String-Math 2014
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Balázs Szendrői
Preface

The conference ‘String-Math 2014’ was held June 9–13, 2014 at the University of Alberta. This was the fourth in a series of large meetings exploring the interface of mathematics and string theory. This edition of String-Math is the first to include satellite workshops: ‘String-Math Summer School’ (June 2–6, 2014 at the University of British Columbia), ‘Calabi-Yau Manifolds and their Moduli’ (June 14–18, 2014 at the University of Alberta), and ‘Quantum Curves and Quantum Knot Invariants’ (June 16–20, 2014 at the Banff International Research Station). This volume presents the proceedings of the conference and these three satellite workshops.

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 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.

The String-Math series of conferences bring together the leading mathematicians and mathematically-minded physicists working in this interface. They are an excellent vehicle for further promoting such interactions, and for 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 earlier conferences in this series — String-Math 2011 at UPenn, String-Math 2012 at the Hausdorff Center in Bonn, and String-Math 2013 at the Simons Center for Geometry and Physics in Stony Brook — have helped identify and establish mathematical string theory as a new branch of mathematics, facilitated the entry into the field of young researchers and newcomers, and served to record the state of the art in a rapidly evolving field.

The ‘String-Math 2014’ conference was organized by Vincent Bouchard (UAlberta), Thomas Creutzig (UAlberta), Emanuel Diaconescu (UAlberta/Rutgers), Charles Doran (UAlberta), David Favero (UAlberta), Terry Gannon (UAlberta), James Lewis (UAlberta), Andreas Malmendier (Colby/UAlberta), Stefan Mendez-Diez (UAlberta), and Callum Quigley (UAlberta). The ‘String-Math Summer School’ was organized by Jim Bryan (UBC). The ‘Calabi-Yau Manifolds and their
Moduli’ workshop was organized by Charles Doran (UAlberta), Mark Gross (Cambridge), Shinobu Hosono (Tokyo), Conan Leung (CUHK), James Lewis (UAlberta), and Yongbin Ruan (U Michigan). The ‘Quantum Curves and Quantum Knot Invariants’ workshop was organized by Vincent Bouchard (UAlberta), Mikhail Khovanov (Columbia), Motohico Mulase (UC Davis), Alexei Oblomkov (UMass), Marko Stovsic (IST), and Piotr Sulkowski (Caltech). These meetings covered a wide array of topics at the interface of mathematics and high energy physics, including:

- Donaldson-Thomas invariants
- Stable quasimaps and Gromov-Witten invariants
- Mirror symmetry, quantization and topological recursion
- Quantization and knot theory
- Mathematical string phenomenology
- Heterotic mirror symmetry
- New and exotic supersymmetric field theories
- Localization and gauge theory
- Gauge theory and Khovanov homology
- Gauge theory angle at integrability
- Conformal field theory
- Homological mirror symmetry
- Gauged linear sigma models
- Categorical constructions of topological field theories
- Non-perturbative dualities, F-theory
- Wall-crossing formulas
- Geometric Langlands
- Arithmetic of strings
- A-twisted Landau-Ginzburg models
- Topological T duality
- String topology
- Elliptic cohomology
- Perturbative amplitudes in gauge theory
- Superstring scattering amplitudes
- Noncommutative geometry

Altogether, the String-Math 2014 conference brought together approximately 130 mathematicians and physicists. There were 25 invited plenary talks given by leaders in both fields. Additionally, there were 22 contributed talks given in parallel sessions. All the talks are available at the conference web site: https://sites.google.com/a/ualberta.ca/stringmath2014/.

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 nine 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 2018, Japan (Tohoku University)
• String-Math 2019, Sweden (Uppsala University)

The conference benefitted from support obtained from the NSF (grant number: NSF DMS 1401390, String Math Conferences 2014), from the Pacific Institute for the Mathematical Sciences through its Collaborative Research Group in Geometry and Physics (2013–2016), from the University of Alberta and from Perimeter Institute for Theoretical Physics.

The editors of String-Math 2014:

Vincent Bouchard
Charles Doran
Stefan Mendez-Diez
Callum Quigley
List of Speakers for String-Math 2014

List of Plenary Speakers for String-Math 2014

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Harvard University

Matt Ballard
University of South Carolina

Christopher E. Beasley
Northeastern University

Tudor Dimofte
Institute for Advanced Study

John Duncan
Case Western Reserve University

Bertrand Eynard
Saclay

Mathias Gaberdiel
ETH Zurich

Davide Gaiotto
Perimeter Institute

Sylvester James Gates
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Jonathan Heckman
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Columbia University

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David Morrison
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Paul Norbury
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Jonathan Rosenberg
University of Maryland

Yongbin Ruan
University of Michigan

Volker Schomerus
DESY

Christoph Schweigert
Universität Hamburg

Eric Sharpe
Virginia Tech

Claire Voisin
École Polytechnique

List of Contributed Speakers for String-Math 2014

John Dixon
Tabacon

Richard Eager
Tokyo University
List of Speakers for the String-Math Summer School

Kevin Costello
Northwestern University

Andy Neitzke
The University of Texas at Austin

Tony Pantev
University of Pennsylvania

Balázs Szendrői
University of Oxford

Eric Zaslow
Northwestern University

List of Speakers for the ‘Calabi-Yau Manifolds and their Moduli’ Workshop

Xi Chen
University of Alberta

David Favero
University of Alberta

Sara Filippini
University of Zurich

Karl Fredrickson
University of California, Riverside

Sergey Galkin
Moscow State University

Andrew Harder
University of Alberta

Atsushi Kanazawa
University of British Columbia/Harvard University

Tyler Kelly
University of Cambridge

Chiu-Chu Melissa Liu
Columbia University

Andreas Malmendier
Utah State University
Stefan Mendez-Diez
University of Alberta
David Morrison
University of California, Santa Barbara
Howard Nuer
Rutgers University
Andre Perunicic
Queen’s University
Mohammad Rahmati
Centro de Investigación en Matemáticas, A.C.
Helge Ruddat
Johannes Gutenberg-Universität Mainz
Alan Thompson
University of Alberta/University of Waterloo
Katrin Wendland
Universität Freiburg
Shing-Tung Yau
Harvard University
Noriko Yui
Queen’s University

List of Speakers for the ‘Quantum Curves and Quantum Knot Invariants’ Workshop

Gaëtan Borot
Max-Planck-Institut für Mathematik
Tudor Dimofte
Institute for Advanced Study
Olivia Dumitrescu
University of Leibniz, Hannover
Pavel Etingof
Massachusetts Institute of Technology

Hiroyuki Fuji
Tsinghua University
Stavros Garoufalidis
Georgia Institute of Technology
Victor Ginzburg
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CRM, Université de Montréal/Concordia University
Lotte Hollands
University of Oxford
Chiu-Chu Melissa Liu
Columbia University
Jun Murakami
Waseda University
Satoshi Nawata
The National Institute for Nuclear Physics and High Energy Physics, Amsterdam
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Duke University
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Piotr Sułkowski
University of Warsaw
Katrin Wendland
Universität Freiburg
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