

# Newsletter of IMPAN



INTERNATIONAL  
GRANTS

OPUS  
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SEMESTERS

CONFERENCES



# International Grants

## ERC Starting Grant:

### Rigidity of Groups and Higher Index Theory

Coordinator: Piotr Nowak



The project “Rigidity of Groups and Higher Index Theory” (acronym: INDEX) is funded by the European Research Council under the Starting Grant scheme. The goal of the project is to find counterexamples to various versions of the Baum-Connes conjecture. The conjecture, formulated by Paul Baum and Alain Connes, is a vast generalization of the Atiyah-Singer index theorem. Its current formulation is in terms of an assembly map from a certain K-homology group, representing equivalence classes of abstract elliptic operators associated to a group  $G$ . The assembly map takes values in the K-theory of the reduced  $C^*$ -algebra of  $G$ , a non-commutative object naturally associated to  $G$ . The conjecture then states that this assembly map is an isomorphism.

It is expected that counterexamples to the Baum-Connes conjecture should be a consequence of a certain fundamental rigidity property of groups, Kazhdan’s property (T). This property, introduced by Kazhdan in 1966, says that the trivial representation of  $G$  on a Hilbert space is an isolated point in the Fell topology among other unitary representations. On the other hand proving the Baum-Connes conjecture one usually proceeds by the so-called Dirac-dual Dirac method, which involves constructing homotopies between the trivial and the regular representation of the group. A natural strategy to constructing counterexamples, formulated by Connes in the 1980ies, states that constructing such homotopies should be impossible in the presence of property (T). However, it turned out that this strategy needs to be adjusted, after results of V. Lafforgue, who in 2001 proved the conjecture for

certain groups with property (T) by constructing such homotopies not through unitary but more general representations on Banach spaces.

Studying strengthened versions of property (T) that would prevent the existence of homotopies between representations in Banach spaces is at the heart of the project. Property (T) in the setting of Banach spaces has several related but inequivalent descriptions. One is through the vanishing of group cohomology with coefficients in Banach modules; i.e. modules given by a Banach space and an isometric representation of the group. Another is in terms of the existence of various types of idempotents in certain group Banach algebras, which are obtained by completing the convolution algebra in an appropriate norm or topology. Yet another characterization is in terms of the existence of a spectral gap for a given representation. All of the above are inter-related and understanding the relations between such notions is an important part of the project.

The project requires blending expertise from several fields of mathematics such as geometric group theory, non-commutative geometry and index theory, K-theory, cohomology of groups, representation theory and abstract harmonic analysis. In the process we will hire several postdocs, PhD students and invite senior researchers to visit our group to collaborate and share their expertise. It is expected that this will allow a permanent research group in the area of analytic and geometric group theory to crystalize at IMPAN.

# New Geometry of Quantum Dynamics

## Research and Innovation Staff Exchange, Horizon 2020

### Network coordinator: Professor Piotr M. Hajac

“New geometry of quantum dynamics” is a project which aims to make significant advances in the field of noncommutative geometry by developing new methods through substantial interaction within its sub-fields and with other areas of pure mathematics. The main focus will be to determine the topological nontriviality of new types of quantum fibrations. Also, we aim to construct quantum metric geometries of crossed products and graph algebras relating the Lipschitz-norm and Dirac-operator approaches. The Project will combine various areas, which although interacting on a fundamental level, have had their concrete and usable connections left mostly unexplored.

The success of the Project depends on connecting centres of excellence in relevant topics for the exchange of ideas and production of high-quality collaborative results. The network has been carefully chosen to include the world’s leading experts as well as promising early career researchers. Not only does this guarantee the participants access to an enormous knowledge base, it will also ensure that new and innovative lines of research will continue to be developed long after the Project has finished.

In particular, the collaborative nature of the Project will be of great benefit to the early career researchers involved. In pure mathematics, fields often become so specialised that only a small number of people around the world might be actively researching a particular topic. This can make career progression very difficult. The interdisciplinary nature of the Project will expose the participants to a host of new mathematics and new collaborations. Consequently, this diversification will result in significantly more career opportunities than would otherwise be available.

The Quantum Dynamics network involves around 50 mathematicians working at 20 research centres located in Europe, North America, Australia and New Zealand:

1. Institute of Mathematics of the Polish Academy of Sciences (network coordinator: Piotr M. Hajac)
2. University of Warsaw (node coordinator: Tomasz Maszczyk)
3. University of Łódź (node coordinator: Bartosz Zieliński)
4. University of Glasgow (node coordinator: Joachim Zacharias)
5. University of Aberdeen

- (node coordinator: Luis Santiago Moreno)
6. University of Copenhagen (node coordinator: Ryszard Nest)
7. University of Münster (node coordinator: Thomas Timmermann)
8. Vrije Universiteit Brussel (node coordinator: Kenny de Commer)
9. Scuola Internazionale Superiore di Studi Avanzati (node coordinator: Ludwik Dąbrowski)
10. Pennsylvania State University, State College (node coordinator: Paul F. Baum)
11. University of Colorado at Boulder (node coordinator: Markus J. Pflaum)
12. University of Kansas, Lawrence (node coordinator: Albert Sheu)
13. University of California at Berkeley (node coordinator: Marc A. Rieffel)
14. University of Denver (node coordinator: Frédéric Latrémolière)
15. The Fields Institute, University of Toronto (node coordinator: George Elliott)
16. University of New Brunswick at Fredericton (node coordinator: Dan Kucerovsky)
17. University of Wollongong (node coordinator: Aidan Sims)
18. Australian National University (node coordinator: Alan Carey)
19. University of Otago (node coordinator: Iain Raeburn)
20. Universidad Michoacana de San Nicolas de Hidalgo (node coordinator: Elmar Wagner)

Main networking activities are carried out through monthly secondments from EU countries to countries located outside of Europe. The seconded researchers focus their investigations on the following cross-cutting thematic areas:

