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Newsletter of IMPAN

OPUS GRANTS

PH.D. THESES

CONFERENCES

SIMONS SEMESTERS

Polish Research Grants: OPUS

Continuation.
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. Four grants from the OPUS 5 edition are presented below. Four grants of the earlier editions were described in the Newsletter of IMPAN no. 6. In the last competition of OPUS 7, two grant applications from IMPAN were selected for funding: the applications by Michał Rams and by Ryszard Rudnicki.

Spectral analysis and asymptotic methods for scalar and matrix difference operators.
Coordinator: Jan Janas, Principal co-investigators: Serguei Naboko and Marcin Moszyński (03.2014–03.2017)

The project concerns spectral analysis of difference (Jacobi) operators of the second order acting in the Hilbert space of square summable scalar or vector sequences. They can be viewed as the discrete analogue of Sturm-Liouville operators and their study has many similarities with Sturm-Liouville theory. Their spectral and inverse spectral theory has many applications in other fields (discrete models of mathematical physics, orthogonal polynomials, completely integrable nonlinear lattices). Moreover, recall that any selfadjoint operator in a separable Hilbert space with a cyclic vector is unitarily equivalent to a Jacobi operator (Stone).

Spectral analysis of Jacobi operators (matrices) has been developing for many years after the second World War. Especially fast progress in the field was made in 80–90 ties of the XX century. This progress has risen new questions and problems.

The main aim of our project is to study the following topics.

i. Asymptotic behaviour of eigenvalues for new classes of complex (or multidimensional) Jacobi matrices.
ii. Constructions of new examples of special unbounded Jacobi operators with the prescribed spectral picture.
iii. An attempt of finding new effective description of the absolutely continuous part of the spectrum of general Jacobi operator.
iv. Studies of the rate of decay of the matrix elements of the Green matrix in the vector case.

Partial results for problems asked in i), ii) and iv) were already achieved earlier by some of us (the members of the project) but only in the l^2 space of scalar sequences.

Real and complex affine algebraic geometry, Coordinator: Zbigniew Jelonek, Investigators: Wojciech Kucharz, Michał Lasoń (02.2014–02.2017)

One of the most important fields in mathematics is an algebraic geometry, which uses algebraic tools to study geometrical objects. When the projective geometry (which focus on compact algebraic varieties) is old and quite well developed, the affine algebraic geometry (which studies algebraic subsets of) is younger and still needs some backgrounds. The aim of the project is to solve following problems connected with an affine algebraic geometry.

