2017 ICCM Best Paper Award

by Shu-Cheng Chang* and Mu-Tao Wang†

The International Consortium of Chinese Mathematicians (ICCM) is pleased to announce the winners of the first ICCM Best Paper Awards, in 2017.

The 2017 Awards—sponsored by the TCL—were given at the first ICCM annual meeting in December 2017 at Sun Yat-Sen University in Guangzhou, China.

Introduction to the Awards

Eligibility

For a paper to be eligible for consideration for a 2017 Best Paper Award, it was required to meet the following criteria:

- That at the time of consideration, the paper is posted on the MathSciDoc website at http://archive.ymsc.tsinghua.edu.cn
- That at least one of the principal authors is of Chinese descent.
- That the paper was published in a respectable journal during the period of 2012 through 2017.

General Information

- Each year at the annual meeting of the ICCM, 10 Gold Awards and 10 Silver Awards will be given to eligible papers that meet the above criteria. In addition, several Distinguished Papers (若琳奖) will be honored. based upon the recommendation of the members of the Best Paper Awards committee.
- The Best Paper Award selection process consists of two rounds. The first round involves 20 subject committees; the second round is conducted by a global committee. Award committee members are appointed by the ICCM scientific committee.
- The Gold Award and the Silver Award are given only for papers authored by participants of the annual meeting of the ICCM. An author of each considered paper will be invited to speak at the annual meeting.
- The Distinguished Paper Award was established and is sponsored by S-T. Yau and Stephen S.-T. Yau, in memory of their mother. Awarded papers will be announced at the annual ICCM meeting. The Distinguished Paper Award is given only to papers authored by participants of the meeting.

Subjects

1. Algebra, lie theory, representation theory
2. Algebraic geometry
3. Differential geometry
4. Geometric modeling and processing, computational geometry
5. Mathematical physics
6. Numerical analysis, numerical linear algebra
7. Probability, information theory
8. Symplectic geometry, metric geometry, geometric topology
9. Algebraic topology, general topology, K-theory and homology
10. Geometric analysis
11. Classical analysis and ODEs, dynamical systems, functional analysis, operator algebras, spectral theory
12. Complex variables, complex analysis
13. Automorphic and geometric representation theory
14. Analysis of PDEs

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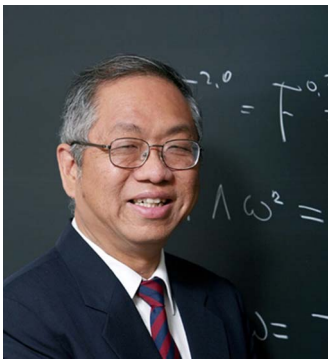
15. Number theory
16. Arithmetic geometry
17. Applied Math A: Shock waves, fluid dynamics, optimization
18. Statistics theory and methods
19. Applications of statistics, data analysis, biostatistics
20. Applied Math B: Control, bio-mathematics, machine learning, combinatorics

The 2017 ICCM Global Selection Committee

Shing-Tung Yau



President of the ICCM

Chair of the 2017 ICCM Best Paper Awards Global Selection Committee

Shing-Tung Yau was born in Shantou, China. After studying mathematics at the Chinese University of Hong Kong, he continued to the University of California, Berkeley in 1969. At the age of 22, Yau was awarded Ph.D. degree under the supervision of Shiing-Shen Chern. After a year as a member of the Institute for Advanced Study, Princeton, and two years at the State University of New York at Stony Brook, he went to Stanford University. Since 1987, he has been a Professor of Mathematics at Harvard University. In 2013, he was also appointed a Professor of Physics at Harvard.

Yau's work is in geometry in the broadest sense. He was the first person to combine differential geometry and analysis to solve longstanding problems in both subjects. Yau's work opened up new directions, set foundations, and changed people's perspectives towards mathematics and their applications in physics and computer science. For example, his proof of the positive energy theorem in general relativity demonstrated—sixty years after its discovery—that Einstein's theory is consistent and stable. His proof of the Calabi conjecture gave solutions of multiple well-known open problems in algebraic geometry and also allowed physicists to show that string theory is a viable candidate for a unified theory of nature. Calabi–Yau manifolds are among the "standard toolkit" for string theorists today.

Professor Yau also spends an enormous amount of energy to train young mathematicians at every level. He has been directors of the Institute of Mathematical Sciences at the Chinese University of Hong Kong, the Morningside Center of Mathematics of the Chinese Academy of Sciences, Center of Mathematical Sciences in Zhejiang University. In December 2009, Shing-Tung Yau was invited to serve as the inaugural director of the Mathematical Sciences Center at Tsinghua University (renamed Yau Mathematical Sciences Center in 2015).

He won Oswald Veblen Prize in 1981, Fields Medal in 1982, MacArthur Fellow Award in 1984, Crafoord Prize in 1994, United States National Medal of Science in 1997, China International Scientific and Technological Cooperation Award in 2003, Wolf Prize in Mathematics and Asian American Engineer of the Year, AAEOY in 2010.