- Noncommutative Borsuk–Ulam–type conjectures
- Noncommutative bordism of quantum fibrations
- Trimming or growing of graphs for graph algebras
- Noncommutative metric geometry of  $C^*$ -dynamical systems and graph  $C^*$ -Algebras
- Noncommutative spectral geometry for quantum group homogeneous spaces



# POLGRAW – member group of the Virgo project

**The Virgo-POLGRAW group was created in 2008 and joined the Virgo project.**

Memorandum of Agreement of Polgraw with the Virgo Collaboration was signed on April, 24th, 2009, and renewed on July, 15th, 2014. The group initially consisted of data analysts and astrophysicists but later expanded by an engineer. Professor Andrzej Królak from IMPAN is the coordinator of Polgraw. In 2013 home institutions of the members of the Polgraw group established the Polish Consortium of the Virgo project. IMPAN is the leader of this Consortium. The Consortium has been placed on the Polish Roadmap of Research Infrastructures by Polish Ministry of Science and Higher Education. The group is being funded by several grants from Polish funding agencies: Ministry of Science and Higher Education and National Science Center.

The group has currently 15 members from 8 Institutions: Institute of Mathematics of Polish Academy of Sciences, N. Copernicus Astronomical Center of Polish Academy of Sciences, Warsaw University, University of Białystok, University of Zielona Góra, University of Wrocław, University of Torun, and National Center for Nuclear Studies.

The group contributes to the following data analysis

activities:

- a. Participation to the all sky search for GWs emitted by rotating neutron stars.
- b. Modeling populations of GW signals from coalescing binary systems of neutron stars and black holes, including black-hole binaries with non-negligible spins.
- c. Searching for coincidences in VIRGO data with gamma ray bursts (GRBs) and their optical afterglows.

The group also maintains and develops in Poland the necessary research infrastructure including technical laboratories and computing power for data storage and analysis. The group is also involved in the following activities: detector characterization - search for periodic interferences in the data, contribution to the construction, maintenance, and development of Advanced Virgo detector, participation to data taking shifts, education of scientists and engineers for research in the fields of gravitational wave astrophysics, gravitational wave astronomy, and gravitational wave detector technology,



Andrzej Królak - leader of the POLGRAW group at the press conference announcing the first direct detection of a gravitational wave signal held at Cascina, Italy, 11th February 2016.

Virgo is a giant laser interferometer designed to detect gravitational waves. It is operated and improved in Cascina, near Pisa on the site of the European Gravitational Observatory (EGO), by an international collaboration of scientists from France, Italy, the Netherlands, Poland, and Hungary.



Polgraw group. From left to right: Paweł Ciecieląg, Magdalena Sieniawska, Orest Dorosh, Izabela Kowalska-Leszczyńska, Dorota Rosińska, Adam Zadrozny, Michał Bejger, Andrzej Królak, Piotr Jaranowski, Tomasz Bulik. (Credits: The Virgo Collaboration)

participation and organization of the schools and conferences including the meetings of the LIGO Scientific Collaboration and Virgo Collaboration, public outreach in the gravitational wave field.

Virgo Project collaborates closely with the LIGO Project. By Memorandum of Understanding between LIGO and Virgo, all analyses are performed jointly by common data analysis groups. The members of the two collaborations have the exclusive right to the data from this unique, global gravitational wave detector network. This very large international infrastructure was built at a cost of around 1 bln US dollars. Polgraw group members have direct influence on the management of the Virgo project and directions of the gravitational wave searches in both LIGO and Virgo data. Andrzej

Królak is a member of the Virgo Steering Committee and a co-chair of one working group.

On the 11th of February 2016 the LIGO-Virgo Consortium announced the first direct detection of a gravitational wave signal. The publication describing this discovery was signed by 1005 authors - members of the Consortium. It included 9 authors from the Virgo-POLGRAW group. Those 9 authors were awarded the Copernicus Medal by Polish Academy of Sciences. All the 1005 authors of the discovery paper (including 9 members of the POLGRAW group) were awarded the Special Breakthrough Prize, USA.



Virgo gravitational wave detector. Cascina near Pisa, Tuscany, Italy.

# Polish Research Grants OPUS

*OPUS is an important competition of the National Science Center (NCN) for the funding of research projects. Currently eleven grants of this type are implemented at IMPAN. Ten grants of the earlier editions were described in the Newsletter of IMPAN no. 6, 7 and 8. In 2015, in the competition of OPUS 9, two grant applications from IMPAN were selected for funding: the applications by Adrian Langer and by Zbigniew Jelonek.*

## Representations of the fundamental group and geometry of algebraic varieties

Coordinator: Adrian Langer (01.2016–01.2019)



The project is in the mainstream of current research on the border of algebraic geometry and arithmetic. It is devoted to the study of geometry of varieties defined over complex numbers and over fields of positive characteristic, mixing the points of view of mathematical physics and number theory. The main motivation behind these studies is their possible application to number theory, topology, differential equations and mathematical physics.

For example, one of the problems pertains to general differential equations on complex algebraic varieties and the attempt to classify them. In simple cases (the so called regular singular case), holomorphic (or algebraic) differential equations can be classified topologically by means of the associated representation of the fundamental group (the so called monodromy representation). The classifying space for representations of the fundamental group has a simple algebraic structure

that can be obtained by writing down the group using its generators and relations between them. However, the holomorphic change of differential equations leads to other algebraic structures that this naive one and it has been well understood only in the curve case. The problem addressed in the project is about existence of such a structure in the general case, when not only the description of the solutions by means of monodromy is insufficient, but also the dimension of the variety is arbitrary. The main motivation behind this problem comes from Deligne's theorem about finiteness of  $l$ -adic sheaves with bounded ramification on varieties defined over finite fields. The proof of this theorem uses some deep results of Lafforgue about Langlands correspondence on curves. The analogous problem on varieties defined over fields of positive characteristic has deep relations to certain conjectures on  $D$ -modules on algebraic varieties. In particular, the solution of such a

problem in positive characteristic would give the proof of Gieseker's conjecture saying that vanishing of the fundamental group implies triviality of all D-modules on such a variety.

