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I. Main tasks of the research unit in 2011

In 2011 the Alfréd Rényi Institute of Mathematics, an important center of international mathematical life, completed its main tasks as described in its foundation document. It maintained its rank and position at the forefront of the world's mathematical research.

The activity of the institute is carried out in nine scientific departments. The research groups with the support of the Academy's Momentum project (in cryptography since 2009, in low dimensional topology since 2010) continued their work within the Department of Discrete Mathematics and the Department of Algebraic Geometry and Differential Topology. Each department is in close connection with the other centers of its research area. They follow their research program on the most recent questions raised by the development of mathematics.

In 2011 two research fellows of the institute received the title "Doctor of Academy", and three completed their PhD. By the end of the year, 14 members of academy (12 according to time sheet statistics), 29 doctors of academy (23 stat.) and 35 PhD or candidate degree holders (30 stat.) worked in the institute. A particular stress was put on involving young talents – PhD students or young postdocs – in the research of the institute. In 2011, three additional such young researchers were employed filling the two new positions provided by the Academy as well as the one that had become vacant. The researchers of the institute supervised 14 PhD students in the joint Doctoral Program with Central European University. In 2011 altogether, counting the recently appointed young researchers, the institute had the opportunity to train 16 promising young talents.

In numbers comparable to recent years, the fellows of the institute published 157 works, 153 of which are scientific; the other four are popular scientific. The scientific works include two edited volumes, two theses of academy doctor title, three PhD theses, one book, seven book chapters, two university lecture notes, 23 publications in conference proceedings, and 113 publications in refereed international journals. Of these 113 papers, 94 appeared in foreign journals; the other 19 in English language international journals published in Hungary.

II. Outstanding research and other results in 2011
a) Outstanding research and other results

Department of Algebra

- A classification of those groups has been obtained whose Noether number is at least half of their order and the Noether number for all these groups has been determined. The theorem reaches a natural theoretical border in view of the earlier results.
- It was shown that for a higher rank simple Lie group, every sequence of lattices converges to the identity.
- It was shown that simple group schemes defined over locally finite fields do not possess nontrivial invariant random subgroups.

- It has been shown that a group is expansive if and only if it is a direct product of expansive simple or Abelian groups.
- Answering a question of Wiegold, it has been shown that every non-Abelian finite simple group has a direct power, which can be generated by two elements.
- The algebraic closure of a field has been located in the endomorphism ring of a very big infinite dimensional vector space. In case of a vector space of countable dimension, it was determined when the given field has an algebraically closed extension within the endomorphism ring.
- New results have been obtained towards the description of all quotient semigroups of commutative semigroups.

Department of Algebraic Geometry and Differential Topology

- They have proven that the prime-to-*p* étale fundamental group of an arbitrary connected algebraic group over an algebraically closed field is commutative. Moreover, every prime-to-*p* étale Galois cover has the structure of a central isogeny.
- They have also given an explicit formula for the corank of l-primary torsion in the Brauer group of a commutative algebraic group.
- They proved that a special fiber of the apparent singularity-fibration (namely the subspace containing Fuchsian equations) in the moduli space of logarithmic connections with fixed locus of singularities and fixed (generic) eigenvalues of their residues is at the same time a fiber of the parabolic fibration, too.
- They proved the existence of smooth stable maps on a 3-manifold given by Dehn surgery along a given link. For a given link they constructed a smooth map of the 3-manifold. They found an example for homeomorphic but not diffeomorphic 4-manifolds which are distinguished by the algebraic/combinatorial properties of the singular sets of stable maps existing on them.
- They continued their research in the combinatorial reformulation of Heegaard-Floer homologies. They proved a formula which determines the spin^c structure attached to a generator. They extended the theory over the integers and also to manifolds containing knots or links in them. They also showed that the Gluck transformation along a certain family of 2-dimensional knots provides the standard 4-dimensional sphere S^4.
- They finished a book with title *Milnor fiber boundary of a non-isolated surface singularity*, which will appear in the Springer series Lecture Notes of Mathematics.
- They continued their study on the "lattice cohomology" of negative definite plumbed 3-manifolds proving a "reduction theorem", which reduces the rank of the lattice where the construction of the corresponding complex is done.
- They found the conjectured identification for negative definite 3-dimensional graph manifolds between the Seiberg-Witten invariant and the Euler characteristic of the lattice cohomology.
- They found a counterexample for the 35 year old Durfee conjecture, which predicted an inequality between the Milnor fiber and geometric genus of a surface singularity. They corrected this inequality and proved the reformulated conjecture in the homogeneous case.