Simon Donaldson

Professor Donaldson is the Royal Society Research Professor at Imperial College London and a permanent member of the Simons Center for Geometry and Physics at Stony Brook University. His primary research areas are differential geometry and topology. He is a fellow of the Royal Society, the Royal Swedish Academy of Sciences, and the American Mathematical Society. Professor Donaldson was awarded the Junior Whitehead Prize (1985), Fields Medal (1986), Royal Medal (1992), Crafoord Prize (1994), Pólya Prize (1999), the King Faisal International Prize (2006), the Nemmers Prize in Mathematics (2008), the Shaw Prize in Mathematics (2009), Breakthrough Prize in Mathematics (2014).

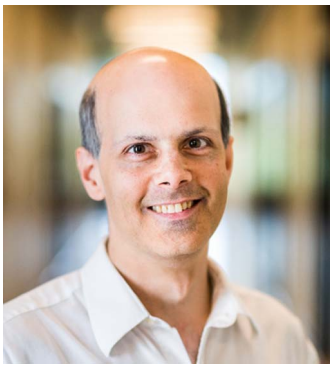
Bjorn Engquist

Professor Engquist is currently Professor of the Computational and Applied Chair I at the Institute for Computational Engineering and Sciences at the University of Texas at Austin. His research mainly focuses on development and analysis of numerical methods for differential equations with applications to multi-scale modeling, electromagnetism and fluid mechanics. Professor Engquist is a member of the American Academy of Arts & Sciences, the Royal Swedish Academy of Sciences, the Royal Swedish Academy of Engineering Sciences, and the Norwegian Academy of Sciences and Letters; besides, he was an invited speaker at the International Congress of Mathematics in 1982 and in 1998. He is a recipient of the first SIAM James H. Wilkinson Prize in Numerical Analysis and Scientific Computing (1982), Peter Henrici Prize (2011), and George David Birkhoff Prize (2012).

Eduard Looijenga

Professor Looijenga is Professor of Mathematics at Yau Mathematical Sciences Center of Tsinghua University. His research areas are algebraic geometry and the theory of algebraic groups, in particular moduli spaces and locally-symmetric varieties. Professor Looijenga was an invited speaker at the International Congress of Mathematicians in 1978. He is a member of the Royal Netherlands Academy of Arts and Sciences and one of the inaugural fellows of the American Mathematical Society.

Bjorn Poonen



Professor Poonen is the Claude Shannon Professor of Mathematics at Massachusetts Institute of Technology. His research focuses on number theory and algebraic geometry; particularly, he is interested in developing methods for determining the rational number solutions to polynomial equations and in proving that certain problems are undecidable. Professor Poonen has been elected to American Mathematical Society and American Academy of Arts and Sciences. He is a recipient of Sloan Research Fellowship (1998), Packard Fellowship (1998), Guggenheim Fellowship (2011), Simons Fellow in Mathematics (2015); besides, he was awarded Chauvenet Prize (2011).

Donald Rubin

Professor Rubin is the John L. Loeb Professor of Statistics at Harvard University. His research interests are causal inference in experiments and observational studies, inference in sample surveys with non-response and in missing data problems, application of Bayesian and empirical Bayesian techniques, and developing and applying statistical models to data in a variety of scientific disciplines. Professor

Rubin has been elected to the Woodrow Wilson Society, Guggenheim Memorial Foundation, Alexander von Humboldt Foundation, American Statistical Association, Institute of Mathematical Statistics, International Statistical Institute, American Association for the Advancement of Science, American Academy of Arts and Sciences, European Association of Methodology, the British Academy, and the U.S. National Academy of Sciences.

Richard Schoen

Professor Richard Schoen is currently an Excellence in Teaching Chair at University of California Irvine and was the Bass Professor of Humanities and Sciences at Stanford University. His research interest mainly lies in differential geometry and notable accomplishments include solutions of the fundamental positive mass conjecture in general relativity (with S.-T. Yau), the Yamabe problem on compact manifolds, and the differentiable sphere theorem (with S. Brendle). Professor Schoen has been elected to the American Academy of Arts and Sciences and the National Academy of Sciences and became a fellow of the American Mathematical Society. He is a recipient of the MacArthur Fellowship (1983), Bôchner Memorial Prize (1989), the Guggenheim Fellowship (1996), the ICCM International Cooperation Award (2010), Wolf Prize (2017), Heinz Hopf Prize (2017), Lobachevsky Prize (2017), and Rolf Schock Prize (2017).

Wilfried Schmid

Professor Schmid is the Dwight Parker Robinson Professor of Mathematics at Harvard University. His research concerns Lie groups and their representations. He introduced geometric methods in the study of infinite dimensional representations; on the other hand, he applied representation-theoretic methods in the other areas of mathematics. Professor Schmid has

served as Mathematics Advisor to the Massachusetts Department of Education, a member of the Steering Committee of Mathematics of the National Assessment of Educational Progress, and a member of the National Mathematics Advisory Panel of the U.S. Department of Education. He is a fellow of the American Mathematical Society in 2012.