The remaining problems are somewhat more difficult to state in an elementary fashion. All of them are related to the study of representations of the fundamental group of an algebraic variety and to geometry of varieties defined over fields of various characteristics. They are also deeply related to arithmetic. They pertain to

a generalization of the non-abelian Hodge theory to positive characteristic and to the p-adic case, the study of homotopy theory of varieties in positive characteristic, the study of monodromy group via log geometry and the study of p-adic Langlands correspondence by means of the newly created perfectoid spaces.

## Singularity theory and affine algebraic geometry

### Coordinator: Zbigniew Jelonek (01.2016–01.2019)

The aim of the project is to describe the topology of proper polynomial mappings. We show that there are only finitely many nonequivalent mappings  $X^n \rightarrow Y^n$  with given geometric degree and determinant, where  $X^n \rightarrow Y^n$  are smooth n-dimensional varieties. Especially interesting are proper mappings  $C^n \rightarrow C^n$ . We show that there are only finitely many topological types of proper polynomial mappings  $C^n \rightarrow C^m$  with bounded degree.

We show that a general polynomial mapping of a given multidegree has a fixed topological type (we say that a general polynomial mapping of a given multidegree has some property if there is an open dense subset in the space of all polynomial mapping of the given multidegree whose all elements have this property). Thus in this case we may effectively compute topological invariants of general mappings of fixed multidegree.

In particular we describe the singularities of general  $C^2 \rightarrow C^2$  polynomial mappings of fixed multidegree. For a general polynomial mapping  $F: C^2 \rightarrow C^2$  we will show that  $\text{Sing}(F)$  is a smooth irreducible curve, we will calculate its degree and genus. We will also describe all singularities (in the domain and in the target) of this mapping and we count them.

We will introduce the notion of a generalised cusp and index of a generalised cusps (informally the index describes how many cusps have been glued together) and show that the sum of indexes of generalised cusps of a proper polynomial mapping is not greater than the number of cusps of a general polynomial mapping of the same multidegree.

We describe also the singularities of general  $C^3 \rightarrow C^3$  polynomial mappings of fixed multidegree. Finally our aim is to describe the singularities of corank 1 of a general polynomial mapping  $F: C^n \rightarrow C^n$ . We will classify all the types of singularities of corank 1 and calculate the dimension and degree of varieties formed by singularities of each type. This task involves ordering the types of singularities according to how complicated they are and devising a method of describing the locus of more complicated singularities using the description of the locus of less complicated singularities.

The approach to studying  $C^n \rightarrow C^m$  polynomial mappings we propose is completely new. So far authors focused only on research of local nature, with the exception of Szafraniec et al., however they focus on computations involving only a single polynomial mapping. We are not aware of any papers concerning the locus of singular points of given type for a general polynomial mapping. Thus one could say that we build the singularity theory for global polynomial mappings and create the suitable tools for doing this.



# The 1st Simons Semester: report

## DYNAMICAL SYSTEMS, *September-December 2015*

Briefly: about 100 mathematicians participated for at least two weeks and about 30 permanent (for most time of the semester). There were 16 mini-courses (6-12 hours) by François Berteloot, Peter Haïssinsky, Davoud Cheraghi, Károly Simon, Antti Käenmäki, Alexander Olevskii, Marco Martens, Zoltán Buczolich, François Ledrappier, Mark Pollicott, Lorenzo Diaz, Anton

Gorodetski, Pierre Berger, Yanqi Qiu, Jörg Schmeling. Remarkable lectures by world leaders in Ergodic Theory, in particular by Jon Aaronson, Jean-Pierre Conze, Eli Glasner, Klauss Schmidt, Jean-Paul Thouvenot, Benjy Weiss. The semester was accompanied by 4 workshops: **Topics in Analysis and Holomorphic Dynamics** (September, Warsaw), **Fractal Geometry and Dynamics**



Participants of the Simons Semester workshops: Ergodic Theory of Dynamical Systems and Translation Surfaces and Dynamics in Będlewo, 22-28 November 2015

(October, Będlewo), **Ergodic Theory of Dynamical Systems** (November, Będlewo), **Translation Surfaces and Dynamics** (November, Będlewo). A two-hour session took place in December 16 on Henon attractor, with talks by world leader in this area: Michael Benedicks, Pierre Berger and Marco Martens.

Notes to some mini-courses and abstracts of talks are available at the semester web page.

All participants were asked after the semester to submit 1/2-1 page long reports. We attached some of them to the report to Simons Foundation. They contain valuable hints to the organizers of consecutive semesters.

Deans of strongest mathematics departments of Polish Universities were informed (on December's yearly meeting) about participants who would potentially look for a job in Poland, also the participants were informed about job possibilities.

Mentoring was not organized formally. Leaders were easily accessible, having offices at IMPAN and some

of them even accommodated at IMPAN guest rooms. Young participants got numerous consultations; they were mentioned in their individual reports. Unfortunately, few local master degree students participated. A remedy would be in future semesters to allocate to participants some ECTS credits.

Many papers resulting from the cooperation between the participants have been prepared. A highlight is the paper: Balázs Bárány, Antti Käenmäki, Ledrappier-Young formula and exact dimensionality of self-affine measures, arXiv:1511.05792., commented by the chairman of the session where the results were presented as the most spectacular recent result in this area. The abstract says "We solve the long standing open problem on exact dimensionality of self-affine measures." The paper combines methods of dynamics and geometric measure theory.

*Feliks Przytycki*

A description of the semester was already presented in the Fall 2015 issue of the Newsletter.  
See also [bcc.impan.pl/15Simons-I](http://bcc.impan.pl/15Simons-I).

## SIMONS SEMESTER ALGEBRAIC GEOMETRY, *April-June 2016*

The current Simons Semester at the Banach Center runs from April to June 2016 and is devoted to Algebraic Geometry with the focus on the following more specific subjects:

- Hyperkähler manifolds,
- K3 surfaces,
- Fano varieties,
- Calabi-Yau varieties,
- linear series.

