

Newsletter of IMPAN



OPUS
GRANTS

PH.D
THESES

CONFE-
RENCES

SIMONS
SEMESTERS



Polish Research Grants OPUS

OPUS is an important competition of the National Science Center (NCN) for the funding of research projects. Currently nine of this type of grants are implemented at IMPAN. Eight grants of the earlier editions were described in the Newsletter of IMPAN no. 6 and 7. In 2015, in the competition of OPUS 7, two grant applications from IMPAN were selected for funding: the applications by Michał Rams and by Ryszard Rudnicki.

Chaos, fractals and conformal dynamics III

Coordinator: Michał Rams, Principal co-investigators: Janina Kotus and Feliks Przytycki (02.2015–02.2018)



The project concerns several areas of dynamical systems and geometric measure theory. The main topic is the relation between geometry and dynamics. The theory we develop connects local properties of the invariant sets and the measures living there with the long time behavior of trajectories. Thanks to expanding properties of the investigated maps, we obtain similarity of the small neighborhoods of typical points to the whole invariant set (fractal property).

We will investigate the low-dimensional dynamics, especially dimension 1 real and complex dynamics (including entire and transcendental maps) and iterated function systems. On the geometric side our main object of study will be the Hausdorff dimension of invariant sets and measures, on the dynamical side Julia set (and other invariant sets), Gibbs (equilibrium)

states and their stochastic properties, pressure, and the Lyapunov exponent.

THE DETAILED LIST OF TASKS:

1. Multifractal formalism: one-dimensional dynamics, real (smooth multimodal maps of the interval) or complex (holomorphic maps), Lyapunov and Birkhoff spectra and their relation to the pressure function, noncontracting (in the central direction), nonconformal (on Bedford-McMullen carpets and similar constructions), noncommutative (for matrix cocycles), on iterated function systems with infinitely many branches (Gauss map).

2. Iterated function systems after Hochman: description of exceptional parameters for families of IFSS in dimension greater than 1.

Asymptotic properties of models of population dynamics

Coordinator: Ryszard Rudnicki, Principal co-investigators: Marta Tyran-Kamińska, Katarzyna Pichór (02.2015–02.2018)

The aim of the project is to build and study mathematical models of population dynamics. We are going to study two types of models: given by piecewise deterministic Markov processes and represented by partial differential equations with non-local terms (called evolution equations).

A piecewise deterministic Markov process (PDMP) is a continuous time Markov process, for which there is an increasing sequence of random times, called jump times, such that its sample paths are defined in a deterministic way between jump times. Such processes are successfully used to describe dispersal in biological systems, cell cycle, gene expression, physiologically structured populations, as well as neural activity.

For example, processes of mRNA transcription and protein translation depend on the state of genes. The dynamics of production of biological molecules is being changed when a gene is transformed from an active state into an inactive state and vice versa.

Other examples of PDMPs are processes whose paths are described by one deterministic dynamics but jumps can occur randomly along paths as in dispersal of cells and insects or phase cell cycle models.

Evolution equations are used to study structured population models. A population is usually heterogeneous and it is important to divide it into homogeneous groups according to some significant parameters such as age, size, maturity, or proliferative state of cells, and to study interactions between such groups. Models of this type are called structured and they describe the time

evolution of the distribution of the population according to the fixed parameters.

Moreover, evolution equations also appear in the description of fragmentation-coagulation processes, cancer growth and genome evolution. Our research objectives are:

1. Long-time behaviour of trajectories and distributions of piecewise deterministic Markov processes appearing in mathematical biology,
2. Asymptotic stability, sweeping and chaos of evolution equations.

We construct mathematical models of biological processes and analyse them by using a broad spectrum of mathematical tools from stochastic processes, partial differential equations, dynamical systems, and functional analysis. In particular, in order to study of the long-time behaviour of distributions of piecewise deterministic Markov processes we are going to prove new theoretical results concerning asymptotic stability and sweeping of stochastic semigroups. Chaotic properties of semiflows generated by evolution equations are studied by means of ergodic theory. The problem is rather difficult because our semiflows are defined on infinite dimensional spaces. In order to prove chaotic behaviour of a semiflow it is enough to show that such a semiflow has an invariant mixing measure whose support is a sufficiently large set, usually, the whole space.



3. Rational functions: Lyapunov exponent, Hausdorff dimension, topology, and geometry: positive upper exponent implying at most finite renormalisability, asymptotical properties of Hausdorff dimension of Julia set around parabolic parameters, Misiurewicz parameters.

4. Thermodynamical formalism in dimension 1, conformal measures: existence of conformal measures for multimodal maps, regular points for geometric pressure, Poincaré series.

5. Iterations of meromorphic functions: Misiurewicz parameters, escape to infinity: proving stochastic properties by inducing, estimations of the Hausdorff dimension of the set of escaping points and corresponding parameters.

The project is a continuation of previous projects 'Chaos, fractals and conformal dynamics' I and II.

Selected, recently defended Ph.D. theses

Regularity of solutions to nonlinear non-diagonal evolutionary systems

Jan Burczak, Supervisors: Prof. W. Zajączkowski (IMPAN), doc. Mgr. Petr Kaplický Ph.D. (Charles University, Prague)



My thesis contains results on regularity of solutions to a *symmetric generalized p -Laplace system*. It is a simplification of the *p -Navier-Stokes system* that was introduced by Olga A. Ladyzhenskaya at her 1966 ICM speech. The p -Navier-Stokes system models behavior of non-Newtonian fluids, including blood, ketchup, syrups or some water suspensions. From the analytical perspective, it seems more manageable than the menacing 3D Navier-Stokes system, whose uniqueness and smoothness is an open Millennium Problem of Clay Mathematics Institute. Namely, for a certain physically plausible combination of the involved parameters, the p -Navier-Stokes system has a unique solution for a given data. Nevertheless, the question of its smoothness remains open. The main

challenge here is a bad pointwise structure of the nonlinear part. This difficulty is retained in the considered by me symmetric p -Laplace system. I developed for it and some of its generalizations an interior regularity theory, including proving local higher regularity of space and time derivatives of solutions as well as their full smoothness except a small set (of zero Lebesgue measure). More importantly, I managed to devise some new analytical tools: *symmetric p -caloric lemma* and technique of raising regularity of a weak solution via *iterations in Nikolskii-Bochner spaces*, that may prove useful for interior regularity analysis of other nonlinear partial differential equations.

Jan Burczak

Ergodic properties of smooth flows on surfaces

Adam Kanigowski, Supervisor: prof. dr hab. Mariusz Lemańczyk



Arnold and Kochergin mixing conservative flows on surfaces stand as the main and almost only natural class of mixing transformations for which higher order mixing has not been established, nor disproved. Under suitable arithmetic conditions on their unique rotation vector, of full Lebesgue measure in the first case and of full Hausdorff dimension in the second, we show that these flows are mixing of any order. For this, we show that they

display a generalization of the so called Ratner property on slow divergence of nearby orbits, that implies strong restrictions on their joinings, which in turn yields higher order mixing. This is the first case in which the Ratner property is used to prove multiple mixing outside its original context of horocycle flows and we expect our approach will have further applications.