Cumrun Vafa

Professor Vafa is the Donner Professor of Science at Harvard University. His research is mainly focused on the nature of quantum gravity and the relation between geometry and quantum field theories and he is known for Vafa-Witten theorem, Gopakumar–Vafa invariant, and F-theory. Professor Vafa has been elected to Harvard Society of Fellows, American Academy of Arts and Sciences, National Academy of Sciences. He was awarded NSF Presidential Young Investigator Award (1989), Alfred P. Sloan Award (1989), Packard Foundation Award (1989), AMS Leonard Eisenbud Prize for Mathematics and Physics (2008), Dirac Medal of the ICTP (2008), Frontiers in Physics Prize (2013), Dannie Heineman Prize for Mathematical Physics (2016), Breakthrough Prize in Fundamental Physics (2017), and Ellis Island Medal of Honor (2017).

The 2017 ICCM Best Paper Award Recipients

Gold Award Recipients

[1] Antonio Auffinger and Wei-Kuo Chen, "The Parisi formula has a unique minimizer" *Communications in Mathematical Physics* **335**, no. 3 (2015): 1429–1444. MathSciDoc 1704.28001

[2] Nicolas Bergeron, Zhiyuan Li, John Millson, and Colette Moeglin, "The Noether-Lefschetz conjecture and its generalizations" *Inventiones mathematicae* **208**, no. 2 (2017): 501–552. MathSciDoc 1703.01004

[3] Huai-Liang Chang, Jun Li, and Wei-Ping Li, "Witten's top Chern class via cosection localization" *Inventiones mathematicae* **200**, no. 3 (2015): 1015–1063. MathSciDoc 1701.01024

[4] Bing-Long Chen, Siu-Hung Tang, and Xi-Ping Zhu, "Complete classification of compact four-manifolds with positive isotropic curvature" *Journal of Differential Geometry* **91**, no. 1 (2012): 41–80. MathSciDoc 1609.10264

[5] Po-Ning Chen, Mu-Tao Wang, and Shing-Tung Yau, "Conserved quantities in general relativity: from the quasi-local level to spatial infinity" *Communications in Mathematical Physics* **338**, no. 1 (2015): 31–80. MathSciDoc 1608.10021

[6] Xinran Li and Peng Ding, "General forms of finite population central limit theorems with applications to causal inference" *Journal of the American Statistical Association* (2017), DOI: 10.1080/01621459.2017.1295865. MathSciDoc 1706.27001

[7] Yangyang Xu and Wotao Yin, "A block coordinate descent method for regularized multiconvex optimization with applications to nonnegative tensor factorization and completion" *SIAM Journal on Imagining Sciences* **6**, no. 3 (2013): 1758–1789. MathSciDoc 1703.25019

[8] Zhiwei Yun and Wei Zhang, "Shtukas and the Taylor expansion of L-functions" *Annals of Mathematics* **186**, no. 3 (2017): 767–911. MathSciDoc 1703.24017

[9] Wei Zhang, "On arithmetic fundamental lemmas" *Inventiones mathematicae* **188**, no. 1 (2012): 197–252. MathSciDoc 1703.24013

1. Antonio Auffinger and Wei-Kuo Chen, "The Parisi formula has a unique minimizer" Communications in Mathematical Physics 335, no. 3 (2015): 1429–1444. MathSciDoc 1704.28001

Abstract

In 1979, G. Parisi predicted a variational formula for the thermodynamic limit of the free energy in the Sherrington-Kirkpatrick model and described the role played by its minimizer. This formula was verified in the seminal work of Talagrand and later generalized to the mixed p-spin models by Panchenko. In this paper, we prove that the minimizer in Parisi's formula is unique at any temperature and external field by establishing the strict convexity of the Parisi functional.

Comment

The authors prove the uniqueness of the Parisi measure by means of stochastic optimal control technique for the Parisi PDE, which leads to the uniqueness of the minimizer in Parisi's formula.

Wei-Kuo Chen

In 2012, Dr. Chen graduated from the University of California at Irvine. He started his postdoctoral research as a Dickson instructors at the University of Chicago right after graduation. His main field of research is probability theory, and he and Dr. Auffinger devote a large amount of their time together to study complex disordered systems, such as spin glasses. These were invented by theoretical physicists in '70 in order to explain the strange magnetic behavior of certain alloys such as CuMn. As part of their research program, they intensively investigated the famous Sherrington-Kirkpatrick (SK) model, the archetypal model of a spin glass. They established uniqueness of the functional order parameter in the Parisi formula for the thermodynamic limit of the free energy by means of the stochastic optimal control theory. This approach was later shown to be of great use in understanding the maximum energy, energy landscape, and chaotic natural of the SK model. Dr. Chen is now an assistant professor at the University of Minnesota.

Antonio Auffinger

Dr. Auffinger received his Ph.D. degree from New York University in 2011. He started his postdoctoral research as a Dickson instructors at the University of Chicago right after graduation. His main field of research is probability theory, and he and Dr. Chen devote a large amount of their time together to study complex disordered systems, such as spin glasses. These were invented by theoretical physicists in '70 in order to explain the strange magnetic behavior of certain alloys such as CuMn. As part of their research program, they intensively investigated the famous Sherrington-Kirkpatrick (SK) model, the archetypal model of a spin glass. They established uniqueness of the functional order parameter in the Parisi formula

for the thermodynamic limit of the free energy by means of the stochastic optimal control theory. This approach was later shown to be of great use in understanding the maximum energy, energy landscape, and chaotic natural of the SK model. Dr. Auffinger is now an associate professor at the Northwestern University.