The acronym for the semester is miniPAGES because this is in fact a half semester (mini) and more precisely this is a Polish Algebraic GEometry mini-Semester.

Scientific activities include three one week long intensive events:

- Introductory School "Varieties of Calabi-Yau type", Warsaw, April 18-22. There were series of lectures
- Automorphism groups of K3 surfaces and their applications by Viacheslav Nikulin (Steklov Mathematical Institute in Moscow and University of Liverpool)
- Hyperkähler manifolds by Kieran O'Grady (Università degli studi di Roma "Sapienza")
- Calabi-Yau threefolds and sheaf counting by Balázs Szendrői (University of Oxford)
- Workshop "Asymptotic invariants attached to linear series", Cracow, May 15-20. There are series of lectures
- Line arrangements and recent research on linear systems of plane curves by Brian Harbourne (University

of Nebraska, Lincoln)

- Positivity and Newton-Okounkov bodies by Alex Küronya (Göthe University of Frankfurt)
- Nagata type statements by Joaquim Roé (Universitat Autònoma de Barcelona) as well as contributed talks. An important part of the workshop are working groups focusing on research problems of high current interest
- Closing conference "Varieties with trivial canonical bundles", Będlewo, June 12-18. The invited speakers are: Ekaterina Amerik, Michel Brion, François Charles, Klaus Hulek, Jun-Muk Hwang, Ljudmila Kamenova, JongHae Keum, Vladimir Lazic, Eyal Markman, Shigeru Mukai, Viacheslav Nikulin, Thomas Peternell, Kristian Ranestad, Alessandra Sarti, Matthias Schuett and Duco van Straten.

as well as series of 6 seminars taking place every week with talks divided in categories: introductory, research and advanced given by well established professors, current postdocs and graduate students. The diversity of talks corresponds to the diversity of the participants.

Apart of the intensive events during the semester the Banach Center will host about 70 participants with research stays ranging from one week to two months. It is not possible to mention here the names of all participants, we mention just a few names of young and experienced researchers by the way of an example:

- Gwyn Bellamy,
- Fedor Bogomolow,
- Arijit Dey,
- Igor Dolgachev,
- Daniel Greb,
- Nikon Kurnosov and many more.

The Algebraic Geometry Simons Semester is organized by **Jarosław Buczyński** (University of Warsaw and IMPAN), **Sławomir Cynk** (Jagiellonian University, Cracow) and **Tomasz Szemberg** (Pedagogical University of Cracow).

The web page of the semester is available at:  
<http://minipages.impan.pl>



Participants of the Simons Semester "Algebraic Geometry"

# Conferences

## THE 2<sup>nd</sup> CONFERENCE OF THE POLISH SOCIETY ON RELATIVITY: 100 YEARS OF GENERAL RELATIVITY

23–28 November 2015

Stefan Banach International Mathematical Center,  
23–27 November 2015, Warsaw

The scientific program covered a broad range of topics from the mathematical structure of General Relativity (GR) and fundamental issues of the classical gravity, through the mathematical models of quantum gravity, to gravitational waves and their detection. Because of the 100 anniversary of GR there was an additional day of the conference (11/28/2015) organized at the Faculty of Physics of University of Warsaw that had a special, historical character. The goal of the conference was to give an account of achievements of GR. This theory had been developed in many different directions. All of them were included in the conference. We invited experts from the leading world centers of mathematical relativity and gravitational physics who presented the state of art in our knowledge and understanding of the various areas of General Relativity:

- *Global Structure of space-time,*
- *Properties of Einstein's equations and evolution of initial data,*
- *Methods of deriving and properties of exact solutions,*
- *Numerical analysis of Einstein's equations,*
- *Black holes,*
- *Cosmology, relativistic astrophysics,*
- *Detection and analysis of gravitational waves,*
- *Models of quantum gravity,*
- *Higher dimensional generalizations of GR,*
- *History of General Relativity,*
- *Alternative theories of gravity.*

THE CONFERENCE WAS ORGANISED JOINTLY BY:  
Stefan Banach International Mathematical Center  
Polish Society on Relativity  
Faculty of Physics, University of Warsaw

### LOCAL ORGANIZING COMMITTEE:

Katarzyna Grabowska  
Wojciech Kamiński  
Ryszard Kostecki  
Andrzej Królak  
Jerzy Lewandowski (Chair)  
Andrzej Okołów  
Piotr Sułkowski  
Adam Szereszewski

### SCIENTIFIC ORGANIZING COMMITTEE:

Piotr Jaranowski  
Jerzy Jurkiewicz  
Andrzej Królak  
Jerzy Lewandowski (Chair)  
Jacek Tafel  
Andrzej Trautman  
Andrzej K. Wróblewski

The participants included many eminent relativists from Poland and abroad including Sir Roger Penrose from Oxford, UK and Kip S. Thorne from California Institute of Technology, USA - one of the founder of the LIGO project that recently led to the detection of gravitational waves.

*Andrzej Królak*

The full program of the meeting  
can be found on the website:  
[http://potor.fuw.edu.pl/gr100y/  
index.php/program/](http://potor.fuw.edu.pl/gr100y/index.php/program/)

# MODERN APPLICATIONS OF OPERATOR THEORY SCHOOL

*Będlewo Conference Center, 10-16 April 2016*

The school and workshop titled “Modern Applications of Operator Theory” (April 10-16, 2016) took place in the IM PAN conference center in Bedlewo, and was organized by Yu. Tomilov (IM PAN) and A. Bobrowski (Lublin University of Technology).

The meeting consisted of two eight-hour lecture courses given by **M. Leautaud** (University Paris-Diderot) and **S. Mischler** (University Paris-Dauphine) and titled “Decay rates for the damped wave equation” and “Semigroups in Banach spaces and applications to (nonlinear) evolution PDEs”, respectively. These courses were accompanied by ten one hour research talks. The speakers ranged from established mathematicians like **C. Batty** (Oxford), **J. Prüss** (Halle) or **R. Chill** (Dresden) to recent PhDs, including **L. Pau-nonen** (Tampere) or **D. Seifert** (Oxford). Overall, the meeting hosted 30 participants from seven countries (Germany, Great Britain, Finland, France, Italy and Poland). More than half of participants were young, mostly Polish, PhD students.

