talagrand posed a conjecture that bounding a Bernoulli process is essentially best achieved by expressing it as a sum of two Bernoulli processes and applying a triangle inequality to one of them while dominating the other with a naturally associated Gaussian process. Talagrand popularized this conjecture by offering a prize for its resolution. After more than fifteen years of dedicated effort and meticulous development of mathematical tools, Rafał Latała accomplished this task in 2014 by publishing, in collaboration with Witold Bednorz, a comprehensive solution in the Annals of Mathematics.

Prof. Rafał Latała. Credit: University of Warsaw.

The FNP President Prof. Maciej Żylicz (left) and the Chair of the FNP Council, Prof. Tomasz Guzik (right) with Prof. Rafał Latała at the awarding ceremony. Credit: FNP.

Jarosław Wiśniewski awarded the Sierpiński medal

Maciej Borodzik

Professor Jarosław Wiśniewski, a mathematician at the University of Warsaw and a member of the IM PAN Scientific Council, was awarded the Sierpiński Medal in 2024 for his outstanding contributions to mathematics. The award ceremony took place on the 12th of June, 2024, at the University of Warsaw, where colleagues, students, and members of the academic community gathered to celebrate his achievements.

The Sierpiński Medal, named after the renowned Polish mathematician Wacław Sierpiński, honors individuals whose work has significantly advanced the mathematical sciences and enhanced the international recognition of Polish mathematics. Professor Wiśniewski's extensive contributions to algebraic geometry made him deserving of this prestigious honor.

Professor Wiśniewski specializes in algebraic geometry, with a focus on complex algebraic varieties, birational geometry, and Mori theory. His research has significantly advanced the Minimal Model Program (MMP), a framework central to simplification and completing the classification of higher-dimensional varieties. His work on Fano varieties, a special class of algebraic varieties with deep applications in geometry and physics, has provided new insights into their structure and classification. These contributions have been instrumental in advancing the understanding of the geometric properties of algebraic spaces.

Prof. Jarosław Wiśniewski with his students: Profs. Adrian Langer (left), Weronika Buczyńska, and Maria Donten-Bury (right). Credit: University of Warsaw.

Prof. Jarosław Wiśniewski. Credit: private archive.

Professor Wiśniewski has published papers in top-tier journals, such as Inventiones Mathematicae, the Journal of the European Mathematical Society, and the Duke Mathematical Journal.

A hallmark of Professor Wiśniewski's career is his dedication to mentoring young mathematicians. Among his Ph.D. students are outstanding mathematicians like Jarosław Buczyński and Adrian Langer. Beyond providing technical guidance, he is known for inspiring his students to approach complex mathematical problems with creativity and rigor, leaving a lasting influence on their professional development.

The ceremony at the University of Warsaw not only honored his groundbreaking research results but also his role as a mentor and leader in the mathematical community. Professor Wiśniewski's ability to connect with and guide the next generation of mathematicians has solidified his legacy as an educator and a researcher.

By awarding him the Sierpiński Medal, the mathematical community acknowledges the depth and significance of his work, as well as his invaluable contributions to shaping the future of mathematics.

Adam Kanigowski awarded the 2024 IM PAN Prize for Outstanding Scientific Achievements

Krzysztof Bogdan

The laureate of the IM PAN Prize for Outstanding Scientific Achievements in Mathematics in 2024 is Adam Kanigowski from the Jagiellonian University and the University of Maryland, recognized for his groundbreaking results in the field of dynamical systems and ergodic theory.

The prize was awarded by a jury consisting of Krzysztof Bogdan (chairman), Piotr Hajłasz, Tadeusz Januszkiewicz, Wojciech Kucharz, Krzysztof Oleszkiewicz, Karol Palka, and Anna Zdunik. A. Kanigowski's research focuses on dynamical systems and ergodic theory, as well as their interactions with number theory, geometry, and probability theory. In particular, A. Kanigowski investigates randomness and chaos in smooth dynamical systems, classification problems in abstract ergodic theory, and so-called nonconventional ergodic theorems at the intersection of dynamical systems and number theory. Together with collaborators, A. Kanigowski has successfully addressed several fundamental open problems including the Rokhlin problem, Ratner's property, ergodic and spectral properties of flows on surfaces, joinings in dynamical systems, Kakutani equivalence, chaotic properties of smooth systems, Sarnak's conjecture, and prime number theorems in dynamical systems.