Adam Kanigowski

Optimal surplus management in insurance

Łukasz Kuciński, Supervisor: prof. dr hab. Lesław Gajek

Surplus corresponds to free capital or personal wealth available to a company or an individual, respectively. We investigate optimal capital distribution between a firm and its owners, and optimal wealth protection for a group of individuals. The former issue is equivalent to a company valuation, a fundamental problem in finance theory. It is assumed that the value is estimated by the sum of the expected present value of firm's future cash flows. The difficulty is that neither the cash flows nor their duration may be known at the valuation date. This leads to a circular reasoning: one needs cash flows to determine value, and the value to determine cash flows. It is shown how the problem can be solved directly and the company valuation formula together with the optimal strategy are given. Consequently, we obtain a more realistic valuation

and gain insight into optimal corporate decision making. The results are developed both in continuous and discrete setup and a corresponding convergence result is provided. The problem is embedded in the optimal stochastic control framework and the main tools are stochastic analysis, fluctuation theory for Lévy processes and random walks.

In the latter problem, we construct a model which allows to reconcile between the two classical problems of finding optimal insurance in single- and multi-agent setups. Consequently, we are able to say whether cooperation is profitable and when does it pay off to create one coalition. Characterization of Pareto optimal strategies is given and the core of a corresponding game is proved to be non-empty.

Łukasz Kuciński



Milnor-Thurston homology of some wild topological spaces

Janusz Przewocki, Supervisor: Dr. hab. Andreas Zastrow

In various fields of mathematics one sometimes approaches topological spaces with bad local properties (as opposed to spaces with good local properties, such as manifolds and CW-complexes). Some examples of these spaces may be: fractals, attractors in some dynamical systems or tiling spaces. For spaces like that the standard algebraic invariants do not work well. Hence the name "wild topological spaces" or "non-tame spaces" is used. A good representative of such a space is provided by an example constructed by Milnor and Barratt [1] in 1962, which has nonzero homology groups in dimensions exceeding topological dimension of the space. Recently people started to look for homology theories that are suitable for this kind of spaces [3, 4].

One of the problems we would like to overcome when constructing such theories is finiteness of cycles, which is, for example, responsible for the pathological behaviour of singular homology in the case of the Barratt-Milnor space. However, there are some homology theories that admit infinite cycles; among them Milnor-Thurston homology theory.

This is the theory that behaves well on CW-complexes

and manifolds (it gives the same results as the singular homology, since it satisfies the Eilenberg-Steenrod axioms), however its behaviour for non-tame spaces is unknown so far.

PhD dissertation *Milnor-Thurston homology of some wild topological spaces* investigates this homology theory in the case of some natural examples of wild topological spaces. First question posed by the author is whether these homology groups detect circular shape of so called Warsaw Circle (it is a space that consists of a sinusoid $\sin(1/x)$ that oscillates towards some accumulation interval that is connected to the end of the sinusoid making a circular shape). The author answers this question in a negative way, and the methods he applies are sufficiently powerful to answer a question posed by Berlanga [2] whether the weak topology on Milnor-Thurston homology groups is Hausdorff. Moreover, some additional properties of 0-th Milnor-Thurston homology are proved, and some peculiar space is constructed where two points that cannot be connected by a path, are connected by a measure-chain.

Janusz Przewocki



References

- [1] M. G. Barratt, J. Milnor, An Example of Anomalous Singular Homology, Proc. Amer. Math. Soc. 13(1962), 293–297
- [2] R. Berlanga, A topologised measure homology, Glasgow Math. J. 50(2008), 359–368
- [3] R. Diestel, P. Sprüssel, On the homology of locally compact spaces with ends, Topology Appl. 158(2011), 1626–1639
- [4] A. Georgakopoulos, Cycle decompositions: from graphs to continua, Advances in Mathematics 229(2012), 935–967

Simons Semester: Dynamical Systems

The current Simons Semester in Banach Center, September-December 2015, is devoted to **Dynamical Systems**.

SOME TOPICS (WITH INDICATED PERIODS OF EXPECTED CONCENTRATION)

Analysis and holomorphic dynamics (September), **Fractals** (October), **Topics in smooth dynamics** (November), **Ergodic theory** (November-December).

ACCOMPANYING CONFERENCES

Topics in Analysis and Holomorphic Dynamics (workshop) Warsaw, September 15–19, *Fractal Geometry and Dynamics*, Będlewo, October 12–16, *Ergodic Theory of Dynamical Systems/ Translation Surfaces and Dynamics*, Będlewo, November 22–28.

There are about 30 permanent (for most of the 4 months Semester period) young participants, employed at IMPAN or getting a local support, phd students and postdocs and a number of local or a shorter period participants. Also a number of professors participates, several of them giving 8–12 hours mini-courses.

The list of countries of origin of the participants shows the truly international character of the Semester. These include Brasil, China, Finland, France, Germany, Hungary, Iran, Ireland, Israel, Italy, Poland, Portugal, Romania, Russia, Spain, Sweden, Thailand, UK, Ukraine, USA, Uzbekistan.

MINI-COURSES

- **François Berteloot** (Université Paul Sabatier, Toulouse) Bifurcations, Currents and Equidistribution phenomena in holomorphic dynamics,
- **Peter Haïssinsky** (Université Paul Sabatier, Toulouse) Some topological characterizations of rational maps and Kleinian groups,
- **Davoud Cheraghi** (Imperial College London) Rigidity, near parabolic renormalization, and indifferent fixed points in complex dynamics,
- **Károly Simon** (Budapest University of Technology and Economics) Dimension Theory of self-affine and almost self-affine sets and measures / Fractal percolation,
- **Antti Käenmäki** (Jyväskylä University, Finland) Dynamics of the scenery flow and conical density theorems, .
- **Alexander Olevskii** (Tel Aviv University) Fourier quasicrystals,
- **Marco Martens** (SUNY, Stony Brook, USA) Henon Renormalization, October 19–30, 2015.
- **Zoltán Buczolich** (Eötvös Loránd University, Budapest) Kakutani-Rokhlin towers, rotations, ergodic averages,
- **François Ledrappier** (University of Notre Dame / CNRS, France) Local Limit Theorem in negative curvature,
- **Mark Pollicott** (University of Warwick, UK) Ergodic theory of hyperbolic flows,
- **Lorenzo Díaz** (PUC, Rio de Janeiro) & Anton Gorodetski (University of California, Irvine) Non-hyperbolic Ergodic Measures,
- **Pierre Berger** (CNRS, Paris 13) Differentiable dynamics near and far from homoclinic bifurcations,
- **Yanqi Qiu** (Aix-Marseille Université) The Theory of Determinantal Point Processes,
- **Jörg Schmeling** (University of Lund) Dimensional aspects in smooth dynamical systems.

The local organizers are Krzysztof Barański (University of Warsaw), Piotr Gałązka (Warsaw University of Technology), Mariusz Lemańczyk (Nicolaus Copernicus University in Toruń), Feliks Przytycki (IMPAN), Michał Rams (IMPAN).

THE WEB PAGE OF THE SEMESTER

bcc.impan.pl/15Simons-I

Inauguration of the program SIMONS SEMESTERS IN BANACH CENTER 2015–2019 took place on 14 September 2015.