Department of Algebraic Logic

- They interpreted first-order predicate logic, the "mother tongue" of present-day scientific thinking, in a rather simple modal propositional logic called L(Df3), solving a long-standing open problem.

- Kleene algebras of computer science have two kinds of motivating examples, the language Kleene algebras and the relational Kleene algebras; these two kinds of algebras are equationally indistinguishable. They showed that if we add the operation of "meet" (corresponding to parallel execution of programs) to the operations of Kleene algebras, then more equations hold in language algebras than in the relational ones – three more equations in a sense –, so the two classes became equationally distinguishable. On the other hand, they showed that the equations valid in the language and the relational algebras continue to be the same if we omit the constant operation corresponding to the empty word (the do-nothing program) when we add the operation "meet". They showed that the free Kleene algebra endowed with the "meet" operation is no longer representable as a language algebra, while if we omit the constant consisting of the empty word when adding "meet" the free algebra remains representable as a language algebra.
- The recent experiments conducted at CERN which indicated the possible existence of neutrinos travelling faster than light were much debated in the scientific community creating a scientific sensation. Researchers of the department showed that relativity theory admits a logical axiomatization, which allows faster than light particles, this proves that the results of the experiments do not disprove relativity theory. They elaborated a version of relativistic dynamics (inelastic collisions, mass) which is applicable to particles moving faster than light. They obtained that negative masses come into the picture, parallel to the negative energy-density occurring in the cosmological theory of our acceleratedly expanding Universe.

Department of Analysis

- A classic theorem on interpolation due to Erdős and Grünwald has been generalized. The exact weighted L_2 Markov factor of multivariate polynomials was determined in case of mixed Laguerre and Hermite weights. They studied the approximation of regular convex bodies by convex algebraic level surfaces and the exact rate of approximation was found. It turned out that this rate depends on the modulus of smoothness of the boundary of convex bodies. They also studied the exact Markov type inequalities in L_2-norm for derivatives of multivariate algebraic polynomials. The sharp upper bounds were found in case of Hermite and mixed Hermite-Laguerre weights.
- Concerning a polynomial Berstein inequality they proved that the real geometric methods due to Sarantopoulos and convex bodies method of Baran are equivalent. In the direction of a famous conjecture of Chung and Goldwasser, they proved an upper estimate to the measure of subsets of the interval [0; 1] where the equation $x + y = 3z$ has no solution.
- They studied several research subjects about vector systems of different linear spaces. A Fourier type analytic approximation studied earlier gave new results in another subject, too. These results are related to matrix theory. A new book about matrix theory is in preparation.

Department of Discrete Mathematics

- They proved several theorems about multi-partite Sperner systems and about their generalizations in the theory of partially ordered sets.
- A classical question about graph sequences is that what graphs can be the limits of Benjamini-Schramm convergent graph sequences. They proved that regular unimodular random graphs can be approximated in some weak sense.

- They proved the conjecture of Haggkvist that every big enough complete bipartite graph can be decomposed into pairwise edge disjoint copies of a given bipartite graph if the trivially necessary divisibility conditions hold.
- They studied randomized streaming algorithms and found an optimal sampling algorithm that solves important problems like finding duplicates in data streams.
- In secret sharing problems they constructed a safe auction protocol.
- They determined the number of longest lattice polygons in triangles of given area. Similarly, they proved a lower bound for the number of convex lattice polytopes in bodies of given value.
- They continued their studies concerning ε-nets and proved sharp lower bounds for their size in various spaces.
- They studied the connection between the chromatic number of an undirected graph and the maximum of the local chromatic numbers of all their orientations. They proved that they might be different but the fractional versions of them are equal to each other.
- They proved structure theorems about approximating subgroups of linear groups. The results involve the product theorem of finite simple groups and several other earlier theorems as special cases.
- They proved theorems and found algorithms in the generalization of the classical "wolf-goat-cabbage" problem.

