

# National Security Agency

## MATHEMATICAL SCIENCES PROGRAM

### Grants for Research in the Mathematical Sciences

#### 2014 Summary

The National Security Agency Mathematical Sciences Program (MSP) was started at NSA in 1987 in response to an increasingly urgent need to support mathematics in the United States. Indeed, the NSA realizes the mutual benefits of maintaining a healthy academic community and is proud to offer funding opportunities for eligible faculty members through the MSP.

#### Program Overview

The MSP supports self-directed, unclassified research, conferences, workshops, and other efforts in the areas of Algebra, Discrete Mathematics, Number Theory, Probability, and Statistics. The program no longer accepts proposals that involve cryptology. Research and conference proposals are reviewed by a Mathematics Review Panel, which is appointed and administered by the American Mathematical Society. Members of the Panel meet annually in May to discuss and to rank the proposals. During the annual panel meeting, panelists use external reviews and their own assessments of the merits of the proposals to arrive at a rating for each proposal. The panelists in each subject area then use these ratings to create a ranked list of proposals within each subject area. The final review panel recommendations are used by the NSA Mathematical Sciences Program Office to make funding decisions.

#### Annual Statistics

The NSA Mathematical Sciences Program entertained a total of 304 research proposals in 2014. After all proposals were thoroughly peer reviewed by the AMS and rated by the NSA's internal process, final decisions on awards were made in accordance with current MSP policies. Those policies emphasize the intellectual quality of the research proposed together with its broad impact of the technical field. Approximately one seventh of the submissions, a total of 45 proposals, were awarded funding as follows: 12 in Algebra, 10 in Discrete Mathematics, 13 in Number Theory, 7 in Probability, and 3 in Statistics. The number of proposals funded in each category was based upon several factors, such as the cost per proposal (e.g. proposals in probability and statistics cost more on average), and the desire to award roughly the same proportion of proposals in a subject category as were received in that category.

It is the MSP's desire to recognize as many PIs as possible with funding during a period of decline in government research funding. To accomplish this, the MSP implemented a policy that prohibits the award of MSP research grants to individuals who possess grants from other United States government agencies (such as the NSF and the ARO) that supports their research for the same time period. There were 16 researchers who declined the MSP award since their research was also recognized by either the NSF or the ARO.

The Mathematics Review Panel also evaluated 22 conference proposals, 9 of which were selected for funding. A complete list of new research awards and new conference awards is listed at the conclusion of this report.

## Other Outreach Efforts

In addition to research and conference grants, the NSA offers other opportunities for students and faculty members in the mathematical sciences. One of the initiatives of the MSP and of the Agency at large is the development and training of a future generation of mathematicians. As part of this initiative, the NSA offers a summer internship program called the Director's Summer Program (DSP). The DSP is the Agency's premier outreach effort to the nation's most talented undergraduates in mathematics and computer science. Participants in the program spend the summer using their mathematical skills to help solve actual problems involving NSA's cryptologic and signals analysis mission. A similar program exists for graduate students, the Graduate Mathematics Program. The NSA is also keenly interested in promoting the involvement and advancement of underrepresented populations in the mathematical sciences. The Mathematical Sciences Program devotes a portion of its resources to conferences for undergraduates and graduate students, Research Experiences for Undergraduates (REUs), and other efforts that enhance participation in the mathematical sciences. In the past, the MSP has funded efforts such as the Infinite Possibilities Conference, the National Research Experience for Undergraduates Program, and the Mathematical and Theoretical Biology Institute Research Program for Undergraduates.

Finally, the NSA has a Sabbatical Program that provides established professors the opportunity to spend a year (or more) working at the NSA. During their stay sabbatical visitors get a rare glimpse of how mathematics is used at the NSA and have the chance to work on actual problems related to NSA's cryptologic and signals analysis mission. The NSA pays 50% of their salary and benefits during the academic year and 100% of salary and benefits during the summer. U.S. citizenship is required for the sabbatical visitor as well as for immediate family members, and it is necessary to obtain an NSA security clearance.

Further information on the Mathematical Sciences Program (grants) or the Sabbatical Program may be obtained from the website [http://www.nsa.gov/research/math\\_research/index.shtml](http://www.nsa.gov/research/math_research/index.shtml), or by contacting the following individuals.