In his studies of these problems, A. Kanigowski achieved groundbreaking results, publishing over 30 articles in leading journals such as Annals of Mathematics, Journal of the AMS, Inventiones Mathematicae, Duke Mathematical Journal, and Journal of the EMS. He collaborates with global experts in the fields of dynamical systems and ergodic theory, including Dmitry Dolgopyat, Bassam Fayad, Giovanni Forni, Mariusz Lemańczyk, Maksym Radziwiłł, Federico Rodriguez-Hertz, and Corinna Ulcigrai. In particular, Kanigowski, together with Bassam Fayad, proved that key classes of mixing flows, such as Arnold and Kochergin flows, exhibit mixing of all orders. These flows lack exponential sensitivity to initial conditions, making the proof challenging while addressing a decades-old open question for these classes. Their work, which introduced an innovative extension of the Ratner property, was published in Inventiones Mathematicae. In collaboration with Mariusz Lemańczyk and Corinna Ulcigrai, Kanigowski established disjointness properties for parabolic flows beyond the homogeneous case. They proved statistical independence for time-changed horocycle flows and Arnold flows, extending the Ratner property to non-homogeneous dynamics. Kanigowski also solved a long-standing conjecture from the 1970s by proving that homogeneous flows with the K-Property are Bernoulli. In another work, jointly with Dmitry Dolgopyat and Federico Rodriguez-Hertz, he demonstrated that exponentially mixing $C^{1+\alpha}$ diffeomorphisms of compact manifolds preserving a smooth measure are Bernoulli, which is a significant advance in the study of deterministic pseudorandomness.

Prof. Adam Kanigowski. Credit: Jagiellonian University.

Borys Kuca awarded the 2024 Kuratowski Prize

Maciej Dołęga

Dr. Borys Kuca was awarded the 2024 Kazimierz Kuratowski Prize for his scientific achievements in mathematics. The jury awarded the prize for a series of results dedicated to studying polynomial configurations in combinatorics, ergodic theory, and fractal geometry, emphasizing his results on the continuous version of Sárközy's problem.

Sárközy wanted to understand the maximal size of a subset of consecutive integers 1, 2, ..., N without a quadratic progression, i.e., without a pair of the form $\{x, x + z^2\}$. He, and independently Furstenberg showed that such a subset cannot be large – its density has to approach 0 as N tends to infinity. Kuca raised a question about the continuous analog of this classical problem: what is the largest size of a subset of R^2 that does not contain a pair of points of the form $\{x, x + (z,z^2)\}$? Together with Orponen and Sahlsten, he found that the sparseness phenomenon of subsets lacking quadratic progressions discovered by Sárközy and Furstenberg also occurs in dimension 2. Indeed, they showed that the Hausdorff dimension of such a compact subset is always smaller than two by an absolute constant. The Hausdorff dimension in this setting has a similar role as density; it measures how dense or sparse a subset is.

Other results of Kuca describe the structure of subsets lacking various polynomial progressions, for which he applies a rich palette of tools such as ergodic theory and higher-dimensional Fourier analysis.

Dr. Kuca obtained his PhD degree at the University of Manchester and spent two years as a postdoc at the University of Jyväskylä and the University of Crete afterward. He currently works as an assistant professor at the Jagiellonian University. The Kuratowski Prize is awarded annually, jointly by IM PAN and the Polish Mathematical Society, to mathematicians under 30 years of age, of Polish origin, or affiliated with a Polish academic institution.

Dr. Borys Kuca. Credit: private archive.

Christopher Schafhauser awarded the Zemánek Prize

Yuri Tomilov

The Barbara and Jaroslav Zemánek Prize in functional analysis, with emphasis on operator theory, has been awarded in 2024 to Christopher Schafhauser (University of Nebraska-Lincoln) for his fundamental contributions to the classification and structure theory of C*-algebras, particularly to the Elliott classification program. The jury emphasized his outstanding results on AF-embeddability of the UCT C*-algebras and his original and innovative approach to the classification of simple nuclear C*-algebras, which led to a breakthrough in the field.