The meeting concentrated on operator-theoretical methods for the study of decay of solutions to PDEs,

and its rates (e.g. energy decay rates). The emphasis has been put on operator semigroups methodology, and its use in dealing with concrete equations.

However, other interesting topics (including Navier-Stokes equations, self-similar solutions of PDEs, equations in scales of Banach spaces, well-posedness of abstract coupled systems, etc.) with potential interactions were discussed as well.

M. Leautaud's lectures focused on the fast-growing theory of operator-theoretical approach to the damped wave equations on compact manifolds. In particular, he discussed well-posedness, energy dissipation and spectral localization for such equations. The interplay between semigroup theory (and especially resolvent estimates), micro-local analysis, and the dynamics of geodesic flows was thoroughly explained and exemplified by a number of examples. He also spoke on the role of the geometric control condition in the study of uniform decay of energy, and presented a proof of the famous Bardos-Lebeau-Rauch-Taylor theorem. Moreover, he showed how Carleman estimates and tunneling lead to a priori decay rates, and thus to e.g.

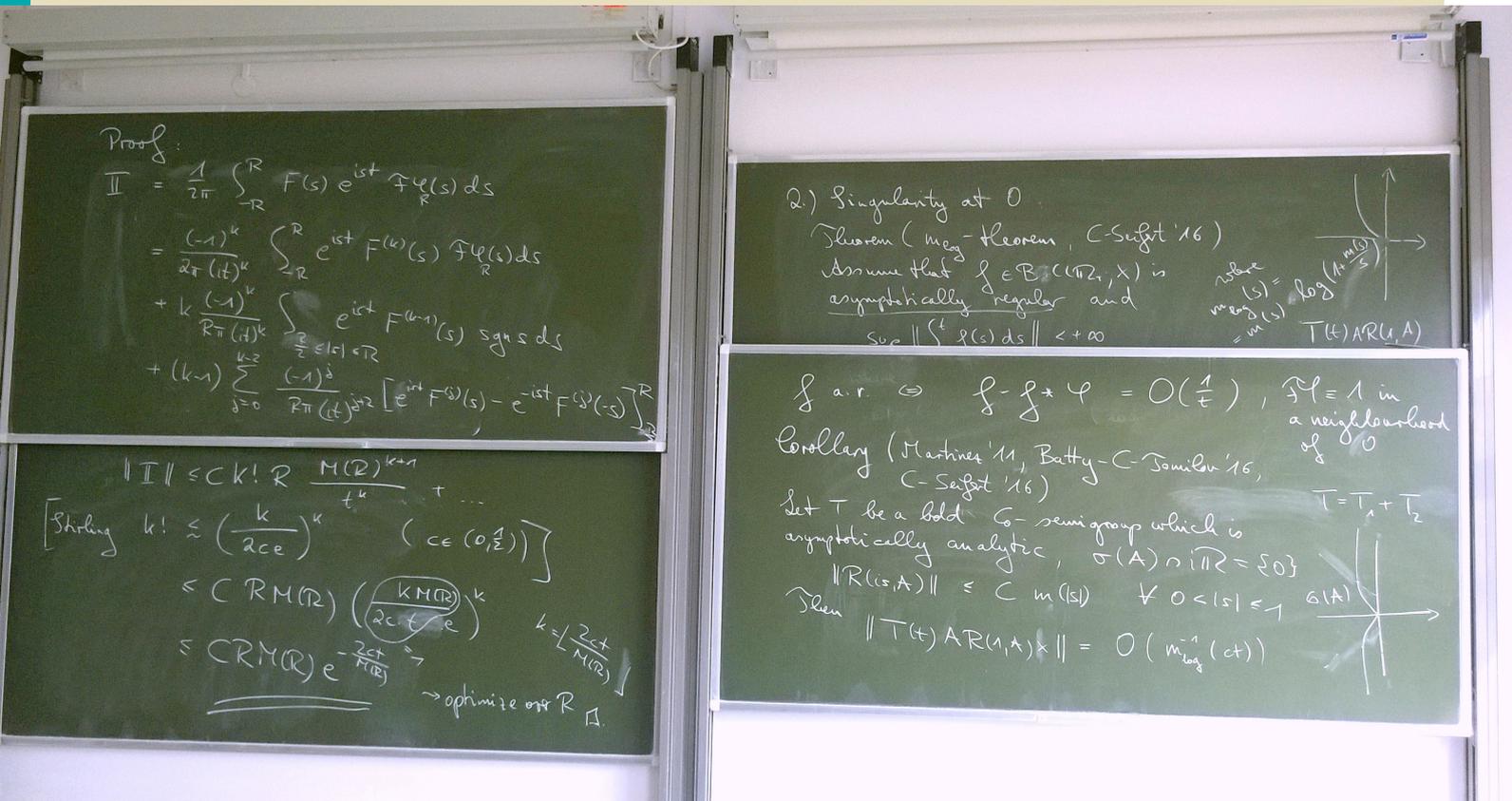


Photo taken during the workshop

the Lebeau theorem on logarithmic decay. Finally, he proved several of his joint results with N. Anantharaman on polynomial decay rates for the damped wave equation on the torus. The ideas based on a blend of micro-local analysis and operator theory were sharply underlined and developed in great detail.

The aim of S. Mischler's course was to discuss recent progress in the theory of semigroups, which has been motivated by applications to several classes of PDEs originating from the kinetic theory of gases, and to biological modelling. First, he presented efficient versions of classical results such as the spectral mapping theorem, Weyl's theorems, Krein-Rutman theorem, and stability under perturbation theorem. Afterwards, he explained the factorization approach for both the spectral analysis of semigroup generators and for the semigroup growth estimates, due to him and to his

colleagues. This approach is based on the iterated Duhamel formula and its resolvent counterpart in the spirit of Dyson series expansion.