Department of Geometry

- They proved an ergodic theorem for the length of the longest convex chain through random points of the plane. Furthermore, they improved the lower bound for the expectation for the length of such chains.
- By means of probabilistic methods, among the suitably scaled n-dimensional cross-polytopes they determined the extremal ones with respect to the mean width.
- They managed to characterize the even cone volume measures. The result is equivalent with solving an important class of Monge-Ampere equations.
- They extended a result, known about the structure of the set of idempotent elements in a Banach algebra, to the set of elements satisfying some polynomial equation, where all roots of the polynomial are distinct.
- They proved that if a class of uniform spaces is closed under products and subspaces, and, in its own right, has certain algebraicity property (the two kinds of structures having no compatibility), then this class is trivial.
- They gave sufficient conditions for four positive numbers to be the areas of the faces of a tetrahedron in spherical 3-space.
- A graph drawn in the plane is called k-quasi-planar if it does not contain k pairwise crossing edges. It has been conjectured for a long time that for every fixed k, the maximum number of edges of a k-quasi-planar graph with n vertices is $O(n)$. They improved the best-known upper bound in the special case where the graph is drawn in such a way that any two edges meet at most once.
- They managed to prove that 1-planar graphs have list-coloring number at most seven.
- They proved the thrackle conjecture if only tangencies are allowed, crossings are not, or if the edges are x-monotone curves.

Department of Set Theory and General Topology

- They obtained significant partial results concerning a more than 40-year-old problem of Arhangelskii, by constructing several models of set theory in which there are Jakovlev spaces – and thus weakly first countable compact spaces – of arbitrarily large cardinality.
- They succeeded in proving resolvability theorems in compact spaces.
- The interconnections between several generalizations of separability have also been studied by them. This research is closely connected with the "Selection Principles in Mathematics" program that is being intensively studied internationally.
- They have continued their studies concerning the cardinal sequences of compact scattered spaces. They obtained interesting results in characterizing cardinal sequences in compact scattered spaces of bigger heights.
- They discovered a genuinely new notion of fractal dimension and already found numerous applications of it. Perhaps most importantly this notion completely describes the classical Hausdorff dimension of the level sets of the generic continuous functions defined on compact spaces. However, it also provides new insight to Mandelbrot's fractal percolation process and Brownian motion; moreover it yields a far reaching generalization of a result of B. Kirchheim.
- According to a (still unsolved) conjecture of Vaught, if a countable set of formulas has uncountably many non-isomorphic models then it has continuum many. A number of partial results on this conjecture have been verified for a more recent variant in which "non-isomorphic" is replaced by "not elementarily embeddable", also for equality free logic.

Department of Number Theory

- A few years ago they showed that the primes contain small gaps infinitely often, which in ratio to the average gap size, can be arbitrarily small, but they could not say much about the frequency of the occurring small gaps. The most important open question in this direction was whether the above mentioned small gaps occur in a positive proportion of all differences. Last year they answered this question positively.
- They showed that a general conjecture (concerning the uniform distribution of primes but also involving Liouville's lambda function) implies the twin prime conjecture itself.
- They achieved the psychological Weyl exponent in the upper bound for the supremum of Hecke-Maass cusp forms in the level aspect. The proof refines their earlier method, making use of the arithmetic structure of the spectral weights.
- They proved that real functions from a general class can be represented as linear combinations of a certain sequence of functions. These functions arose in investigations about automorphic forms, and they are closely connected to the Wilson functions, introduced recently by Groenevelt.

Department of Probability Theory and Statistics

- They proved that although the trigonomic series with large gaps (lacunary series) in their asymptotic behavior resemble independent identically distributed random variables their permutations are sharply different.
- The secret key capacity of multiple access channels was determined.