1. **Effective description of the bifurcation set of a polynomial mapping** $f: X \to K^m$ ($K = \mathbb{C}$ *or* $K = \mathbb{R}$).
   a. *Polynomial mapping* $f: K^n \to K$. In the past I have described (with K. Kurdyka) the algorithmic method of finding a bifurcation set of a polynomial $f: \mathbb{C}^n \to \mathbb{C}$. Now I would like to find a better algorithm which works also in a real case. This algorithm gives a solution of the important for application problem: how to find a global supremum of a real polynomial.
   b. *Effective Thom isotopy lemma*. More generally previously I showed (with K. Kurdyka) how to effectively described the bifurcation set for a dominant polynomial mapping $f: X \to \mathbb{C}^m$ in the case of smooth affine variety. I generalize this result to the case of arbitrary (singular) affine variety.
2. **Characterization of the asymptotic variety**. Let $K = \mathbb{C}$ or $K = \mathbb{R}$ and let $f: K^n \to K^m$ be a generically finite mapping of degree d between affine spaces. I would like to show that the asymptotic variety S_f of the mapping f, is covered by polynomial curves of degree at most $d-1$, which is the best possible number. Additionally if X is a K-uniruled affine variety covered by polynomial curves of degree at most d_1, and $f: X \to K^m$ is a generically finite polynomial mapping of degree d_2, then the set S_f is covered by polynomial curves of degree at most $d_1 d_2$ for $K = \mathbb{C}$ and of degree at most $2d_1 d_2$ for $K = \mathbb{R}$. Using these results we prove real counterparts of our previous complex results.
3. **The set of fixed points of a polynomial automorphisms**. In my previous paper I have described the set of fixed points of a polynomial automorphisms $\Phi: K_2 \to K_2$. In particular I have observed that if the set of fixed points of such a polynomial automorphism is a curve then this curve is a parametric curve. This suggests that for an automorphism $\Phi: K^n \to K^n$ if a component H of $Fix(\Phi)$ is a hypersurface, then it have to be uniruled. Now I would like to prove that indeed such components of $Fix(\Phi)$ are uniruled.
4. **Application of vector bundles in affine algebraic geometry.**
   a. *On smooth hypersurfaces containing a given subvariety*. Let X^n be a nonsingular affine variety (of dimension n) over an algebraically closed field k. It is known, that any closed nonsingular subvariety $Y^r \subset X^n$ with $n \geq 2r + n$ is contained in a nonsingular hypersurface. Recall that a subvariety $H \subset X$ is a hypersurface if its ideal $I(H) \subset k[X]$ is generated by a single polynomial. Our aim is to prove similar results in the real algebraic case and in the complex analytic (Stein) case.
   b. *Exotic affine varieties*. Let Γ_i, $i = 1, \ldots, d$ ($d \geq 1$) be non-rational smooth affine curves. I show that the Stein variety $X = \mathbb{C} \times \Pi_{i=1}^{d} \Gamma_i$ has uncountably many different structures of affine variety.

IMPAN launched a new National Analysis Seminar

The main goal of the seminar is to promote widely understood Analysis and to stimulate the mutual exchange of ideas and concepts between mathematicians representing different areas of Analysis. The seminar consists of two talks: an introductory talk and a main talk. While the introductory part is intended to be an introduction to the subject of the main talk and an intuitive explanation of basic notions and tools, the main talk concentrates on a presentation of new concepts and ideas in a non-technical way. The organizers: F. Przytycki, Yu. Tomilov, M. Wojciechowski, and P. Wojtaszczyk.

May 21, the main talk: Izabella Laba (Univ. of British Columbia), Harmonic analysis and additive combinatorics on fractal sets.

Orthogonal expansions in harmonic analysis
Coordinator: Adam Nowak, Principal co-investigator: Krzysztof Stempak. (02.2014–02.2017)

This research project concerns aspects of harmonic analysis related to classical orthogonal expansions and partially to maximal operators as such. The main aim of the project is to elaborate necessary tools and provide answers to several interesting questions that arose recently in connection with a dynamic development of these areas of harmonic analysis. The proposed research tasks split naturally into three groups.

The first group embraces investigations of potential operators in the settings of discrete Jacobi, Laguerre and Fourier-Bessel expansions, and in the framework of continuous orthogonal expansions related to the Hankel transform. We plan to find sharp estimates of the Riesz and Bessel potential kernels which in each case are given only implicitly. This will enable us to characterize Lp-Lq mapping properties of the associated potential operators. Such results would be desirable sharp analogues of the celebrated classic Hardy-Littlewood-Sobolev fractional integration theorem.

The second circle of problems pertains to mapping properties of fundamental harmonic analysis operators, such as Riesz transforms, spectral multipliers, Littlewood-Paley-Stein square functions and Lusin's area integrals, in the context of the Dunkl harmonic oscillator, as well as in the closely related setting of symmetrized Laguerre expansions of convolution type. The main emphasis will be put on the essentially unexplored, from harmonic analysis perspective, situation when the Dunkl multiplicity function is not non-negative. The latter postulate is crucial in several important aspects of the Dunkl theory, like existence of a convolution structure or existence and uniqueness of the intertwining operator.