The ceremony was attended by

- the cultural attaché of the American Embassy, Mr. Kenneth Wetzel,
- Vice-President of the Central Council of Science and Higher Education, prof Zbigniew Marciniak,
- Vice-Presidents of the Polish Academy of Sciences, prof. Paweł Rowiński,
- Dean of the Division III of the Academy, prof. Roman Micnas,
- Directors of several institutes of the Academy,
- other guests, as well as the participants of the currently held semester on Dynamical Systems and faculty of IMPAN

Upcoming Semesters

- 1. Dynamical Systems (1.09–31.12. 2015)
- 2. Algebraic Geometry (18.04–18.06. 2016)
- 3. Noncommutative geometry the next generation (1.09–30.11. 2016)
- Organizers: P.F. Baum, A. Carey, P.M. Hajac, K.R. Strung
- 4. CrossFields PDEs (start 1.12.2016)
- Organizers: E. Feireisl, P. Gwiazda, P.B. Mucha, A. Świerczewska-Gwiazda
- 5. Emergent trends of Complex Analysis and Functional Analysis (Spring 2017),
- Organizers: A. Borichev (France), A. Baranov (Russia), Yu. Tomilov (Poland)
- 6. Symmetry and geometric Structures,
- Organizers: P. Nurowski, M. Eastwood, W. Kryński, B. Warhurst

Participants of Simons Semester's workshop in September



Conferences

GEOMETRY OF JETS AND FIELDS

10–16 May, 2015, Będlewo

The conference *Geometry of Jets and Fields* was one of the activities of the research group led by Professor Janusz Grabowski and supported by the Polish National Science Centre grant MAESTRO. Program of the conference concerned differential geometry and its applications to physics.

THERE WERE THREE MAIN TOPICS:

- (1) geometric aspects of mechanics and field theory,
- (2) geometric structures, e.g. symplectic, cosymplectic, Poisson, etc.,
- (3) graded geometry and supergeometry.

The conference was also an opportunity to celebrate the 60th birthday of Professor Janusz Grabowski.

The opening lecture, “*The works of William Rowan Hamilton in geometric optics and the Malus-Dupin theorem*”, by professor Charles-Michel Marle, had a special meaning for all the conference, showing how important is finding a proper geometrical language for a physics problem. The lecture concerned properties of so called rectangular family of light rays in interaction with reflecting and refracting optical instruments. The original proof of the Malus-Dupin theorem, describing the properties of rectangular families of rays, is quite complicated. It was shown during the lecture that the proper language to describe geometric optics is that of symplectic geometry. In symplectic geometry, the description of rectangular families of light rays is so simple that it is almost not necessary to formulate any theorem about them and even less necessary to prove it. Looking for a proper mathematical language to



describe different physical systems and mathematical phenomena was then a common motive of the conference.

Many participants, as well as members of the Scientific and Organizing Committees, expressed their opinion that the scientific level of the conference was very high. Most of the lectures contained new unpublished results, while others were interesting survey lectures which can serve as a source of inspiration and bibliographical data.

The conference gathered 58 participants from Europe, USA, India and China. There were 22 plenary lectures, 2 short contributions and the poster session with 10 posters. The winner of the contest for the best poster, Dr. Andrew James Bruce from IMPAN, had the opportunity to give a special talk on the topic of the poster.

Participants could enjoy a barbeque in the gardens of Będlewo Castle, conference dinner with a birthday cake, and an excursion to Poznań with guided tour through local brewery. The friendly atmosphere created by the staff members of the Mathematical Conference Center in Będlewo contributed considerably to the success of the conference.

The conference was supported by the Banach Center, Warsaw Center of Mathematics and Computer Science, and National Science Center.

The contributions of the conference will be published as a volume of the Banach Center Publications (in preparation).

SCIENTIFIC COMMITTEE

- Jose F. Carinena (University of Zaragoza)
- Yvette Kosmann-Schwarzbach (Ecole Polytechnique)
- Manuel de Leon (ICMAT, Madrid)
- Charles Michel Marle (Universite Pierre et Marie Curie)
- Giuseppe Marmo (INFN, Napoli)
- Norbert Poncin (University of Luxembourg)
- Paweł Urbański (University of Warsaw)
- Alexandre M. Vinogradov (Levi-Civita Institute)

ORGANIZING COMMITTEE

- Katarzyna Grabowska (University of Warsaw)
- Michał Józwiowski (IMPAN)
- Javier de Lucas (University of Warsaw)
- Mikołaj Rotkiewicz (University of Warsaw)

The details of the conference, including the list of speakers, the titles and abstracts of all talks, as well as the majority of presentations, can be found at the web page www.impan.pl/~gjf.

Janusz Grabowski



MATHEMATICAL FLUID MECHANICS: OLD PROBLEMS, NEW TRENDS – A WEEK FOR WOJCIECH ZAJĄCZKOWSKI

August 30 – September 05, 2015, Będlewo

The conference *Mathematical Fluid Mechanics: Old Problems, New Trends*— a week for Wojciech Zajączkowski continued the tradition of meetings of specialists in regularity theory of partial differential equations, facilitated by the Banach Center. The previous ones in this century include:

- 2001 Evolution equations, Warsaw
- 2003 Regularity and other qualitative aspects of the Navier-Stokes equations, Będlewo
- 2006 Parabolic and Navier-Stokes Equations, Będlewo
- 2008 Parabolic and Navier-Stokes Equations in honour of V.A. Solonnikov, Będlewo
- 2009 Nonlinear Parabolic Problems in honor of Herbert Amann, Będlewo
- 2010 Regularity aspects of PDE — a week for W. Zajączkowski, Będlewo
- 2012 Parabolic and Navier-Stokes Equations, Będlewo.

The main purpose of this conference was to facilitate the meeting of leading specialists in the Navier-Stokes and regularity aspects of PDEs on the occasion of celebration the 70th birthday of professor Wojciech Zajączkowski.

SCIENTIFIC COMMITTEE:

- Piotr Biler (Mathematical Institute, University of Wrocław),
- Eduard Feireisl (Czech Academy of Sciences, Prague),
- Konstantin Pileckas (Vilnius University),

- Gregory Seregin (University of Oxford),
- Yoshihiro Shibata (Waseda University, Tokyo)

ORGANIZING COMMITTEE:

- Jan Burczak (IMPAN, Warsaw),
- Takayuki Kobayashi (Waseda University, Tokyo),
- Piotr B. Mucha (MIMUW, Warsaw),
- Milan Pokorný (Charles University in Prague),
- Joanna Renclawowicz (IMPAN, Warsaw)

The conference gathered 65 participants (including 18 mathematicians from Poland) who gave 53 lectures.

INVITED SPEAKERS:

- Arina Arkhipova (St. Petersburg State University)
- Hugo Beirão da Veiga (University of Pisa)
- Piotr Biler (University of Wrocław)
- Jean Chemin (Université Pierre et Marie Curie, Paris)
- Hi Jun Choe (Yonsei University, Seoul)
- Raphaël Danchin (Université Paris-Est Créteil)
- Reinhard Farwig (Technische Universität Darmstadt)
- Eduard Feireisl (Czech Academy of Sciences, Prague)
- Piotr Gwiazda (University of Warsaw)
- Nina Ivochkina (St. Petersburg State University)
- Grzegorz Karch (University of Wrocław)
- Hideo Kozono (Tohoku University, Sendai)
- Irena Lasiecka (University of Memphis)
- Marta Lewicka (University of Pittsburgh)
- Josef Málek (Charles University in Prague)
- Antonín Novotný (Université de Toulon)
- Konstantin Pileckas (Vilnius University)
- Gregory Seregin (University of Oxford)
- Yoshihiro Shibata (Waseda University, Tokyo)
- Vsevolod Solonnikov (Steklov Institute, St. Petersburg)
- Gerhard Ströhmer (The University of Iowa, Iowa City)

Joanna Renclawowicz



ANALYTIC, ALGEBRAIC AND GEOMETRIC ASPECTS OF DIFFERENTIAL EQUATIONS

*September 7 – 19, 2015,
Będlewo*

The overall goal of the school and conference was to bring together the leading experts in the theory of differential and difference equations in the complex domain from different countries, to tackle and find approaches to the open problems, exchange recent research results, learn new methods in the related areas (which is invaluable especially for younger researchers) and identify new topics for future research. The meeting was also an occasion to promote existing and start new collaboration between colleagues in different countries.