Schafhauser received his PhD in 2015 from the University of Nebraska-Lincoln under the supervision of Allan Donsig and David Pitts. Before rejoining the University of Nebraska-Lincoln in 2019, he held postdoctoral positions at the University of Waterloo and York University in Canada.

The Barbara and Jaroslav Zemánek Prize was founded in 2018 by the Institute of Mathematics of the Polish Academy of Sciences to encourage research in functional analysis, operator theory, and related topics. The Prize is awarded to mathematicians under thirty-five years of age who have made important

contributions to the field.

The Prize Jury for 2023 consisted of F. Gesztesy (Baylor University), S. Grivaux (Lille University), N. Nikolski (University of Bordeaux), G. Pisier (Texas A&M), A. Skalski (IM PAN), Y. Tomilov (IM PAN), and S. Vaes (KU Leuven).

The award ceremony, featuring the introductory lecture titled "Introduction to the classification of simple nuclear C*-algebras" by Stuart White (University of Oxford) and the Laurate's lecture on "Lifting problems in C*-algebras and applications'" was held at IM PAN, Warsaw, on October 25th, 2024.

For more detailed information about the Prize, please visit the webpage: https://www.impan.pl/en/activities/awards/b-and-j-zemanek-prize.

Prof . Christopher Schafhauser. Credit: private archive.

IM PAN Director Prize for publications in 2023

Piotr Nowak

◆ **dr hab. Piotr Achinger**
P. Achinger, M. Lara, A. Youcis,
"Geometric arcs and fundamental groups of rigid spaces", J. Reine Angew. Math., vol. 2023, no. 799, 2023, pp. 57-107.

◆ **dr hab. Paweł Dłotko & mgr Davide Gurnari**
P. Dłotko, D. Gurnari
"Euler characteristic curves and profiles: a stable shape invariant for big data problems", GigaScience, Volume 12, 2023.

◆ **prof. Piotr Gwiazda**
E. Feireisl, P. Gwiazda, A. Świerczewska-Gwiazda,
"Time periodic motion of temperature driven compressible fluids", Math. Ann., 387, 1603–1627 (2023).

◆ **prof. Tomasz Komorowski**
A. Dunlap, Yu Gu ,T. Komorowski,
"Fluctuation exponents of the KPZ equation on a large torus", Comm. Pure Appl. Math., 2023, 76: 3104-3149.

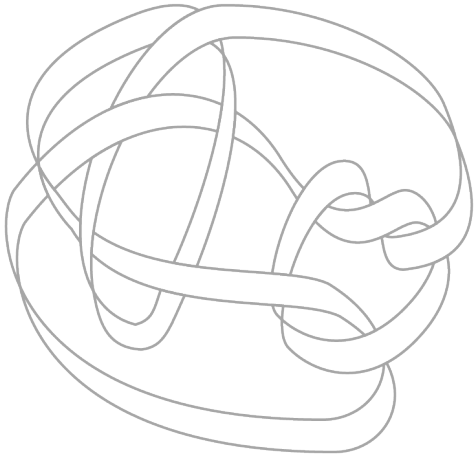
◆ **dr Łukasz Kuciński & dr hab. Piotr Miłoś**
M. Zawalski, M. Tyrolski, K. Czechowski, T. Odrzygóźdź, D. Stachura, P. Piękos, Y. Wu, Ł. Kuciński, P. Miłoś,
"Fast and Precise: Adjusting Planning Horizon with Adaptive Subgoal Search", ICLR 2023
https://iclr.cc/virtual/2023/poster/11591.

◆ **prof. Adam Nowak**
A. Nowak, E. Sasso, P. Sjögren, K. Stempak,
"On non-centered maximal operators related to a non-doubling and non-radial exponential measure",
Math. Ann., 388, 2887–2929 (2024).

◆ **prof. Adam Skalski**
S. Raum, A. Skalski,
„Factorial multiparameter Hecke von Neumann algebras and representations of groups acting on zright-angled buildings", J. Math. Pures Appl., Volume 172, April 2023, Pages 265-298.

◆ **dr Mateusz Wasilewski**
M. Caspers, G. Vos, M. Klisse, A. Skalski, M. Wasilewski,
"Relative Haagerup property for arbitrary von Neumann algebras", Adv. Math., Volume 421, 2023, 109017.