Finally, the third group of questions is related to maximal operators. Here we plan to study the Hardy-Littlewood maximal operator and its variants in a general framework of metric measure spaces. Our main interest will be focused around behavior of these operators on Lebesgue spaces, likewise on more exotic local Campanato and Morrey spaces which actually first need to be defined. Even more intriguing seems to be the task of investigating non-centered Hardy-Littlewood type maximal operators related to certain families of non-doubling and non-radial measures in Euclidean spaces. Not much is known in the simpler (though by no means simple) non-doubling radial case, and the situation we want to inspect appears to be *terra incognita*.

Stochastic Analysis and Evolution Equations
Szymon Peszat (02.2014 – 02-2017)

The aim of this project is to answer some questions arising in the theory of stochastic evolution equations of Mathematical Physics. We will study two classes of such equations important in Fluid Dynamics and theory of phase transitions. Solutions to both classes of equations are infinite-dimensional Markov processes. In order to study these processes we will need to develop new analytical tools. Some of the analytic results obtained in the course of the project will be new and important even in the finite-dimensional case. In broad terms, the focus of this project is on the following three research tasks:

1. Analytical tools for stochastic evolution equations,
2. Equations of Mathematical Physics,
3. Asymptotic behavior of dynamical systems perturbed by small noise.

Selected Ph.D. theses

Moment comparisons for mixtures of ordered distributions
Patryk Miziuła, Supervisor: prof. dr hab. Tomasz Rychlik

We consider mixtures of unknown distribution functions according to various known mixing distribution functions. The only assumption we need is that the mixed distribution functions are ordered. This general model is useful in various branches of applied mathematics, e.g., in the reliability theory and the insurance mathematics. Many interesting interpretations can be obtained by choosing proper mixing distribution functions and embedding them in the framework of the model.

We provide methods which allow us to compare moments of considered mixtures. We are able to write down optimal bounds on differences of expectations and on quotients of variances of these mixtures. Furthermore, we can estimate quotients of more general dispersion measures of the mixtures. The lower and upper bounds are very simple functions of the mixing distribution functions. They are completely independent of the mixed distribution functions. Therefore they are valid for all the possible mixed distribution functions.

The application of the general model we broadly discuss in the dissertation is estimating moments of lifetime of reliability systems with identical, but not independently working, elements. These results can be used, for example, to predict failures of networks of high-voltage lines or any other, possibly very complex, industrial structures composed of many identical elements. A model of flood insurance of a factory placed by the river is considered as well.

Certain combinatorial invariants in structures related to Banach spaces
Damian Sobota, Supervisor: prof. dr hab. Piotr Koszmider

In set theory a combinatorial invariant is the maximal cardinal up to which a specific diagonalization procedure can be carried out e.g., for the invariant b (bounding number), given a family F of cardinality smaller than b of functions from the set N of natural numbers into itself we can find a function g such that for every f in F it holds that $f(n)<g(n)$ for all but finitely many n. That is b is the minimal cardinality of F for which finding such g may not be possible. The concrete values of such interesting invariants are undecidable based on the usual axioms, e.g., b consistently can be the first uncountable cardinal, or the second, etc. We say that an invariant is optimal for some class of structures if it is provably equal to the minimal size of such a structure. For example by a result of A. Aviles, b is optimal for subspaces of weakly compactly generated Banach spaces which are not weakly compactly generated. Finding the optimal invariant shows a logical and combinatorial

link between the type of diagonalization related to the invariant and a given class of structures. In my PhD thesis I study relations between those invariants and properties of Banach spaces and related structures.

For example, we are interested in the optimal invariant for the class a non-reflexive Banach spaces with the Grothendieck property. (A Banach space X has the Grothendieck property if every weak* convergent sequence in the dual space X* is weakly convergent). It turns out that the density of such a space cannot be smaller than the invariant s (splitting number) defined as the minimal cardinality of a family Fof subsets of the set N of natural numbers such that for every infinite subset A of N there exists B in F such that both the difference of A and B and their intersection are infinite. A question remains: is there a non-reflexive Banach space with the Grothendieck property having density equal to s?