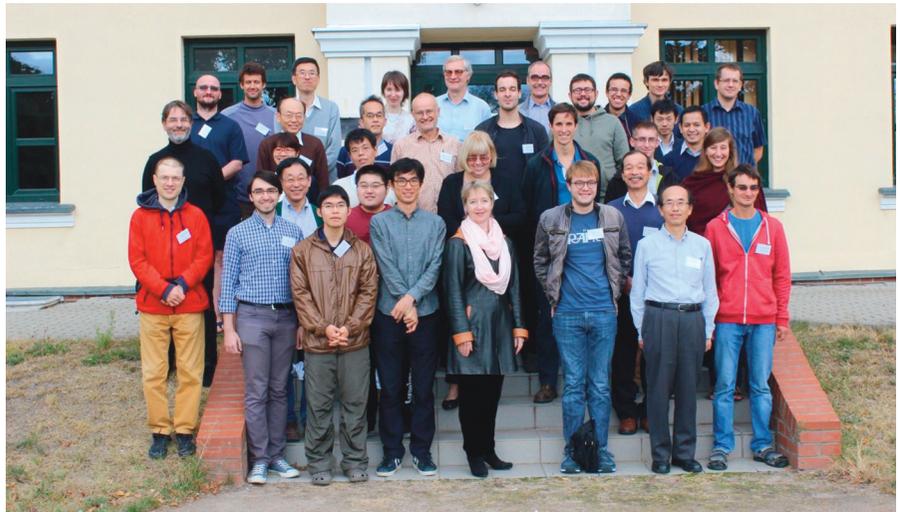
THE ORGANIZING AND SCIENTIFIC COMMITTEES CONSISTED OF:

- Galina Filipuk (Warsaw),
- Yoshishihe Haraoka (Kumamoto),
- Grzegorz Łysik (Kielce) – chair,
- Sławomir Michalik (Warsaw, UKSW),
- Werner Balsler (Ulm),
- Moulay Barkatou (Limoges),
- Stefan Hilger (Eichstätt),
- Masatake Miyake (Nagoya),
- Hidetoshi Tahara (Sophia U.),
- Masafumi Yoshino (Hiroshima),
- Henryk Żołądek (Warsaw).

DURING THE SCHOOL SERIES OF 5 ONE-HOUR LECTURES WERE GIVEN BY:

- Jean-Philippe Anker (Orleans, France) An introduction to Dunkl theory,
- Yoshishige Haraoka (Kumamoto, Japan) Holonomic systems,
- Irina Markina (Bergen, Norway) Sub-Riemannian geometry and sub-elliptic operators,
- Javier Sanz (Valladolid, Spain) Asymptotic analysis and summability of formal power series,
- Yoshitsugu Takei (Kyoto, Japan) WKB analysis and Stokes geometry of differential equations.

The school was attended by 35 participants from 8 countries (France, Italy, Japan, Norway, Poland,



Russia, Spain and United Kingdom). The costs of stay during the school and conference of 16 young participants of the school as well as the lecturers were covered by the Warsaw Center of Mathematics and Computer Science and the Banach Center.

THE MAIN TOPICS OF THE CONFERENCE INCLUDED:

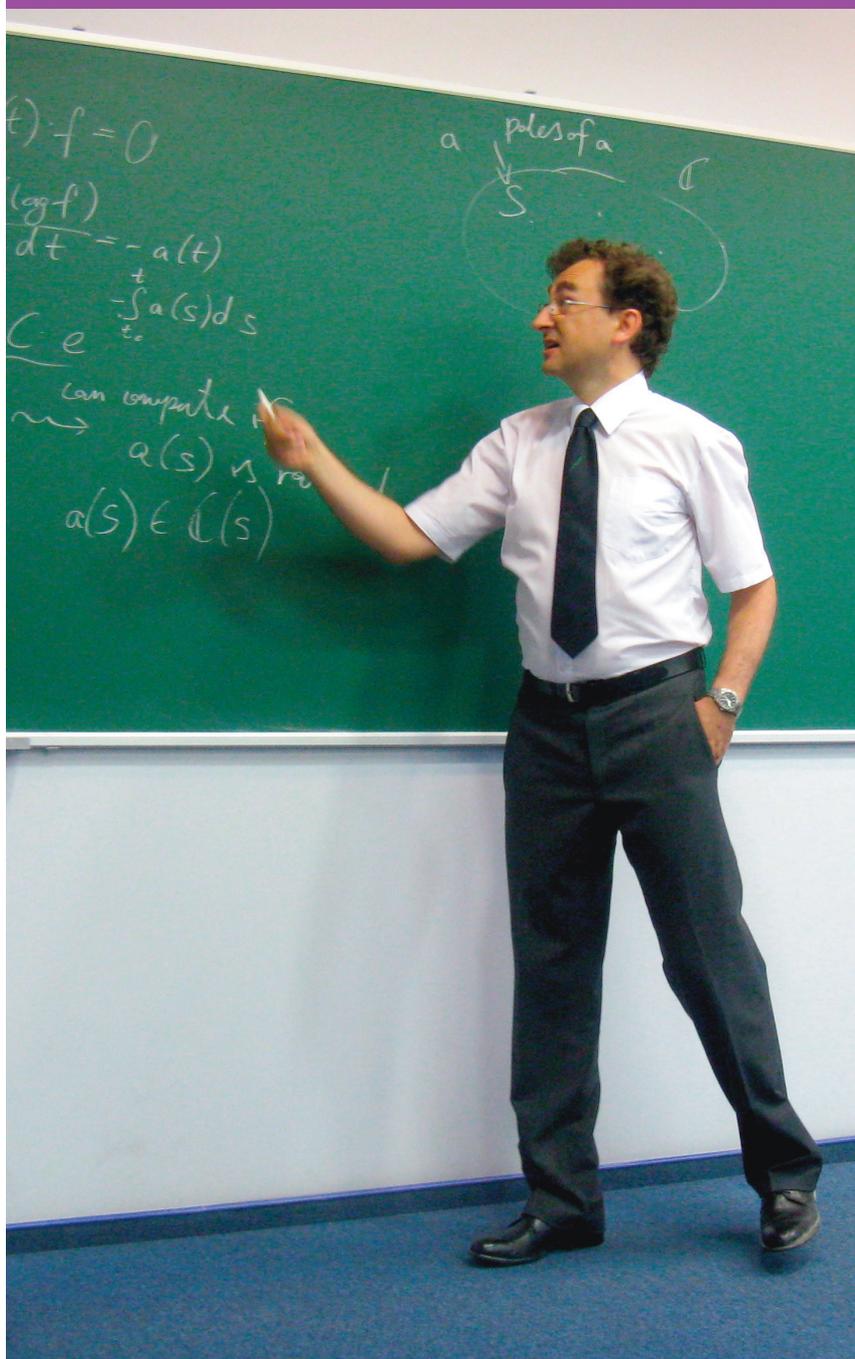
- Ordinary differential equations with meromorphic coefficients
- Holonomic systems and hypergeometric functions in several variables
- Singularities and asymptotics of solutions to Painlevé equations
- Orthogonal polynomials
- Riemann-Hilbert problems
- WKB analysis of singular perturbations of ODEs
- Summability of formal solutions of differential and difference equations

The invited lecturers were given by Takashi Aoki (Kinki U.), Peter Clarkson (Canterbury), Yoshishige Haraoka (Kumamoto), Stefan Hilger (Eichstätt), Shingo Kamimoto (Hiroshima), Hirinobu Kimura (Kumamoto), Alberto Lastra (Alcalá), Masatake Miyake (Nagoya), Toshio Oshima (Josai U.), Javier Sanz (Valladolid), Jiro Sekiguchi (Tokyo), Hidetoshi Tahara (Sophia U.), Yoshitsugu Takei (RIMS, Kyoto), Masafumi Yoshino (Hiroshima) and Henryk Żołądek (Warsaw). In addition to invited lectures, there were also presented 26 shorter talks and 1 poster.