2. Nicolas Bergeron, Zhiyuan Li, John Millson, and Colette Moeglin, "The Noether-Lefschetz conjecture and its generalizations" ***Inventiones mathematicae*** **208, no. 2 (2017): 501–552. MathSciDoc 1703.01004**

Abstract

We prove the Noether-Lefschetz conjecture on the moduli space of quasi-polarized $K3$ surfaces. This is deduced as a particular case of a general theorem that states that low degree cohomology classes of arithmetic manifolds of orthogonal type are dual to the classes of special cycles, i.e. sub-arithmetic manifolds of the same type. Earlier results for compact manifold are extended to non-compact manifolds in this paper. This allows us to apply our results to the moduli spaces of quasi-polarized $K3$ surfaces.

Comment

The authors prove the Noether-Lefschetz conjecture, raised by Maulik and Pandaripande, on moduli spaces of K3 surfaces. This conjecture, motivated from the formalism of Bocherds and Bruinier, answers the foundational question in the study of cycle theory of the moduli spaces of $K3$ surfaces.

Zhiyuan Li

Born in 1983, is a Chinese mathematician in the area of algebraic geometry, notably in the area of moduli theory and its connections to Langland's program. In 2016, he and his collaborators proved the Noether-Lefschetz conjecture on moduli spaces of $K3$ surface and solved the Hodge type questions on arithmetic manifolds of orthogonal type using automorphic representation theory. The Noether-Lefschetz conjecture, raised by Davesh Maulik and Rahul Pandharipande, is a fundamental question in studying the geometry of moduli space of K3 surfaces. Later this year, they generalized their method to prove the cohomological tautological conjecture and generalized Franchetta conjecture on moduli space of hyperkähler manifolds. Zhiyuan Li began his studies at the University of Science and Technology of China. He earned his doctorate at Rice University under Brendan Hassett's supervision in 2012. He was a Szegö assistant professor in Stanford University from 2012 to 2015 and worked in Bonn University from 2015 to 2016. In 2016, he was recruited by the Recruitment Program for Young Professionals and joined the Shanghai center of mathematical science as a Young Investigator.

Nicolas Bergeron

Nicolas Bergeron is a professor of the Institut de mathématiques de Jussieu. He learned from Professor Jean-Pierre Otal, and obtained his Ph.D. degree from ENS Lyon in 2000. His research interests are geometry and topology of locally symmetric spaces, arithmetic groups, the spectrum of cohomology groups.

John Millson

John Millson was born in 1946 in Kingston, Ontario, Canada and attended Kingston Collegiate and Vocational Institute. In 1964 He began his undergraduate studies at M.I.T. He spent his junior year (1966–67) in Paris where he took Math. He graduated from Berkeley in 1973 and went to the Institute for Advanced Study at Princeton. In 2009, he and his collaborators (HMSV) computed the relations among Kempe's generators, thereby proving the "Second Main Theorem" for ordered points on the line 115 years after the First Main Theorem was proved. In 2010, he was asked by S.T. Yau and Lizhen Ji to write an article about his career for a book honoring Chern's hundredth birthday (Chern was his teacher in Berkeley).

Colette Moeglin

Colette Moeglin is a Directeur de recherche at the Centre national de la recherche scientifique and is currently working at the Institut de mathématiques de Jussieu. She was a speaker at the 1990 International Congress of Mathematicians, on decomposition into distinguished subspaces of certain spaces of square-integral automorphic forms. She was a recipient of the Jaffé prize of the French Academy of Sciences in 2004, "for her work, most notably on the topics of enveloping algebras of Lie algebras, automorphic forms and the classification of square-integrable representations of reductive classical p-adic groups by their cuspidal representations".

3. Huai-Liang Chang, Jun Li, and Wei-Ping Li, "Witten's top Chern class via cosection localization" Inventiones mathematicae 200, no. 3 (2015): 1015–1063. MathSciDoc 1701.01024

Abstract

For a Landau-Ginzburg space, we construct Witten's top Chern class as an algebraic cycle using cosection localized virtual cycles in the case where all sectors are narrow, verify all axioms of this class, and derive an explicit formula for it in the free case. We prove that this construction is equivalent to the constructions of Polishchuk-Vaintrob, Chiodo, and Fan-Jarvis-Ruan.

Comment

The paper gives an algebraic-geometric construction of Witten's top Chern class for general Landau-Ginzburg spaces, which is motivated by a conjecture of Witten, and verifies all axioms for the class they constructed. Their class is an algebraic cycle of moduli spaces and they proved that its associated homology class coincides with the class of Fan-Jarvis-Ruan.

Huai-Liang Chang

Huai-Liang Chang is an associate professor in the department of mathematics at Hong Kong University of Science and Technology. In 2001, he got his bachelor's degree in mathematics from National Cheng Kung University. In 2007, he got his Ph.D. degree in mathematics from Stanford University. He worked as a postdoc in mathematical physics, International School for Advanced Studies, SISSA, Italy, 2007–2009. His research interests are algebraic geometry and string theory.