We are also interested in the relations between Boolean algebras and Banach spaces of continuous functions or more general in the families of projections in C*-algebras. For example, we are working on a consistent construction of an infinite C*-algebra of density strictly less than the continuum and having the Nikodym property: every sequence of functionals on A which is bounded on every projection of A is also uniformly bounded (i.e. bounded as a sequence of functionals in the dual space to A as a Banach space). We have already known that such a C*-algebra cannot have density less than either b or s. This may lead to finding the optimal invariant for C*-algebras with the Nikodym property, this invariant cannot be bigger than the continuum since by a classical result of Darst all von Neumann algebras have the Nikodym property.

Mathematical models of phenotypic evolution and their asymptotic properties

Paweł Zwoleński,
Supervisor: prof. dr hab. Ryszard Rudnicki

Hermaphrodites, the individuals having both male and female reproductive systems, are numerous water and terrestrial organisms and their examples are flowering plants, snails and sponges. In order to describe evolution of these populations we study constant lifetime phenotypic traits of individuals and build a stochastic process as an individual-based model including inheritance of traits, intra-specific competition and mortality at trait-dependent rates. The examples of phenotypic traits are skin color or average body mass. When the number of individuals tends to infinity we prove a law of large numbers: a sequence of suitably rescaled versions of stochastic process considered tend in Skorokhod space to a nonlinear measure-valued evolution equation. In the case of random mating the limiting equation contains bilinear mating-inheritance operator and its particular case is Tjon-Wu equation describing the energy distribution of colliding gas particles. Under suitable conditions we prove the asymptotic stability result: distribution of phenotypic traits in the population converges to a stationary distribution as time tends to infinity. As a by-product we obtain relatively easy proof of Lasota-Traple theorem concerning asymptotic stability of Tjon-Wu equation. We consider applications of our theorem to some biologically reasonable examples of phenotypic inheritance such as mean parental trait inheritance with external additive or multiplicative noise.

Simons Semesters in Banach Center

IMPAN has won 5 years grant for the program "Simons Semesters in Banach Center"

What we are going to do ...

We want to establish a program: "Simons Semesters in the International Banach Center", as a new form of research activity at the Institute of Mathematics of the Polish Academy of Sciences (IMPAN). Banach Center (BC) is the conference establishment of IMPAN. We request financial support from the Simons Foundation for "Simons Semesters Fellows", distinguished senior and outstanding young researchers invited to IMPAN to lead the Semesters. We request support for 2–4 month long visits for each Semester for five consecutive years.

We plan to run expert-guided semester-long courses and shorter mini-courses for young mathematicians. The Simons Semester fellows will be expected to teach, provide tutoring, and collaborate with younger colleagues at IMPAN. It is assumed that some of these interactions will lead to fruitful and extended cooperation. The topics of the semesters will cover areas of modern mathematics in which we have some background but need outside expertise to reach the forefront.

The scope of the program will include PhD students and young post-docs of IMPAN and PhD students of other leading mathematical departments in Poland and in Central-Eastern Europe.

How we are going to do it ...

We intend to organize semesters in selected key areas of modern mathematics. A full semester would last 4 months and include research, seminars, and courses, with about 30 participants and 3 intensive workshops/schools with up to 100 participants. Each semester will typically start with an intensive week of introductory courses aimed at less prepared participants. The regular research will take place in the Institute premises at Warsaw, while workshops/schools will take place at the Research and Conference Center of IMPAN at Będlewo. We plan one full semester per year and one shorter mini-semester (about 2 months long).

We plan open calls to propose and run the semesters (except the first two). The first semester, already in Fall 2015, will be Dynamical Systems. The second one, in Spring 2016, will be devoted to Algebraic Geometry.

More information about the program and the Simons Foundation can be found at www.impan.pl/BC and www.simonsfoundation.org.