The conference was attended by 43 participants from 10 countries (Bulgary, France, Philippines, Germany, Italy, Japan, Poland, Russia, Spain and United Kingdom). Its worth to point out that almost half of the participants (20) came from Japan. Abstracts and presentations of talks can be found at bcc.impan.pl/15AAGA/
Grzegorz Łysik

Institute's News

IMPAN Prizes



IMPAN Scientific Prize is awarded by IMPAN Director yearly since 2009, for outstanding achievements in mathematics. This prize in 2015 was awarded to **Adrian Langer** for outstanding achievements in algebraic geometry:

1. li spaces of semistable sheaves on algebraic varieties. In particular, the proof of Maruyama's conjecture about existence of the moduli space in positive and mixed characteristics;
2. Results on Bogomolov type inequalities for Higgs bundles in positive and zero characteristics, including the solution of Narasimhan's problem in characteristic zero;
3. Results on the fundamental group of algebraic schemes in positive characteristic.

Scientific Awards ceremony took place on June 18, during an open meeting of Scientific Council of the Institute. Adrian Langer delivered a plenary lecture entitled "On unimportance and impossibility of solving differential equations (and on applications of these facts in algebraic geometry)"

Adrian Langer during the plenary lecture

Kazimierz Kuratowski Award is awarded yearly by IMPAN and Polish Mathematical Society for young mathematicians under 30 years old for their outstanding mathematical results.

Joanna Kułaga-Przymus from IMPAN and UMK (Nicolaus Copernicus University) and **Mateusz Michałek** from IMPAN are Kuratowski Award winners in 2015;

Joanna Kułaga-Przymus for outstanding results in ergodic theory and Mateusz Michałek for papers on the border of algebraic geometry and combinatorics.

Ph.D. thesis Prize is awarded by IMPAN Director for an outstanding doctoral thesis at IMPAN once a year. The main award is named **Marek Wacławek award**.

In 2015 the main prize was awarded to Adam Kanigowski for the thesis *Ergodic properties of smooth flows on surfaces*.

Moreover, the prize was awarded to

→ **Łukasz Kubat**, *Structures and representations at plactic algebras*,

→ **Patryk Miziūła**, *Moment comparisons for mixtures of ordered distributions*,

→ **Tomasz Z. Szarek**, *Calderón-Zygmund operators in harmonic analysis of classical orthogonal expansions*.

Faculty Awards

The 2015 ERC Starting Grant for **Piotr Nowak**

Dr. Piotr Nowak from the Institute of Mathematics of the Polish Academy of Sciences and Faculty of Mathematics, Informatics and Mechanics at the University of Warsaw (MIM UW) won a prestigious European Research Council grant, which will be carried out in IMPAN. It is the first mathematical ERC grant in Poland. Since 2008, European Research Council has been awarding grants to researchers who plan to conduct breakthrough research in the European Union and associated states. In this year's edition of the ERC Starting Grant competition, there were 2920 applications submitted by young researchers, of which about 300 are expected to be financed. The project "Rigidity of groups and higher index theory" relates to the index theory, which constitutes a bridge between mathematical analysis on one side, and geometry and topology on the other. The objective of the project is to test the boundaries of famous conjectures related to the so-called Baum-Connes conjecture. They refer to the behaviour of objects (spaces, groups) in a large scale, and they are studied because of their (uniquely defined)

rigidity. The project requires to combine techniques from many fields of mathematics, from geometry and topology, through different aspects of mathematical analysis, to algebra.

The project will allow new understanding of significant characteristics and structure of some basic algebraic (group C^* -algebras) as well as geometrical objects (manifolds).

Dr. Piotr Nowak obtained the doctoral degree at the Vanderbilt University, Nashville, Tennessee, USA in 2008. For the following four years, he worked at the Texas A&M University, College Station, and in the Mathematical Sciences Research Institute in Berkeley, California. From 2012, he has been working in Poland at the Institute of Mathematics of the Polish Academy of Sciences and at the University of Warsaw on one of the few so-called joint research positions. He is the author of over 20 articles in excellent research journals. In 2012, together with his doctorate supervisor, Guoliang Yu, he published a book which constitutes an introduction to large scale geometry.

The 2015 National Science Centre Award for **Piotr Śniady**

Professor Piotr Śniady won the 2015 Polish National Science Centre Award in the field of sciences and technology for obtaining significant results in representation theory and noncommutative probability. The other two laureates are: dr. hab. Michał Bilewicz (University of Warsaw) in the field of humanities, and dr. hab. Wiesław Babik (Jagiellonian University) in the field of life sciences. Piotr Śniady is an employee of IMPAN as well as of the Faculty of Mathematics and Computer Science at Adam Mickiewicz University in Poznań.

The National Science Centre Awards are given to scholars who are under 40 years of age for

significant scientific achievements made within the framework of basic research conducted in a Polish scientific unit, and documented in publications affiliated in a Polish unit. The Award is funded by enterprises involved in supporting scientific activity. The National Science Centre Award is given in three research areas by the Council of the National Science Centre and the jury composed of the representatives of the Centre and of the Award sponsors. There were 72 candidates put up for the 2015 National Science Centre Award.

NEW FACULTY – Autumn 2015

3–7 YEARS POSITIONS

- Christophe Eyrat, 3-years associate professor position, algebra and algebraic geometry
- Jakub Gismatullin, 6-years adiunkt position, foundations of mathematics
- Karol Palka, 7-years adiunkt position, algebra and algebraic geometry
- Masha Vlasenko, 5-years adiunkt position, algebra and algebraic geometry

½–2 YEARS POSITION

- Sylwia Antoniuk, adiunkt position, topology
- Davide Azevedo, postdoc position, dynamical systems
- Maciej Borodzik, associate professor position, algebra and algebraic geometry
- Jan Burczak, adiunkt position, differential equations
- Bogdan Ćmiel, postdoc position, mathematical statistics
- Lionel Darondeau, postdoc position, algebra and algebraic geometry
- Saeed Ghasemi, adiunkt position, foundations of mathematics
- Piotr Gwiazda, professor position, differential equations
- Marek Kaluba, postdoc position, topology
- Tomasz Klimsiak, adiunkt position, probability theory and mathematics of finance

- William Mance, adiunkt position, dynamical systems
- Patryk Miziuta, postdoc position, mathematical statistics
- Eva Pernecka, adiunkt position, functional analysis
- Rafał Pierzchała, adiunkt position, differential equations
- Tomasz Szemberg, professor position, algebra and algebraic geometry
- Tomasz Zachary Szarek, postdoc position, functional analysis
- Tomasz Rogala, postdoc position, probability theory and mathematics of finance
- Anna Talarczyk-Noble, associate professor position, probability theory and mathematics of finance
- Łukasz Garncarek, postdoc position, topology, WCMCS
- Jan Rozendaal, postdoc position, functional analysis, WCMCS
- Olli Toivanen, postdoc position, differential equations, WCMCS
- Piotr Achinger, postdoc position, algebra and algebraic geometry, WCMCS/EPDI
- Olena Karpel, postdoc position, dynamical systems, grant MAESTRO
- Giovanni Moreno, adiunkt position, mathematical physics and differential geometry, Marie Skłodowska-Curie Individual Fellowship

Publisher's pick

Editorial team of the Journal of Physics A highlights the stories behind the research for articles that could be of particular interest to readers.

