

# Proceedings of Symposia in PURE MATHEMATICS

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Volume 88

## String-Math 2013

Conference

June 17–21, 2013

Simons Center for Geometry and Physics,  
Stony Brook, NY

Ron Donagi

Michael R. Douglas

Ljudmila Kamenova

Martin Roček

Editors



**American Mathematical Society**

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## Preface

The conference ‘String-Math 2013’ was held June 17–21, 2013 at the Simons Center for Geometry and Physics. This was the third in a series of large meetings exploring the interface of mathematics and string theory. This volume presents the proceedings of that conference.

The nature of interactions between mathematicians and physicists has been thoroughly transformed in recent years. String theory and quantum field theory have contributed a series of profound ideas which gave rise to entirely new mathematical fields and revitalized older ones. The influence flows in both directions, with mathematical techniques and ideas contributing crucially to major advances in string theory. There is now a large and rapidly growing number of both mathematicians and physicists working at the string-theoretic interface between the two academic fields.

For mathematics, string theory has been a source of many significant inspirations, ranging from Seiberg-Witten theory in four-manifolds, to enumerative geometry and Gromov-Witten theory in algebraic geometry, to work on the Jones polynomial in knot theory, to recent progress in the geometric Langlands program and the development of derived algebraic geometry and n-category theory. In the other direction, mathematics has provided physicists with powerful tools, ranging from powerful differential geometric techniques for solving or analyzing key partial differential equations, to toric geometry, to K-theory and derived categories in D-branes, to the analysis of Calabi-Yau manifolds and string compactifications, to the use of modular forms and other arithmetic techniques. The depth, power and novelty of the results obtained in both fields thanks to their interaction is truly mind-boggling.

In the past few years, the annual String-Math conferences have become the central venue for these profound and wide-ranging interactions. They bring together the leading mathematicians and mathematically-minded physicists working in this interface. These meetings promote and publicize such interactions, giving attendees greater opportunities to cross cultural boundaries, learn aspects of other fields relevant for their research, and advertise important developments to audiences that might not otherwise hear of them or appreciate their importance.

The 2013 conference was organized by Alexander Abanov, Michael Douglas, Ljudmila Kamenova, Claude LeBrun, John Morgan, Nikita Nekrasov, Leonardo Rastelli, and Martin Roček. The Steering Committee consisted of Ron Donagi, Dan Freed, Nigel Hitchin, Sheldon Katz, Maxim Kontsevich, David Morrison, Edward Witten, and Shing-Tung Yau. The meeting covered a wide array of topics at the interface of mathematics and high energy physics, including:



- New and exotic supersymmetric field theories
- Localization and gauge theory
- Gauge theory and Khovanov homology
- Perturbative amplitudes
- Topological phases of matter
- Gauge theory angle at integrability
- Homological mirror symmetry
- Categorical constructions of topological field theories
- Mathematical string phenomenology
- Non-perturbative dualities, F-theory
- Wall-crossing formulas
- Hitchin systems
- Geometric Langlands
- Arithmetic of strings
- Gromov-Witten theory and enumerative geometry
- A-twisted Landau-Ginzburg models
- String topology
- Elliptic cohomology
- Heterotic mirror symmetry
- Topological T duality
- Superstring scattering amplitudes
- Chiral de Rham complexes
- Noncommutative geometry

Altogether, this conference brought together approximately 130 mathematicians and physicists. There were 24 invited plenary talks given by leaders in both fields. Additionally, there were 32 contributed talks given in parallel sessions on the Tuesday and Wednesday of the meeting. All the talks are available at the conference web site: <http://scgp.stonybrook.edu/events/event-pages/string-math-2013>.

The math/strings collaboration is clearly here to stay, and we expect this conference series to continue as long the subject remains active and exciting. The venues and years of the first seven conferences of the String-Math series are:

- String-Math 2011, Philadelphia (Penn), June 6–11, 2011
- String-Math 2012, Bonn (Hausdorff center for Mathematics), July 16–21, 2012
- String-Math 2013, Stony Brook (Simons Center for Geometry and Physics), June 17–21, 2013
- String-Math 2014, Edmonton (U of Alberta), June 9–13, 2014
- String-Math 2015, China (Tsinghua Sanya International Mathematics Forum, Sanya, Hainan, China), Dec 31, 2015–Jan 5, 2016
- String-Math 2016, Paris (Institut Poincare), June 27–July 2, 2016
- String-Math 2017, Hamburg

The conference benefitted from support obtained from the NSF (grant number: NSF DMS 1305697 String-Math 2013) and from SCGP. We are also very grateful to Sergei Gelfand and Chris Thivierge of AMS for their help in various stages of preparing this volume.

The editors of String-Math 2013:

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