SIMONS FOUNDATION

Targeted Grants to Institutes:

The program is intended to support institutions in the mathematics and physical sciences through funding to centers of excellence, to help establish scientific culture and strengthen contacts within the international scientific community.

IMPANGA 2000–2015

Let us start with the explanation of the meaning of the name "IMPANGA". It comes from the two names in Polish: ***IMPANGA = IM PAN Geometria Algebraiczna***

At the beginning, in 2000, it was just the name of a new seminar on algebraic geometry at IM PAN, invented by the author of the present note. Nowadays, the activities of IMPANGA are much wider; in fact, IMPANGA is an algebraic geometry environment, organizing mathematical events (i.e. the seminar, schools, workshops etc.) and editing IMPANGA Lecture Notes. Mathematicians related to IMPANGA are mainly interested in complex algebraic geometry. This is a classical area of algebraic geometry; here one attacks the key problems of geometry and related important problems of algebra and combinatorics. The IMPANGA Seminar meets each second week at IM PAN in Warsaw for two sessions, and the participants come from all around Poland and abroad. This is a research seminar with lectures in English. The speakers at the IMPANGA Seminar have included: J.P. Brasselet, S. Capell, H. Duan, H. Esnault, L. Gruson, F. Hirzebruch, L. Katzarkov, V. Kiritchenko, A. Lascoux, V. Lazić, V. Mehta, M. Oka, T. Peternell, C. Ranestad, B. Totaro and J. Włodarczyk. For a detailed program of the seminar, see the home page of IMPANGA:

www.impan.pl/~pragacz/impanga.htm

The following areas of algebraic geometry have been represented at IMPANGA: complex algebraic geometry (both projective and affine), vector bundles, moduli spaces (of vector bundles, curves and abelian varieties), intersection theory and enumerative geometry, classical algebra and combinatorics, Schubert calculus, singularities and especially the global theory of singularities, analytic geometry and local algebra, algebraic topology, geometry and topology of surfaces, Calabi-Yau manifolds, K-theory, symplectic geometry and topology, abelian varieties, arithmetic algebraic geometry, algebraic geometry in positive characteristic and others.

IMPANGA has organized conferences, schools, minischools, workshops, research groups, sessions and summer seminars. At the Banach Center in Warsaw, the following schools took place: *Characteristic classes* (2002), *Stratifications of moduli spaces* (2002), *Schubert varieties* (2003), *Symplectic topology* (2004), *Moduli spaces* (2005), *Holomorphic symplectic singularities* (2006). Also, the Center hosted the sessions: *Hommage à Grothendieck* (2004), *Algebraic cycles and motives* – IMPANGA 100 (2005), *In honor of Hoene-Wroński* (2007), *Zeta functions* (2007), and research groups: *Classical algebra, combinatorics and Hoene-Wroński* (2008), *Thom polynomials and the Green-Griffith conjecture* (2011), *The ubiquity of Wrońskians* (2011), *Okounkov bodies and Nagata type conjectures* (2013), *The geometry of homogeneous varieties* (2013), *Abelian varieties* (2014). For more details, see the above mentioned web page. In 2003, IMPANGA organized jointly with the Institutes of Mathematics of Bulgarian and Romanian Academies of Science the conference *Algebraic geometry, algebra and applications* in Borovetz (Bulgaria). IMPANGA also contributed in various ways to algebraic geometry conferences and schools organized in Poland, e.g., *Manifolds in mathematics and in other fields* (IM PAN, 2002; organized by F. Hirzebruch and S. Janeczko), and Okounkov solids, organized by T. Szemberg at the Pedagogical University in Cracow, 2011.