Jun Li

Jun Li is a professor at the Department of Mathematics, Stanford University. Since receiving his Ph. D from Harvard University in 1989, he was on the faculty of UCLA from 1992–96, before joining Stanford University. His research interest is in algebraic geometry; he has made significant contribution to the research on moduli of vector bundles, stable morphisms and Gromov-Witten invariants. He was the recipient of Sloan fellowship and Terman fellowship; he was awarded the Morningside Gold Medal in 2001. His research interest is algebraic geometry.

Wei-Ping Li

Wei-Ping Li is a chair professor in the department of mathematics at Hong Kong University of Science and Technology. In 1984, he got his bachelor's degree in mathematics from Nankai University. He learned from Professor Robert Friedman, Columbia University during the Ph. D. period. His research interest is algebraic geometry.

4. Bing-Long Chen, Siu-Hung Tang, and Xi-Ping Zhu, "Complete classification of compact four-manifolds with positive isotropic curvature" *Journal of Differential Geometry* 91, no. 1 (2012): 41–80. MathSciDoc 1609.10264

Abstract

In this paper, we completely classify all compact 4-manifolds with positive isotropic curvature. We show that they are diffeomorphic to S^4 or RP^4 or quotients of $S^3 \times R$ by a cocompact fixed point free subgroup of the isometry group of the standard metric of $S^3 \times R$, or a connected sum of them.

Comment

In this paper, these authors developed a surgery theory of the Ricci flow on orbifolds, which shows that in many essential cases the orbifold singularities must be inevitably introduced by the surgery procedure. Using this method, the authors gave a complete classification of all compact 4-dimensional manifolds that admit a metric with positive isotropic curvature.

Bing-Long Chen

Bing-Long Chen was born in 1974 in Shanxi province, China. He finished his middle school education in the 1st Middle School in Fenxi County in 1992, and came to Sun Yat-sen University (Zhongshan University) in Guangzhou studying mathematics. He received his Ph.D. degree majored in Pure Mathematics in 2000 from Sun Yat-sen University and became a professor there in 2004. He was awarded the National Science Fund for Distinguished Young Scholars in 2010 and was selected as a Chang Jiang Scholar by the Ministry of Education of China in 2014.

Siu-Hung Tang

Siu Hung Tang has been an associate professor at the Sun Yat Sen University since 2007. He received his Ph.D. degree at Purdue University in 1999. After his postdoctoral at the University of California, Berkeley and the Chinese University of Hong Kong, he held a visiting position at the University of Kentucky.

Xi-Ping Zhu

Xiping Zhu is Vice President and Professor of Mathematics at Sun Yat-sen University (SYSU). Professor Zhu is also a Standing Member of the SYSU Committee of the Communist Party of China. He received his Ph.D. in Science from the Chinese Academy of Sciences. Professor Zhu's primary research interest is geometric analysis. He has solved several world-famous mathematical open problems and conjectures; for instance, with Huai-Dong Cao, he gave a complete proof of the Hamilton-Perelman theory on Poincaré and Thurston's geometrization conjecture. Jointly with Bing-Long Chen, Siu-Hung Tang and Huiling Gu, he made important contributions to the Ricci flow and its geometric applications, including solving the open problem of the fundamental uniqueness theorem of the Ricci flow theory, proving a conjecture on four-dimensional manifolds with positive isotropic curvature, proving Hamilton's conjecture on Type II singularities of the Ricci flow, and partially solved Shing-Tung Yau's uniformization conjecture. Professor Zhu has received many accolades, which include the National Science Foundation for Distinguished Young Scholars of China (1998), the Morningside Silver Medal of Mathematics (2004), among others. Professor Zhu was a distinguished professor for Chang Jiang Scholars (2001–2006), an advisor to the winners of the 100 National Outstanding Doctoral Dissertation Award (2002 and 2013), and an academic leader of the Innovative Research Group of the National Science Fund of China (2015). He received the Chern Prize in 2016.

5. Po-Ning Chen, Mu-Tao Wang, and Shing-Tung Yau, "Conserved quantities in general relativity: from the quasi-local level to spatial infinity" ***Communications in Mathematical Physics*** **338, no. 1 (2015): 31–80. MathSciDoc 1608.10021**

Abstract

We define quasi-local conserved quantities in general relativity by using optimal isometric embedding to transplant Killing fields in the Minkowski spacetime back to the 2-surface of interest in a physical spacetime. To each optimal isometric embedding, a dual element of the Lie algebra of the Lorentz group is assigned. Quasi-local angular momentum and quasi-local center of mass correspond to pairing this element with rotation Killing fields and boost Killing fields, respectively. They obey classical transformation laws under the action of the Poincaré group. We further justify these definitions by considering their limits as the total angular momentum and the total center of mass of an isolated system.

These expressions were derived from the Hamilton-Jacobi analysis of gravitation action and thus satisfy conservation laws. As a result, we obtained an invariant total angular momentum theorem in the Kerr spacetime. For a vacuum asymptotically flat initial data set of order 1, it is shown that the limits are always finite without any extra assumptions. We also study these total conserved quantities on a family of asymptotically flat initial data sets evolving by the vacuum Einstein evolution equation. It is shown that the total angular momentum is conserved under the evolution. For the total center of mass, the classical dynamical formula relating the center of mass, energy, and linear momentum is recovered, in the nonlinear context of initial data sets evolving by the vacuum Einstein evolution equation. The definition of quasi-local angular momentum provides an answer to the second problem in classical general relativity on Penrose's list.