He motivated and illustrated the abstract theory by applications to several important PDEs.

In particular, he concentrated on a unified treatment of convergence to equilibrium for the discrete and classical Fokker-Planck equations. Other applications included long-time asymptotics of solutions to the Keller-Segel equation for chemotaxis, and solutions to a time elapsed neuron network model.

The meeting was completed by an inspiring Open Problems Session. Following the meeting's success and expressed enthusiasm of its participants, it is planned to organize similar events on regular basis.

*Yuriy Tomilov*

## COMBINATORICS AND GROUPS

*Będlewo Conference Center, 11-14 April 2016*

The aim of the meeting was to bring together researchers working in a broadly understood field of Combinatorics and Group Theory, both from Poland and from abroad. The core of the conference is the collaboration between researchers from University of Wrocław, Adam Mickiewicz University and the Institute of Mathematics of the Polish Academy of Sciences. During the conference most of the participants gave talks, in particular there were six longer invited talks and twelve shorter ones. The free time was devoted entirely to collaborations. This was the second meeting of this form and we expect to continue in the upcoming years.

### ORGANIZING COMMITTEE:

Tadeusz Januszkiewicz  
Tomasz Łuczak  
Sylvia Antoniuk  
Łukasz Garncarek  
Jakub Gismatullin  
Piotr Nowak  
Damian Osajda

### PROGRAM COMMITTEE:

Sylvia Antoniuk  
Jakub Gismatullin  
Damian Osajda

### SELECTED TALKS DELIVERED AT THE CONFERENCE:

**Christopher Cave** *Expanders, ghosts and amenable actions*

**Jeremie Chalopin** *Helly graphs and Helly groups,*  
**Victor Chepoi** *Sweakly modular graphs and their complexes*

**Yusuf Civan** *Castelnuovo-Mumford regularity of graphs*

**Dawid Kielak** *The Bieri-Neumann-Strebel invariants, and Thurston and Alexander norms for free-by-cyclic groups*

**Adam Timar** *Indistinguishable clusters in random spanning forests*

**Michał Adamaszek** *Euclidean Rips complexes*  
**Aleksandra Kwiatkowska** *Uniqueness of an invariant probability measure concentrated on an orbit*

**Yuval Peled** *Simple connectivity of random simplicial complexes via triadic process propagation.*

*Piotr Nowak*

# Institute's News

## IMPAN Prizes

### IMPAN Scientific Prize

The 2016 IMPAN Scientific Prize was granted to Professor Krzysztof Oleszkiewicz from the Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw for outstanding achievements in probability theory and its applications. The Award Ceremony after which the laureate will deliver a lecture will take place during the June session of the Scientific Council of IMPAN.



Photo by Anna Myjak-Pycia

The IMPAN Scientific Prize is conferred annually for exceptional accomplishments in the field of Mathematics. The laureate is chosen by a Jury made up of 7 members appointed by the Director of IMPAN after consulting the Scientific Council of IMPAN.

### The Kazimierz Kuratowski Award

The 2016 Kazimierz Kuratowski Award was granted to Dr. Piotr Achinger from the Institute of Mathematics of the Polish Academy of Sciences for his work on the algebraic geometry in positive characteristic. The Award Ceremony will take place in Olsztyn during the 7th Forum of Polish Mathematicians on 12-17 September 2016.

The Award was introduced in 1981 by Zofia Kuratowska, the Institute of Mathematics of the Polish Academy of Sciences and the Polish Mathematical Society (PTM). Among the previous laureates, there are many prominent Polish mathematicians.



# Faculty Awards

## Stefan Banach Medal for Professor Henryk Iwaniec

Professor Henryk Iwaniec from Rutgers University was announced this year's laureate of the Stefan Banach Medal, a prestigious prize awarded by the Presidium of the Polish Academy of Sciences for outstanding achievements in mathematical sciences. On this occasion, professor Iwaniec delivered a lecture entitled "Zeros of the zeta function" on 3 December 2015 at the Institute of Mathematics of the Polish Academy of Sciences.



Professor Iwaniec during the lecture "Zeros of the zeta function"

## The Polish Mathematical Society (PTM) Award for Young Mathematicians

The PTM Award for Young Mathematicians for the year 2015 was granted to Dr. Adam Kanigowski from the Institute of Mathematics of the Polish Academy of Sciences. He was awarded for the series of six papers in the field of ergodic theory and operators theory. The Award Ceremony will take place in Olsztyn during the 7th Forum of Polish Mathematicians on 12-17 September 2016.





Professor Andrzej Królak and Professor Jerzy Duszyński, President of the Polish Academy of Sciences  
Photo by Jakub Ostałowski/PAN

## Medal of the Polish Academy of Sciences for POLGRAW



On 11 February, at a press conference, scientists from Virgo-POLGRAW group announced the discovery of gravitational waves. The leader of POLGRAW is Professor Andrzej Królak from the Institute of Mathematics of the Polish Academy of Sciences. On March 15, 2016, the Presidium of the Polish Academy of Sciences awarded Polish Research Team POLGRAW the Mikołaj Kopernik Medal of the Polish Academy of Sciences for the discovery they made.

The Mikołaj Kopernik Medal is the most important and prestigious award of the Polish Academy of Sciences. The award ceremony was part of the meeting of the Presidium on April 19, 2016, at the Staszic Palace in Warsaw, and it was attended by 7 out of 9 awarded scientists, including the leader of the Research Team POLGRAW – professor Andrzej Królak.

## Special Breakthrough Prize for detection of gravitational waves

On May 2, 2016, the Selection Committee of the Breakthrough Prize in Fundamental Physics announced the award of a Special Breakthrough Prize in Fundamental Physics for scientists and engineers who greatly contributed to the detection of gravitational waves – a milestone discovery in the world of science made 100 years after Albert Einstein himself foresaw they existed. The detection was announced on February 11, 2016. The

leader of the research team POLGRAW which made the discovery was professor Andrzej Królak.