The two largest events, organized by IMPANGA at the Banach Center in Będlewo, were: *Impanga summer school on algebraic geometry* (2010):

www.impan.pl/~impanga/school
and the Conference *IMPANGA 15* (2015):
www.impan.pl/~impanga15

The former event was devoted to Prym varieties and their moduli, moduli spaces of curves and abelian varieties, differential forms and applications to moduli, K3 and Enriques surfaces, invariants of singularities in birational geometry, minimal model program, toric varieties and equivariant cohomology. The latter conference was mainly devoted to Chern class formulas for degeneracy loci, equivariant cohomology of flag varieties, moduli spaces of abelian varieties and surfaces, classes of singular varieties, Thom polynomials, tropical algebraic geometry and its applications, geometry in positive characteristic and filtrations of B-modules.

The lecturers at the conferences, schools and workshops of IMPANGA have included (apart from the speakers at the Seminar mentioned above): K. Altmann, P. Aluffi, D. Anderson, G. Bérczi, M. Brion, A. Buch, P. Cascini, C. Ciliberto, I. Coskun, J.M. Drezet, G. Farkas, G. van der Geer, T. Gómez, B. Harbourne, J. Huh, J.M. Hwang, M. Kazarian, S. Kebekus, J. Keum, M. Lehn, R. Miranda, S. Mukai, J. P. Murre, M. Mustață, T. Ngô Dac, K. Ono, R. Rimányi, F. Russo, A.H.W. Schmitt, J. Schürmann, F.O. Schreyer, V. Srinivas, H. Tamvakis and M. Vlasenko.

The meetings of IMPANGA inspired many papers; in particular, they inspired 15 papers of the author of the present note.

Apart from those already mentioned, the mathematicians contributing to IMPANGA (in various ways) include: P. Achinger, J. Adamus, G. Banaszak, M. Borodzik, P. Borówka, J. Buczyński, W. Buczyńska, M. Chałupnik, P. Chojecki, S. Cynk, M. Donten-Bury, M. Dumnicki, Ch. Eyral, L. Gatto, K. Han, Z. Jelonek, G. Kapustka, M. Kapustka, P. Karwasz, J. Kass, J. Kędra, O. Kędzierski, M. Koras, A. Küronya, S. Kwak, A. Langer, T. Maszczyk, M. Michałek, Ö. Özturk, K. Palka, E. Postinghel, S. Rams, I. Scherbak, T. Szemberg, J. Szpond, M. Szyjewski, H. Tutaj-Gasińska, B. Wajnryb, A. Weber and J. Wiśniewski.

IMPANGA edited the following lecture notes: *Topics in cohomological studies of algebraic varieties* (Birkhäauser 2005), *Algebraic cycles, sheaves, shtukas, and moduli* (Birkhäuser 2007), *Hoene-Wroński: życie, matematyka i filozofia* (in Polish, IM PAN 2008) and *Contributions to algebraic geometry* (EMS Publishing House, 2012). The next volume of IMPANGA Lecture Notes is in preparation.

Long live IMPANGA!

Piotr Pragacz, April 2015

Conferences

QUANTUM PROBABILITY, GROUPS AND GEOMETRY

April 7–10 2015, Warsaw

The network **Quantum groups, operators and noncommutative probability (QOP)**, joining IMPAN, University of Leeds and Lancaster University (both UK) has been active since 2013. The initial funding for this collaboration came from a grant of the London Mathematical Society, and the network was also financially supported by the Warsaw Centre of Mathematical Sciences, Banach Center and both of the British participating institutions. The research themes of the network cover quantum group theory, noncommutative harmonic analysis, the study of Banach algebras and Banach spaces, quantum probability and stochastic analysis and applications of set theory to functional analysis. Persons responsible for leading the nodes are respectively Harold Garth Dales (Lancaster), Matthew Daws (Leeds) and Adam Skalski (Warsaw).