Comment

This paper gives a very precise definition of quasi local conserved quantities of physical interest in general relativity. It solves an old problem that was proposed by Penrose. It also answers questions related to the asymptotically fall-off of such quantities.

Po-Ning Chen

Po-Ning Chen is an assistant professor in the department of mathematics at University of California, Riverside. In 2006, he got his bachelor's degree in mathematics from MIT. In 2011, he got his Ph.D. degree from Harvard University. His research fields are differential geometry and general relativity.

Mu-Tao Wang

Mu-Tao Wang is currently Professor of Mathematics at Columbia University. He earned his BS in Mathematics at National Taiwan University in 1988 and his MS from the same institution in 1992. He received a Ph.D. in Mathematics in 1998 from Harvard University. Wang's research is focused in the fields of differential geometry and mathematical physics, specifically general relativity. In the field of general relativity, he is especially known for his work on quasilocal mass-energy; the Wang-Yau quasi-local mass is named in his honor. He has received awards including the 2010 Morningside Mathematics Gold Award, the 2007 Chern Award etc.

Shing-Tung Yau

Professor Shing-Tung Yau is the William Casper Graustein Professor of Mathematics at Harvard University. He is the inaugural Director of the Yau Mathematical Sciences Center of Tsinghua University. Professor Yau has made fundamental contribution to differential geometry, differential equations and mathematical physics. Professor Yau is honored by numerous prestigious prizes and awards, including Oswald Veblen Prize (1981), John J. Carty Award for the Advancement of Science (1981), Fields Medal (1982), Humboldt Research Award (1991), Alexander von Humboldt Foundation (1991), Crafoord Prize (1994), United States National Medal of Science (1997), China International Scientific and Technological Cooperation Award (2003), and Wolf Prize in Mathematics (2010). He is a member of the United States National Academy of Sciences, a member of Russian Academy of Sciences, a foreign member of the Chinese Academy of Sciences, and a member of Academia Sinica.

6. Xinran Li and Peng Ding, "General forms of finite population central limit theorems with applications to causal inference" *Journal of the American Statistical Association* (2017), DOI: 10.1080/01621459.2017.1295865. MathSciDoc 1706.27001

Abstract

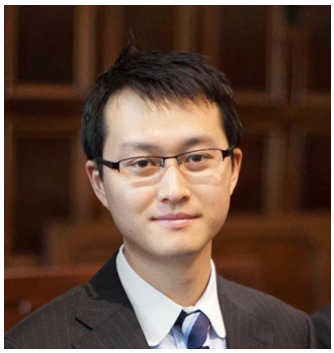
Frequentists' inference often delivers point estimators associated with confidence intervals or sets for parameters of interest. Constructing the confidence intervals or sets requires understanding the sampling distributions of the point estimators, which, in many but not all cases, are related to asymptotic Normal distributions ensured by central limit theorems. Although previous literature has established various forms of central limit theorems for statistical inference in super population models, we still need general and convenient forms of central limit theorems for some randomization-based causal analysis of experimental data, where the parameters of interests are functions of a finite population and randomness comes solely from the treatment assignment. We use central limit theorems for sample surveys and rank statistics to establish general forms of the finite population central limit theorems that are particularly useful for proving asymptotic distributions of randomization tests under the sharp null hypothesis of zero individual causal effects, and for obtaining the asymptotic repeated sampling distributions of the causal effect estimators. The new central limit theorems hold for general experimental designs with multiple treatment levels, multiple treatment factors and vector outcomes, and are immediately applicable for studying the asymptotic properties of many methods in causal inference, including instrumental variable, regression adjustment, rerandomization, clustered randomized experiments, and so on. Previously, the asymptotic properties of these problems are often based on heuristic arguments, which in fact rely on general forms of finite population central limit theorems that have not been established before. Our new theorems fill in this gap by providing more solid theoretical foundation for asymptotic randomization-based causal inference.

Comment

This paper deals with the classical issue of the finite population version of the central limit theorem applied to causal inference in randomized experiments—for over a half century, the mathematical arguments, as far as they went, relied on a survey sampling argument due to the Hungarian mathematician Hajek, but Ding and Li created a mathematically tight framework that has wide applicability to a vast array of finite population causal inference experimental designs and their estimands and estimators.

Peng Ding

Peng Ding an assistant professor in the Department of Statistics, UC Berkeley. He obtained his Ph.D. from



the Department of Statistics at Harvard University in May 2015.

Xinran Li

Xinran Li is a Ph.D. candidate in the Department of Statistics at Harvard University.