- Let us suppose that a random walk takes place on a square lattice on the upper half plane and a comb structure on the lower half plane, i.e. horizontal lines below the horizontal axis are removed. They gave strong approximations for the components with random time changed Wiener processes. As consequences, they gave limiting distributions and some laws of the iterated logarithm.
- They established the relation between the maxima of a set of random functions and the complexity of the set.
- The logarithmic Sobolev inequality was generalized to the case when the Gaussian distribution is supplanted by any measure vaguely resembling the Gaussian one.
- Members of the department described a colliding system of two random walks with internal states where the speeds of the particles are represented by exponential clocks and are included in the set of internal states.
- Using a Brownian motion they defined a new type of covariance for random vectors with a finite second moment having the property that it is equal to zero if and only if the random vectors are independent.
- They sharpened the inequality on binomial and Gaussian distributions they found earlier.

Applied research

The main research profile of the Rényi Institute is pure (exploring) research. Applied research (in mathematics, bioinformatics, informatics) is carried out by research groups, mostly related to the Department of Discrete Mathematics and the Department of Probability Theory and Statistics, namely the research groups of bioinformatics, database theory, information theory and mathematical immunology. Due to the continuous decrease in national project funding opportunities, only bioinformatics and cryptography research was funded, namely, by the "Momentum" program of the Academy in 2011. The research group, consisting of 10 researchers, established in the framework of the "Momentum" program of the Hungarian Academy of Sciences has continued its work in the designated areas of cryptography. One of their most important results of them is on the topic of online secret sharing, building on their results in ("traditional") secret sharing from the previous years. They have succeeded in finding the online and (usual) offline complexity of certain graphs and gave sharp estimates on the complexity of paths and cycles of length n. They pioneered the handling of linear programs related to secret sharing and the problems occurring in the process of obtaining solutions. Finding the capacity of certain secret sharing schemes leads to enormous LP problems, not solvable in practice. Their main result is the reduction of the size of the problems using information theory tools, yielding exact estimates for the capacities of some concrete system. Using these results they managed to solve a problem in the area that earlier was thought impossible to solve.

In the framework of the project "Comparative Genomics and Next Generation Sequencing" they have continued the research related to bioinformatics and discrete mathematics problems originating from genomics. The main topics remain genome rearrangement, insertion-deletion process (statistical alignment), phylogenetic (evolutionary) trees and the quest for new statistical methods. In the consortium of the project the institute develops the main part of the software containing new generation genome sequencing methods.

b) Relationship between science and society

The basic research themes of the institute are not ideal to become immediate subjects of dialogue between science and society. There were, however, some activities and events at the institute which attracted wider interest.

The members of the institute took a leading part in popularizing mathematics; they gave several public lectures, film screenings and meetings with university and high school students, among others, in the framework of the Festival of Hungarian Science. Similarly, they took an active part in nurturing new talents in mathematics by organizing several mathematical camps and other programs for elementary and secondary (high school) students. The success of these events is shown by the fact that most of the winners of the national mathematical competitions of Hungary were participants of these programs in 2011 or in previous years.

III. A presentation of national and international relations

National relations

The research fellows of the institute participated in the work of several universities (e.g. ELTE, BME, University of Debrecen, and University of Szeged) as instructors, especially in giving courses for senior or PhD students of mathematics and physics. The joint mathematical PhD and MSc programs of Central European University and the institute began its ninth year. The department has 25 PhD students and 14 MSc students. The professors of the program are mostly the fellows of the institute; they gave 15 courses last year. Counting the students at all universities, the researchers of the institute supervised 35 PhD students, 14 MSc and 7 BSc students and 5 scientific scholarship holders. The research fellows of the institute provide the majority of the professors for the Budapest Semesters in Mathematics program – organized mostly for American students. Forty-three fellows of the institute (61 percent of them) instructed in some Hungarian university. The number of classes they instructed exceeded 5000 in 2011.

The weekly research seminars of the institute continued. The importance of the seminars exceeds the framework of the institute. They influence the trends in all of Hungarian mathematical research.