Recently, the following authors of the paper „Higher order mechanics on graded bundles” have been honored in the above-mentioned way:

- Andrew Bruce (Institute of Mathematics, Polish Academy of Sciences),
- Katarzyna Grabowska (Faculty of Physics, University of Warsaw) and
- Janusz Grabowski (Institute of Mathematics, Polish Academy of Sciences).

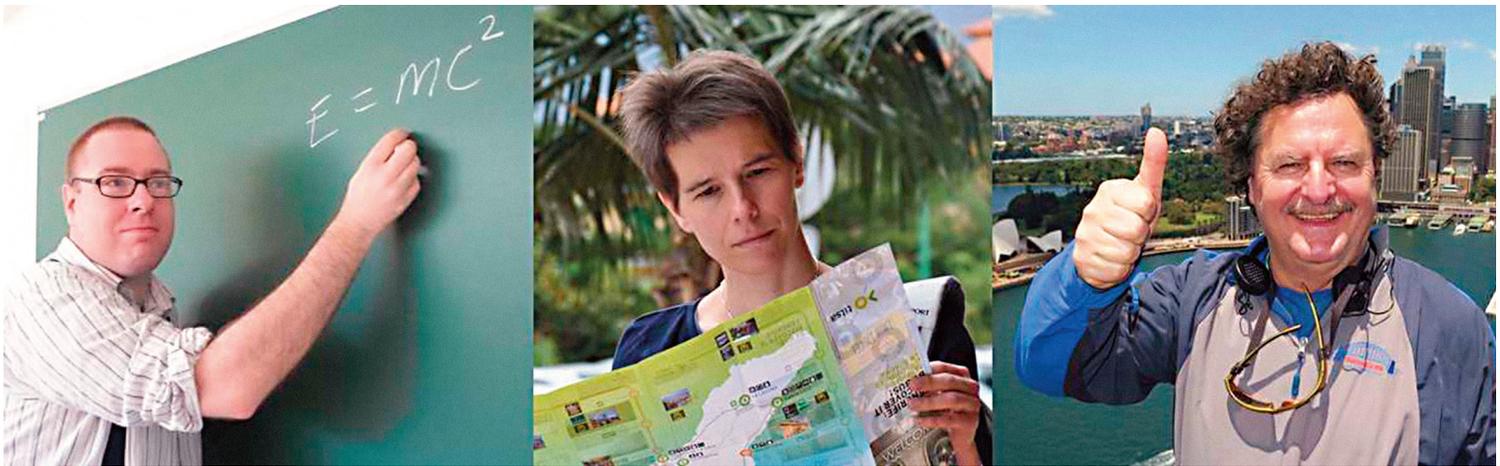
Interview with the authors is placed on the website iopscience.iop.org/1751-8121/page/Interview-with-Janusz-Grabowski

Interview-with-Janusz-Grabowski

ABSTRACT OF THE PAPER

(*J. PHYS. A: MATH. THEOR.* **48** 205203)

In this paper we develop a geometric approach to higher order mechanics on graded bundles in both, the Lagrangian and Hamiltonian formalism, via the recently discovered weighted algebroids. We present the corresponding Tulczyjew triple for this higher order situation and derive in this framework the phase equations from an arbitrary (also singular) Lagrangian or Hamiltonian, as well as the Euler–Lagrange equations. As important examples, we geometrically derive the classical higher order Euler–Lagrange equations and analogous reduced equations for invariant higher order Lagrangians on Lie groupoids.



Andrew Bruce, Katarzyna Grabowska and Janusz Grabowski

SIMONS SEMESTER, SHORT TIME POSITIONS

- Jordi Canela Sanchez, visiting adiunkt position, dynamical systems
- Davoud Cheraghi, visiting professor position, dynamical systems
- Antti Käenmäki, visiting professor position, dynamical systems
- Khudoyor Mamayusopov, visiting assistant position, dynamical systems
- Roman Nikiforov, visiting adiunkt position, dynamical systems
- Mark Pollicott, visiting professor position, dynamical systems
- Károly Simon, visiting professor position, dynamical systems

- Marks Ruziboev, visiting adiunkt position, dynamical systems
- Aminasadat Talebi, visiting assistant position, dynamical systems
- Yiwei Zhang, visiting adiunkt position, dynamical systems
- Qiu Yangi, visiting adiunkt position, dynamical systems

EXCHANGE:

- Galina Filipuk (MIM UW) adiunkt position, differential equations
- Daria Michalik (UKSW) adiunkt position, topology
- Andrzej Weber (MIM UW) associate professor position, topology

Abbreviations:

WCMCS – Warsaw Center of Mathematical and Computer Science, created jointly by IMPAN and MIMUW;
MIMUW – Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw;
UKSW – Cardinal Stefan Wyszyński University

They passed away

PROFESSOR CZESŁAW OLECH *passed away on July 1, 2015 in Warsaw.*

Professor Olech was born on May 22, 1931 in Pińczów near Kielce. He received his high school education in Kielce, followed by the degree of M.S. in mathematics from the Jagiellonian University in 1954. There he met professor Tadeusz Ważewski who soon recognized his mathematical talent.

Since 1954 he worked in the Institute of Mathematics of the Polish Academy of Sciences (Krakow Branch). He got his PhD in 1958 under the supervision of Ważewski. In 1962 he received his second scientific degree (habilitation) and became full professor in 1973. In the period spent in Kraków he often lectured at the AGH University of Science and Technology.

Early in his carrier he visited top mathematical centers in the United States of America. On an invitation by Solomon Lefschetz he spent one year in the Research Institute for Advanced Studies in Baltimore. This visit was followed by several others, mainly in Brown University where the new Center for Dynamical Systems was founded and run by Joseph La Salle with the help of Solomon Lefschetz.

One of the first problems studied by Professor Olech in United States concerned stability theory. His first result published there on the global asymptotic stability of an equilibrium for ODE's in dimension 2, known later as Olech's theorem, has been often applied in mathematical economy and is quoted in textbooks. His joint paper with Philip Hartman, extending Olech's theorem, is among classical achievements of that time in the field of dynamical systems. Later Olech became an associate editor of *Journal of Differential Equations*, one of the main journals in the field of differential equations, published by the Lefschetz Center for Dynamical Systems.

The main achievements of Professor Olech in the late 60-ties concerned optimal control theory. There he got fundamental results concerning existence of optimal control in a general setting and structural results which were far reaching extensions of the so-called bang-bang principle. In particular, he generalized a famous theorem of A.A. Lyapunov on the convexity of the image of a vector valued measure. For these results he was

invited to present a lecture at the International Congress of Mathematicians in Nice in 1970.

In 1970 he moved, together with his family, to Warsaw where he was elected director of the Institute of Mathematics of the Polish Academy of Sciences. Two years later he also became the director of the Stefan Banach International Mathematical Center, created in 1972. He was the director of the Institute till 1986 and the director of the Banach Center till 1992. During that time Banach Center became one of the most prestigious places for international meetings of mathematicians.