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## New Research Grants Being Funded

### Algebra (12):

Pramod N.	Achar	Modular Derived Categories in Representation Theory
Paolo	Aluffi	Segre Classes as Integrals Over Polytopes and Other Problems in Intersection Theory
Jon	Carlson	Modular Representations of Finite Groups
Giulio	Caviglia	Problems on Free Resolutions and Hilbert Functions
Calin	Chindris	Algebraic and Geometric Aspects of Representations of Algebras
Eric	Friedlander	Modular Representations and Intersections on Singular Varieties
Kyungyong	Lee	Combinatorics of Canonical Bases : Cluster Algebras, Hilbert Schemes and Quantum Groups
Martin	Lorenz	Noncommutative and Commutative Invariant Theory
Justin	Lynd	Simple Fusion Systems and Transporter Systems
Hung	Nguyen	Representations of Finite Groups of Lie Type and Related Problems
Dmitri	Nikshych	Classification of Tensor Categories and Hopf Algebras
Richard	Weiss	Descent in Buildings

### Discrete Mathematics (10):

Jozsef	Balogh	Sparse Discrete Structures
Francine	Blanchet-Sadri	Repetitions in Strings
Daniel	Cranston	Strengthening Brooks' Theorem: Improved Upper Bounds for Chromatic Number of Graphs
Jonathan	Cutler	Enumerative Extremal Problems
Jesus A.	de Loera	Non-negative Solutions of Linear Diophantine Equations: New Theory With Colors or Multiplicity
Andrzej	Dudek	Ramsey-Type Numbers
Leonid	Fukshansky	Analytic Techniques and Algebraic Constructions in Geometric Lattice Theory
Jessica	Striker	Combinatorial Objects and Actions in Algebra, Geometry, and Physics
Wojciech	Szpankowski	Asymptotic Solutions to Multi-Dimensional and Non-Linear Recurrences Arising in Computer Science and Information Theory
Vladimir D.	Tonchev	Codes, Galois Geometries, and New Invariants for Incidence Structures

### Number Theory (13)

Jeffrey	Achter	Arithmetic structures from exceptional periods
Michael	Filaseta	Polynomial Research in Number Theory
Solomon	Friedberg	Metaplectic Eisenstein series and their residues
Dorian	Goldfeld	Trace Formulae, L-functions, and Analytic Number Theory
Joseph	Hundley	Fourier Coefficients, Integral Representations, and Liftings
Dino	Lorenzini	Arithmetic on Algebraic Varieties
Micah	Milinovich	Extremal Problems in Number Theory
Mihran	Papikian	Function Fields, Modular Varieties and Arithmetic Applications
Rachel	Pries	Curves and Abelian Varieties: Supersingularity and Beyond
Joseph	Rabinoff	Berkovich Skeleta, Tropicalizations, and Applications
Bianca	Viray	Rational Points and Brauer Groups
Thomas	Weston	Arithmetic of Galois Representations Attached to Automorphic Forms
Dan	Yasaki	Voronoi Reduction Theory and Applications to Arithmetic Groups

**Probability (7):**

Nicolas	Lanchier	Stochastic Spatial Models of Social Dynamics
Robert	Neel	Martingale Methods for Geometric Structures Including Minimal Submanifolds, Curvature Flows, and Sub-Riemannian Manifolds
Jonathon	Peterson	Self-interacting Random Walks and Particle Systems
gor	Pritsker	Polynomials with Random and Integer Coefficients
Mrinal	Roychowdhury	Quantization
Cristiana	Tone	Limit Theorems for Random Fields Satisfying Strong Mixing Conditions
Yizao	Wang	Limit Theorems for Random Fields

**Statistics (3):**

Victor	Patrangenaru	Nonparametric Statistical Analysis of Spatial Scenes from Digital Camera Images and from Medical Stereo Images
Hongqi	Xue	High-Dimensional Variable Selection for Nonlinear Additive Ordinary Differential Equation Models
Cunhui	Zhang	Statistical Method and Theory for High-dimensional Data

**Conferences (9):**

Matthew	Baker	p-adic Methods in Number Theory
Gove	Effinger	12th International Conference on Finite Fields and Their Applications (Fq12)
Frederick	Hoffman	Forty-Sixth and Forty-Seventh Southeastern International Conferences on Combinatorics, Graph Theory and Computing
Rosa	Orellana	Conference Series: Discrete Mathematics Days in the Northeast
Christos	Papadimitriou	Reunion Workshops on Computational Aspects of Evolution, Quantum Hamiltonian Complexity, Discrete Algebraic Geometry, Spectral Graph Theory, and Information Theory
Paul	Pollack	Carl Pomerance 70th Birthday Conference
Nathan	Reading	Triangle Lectures in Combinatorics
John	Shareshian	The Mathematics of Michelle Wachs - Miami 2015
Bimal	Sinha	9th Annual Probability and Statistics Day at UMBC

For a list of the research grants whose second years are now being funded, please request a copy of the Year 2013 Summary on the Mathematical Sciences Program (available either from Jim Maxwell of the AMS, [jwm@ams.org](mailto:jwm@ams.org), or from the NSA MSP).