List of new grants at IM PAN in 2024



Paweł Zdanowski

NCN Grants:

Forcing axioms, inner models and determinacy.
(MAESTRO)
dr hab. Grigor Sargsyan
2024 – 2029

Generic large cardinals and determinacy.
(WEAVE-UNISONO)
dr hab. Grigor Sargsyan
2024 – 2027

Graded differential geometry with applications.
(WEAVE-UNISONO)
prof. Janusz Grabowski
2024 – 2027

Side Conditions and the Saturation of the Non-stationary Ideal.
(POLONEZ BIS)
dr Rahman Mohammadpour
2024 – 2026

Functional calculi for semigroup generators and related matters.
(OPUS)
prof. Yuriy Tomilov
2024 – 2027

Between nonlinear partial differential equations and Sobolev-type inequalities.
(OPUS)
dr hab. Jarosław Mederski
2024 – 2028

Advanced problems in contact manifolds, secant varieties, and their generalisations .
(OPUS)
prof. Jarosław Buczyński
2024 – 2028

Nonlinear systems - new challenges.
(OPUS)
prof. Piotr Gwiazda
2024 – 2028

On Zariski pairs of surface singularities.
(OPUS)
dr hab. Christophe Eyral
2024 – 2026

Homotopy Theory in Arithmetic Geometry via Condensed Mathematics.
(SONATA)
dr Marcin Lara
2024 – 2027

Isolated singularities of semilinear elliptic equations with Feller operators: a probabilistic approach.
(PRELUDIUM)
mgr Kamil Dunst
2024 – 2027

NSF –NAWA joint grants:

Spectral and geometric methods for damped wave equations with applications to fiber lasers.
(IMPRESS-U)
prof. Yuriy Tomilov
2024 – 2026

NARODOWE CENTRUM NAUKI

New Faculty in 2024

Jakub Paulus & Piotr Nowak

The following new employees were hired at IM PAN in 2024:

1. dr Tattwamasi Amrutam (2 years)
   Dynamical Systems, Ergodic Theory, Number Theory

2. dr Ayreena Bakhtawar (2 years)
   Dynamical Systems, Ergodic Theory, Number Theory

3. dr Jacopo Bassi (2 years)
   Operator Algebras, Group Theory, Dynamical Systems

4. dr Michał Bogdan (2 years)
   Mathematical Physics, Dynamical Systems, Geometric Topology

5. dr Julian Brüggemann (2 years)
   Algebraic Topology, Geometric Topology, Combinatorics

6. dr Iván Caamaño Aldemunde (2 years)
   Classical Analysis and ODEs, Metric Geometry

7. mgr Igor Chełstowski (1 year)
   Mathematical Physics, Operator Algebras

8. dr Leonidas Daskalakis (2 years)
   Classical Analysis and ODEs, Dynamical Systems, Number Theory

9. mgr John Dolor Manzanares (3 years)
   Algebraic Topology, Statistics Theory, Machine Learning

10. dr Dimitris Gerontogiannis (2 years)
    Dynamical Systems, Functional Analysis, Operator Algebras

11. dr Marcin Lara (5 years)
    Algebraic Geometry, Number Theory

12. prof. Michael Levin (1 year)
    Geometric Topology, Dynamical Systems

13. dr Chunlin Liu (2 years)
    Dynamical Systems, Probability

14. dr Asier López-Górdon (2 years)
    Mathematical Physics, Symplectic Geometry, Differential Geometry

15. mgr Yuze Luan (2 years)
    Algebraic Geometry

16. dr Rahman Mohammadpour (2 years)
    Logic

17. dr Mark Pentigore (2 years)
    Group Theory, Geometric Topology, Metric Geometry

18. dr Katarzyna Ryszewska (1 year)
    Analysis of PDEs, Functional Analysis

19. dr Roberto de Santana Araujo (2 years)
    Differential Geometry

Editorial Board: Maciej Dołęga, Yonatan Gutman.
Graphic Design: Agnieszka Kaliszewska.
Contact: newsletter@impan.pl

IM PAN
ul. Śniadeckich 8
00-656 Warsaw, Poland
www.impan.pl

Stefan Banach International
Mathematical Center
ul. Śniadeckich 8
00-656 Warsaw, Poland

Będlewo Research
and Conference Center
ul. Parkowa 1, Będlewo
62-060 Stęszew, Poland