In 1978 professor Olech was elected a member of the Executive Committee of the International Mathematical Union (IMU), where he served for two terms (1979–1986). In the same year it was decided by the General Assembly of IMU that the next International Congress of Mathematicians will take place in Warsaw and Olech became the chairman of the Organizing Committee. Due to political problems of that time (martial law in Poland) the congress took place in 1983 instead of 1982 as originally planned. Professor Olech devoted a tremendous amount of work and diplomatic skills for making the event successful, which was difficult due to the political and economical instabilities.

After resigning of the directorship he continued his earlier scientific research concerning differential inclusions and nonsmooth and convex analysis. Together with G.H. Meisters he published a solution to the global asymptotic stability Jacobian conjecture for the polynomial case. In the years 1990–2002 he served as the chairman of the Scientific Council of the Institute.

Since 1973 professor Olech run a weekly seminar in the Institute. Occasionally he lectured at University of Warsaw. The seminar gathered a group of young people including his graduate students. He created a friendly atmosphere which was inspiring and creative for the young participants. He was able to devote time and give help to his students in spite of his duties as the director. He successfully supervised 9 PhD students, in particular at IMPAN Bronisław Jakubczyk 1977, Barbara Kaśkosz 1977, Tran Cao Nguyen 1978, Tadeusz

Rzeżuchowski 1980, Witold Respondek 1981, Zbigniew Bartosiewicz 1981, Andrzej Fryszkowski 1982, H el ene Frankowska 1984 and S. Atanasov  iwko 1986. Some of them are currently professors of mathematics in Poland, France and United States.

He was full member of the Polish Academy of Sciences and a member of its Presidium, doctor honoris causa of the Jagiellonian University and Vilnius University and the AGH University of Science and Technology in Krak ow. He was also a member of the Pontifical Academy of Sciences and Russian Academy of Sciences and also a member of the Polish and American Mathematical Societies. Being one of the founders of the European Mathematical Society he was its vice-president in 1991–1992. For his achievements he was awarded many scientific and state prizes. He should be remembered not only as a great mathematician but, as one of his mathematical friends from abroad said, a statesmen of Polish mathematics.

Bronisław Jakubczyk



CZESŁAW RYLL-NARDZEWSKI

On September 18th, 2015, Czesław Ryll-Nardzewski passed away at the age of 89. Since 1954 he was a professor of a few Polish universities, and of the Institute of Mathematics of the Polish Academy of Sciences.

He spent a year as a visiting professor at the University of California Berkeley, collaborating with A. Tarski. In 1979 he was elected a member of the Polish Academy of Sciences. During his lifetime he published more than 100 papers, but left quite a few results unpublished; some of them were published by other mathematicians.

He was a teacher of several generations of mathematicians, and supervised more than 10 PhD theses from many areas of mathematics.

He was awarded a professorship at Wrocław University at the age of 28, which was quite unusual at the time.

Ryll-Nardzewski's adventure with science starts from experimental chemistry (pyrotechnics), medicine and physics. He inherited medical skills from his parents: his father was an army colonel and a well known dermatologist, after the war a professor at a medical school in Lublin, and his mother was a gynaecologist.

Mathematics was his very late scientific choice.

During the war, his parents arranged for him to have German lessons with a mathematician, Professor

Stefan Straszewicz, who convinced him to study mathematics.

His characteristic feature in approaching mathematics was to treat it as a unified system, rules of which he understood and applied in various subareas, obtaining many spectacular theorems.

Ryll-Nardzewski received several scientific grants. The filling of an application form always created a problem when he had to define his main research area. For many years he was the editor of the mathematical series of the Bulletin of the Polish Academy of Sciences, and a member of the editorial boards of *Studia Mathematica*, *Fundamenta Mathematicae*, *Colloquium Mathematicum* and a few other journals.

He popularised mathematics, being an author of many fairly non-trivial elementary problems for talented primary school students.

When the martial law was declared in Poland in 1981, he was serving as director of the Institute of Mathematics of the Technical University of Wrocław. Using his position, he prevented expelling a few politically active students.

For his scientific achievements he was awarded high Polish decorations, and many major prizes by mathematical institutions; however, he never accepted any honorary academic title. He was also a respected bridge player.

Ryszard Frankiewicz



STEFAN ROLEWICZ

passed away on July 9, 2015 in Warsaw.



A few days before his passing away, Professor Stefan Rolewicz called me to let me know that he was going to the hospital for a serious surgery, and he wanted to say goodbye. I thanked him for his great contribution to the Institute's life, and I wished him a successful surgery. I did not think that it could really be our last conversation.

Professor Rolewicz was one of the laureates of the first Polish Mathematical Olympiad in 1949/50 (among other laureates there were: professor Balcerzyk, professor Bessaga and professor Pełczyński). This success encouraged him to undertake studies on the Faculty of Mathematical and Natural Sciences of the University of Warsaw.

In 1955, professor Rolewicz graduated from this faculty (which in the meantime changed its name to: Faculty of Mathematics and Physics) majoring in mathematics. In 1958, he defended his doctoral thesis, which he wrote under the supervision of professor Stanisław Mazur. He obtained the habilitation in 1962, and the professorship in 1970, when he was 38 years old.

Professor Rolewicz worked at the Institute of Mathematics of the Polish Academy of Sciences from 1956. In 1971–2005, he was the head of the Department of Mathematical Analysis. His field of research was functional analysis and its applications in mathematical optimization theory, control theory and convex analysis. He was the author of a few monographs highly appreciated worldwide, and of over 160 research articles. He promoted 14 doctoral students. The first one was professor Malanowski, in 1965.

He co-authored many of his works, most of them with his wife, Danuta Przeworska-Rolewicz (at least 15).

In 1968, professor Rolewicz was the laureate of the scientific Stefan Banach's Award of the Polish Mathematical Society (together with Danuta Przeworska-Rolewicz).

THE MONOGRAPHS BY PROFESSOR ROLEWICZ INCLUDE:

- *Equations in linear spaces* (co-authored by Danuta Przeworska-Rolewicz), 1968;
- *Metric Linear Spaces*, 1973 (I learned from it when I was a student);
- *Functional Analysis and Control Theory*, PWN 1974, 1976 German translation, 1987 English translation;
- *Foundations of Mathematical Optimization. Convex Analysis without Linearity* (co-authored by Diethard Pallaschke), Kluwer 1997.

While studying the problems of unsmooth optimization, professor Rolewicz cooperated with economists, among others with the Central Economics and Mathematics Institute of the Russian Academy of Sciences (until 1991 the Academy of Sciences of the USSR). This long-standing cooperation with IMPAN was supervised by professor Rolewicz.

In recent years, professor Rolewicz conducted a nationwide seminar at IMPAN concerning Mathematical Methods of Technology and Economy.

Professor Rolewicz was the editor of *Applicationes Mathematicae*, *Commentationes Mathematicae*, *Control and Cybernetics*, *Zeitschrift für Analysis und ihre Anwendungen*, *Scientia Mathematica Japonica*.

For many years (1989–2006), he supervised the publishing activity of IMPAN. He was a co-creator of our publishing house. Together with Birkhauser publishing

IN MEMORY OF WITOLD KONDRACKI

Witold Kondracki passed away on June 24, 2015, at the age of 65.

Witold Kondracki was born in 1950 in the Warsaw district of Żoliborz. Little Witek had passion for chemistry and for what was most spectacular about it – pyrotechnical experiments. It was because of one of such experiments that in 1964 the house he was living in was shaken by an explosion, as a result of which Witold lost his sight.