The fellows of the institute participate in the mathematical life well above the national average. They hold important positions in the Mathematics Section of the Academy and its committees, the Council of the Research Institutes of the Academy, the Committee of Mathematics and Sciences, the committees of OTKA, and the Board of the János Bolyai Mathematical Society. The president of the János Bolyai Mathematical Society, the chairman of the Bolyai Research Fellowship Committee, the mathematics coordinator of the Board of Young Researchers of HAS, the chairman of the Section of Mathematics of HAS, the chairman and the secretary of the Mathematics Committee of HAS, the chairman of the Mathematics Doctoral Committee (HAS), the chairman of the Committee of Biometrics and Biomathematics of HAS, the chairman of the External Advisory Board of the Institute of Computer Science an Automation of HAS, the chairman of the CEU Mathematics Doctoral Program are all fellows of the institute.

International relations

Traditionally, the researchers of the institute have very wide-ranging international relations. The cooperation manifests mostly in joint publications, study trips in both directions, joint projects and jointly organized conferences. In general, this cooperation does not need institutional form, but their success is indicated by the large number of joint publications. Forty-five fellows of the institute (counted with multiplicity) participated in the organization of international conferences and workshops in 2011, out of which 13 were organized – completely or partly – by the Rényi Institute.

The scientific visits in the framework of the bilateral agreements of the Academy successfully helped scientific cooperation. They opened the possibility for successful joint research, useful exchange of information and sometimes for participation in conferences.

The fellows of the institute held 12 memberships in international scientific committees and 101 memberships in editorial boards of international journals. They gave 235 lectures at international conferences, many of which were invited or plenary talks. It should be mentioned that a member of the institute was an invited speaker at the Galois Bicentennial Festival at the Paris-Sorbonne University.

Nine members of the institute spent professional visits of more than 6 months of at the following institutions: University College of London (UK), École Polytechnique Fédérale de Lausanne (Switzerland), Universitat Politècnica de Catalunya – Barcelona Tech (Spain), Auburn University (USA), University of Delaware (USA), University of Chicago (USA), City University of New York (USA), National Science Foundation (USA). The expenses were covered in all cases by the other party.

Several visitors came from non-European and European countries with the support from various sources like Fulbright scholarships, OTKA projects, bilateral agreements of the Academy and (in growing numbers) independent sources provided by the visitors. Altogether, the institute hosted close to 150 visitors in 2011, not counting conference participants.

The scientific meetings organized completely or partially by the institute were as follows.

- 2nd Emléktábla Workshop, January 24-27, 2011
- Paul Turán Memorial Lectures 2011, June 1-3, 2011
- Higher Order Fourier Analysis Summer School, June 2-4, 2011
- Summer Symposium in Real Analysis XXXV, June 6-11, 2011
- Infinite and Finite Sets, Conference in honor of András Hajnal, June 13-17, 2011
- 3rd Emléktábla Workshop, June 27-30, 2011
- Beyond Next Generation Sequencing Workshop, July 20-23, 2011
- Memphis-Budapest Summer School in Combinatorics, August 7-20, 2011
- Topology of Manifolds Summer School, August 15-19, 2011
- Paul Turán Memorial Conference, August 22-26, 2011
- Workshop in honor of the 70th birthday of Péter Vértesi, August 27, 2011
- European Conference on Combinatorics, Graph Theory and Applications (EuroComb'11), August 29-September 2, 2011
- Conference in honor of the 70th birthday of Gyula Katona, September 3-4, 2011

Among the conferences organized by the institute EuroComb'11, the biggest European combinatorial conference – the discrete mathematics European Prize is presented here, too – should be specifically mentioned with its more than 270 participants. Together with the conference to honor the 70th birthday of Gyula Katona, the number of participants was close to 300. It was an honor to Hungarian discrete mathematics research that the right to host this bi-annual conference was given to the institute outstripping several other applications.

The conferences to honor the centennial of the birthday of Paul Turán (more than 180 participants), to honor the 80th birthday of András Hajnal (more than 80 participants), and the Summer Symposium in Real Analysis (more than 70 participants) are worth mentioning, too.

These conferences were supported (in addition to Hungarian sources) by the European Research Council, the Center for Discrete Mathematics and the Number Theory Foundation.