The main aim of QOP activities is maintaining and further development of the existing contacts between mathematicians from Poland and Great Britain who work in the areas of the project, and also extending these collaborations via involving other scientists related to the participating institutions, with a special focus on PhD students and postdoctoral researchers. To date, there have been 6 meetings of the network,

2 in Lancaster, 2 in Leeds and 2 in Warsaw. Each time they took a form of a week-long workshop, with two days devoted to a series of lectures and the remaining time used for focused discussions in smaller subgroups. The speakers were mainly mathematicians working in Poland and Great Britain, but some lectures were also delivered by researchers based in France, Ireland and USA. During network's existence over 15 articles have been written as a result of the collaborations between participants affiliated with different nodes; these include papers accepted for publication in Crelle's Journal, Journal of Functional Analysis, Journal of the London Mathematical Society and Studia Mathematica.

The last meeting, titled „Quantum Probability, Groups and Geometry" took place in Warsaw between 7th and 10th April 2015. It had 25 participating mathematicians coming from 6 institutions in Poland, UK and France, including 5 PhD students and 5 postdoctoral researchers. More information on the activities of the network, including the list of all its individual members and schedules of the meetings organized under the auspices of QOP may be found at www.maths.lancs.ac.uk/qop//index.html

Adam Skalski

→ QOP 2015

ALGEBRAIC GEOMETRY CONFERENCE IMPANGA 15

April 12–18 2015, Będlewo

The event was a part of IMPANGA seminar activities – every five years we are organizing an international conference in algebraic geometry. This year's conference was very special – we were celebrating fifteen years of IMPANGA, and 60th birthday of Professor Piotr Pragacz.

The conference exposed richness of algebraic geometry, especially: symmetric functions and polynomials, Schubert varieties and degeneracy loci, characteristic classes (particularly of singular varieties), Thom polynomials, characteristic p problems, arithmetic algebraic geometry, moduli problems, tropical geometry.

IMPANGA15 gathered 77 participants from Europe, United States, and Asia. Apart from 17 plenary lectures, there were also 9 shorter talks delivered by participants. During the conference there was a poster session with

a range of interesting presentations. Numerous people contributed to the success of the conference. The organising committee consisted of J.Buczyński (IMPAN & University of Warsaw), M.Donten-Bury (University of Warsaw & Freie Universitat Berlin), G.Kapustka (IMPAN & Jagiellonian University), O.Kędzierski (University of Warsaw & IMPAN), M.Michałek (IMPAN & University of California, Berkeley), E.Postinghel (University of Leuven), and J.Szpond (Pedagogical University of Cracow). Moreover, the scientific committee helped to make the event exceptional: Paolo Aluffi (Flordia State University), Bernard Leclerc (Université de Caen), Richárd Rimányi (University of North Carolina at Chapel Hill), Matthias Schütt (Leibniz Universität Hannover), Ravi Vakil (Stanford University).

Invited speakers of the conference were David Anderson (Ohio State University), Anders Buch (Rutgers University), Hélène Esnault (Freie Universität Berlin), Gerard van der Geer (Universiteit van Amsterdam), June Huh (Princeton University & Institute for Advanced Study), Toshiyuki Katsura (Hosei University), Maxim Kazarian (Steklov Institute of Mathematics & Moscow Independent University), JongHae Keum (Korea Institute for Advanced Study), Allen Knutson (Cornell University), Adrian Langer (IMPAN & University of Warsaw), Laurentiu Maxim (University of Wisconsin, Madison), Toru Ohmoto (Hokkaido University), Sam Payne (Yale University), Piotr Pragacz (IMPAN), Steven Sam (University of California, Berkeley), Harry Tamvakis (University of Maryland), and Orsola Tommasi (Leibniz Universität Hannover). The conference was generously supported by Foundation Compositio Mathematica, Warsaw Centre of Mathematics and Computer Science, Stefan Banach International Mathematical Center and Polish Academy of Science (DUN initiative).

IMPANGA15 was also an opportunity to honour Professor Piotr Pragacz on the occasion of his birthday. He was the special honorary guest of the meeting. During the conference we had a barbeque and the conference banquet. On Wednesday, April 15th, in the afternoon, there was an excursion to Poznań. It included a guided tour around the Old Market Square and a piano concert by Maria Wójcik, who played short pieces composed by F. Chopin. The concert took place in the Red Hall in the Działyński Palace near the Old Market Square.