The Selection Committee, each year composed of many prominent scientists, can award the Special Breakthrough Prize in Fundamental Physics on any occasion, in addition to the Breakthrough Prize which is conferred annually.

# They passed away

## IN MEMORY OF PROFESSOR PIOTR ANTOSIK (1929 – 2015)

Piotr Antosik was born on 27 June 1929 in Skoczylody, Łódź Voivodeship. His adventure with Mathematics started when he began studies at the Moscow State V. I. Lenin Pedagogical Institute which he finished in 1954. Upon his return to Poland, he started working at the Higher Pedagogical School in Katowice.

In Silesia, he met professor Jan Mikusiński, who was surrounded by a group of young mathematicians fascinated with the research their master carried out. In 1964, Piotr Antosik defended his PhD thesis, and in 1966, he began his employment at the Institute of Mathematics of the Polish Academy of Sciences in a newly created laboratory in Katowice. Apart from conducting intensive scientific research, Piotr Antosik substituted Professor Mikusiński in administering the laboratory, which in the 70s was part of the continually transforming units of the Polish Academy of Sciences, among others of the Centre for Scientific Research in Gliwice and of the Department of Complex Control Systems, and which in 1977 was converted into a branch of the Institute of Mathematics Polish Academy of Sciences. Also in 1977, he received habilitated-doctor degree, and in 1988, he became extraordinary professor (an academic title granted by the President of the Republic of Poland). Professor Antosik maintained intense cooperation with mathematicians both from Eastern Europe and United States, and in 1974-75, 1981-83 and 1988-91, he worked at different American universities.

Professor Antosik promoted three doctors, including **Piotr Mikusiński**, now a professor at the University of Central Florida, as well as **Józef Burzyk** and **Czesław Klisia**.

Professor Antosik conducted scientific research within the field of theory of generalized functions and functional analysis. He published about sixty scientific papers and three books: on the theory of distributions with professor J. Mikusiński and R. Sikorski, on the applications of matrix methods in functional analysis with Ch. Swartz, and on the theory of generalized functions with A. Kamiński.

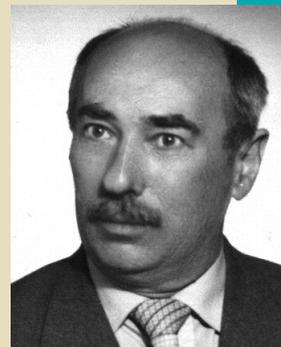
Professor Antosik actively participated in the life of

the Silesian mathematical community. In 1984-1986, he was the President of the Upper Silesian Branch of the Polish Mathematical Society, and in 1977-1980 – of the Regional Committee for Mathematical Olympiad in Katowice. He participated in the process of popularizing Mathematics in school environment through delivering popular science lectures for students and teachers in secondary schools. His contribution to organizing scientific sessions and conferences by the branch of IM PAN in Katowice was significant. He was the main organizer of the so called “mountain seminars”, i.e. weekly trips for the participants of professor Mikusiński’s seminar to mountain towns. Over the course of a year, two such seminars were organized, and both Polish and foreign mathematicians participated in them.

Professor Antosik took a keen interest in the affairs of employees of the IM PAN branch, and was always willing to help them in many private matters. At the same time, he was a very modest man. When the scientific subject-matter related to the generalized functions started to deplete, he employed people engaged in other research, and let the branch change its scientific profile unobstructed. Thanks to this, I had the opportunity to work at the Institute of Mathematics of the Polish Academy of Sciences.

Professor Antosik passed away on 23 October 2015 in Katowice. He was buried in a family tomb in Skoczylody. We lost a man of a great heart, a friend, a person very much involved in the development of Mathematics in the Upper Silesia.

*Based on a memoir written by Ryszard Rudnicki and Krystyna Skórnik*



## PROFESSOR JERZY BROWKIN

### *passed away on November 23, 2015 in Warsaw*



Professor Jerzy Browkin was born in 1934 in Maciejów, near Kowel, Poland (now Ukraine). In 1952, he finished the renowned Reytan High School in Warsaw. Also in 1952, he was laureate of the first prize in the 3rd Polish Mathematical Olympiad. In 1952-1956, he studied mathematics at the Faculty of Mathematics, Physics and Chemistry of the University of Warsaw. Since 1955, Jerzy Browkin worked at the University of Warsaw until his retirement in 2006. In the years 2007-2015, he held a part-time, full professor position at IMPAN, mostly in the Department of Number Theory.

In 1963, he was awarded Ph.D degree at the University of Warsaw. The title of his PhD thesis was "Construction of the class field tower" (in Polish). Although formally his Ph.D was supervised by A. Mostowski, he considered himself a student of W. Sierpiński and I. R. Shafarevich. In 1969, Jerzy Browkin obtained his habilitation degree. The title of his habilitation dissertation was "Zeros of forms" (in Polish). In 1987, he received the title of extraordinary professor, and in 1993, the scientific title of professor.

Jerzy Browkin was very involved in organizing the life of mathematical community. During the years 1977-1980, Jerzy Browkin was a vice-dean, and in 1987-1991, a dean of the Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw.

He was the Secretary of the Organizing Committee of the International Congress of Mathematicians, 1982, held in Warsaw in 1983. In 1970-1972, he was a member, and in 1972-1974, the Chairman of the Regional Mathematical Olympiad Committee, Warsaw I. He published two volumes with the problems and solutions of Polish Mathematical Olympiads (Vol. 5 and 6). In 1975-1991, he was the Secretary of the Editorial Board of *Acta Arithmetica*, and in 1991-2015, a member of the Advisory Editorial Board.

Jerzy Browkin's scientific interests in consecutive decades were:

- elementary theory of numbers,
- algebraic number theory
- zeros of forms in local fields,
- arithmetic problems in algebraic K-theory
- the abc-conjecture
- computation of tame kernels of quadratic and cubic fields
- elliptic curves.