IV. Brief summary of national and international research proposals awarded in 2011

National grants

The research teams of the institute have been as successful as in previous years with Hungarian OTKA (Hungarian Scientific Research Fund) project proposals, further receiving fundings for further 4 research and 3 postdoc projects. Being successful is relative here and meant only in comparison with the overall number of winning projects, as the total number of funded projects was very low. Still they managed to maintain that the faculty of the institute – with very few exceptions - are members of at least one running OTKA project. But the low level of the total income of the institute from these sources seriously impacts the funding of research.

The projects for the "Momentum" call for special projects of the Hungarian Academy of Sciences remain very important and valuable to the institute. The funding of the *cryptography project* awarded in 2009 and the second Momentum project won in 2010 to study *low dimensional topologies* gave the majority of the institute's non-OTKA national grant funds.

The institute won in 2010 and completed in 2011 a so-called TÁMOP project to build library database and develop WEB page, in total for 17 million HUF. As a result of this development they have created the "Unified HU Math Catalogue" MatEK (in Hungarian: Matematikai Egyesített Katalógus, http://matek.ek.szte.hu/matek/opac), which is simultaneously searching from (currently 7) Hungarian libraries (BME OMIKK, University and National Library of the University of Debrecen, University Library of Eötvös University, Library of the Hungarian Academy of Sciences, Library of the Alfréd Rényi Institute of Mathematics, Library of the Computer and Automation Research Institute of the Hungarian Academy of Sciences, Library of the University of Szeged), covering therefore all national collections with substantial mathematics holdings.

Other than the above mentioned, there were no further project funding possibilities in Hungary in 2011, neither for exploring, nor for applied research.

International grants

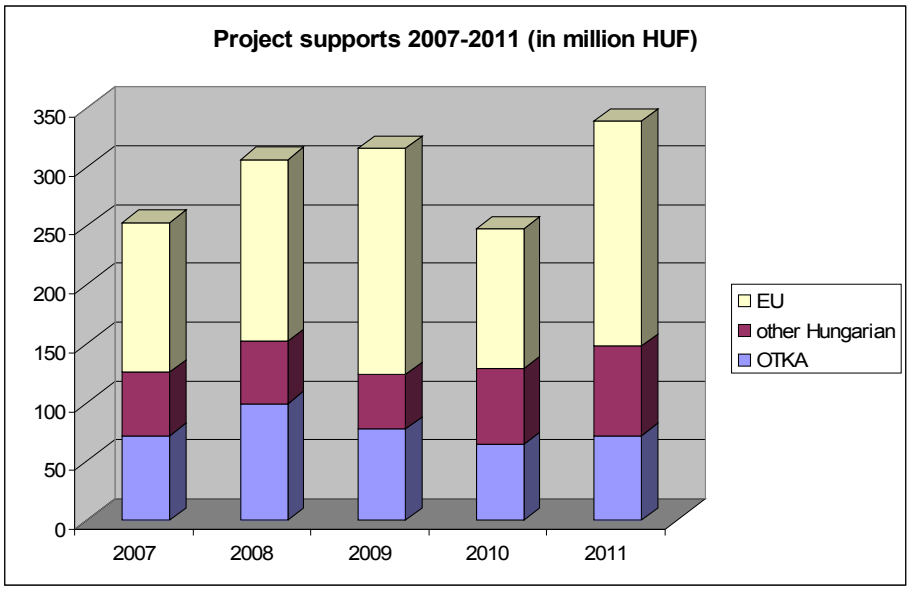
In FP7 new types of research projects, the Starting Independent Researcher and Advanced Investigators Grants of the European Research Council, namely, were introduced. These projects basically fund with several million Euros the research of small research groups run by the principal investigator (the starting independent researcher or the advanced investigator). There are a low number of funded projects and therefore these are highly competitive research calls. It is a great success for the institute that the PRIMEGAPS project, won in 2008 and the DISCONV project, won in 2010 were followed by another successful Advanced Investigators Grant application – headed by a member of the institute and including several other members – in the 2011 round. The supported research will start in Spring 2012, after signing the research grant agreement, and therefore the funding will only be available from 2012. This tops up the number of ERC Advanced Investigator Grants won by the institute to three, one of the highest among the European mathematical research centers.