More information about the conference can be found at www.impan.pl/~impanga15

↓ IMPANGA 2015

Banach Center selected upcoming events 2015

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

	TITLE	DATE	ORGANIZERS	PLACE
1	16th International Conference on Functional Equations and Inequalities (16th ICFEI)	17–23.05.2015	J. Brzdęk, K. Ciepliński, Z. Leśniak, A. Bahyrycz, M. Piszczek, J. Olko, P. Solarz, J. Wiercioch	Będlewo
2	Operator-Theoretical Approaches to Energy Decay **(research group)**	24–30.05.2015	Y. Tomilov	Warsaw
3	Micro and Macro Systems in Life Sciences (MMSLS 2015) **(conference)**	08–13.06.2015	M. Lachowicz, U. Ledzewicz, Z. Szymańska, M. Zaborowski	Będlewo
4	Dynamics, Topology and Computations **(conference)**	14–20.06.2015	T. Kapela, K. Mischaikow, M. Mrozek, P. Zgliczyński	Będlewo
5	Groups and Their Actions **(conference)**	21–27.06.2015	A. Bier, W. Hołubowski, W. Tomaszewski	Będlewo
6	Conference on Geometric Group Theory	28.06–03.07.2015	T. Elsner, J. Dymara, Ś. Gal, P. Nowak, J. Świątkowski	Wrocław
7	Topological Quantum Groups – Graduate School	28.06–11.07.2015	U. Franz, A. Skalski, P. Sotan	Będlewo
8	3-rd Conference on Finite Dimensional Integrable Systems in Geometry and Mathematical Physics 2015	12–17.07.2015	A. J. Maciejewski, V. Matveev, M. Przybylska, S. Tabachnikov	Będlewo
9	Nonlinear Control and Geometry	23–29.08.2015	M. Grochowski, B. Jakubczyk, W. Kryński, G. Pietrzkowski, W. Respondek	Będlewo
10	Mathematical Fluid Mechanics: Old Problems, New Trends – a week for Wojciech Zajączkowski	30.08–05.09.2015	J. Burczak, T. Kobayashi, P. B. Mucha, M. Pokorny, J. Renctawowicz	Będlewo
11	Geometric Singularity Theory **(conference)**	06–11.09.2015	W. Domitrz, G. Ishikawa, S. Izumiya	Warsaw
12	Analytic, Algebraic and Geometric Aspects of Differential Equations **(School and conference)**	06–19.09.2015	G. Filipuk, Y. Haraoka, G. Łysik, S. Michalik	Będlewo
13	Topology Retreat **(research group)**	29.09.-03.10.2015	R. Sauer, P. Nowak	Będlewo
14	Higgs Bundles and Relations to Langlands Programme **(research group)**	08–09.10.2015	P. Achinger, P. Chojecki, A. Langer	Warsaw
15	Workshop on Almost Hermitian and Contact Geometry	18–24.10.2015	I. Agricola, T. Friedrich, A. Tralle	Będlewo
16	Dynamical Systems **(Simons Semester)**	September–December 2015	K. Barański, M. Lemańczyk, F. Przytycki, M. Rams	Warsaw
16a	Topics in Analysis and Holomorphic Dynamics **(Simons Semester workshop)**	15–19.09.2015	J. Graczyk, F. Przytycki, P. Strzelecki	Warsaw
16b	Fractal Geometry and Dynamics **(Simons Semester Conference)**	11–17.10.2015	M. Rams, F. Przytycki	Będlewo
16c	**I.** Ergodic Theory of Dynamical Systems **II.** Translation Surfaces and Dynamics **(Simons Semester Conference)**	22–28.11.2015	M. Lemańczyk, K. Frączek	Będlewo

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