7. Yangyang Xu and Wotao Yin, "A block coordinate descent method for regularized multiconvex optimization with applications to nonnegative tensor factorization and completion" ***SIAM Journal on Imagining Sciences*** **6, no. 3 (2013): 1758–1789. MathSciDoc 1703.25019**

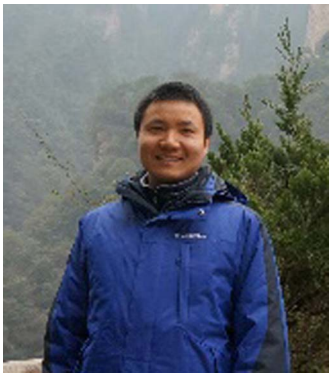
Abstract

This paper considers regularized block multiconvex optimization, where the feasible set and objective function are generally nonconvex but convex in each block of variables. It also accepts nonconvex blocks and requires these blocks to be updated by proximal minimization. We review some interesting applications and propose a generalized block coordinate descent method. Under certain conditions, we show that any limit point satisfies the Nash equilibrium conditions. Furthermore, we establish global convergence and estimate the asymptotic convergence rate of the method by assuming a property based on the Kurdyka–Lojasiewicz inequality. The proposed algorithms are tested on nonnegative matrix and tensor factorization, as well as matrix and tensor recovery from incomplete observations. The tests include synthetic data and hyperspectral data, as well as image sets from the CBCL and ORL databases. Compared to the existing state-of-the-art algorithms, the proposed algorithms demonstrate superior performance in both speed and solution quality. The MATLAB code of nonnegative matrix/tensor decomposition and completion, along with a few demos, are accessible from the authors' homepages.

Comment

This paper describes a generalized block coordinate descent method for problems where the feasible set and objective function are generally nonconvex but convex in each block of variables.

Yangyang Xu



Yangyang Xu is now a tenure-track assistant professor in the Department of Mathematical Sciences at Rensselaer Polytechnic Institute. He received his B.S. in Computational Mathematics from Nanjing University in 2007, M.S. in Operations Research from Chinese Academy of Sciences in 2010, and Ph.D. from the Department of Computational and Applied Mathematics at Rice University in 2014. His research interests are optimization theory and methods and their applications such as in machine learning, statistics, and signal processing. He developed optimization algorithms for compressed sensing, matrix completion, and tensor factorization and learning. Recently, his research focuses on first-order methods, operator splitting, stochastic optimization methods, and high performance parallel computing. These works are motivated by very "big" problems arising in data science and engineering.

Wotao Yin

Wotao Yin is a professor in the Department of Mathematics of UCLA. His research interests lie in computational optimization and its applications in image processing, machine learning, and other data science problems. He received his B.S. in Mathematics from Nanjing University in 2001 and M.S. and Ph.D. in Operations Research from Columbia University in 2003 and 2006, respectively. During 2006–2013, he was with Rice University. He won NSF CAREER award in 2008, Alfred P. Sloan Research Fellowship in 2009, Morningside Gold Medal in 2016. He invented fast algorithms for sparse optimization and has been leading the research of optimization algorithms for large-scale problems. His methods and algorithms have found very broad applications across different fields of science and engineering. Google Scholar recorded his 90 papers, out of which 27 have been cited at least

100 times, and 3 have had over 1000 citations. His total citation is over 13,000. He also published about 20 open-source software packages and 2 review articles.

8. Zhiwei Yun and Wei Zhang, "Shtukas and the Taylor expansion of L-functions" Annals of Mathematics 186, no. 3 (2017): 767–911. MathSciDoc 1703.24017

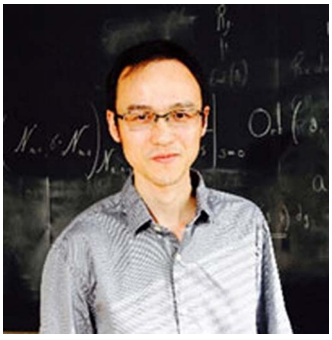
Abstract

We define the Heegner-Drinfeld cycle on the moduli stack of Drinfeld Shtukas of rank two with r-modifications for an even integer r. We prove an identity between (1) The r-th central derivative of the quadratic base change L-function associated to an everywhere unramified cuspidal automorphic representation π of $PGL(2)$; (2) The self-intersection number of the π-isotypic component of the Heegner-Drinfeld cycle. This identity can be viewed as a function-field analog of the Waldspurger and Gross-Zagier formula for higher derivatives of L-functions.

Comment

Birch and Swinnerton-Dyer conjectured a connection between analytic number theory and arithmetic geometry. The authors have proved an arithmetic intersection formula which is far more general than the previous results. Such results had been sought after for over 50 years, but even in the simplest case of elliptic curves no one previously had a conjecture for anything beyond that.

Wei Zhang



Wei Zhang received his B.S. from Peking University in 2004 and his Ph.D. from Columbia University in 2009, both degrees in mathematics. After a postdoctoral fellowship and a Benjamin Pierce Fellowship at Harvard, he joined the mathematics faculty at Columbia University in 2011. He joins the MIT Department of Mathematics as a full professor in 2017. Zhang works in number theory, automorphic forms, and arithmetic geometry. His research program involves fundamental objects such as L-functions, which appear in the Riemann hypothesis and its generalizations, and are central to the Langland's program. He has been developing the theory of relative trace formula to connect L-functions with algebra-geometric objects, notably the discovery of "arithmetic fundamental lemmas". In the function field case, he and Zhiwei Yun have discovered geometric interpretations for the higher derivatives of L-functions. In another direction, Zhang and his collaborators have made significant advances on conjectures subsequent to the Gross–Zagier theorem on elliptic curves, including a proof of the Birch and Swinnerton-Dyer conjecture for approximately 66% of elliptic curves. Zhang received the 2010 SASTRA Ramanujan Prize, the Sloan Research Fellowship in 2013, Morningside Gold Medal of Mathematics at ICCM 2016, and a Simons Fellowship in 2017.