In the framework of FP7 there were three further individual mobility grants run by the institute, each employing one returning (to Hungary) or foreign researcher. The foreign researchers staying at the institute for a longer period successfully joined the research groups, opened new international research connections with their series of lectures and personal consultations.

The Rényi Institute is a member of a consortium led by German and Danish SME's which submitted in 2009 a research project proposal "Comparative Genomics and Next Generation Sequencing" for EU 7 "Research for the benefit of specific groups" call and was awarded the funding in 2010. The total funding of the project for almost two years will be around 600,000 Euros. The tasks for 2011 were completed according to the work plan, the yearly (midterm) report of the project was accepted and the funding will continue till the Fall of 2012.

Altogether, despite the decreasing national project proposal opportunities the total research grant income of the institute in 2011 exceeded the grant income of 2010. The support of OTKA and Momentum projects were slightly more than the similar support of the previous year, while the support of international projects from the EU, after touching the minimum in 2010 – increased by close to 60%. Therefore, the total project research grant income in 2011 was record high. The running Momentum, OTKA and EU projects will jointly ensure that there will be no decrease in the total research grant income of the institute in 2012. The success of the research grant proposals for future years depends to a great extent on whether there will be new types of national or international project proposal calls.

The following diagram shows the amount of project support received during the last 5 years.



V. List of important publications in 2011

1. Anh PN, Kim JK: Outer approximation algorithms for pseudomonotone equilibrium problems. Computers & Mathematics with Applications, 61 (9): 2588-2595 (2011)

2. Balog A, Cojocaru AC, David C: Average twin prime conjecture for elliptic curves. American Journal of Mathematics, 133 (5): 1179-1229 (2011)

3. Aistleitner C, Berkes I, Tichy RF: On permutations of Hardy-Littlewood-Pólya sequence. Transactions of the American Mathematical Society, 363 (12): 6219-6244 (2011)

4. Ball KM, Böröczky KJ: Stability of some versions of the Prékopa-Leindler inequality. Monatshefte für Mathematik, 163 (1): 1-14 (2011)

5. Domokos M, Szabó E: Helly dimension of algebraic groups. Journal of the London Mathematical Society-Second Series, 84 (1): 19-34 (2011)

6. Aydinian H, Czabarka E, Erdős PL, Székely LA: A tour of M-part L-Sperner families. Journal of Combinatorial Theory Series A, 118 (2): 702-725 (2011)

7. Füredi Z, Riet AE, Tyomkyn M: Completing partial packings of bipartite graphs. Journal of Combinatorial Theory Series A, 118 (8): 2463-2473 (2011)

8. Guralnick RM, Maróti A: Average dimension of fixed point spaces with applications. Advances in Mathematics, 226 (1): 298-308 (2011)

9. Némethi A: The Seiberg-Witten invariants of negative definite plumbed 3-manifolds. Journal of the European Mathematical Society, 13 (4): 959-974 (2011)

10. Fox J, Pach J, Tóth CD: Intersection patterns of curves. Journal of the London Mathematical Society-Second series, 83 (2): 389-406 (2011)

11. Hiai F, Mosonyi M, Petz D, Beny C: Quantum f-divergences and error correction. Reviews in Mathematical Physics, 23 (7): 691-747 (2011)

12. Jaikin-Zapirain A, Pyber L: Random generation of finite and profinite groups and group enumeration. Annals of Mathematics, 173 (2): 769-814 (2011)

13. Balogh J, Bollobás B, Simonovits M: The fine structure of octahedron-free graphs. Journal of Combinatorial Theory Series B, 101 (2): 67-84 (2011)

14. Simonyi G, Tardos G: On directed local chromatic number, shift graphs, and Borsuk-like graphs. Journal of Graph Theory, 66 (1): 65-82 (2011)

15. Bhupal M, Stipsicz AI: Weighted homogeneous singularities and rational homology disk smoothings. American Journal of Mathematics, 133 (5): 1259-1297 (2011)