Jerzy Browkin was the author of about 50 research papers, with several co-authors (7 joint with Andrzej Schinzel). Most cited one is: J. Browkin, A. Schinzel, "On Sylow 2-subgroups of  $K_2\mathcal{O}_F$  for quadratic number fields  $F$ ", *J. Reine Angew. Math.* 331 (1982), 104–113.

Professor Browkin is remembered by his students as a superb lecturer, characterized by high clarity and precision. He was the author of several monographs and textbooks having many editions, from which generations of students have been learning, in particular:

- a. "Wybrane Zagadnienia Algebry" Biblioteka Matematyczna T. 31, PWN, Warszawa 1968.
- b. "Teoria Ciał", Biblioteka Matematyczna T. 49, PWN Warszawa 1977.
- c. "Teoria Reprezentacji Grup Skończonych", PWN Warszawa, 2010.
- d. (Selected Topics in Algebra; Field Theory; Representations of Finite Groups).

I myself attended neither Professor Browkin's courses nor regular seminars. But Professor Browkin was always around since I was a student at the University of Warsaw in early 70ties, always friendly, energetic and enthusiastic. I remember some episodes from his life, for example, his excitement when Paul Erdős occupied his desk at ICM in Warsaw solving mathematical problems; his beautiful lectures at Colloquium for PhD students at IMPAN, in 2006 „New tables of elliptic curves”, and in 2008 „abc Theorem for polynomials”; the attempts to involve him in cryptography at IMPAN by Professor Jerzy Urbanowicz for whom Professor Browkin was a mentor in algebraic K-theory.

*Feliks Przytycki*

*(based on the note by the editors of the web page of the Polish Mathematical Society, November 2015, and on the article by Andrzej Schinzel, "Jerzy Browkin (1934 -- 2015)", Acta Arithmetica 172.3 (2016).*

# Banach Center selected upcoming events 2016

For more information, please check out: [www.impan.pl/BC/Program/2015.html](http://www.impan.pl/BC/Program/2015.html)

	TITLE	DATE	ORGANIZERS	PLACE
1.	X Forum of Partial Differential Equations ( <b>conference</b> )	19-24.06.2016	A. Świerczewska-Gwiazda, A. Wróblewska-Kamińska, E. Zatorska	Będlewo
2.	3rd Conference on Nonlocal Operators and Partial Differential Equations	27.06.-01.07.2016	K. Bogdan, M. Kassmann, K. Kaleta, et al.	Będlewo
3.	Singularities of General Relativity and their Quantum Fate ( <b>conference</b> )	27.06.-01.07.2016	W. Piechocki, A. Królak, D. Garfinkle, C. Kiefer	Warsaw
4.	Foliations 2016 ( <b>conference</b> )	11-17.07.2016	S. M. Walczak, M. Badura, M. Ciska-Niedziatomska, et al.	Będlewo
5.	Transfinite Methods in Banach Spaces and Algebras of Operators ( <b>conference</b> )	17-23.07.2016	A. Aviles, P. Koszmider, N. J. Laustsen	Będlewo
6.	17th Workshop: Non-commutative Probability, Lévy Processes and Operator Algebras, with Applications	24-30.07.2016	M. Bożejko, R. Lenczewski, R. Śaławata, et al.	Będlewo
7.	Harmonic Analysis, Complex Analysis, Spectral Theory and all that ( <b>conference</b> )	31.07.-06.08.2016	K. Barański, T. Iwaniec, S. Petermichl, et al.	Będlewo
8.	Galois Representations and Automorphic Forms ( <b>conference</b> )	14-20.08.2016	G. Banaszak, S. Barańczuk, T. Berger, et al.	Będlewo
9.	IBC on the 70th anniversary of Henryk Woźniakowski	28.08.-02.09.2016	B. Z. Kaciewicz, M. Kowalski, M. Kwas, et al.	Będlewo
10.	Symposium on Functional Analysis and Optimization. Stefan Rolewicz in memoriam	31.08.-02.09.2016	E. Bednarczuk, D. Pallaschke, T. Regińska	Warsaw
11.	Noncommutative Geometry the Next Generation ( <b>Simons Semester</b> )	01.09.-31.11.2016	P. F. Baum, A. Carey, P. M. Hajac, et al.	Warsaw
12.	Noncommutative Geometry and Quantum Groups ( <b>Simons Semester school</b> )	04-17.09.2016	P. F. Baum, A. Carey, P. M. Hajac, et al.	Będlewo & Warsaw
13.	7th Euro-Japanese Workshop on Blow-up	04-10.09.2016	M. Fila, G. Karch, D. Wrzosek	Będlewo
14.	Mathematics of Pattern Formation ( <b>conference</b> )	11-17.09.2016	G. Karch, A. Marciniak-Czochra, P. Gwiazda	Będlewo
15.	Stochastic Models V ( <b>conference</b> )	11-17.09.2016	K. Dębicki, Z. Palmowski, R. Szekli - chairman, et al.	Będlewo
16.	6th Polish Combinatorial Conference	18-24.09.2016	J. Grytczuk, J. Jaworski, P. Micek, et al.	Będlewo
17.	50th Seminar "Sophus Lie"	25.09.-01.10.2016	I. Agricola, A. Fiałowski, J. Grabowski, et al.	Będlewo
18.	Cyclic Homology ( <b>Simons Semester conference</b> )	17-21.10.2016	J. Cuntz, P. M. Hajac, T. Maszczyk, et al.	Warsaw
19.	Noncommutative Index Theory ( <b>Simons Semester conference</b> )	24-28.10.2016	P. F. Baum, A. Carey, M. J. Pflaum, et al.	Warsaw
20.	Topological Quantum Groups and Hopf Algebras ( <b>Simons Semester conference</b> )	14-18.11.2016	K. De Commer, P. M. Hajac, R. Ó Buachalla, et al.	Warsaw
21.	Structure and Classification of $C^*$ -algebras ( <b>Simons Semester conference</b> )	21-25.11.2016	G. Elliott, K. R. Strung, W. Winter, et al.	Warsaw

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continuation of the series published by PAN, founded in 1953)

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