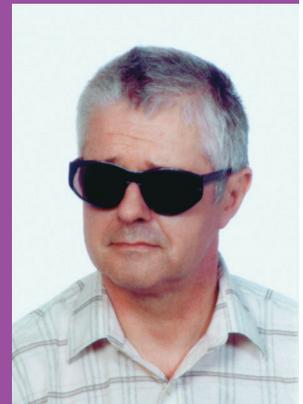
Witold Kondracki worked at the Institute of Mathematics for over 40 years. He had links to the Institute since he obtained a degree at the Faculty of Physics of the University of Warsaw in 1973. At the same time, he also studied at the Faculty of Mathematics of the University of Warsaw. The Institute was his only place of work up until his premature passing. It was here that in 1976 he obtained his doctorate on the basis of a thesis written under the supervision of Krzysztof Maurin entitled Geometrisation of classical field theory and its application in the theory of Yang-Mills fields, and that in 1985 he obtained the habilitated doctor degree on the basis of a thesis entitled On the stratification of the orbit space for the action of automorphisms on connections. He was a highly educated, excellent scientist with very broad interests. In 1988, he was awarded a prize by the Polish Mathematical Society. In 1989–90, he was a scholarship-holder of a Humboldt Foundation at the Max Planck Institute for Physics and Astrophysics. He also stayed for a few months at the Harvard University. He specialized mainly in the applications of mathematics to the basic theories of physics

describing our Universe. He was also interested in the foundations of mathematics, in particular, number theory and its applications to cryptography. In recent years, he worked on the applications of statistical methods to data analysis, and he participated in a large international project devoted to gravitational waves detection. He promoted one doctor.

While working on a given problem, Witold always organized a small group of people for whom he was a leader and a motive force. For each of his collaborators he would come up with some expressive nickname, which helped to integrate the group. When cooperating with other people he was characterized by an extraordinary inquisitiveness which led to the problem solution. He mobilized his colleagues by calling them and arranging meetings. Witold Kondracki had very broad interests and great passions. In particular, he had passion for travel. He travelled to many Asian countries. I recall when we travelled together to India. Witek, thanks to his knowledge and contacts, was the main organizer and guide during this journey. For me and for some other participants, it was a first trip to India. I remember that Witek laughed at our anxiety and at our ignorance of this country, the country of which he was connoisseur.

Witold Kondracki was married and fathered three children.

Andrzej Królak



house, he organized the reissue of the series *Mathematical Monographs*.

For several years, professor Rolewicz was the chair of the Council of the Foundation for the Development of Polish Mathematics.

He was a member of the Polish Mathematical Society, for many years he acted as its treasurer, and in

1983–1987 – as the President of the Warsaw branch of the Society.

He was elected full member of the Warsaw Scientific Society.

He was a modest, wise and extraordinarily kind-hearted man, a good soul of our Institute.

Feliks Przytycki

Banach Center Upcoming Events 2015–2016

For more information, please check out: <http://www.impan.pl/BC/Program/2015.html>

	TITLE	DATE	ORGANIZERS	PLACE
1.	XLI Conference on Mathematical Statistics	06–11.12.2015	A. Markiewicz, K. Filipiak, Ł. Smaga, W. Wołyński	Będlewo
2.	Algebraic Geometry (Simons Semester)	18.04–18.06.2016	J. Buczyński, S. Cynk, Tomasz Szemberg	Warsaw/ Cracow/ Będlewo
3.	Varieties of Calabi-Yau Type (Simons Semester school)	17–23.04.2016	M. Kapustka, O. Kędzierski, L. H. Halle, V. Lazic	Warsaw
4.	Asymptotic Invariants Attached to Linear Series (Simons Semester conference)	15–21.05.2016	J. Buczyński, P. Pokora, S. Rams, T. Szemberg	Cracow
5.	Varieties with Trivial Canonical Bundles (Simons Semester conference)	12–18.06.2016	P. Borówka, S. Cynk, M. Donten-Bury, et al.	Będlewo
6.	Probabilistic Aspects of Harmonic Analysis (conference)	14–21.05.2016	M. Preisner, K. Bekata, W. Cygan, et al.	Będlewo
7.	Symposium on Complex Analysis and Geometry	05–11.06.2016	S. Kotodziej, S. Dinew, R. Czyż	Będlewo
8.	X Forum of Partial Differential Equations (conference)	19–24.06.2016	A. Świerczewska-Gwiazda, A. Wróblewska-Kamińska, E. Zatorska	Będlewo
9.	3rd Conference on Nonlocal Operators and Partial Differential Equations	27.06.–01.07.2016	K. Bogdan, M. Kassmann, K. Kaleta, T. Kulczycki	Będlewo
10.	Foliations 2016 (conference)	11–17.07.2016	S. M. Walczak, M. Badura, M. Ciska-Niedziałomska, et al.	Będlewo
11.	Transfinite Methods in Banach Spaces and Algebras of Operators (conference)	17–23.07.2016	A. Aviles, P. Koszmider, N. J. Laustsen	Będlewo
12.	17th Workshop: Non-commutative Probability, Lévy Processes and Operator Algebras, with Applications	24–30.07.2016	M. Bożejko, R. Lenczewski, R. Satařpata, P. Śniady, et al.	Będlewo
13.	Harmonic Analysis, Complex Analysis, Spectral Theory and all that (conference)	31.07.–06.08.2016	K. Barański, T. Iwaniec, S. Petermichl, F. Przytycki et al.	Będlewo
14.	Galois Representations and Automorphic Forms (conference)	14–20.08.2016	G. Banaszak, S. Barańczuk, T. Berger, K. Kłosin.	Będlewo
15.	IBC on the 70th anniversary of Henryk Woźniakowski	28.08.–02.09.2016	B. Z. Kacewicz, M. Kowalski, M. Kwas, L. Plaskota, G. Wasilkowski	Będlewo
16.	Noncommutative Geometry the Next Generation (Simons Semester)	01.09.–31.11.2016	P. F. Baum, A. Carey, P. M. Hajac, et al.	Warsaw
17.	7th Euro-Japanese Workshop on Blow-up	04–10.09.2016	M. Fila, G. Karch, D. Wrzosek	Będlewo
18.	Mathematics of Pattern Formation (conference)	11–17.09.2016	G. Karch, A. Marciniak-Czochra, P. Gwiazda	Będlewo
19.	Stochastic Models V (conference)	11–17.09.2016	R. Szekli, K. Dębicki, Z. Palmowski, T. Rolski	Będlewo
20.	6th Polish Combinatorial Conference	18–24.09.2016	J. Grytczuk, J. Jaworski, P. Micek, et al.	Będlewo
21.	50th Seminar "Sophus Lie"	25.09.–01.10.2016	I. Agricola, A. Fiałowski, J. Grabowski, et al.	Będlewo

IMPAN

8 Śniadeckich street
00-656 Warsaw
Poland
tel.: +48 22 5228100
fax: +48 22 6293997
www.impan.pl
im@impan.pl

Stefan Banach International Mathematical Center

8 Śniadeckich street
00-656 Warsaw, Poland
tel.: +48 22 5228232
fax: +48 22 6225750
<http://www.impan.pl/BC/>
banach.center.office@impan.pl

Będlewo Research and Conference Center

Będlewo, 1 Parkowa street
62-060 Stęszew, Poland
tel.: +48 61 8135187
fax: +48 61 8135393
<http://www.impan.pl/EN/Bedlewo/>
bedlewo@impan.pl