Zhiwei Yun

Zhiwei Yun is a Professor of Mathematics at Yale University and will be a Professor of Mathematics at MIT. He was born in 1982 in Changzhou, China. He received his B.S. degree from Peking University in 2004 and his Ph.D. degree from Princeton University in 2009 under the advice of Robert MacPherson. He was a Moore instructor at MIT, an Assistant Professor and then an associate professor at Stanford University until 2016 before joining Yale.

His research interest includes representation theory, the Langland's program and related problems in algebraic geometry. His work uses techniques from algebraic geometry to solve problems in representation theory and number theory. He received a gold medal in IMO in 2000. He received the SASTRA Ramanujan Prize in 2012, and the Morningside Silver Award in 2016. He received a 5 year Packard Fellowship in 2013. He will give an invited address at ICM 2018.

9. Wei Zhang, "On arithmetic fundamental lemmas" Inventiones mathematicae 188, no. 1 (2012): 197–252. MathSciDoc 1703.24013

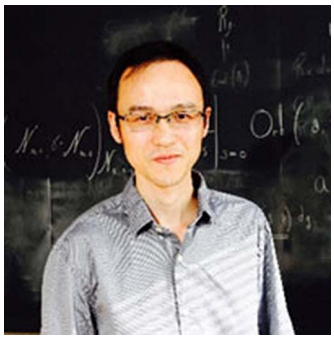
Abstract

We present a relative trace formula approach to the Gross–Zagier formula and its generalization to higher-dimensional unitary Shimura varieties. As a crucial ingredient, we formulate a conjectural arithmetic fundamental lemma for unitary Rapoport–Zink spaces. We prove the conjecture when the Rapoport–Zink space is associated to a unitary group in two or three variables.

Comment

The paper is novel and creative, makes a great contribution to the study of the arithmetic Gan-Gross-Prasad conjecture for unitary groups.

Wei Zhang



Wei Zhang received his B. S. from Peking University in 2004 and his Ph.D. from Columbia University in 2009, both degrees in mathematics. After a postdoctoral fellowship and a Benjamin Pierce Fellowship at Harvard, he joined the mathematics faculty at Columbia University in 2011. He joins the MIT Department of Mathematics as a full professor in 2017. Zhang works in number theory, automorphic forms, and arithmetic geometry. His research program involves fundamental objects such as L-functions, which appear in the Riemann hypothesis and its generalizations, and are central to the Langland's program. He has been developing the theory of relative trace formula to connect L-functions with algebra-geometric objects, notably the discovery of "arithmetic fundamental lemmas". In the function field case, he and Zhiwei Yun have discovered geometric interpretations for the higher derivatives of L-functions. In another direction, Zhang and his collaborators have made significant advances on conjectures subsequent to the Gross–Zagier theorem on elliptic curves, including a proof of the Birch and Swinnerton-Dyer conjecture for approximately 66% of elliptic curves. Zhang received the 2010 SASTRA Ramanujan Prize, the Sloan Research Fellowship in 2013, Morningside Gold Medal of Mathematics at ICCM 2016, and a Simons Fellowship in 2017.

Silver Award Recipients

[1] Ben Andrews and Haizhong Li, "Embedded constant mean curvature tori in the three-sphere" *Journal of Differential Geometry* **99**, no. 2 (2015): 169–189. MathSciDoc 1611.10007

[2] Kwokwai Chan, Siu-Cheong Lau, and Naichung Conan Leung, "SYZ mirror symmetry for toric Calabi-Yau manifolds" *Journal of Differential Geometry* **90**, no. 2 (2012): 177–250. MathSciDoc 1608.34009

[3] Chieh-Yu Chang and Matthew A. Papanikolas; with an appendix by Brian Conrad, "Algebraic independence of periods and logarithms of Drinfeld modules" *Journal of the American Mathematical Society* **25**, no. 1 (2012): 123–150. MathSciDoc 1611.24010

[4] Bingyi Chen, Dan Xie, Shing-Tung Yau, Stephen Yau, and Huaiqing Zuo, "4d N=2 SCFT and singularity theory Part II: complete intersection" *Advances in Theoretical and Mathematical Physics* **21**, no. 1 (2017): 121–145. MathSciDoc 1712.01001

[5] Jianqing Fan, Xu Han, and Weijie Gu, "Estimating false discovery proportion under arbitrary covariance dependence" *Journal of the American Statistical Association* **107**, no. 499 (2012): 1019–1035. MathSciDoc 1707.33001

[6] Xiangdi Huang, Jing Li, and Zhouping Xin, "Global well-posedness of classical solutions with large oscillations and vacuum to the three-dimensional isentropic compressible Navier-Stokes equations" *Communications on Pure and Applied Mathematics* **65**, no. 4 (2012): 549–585. MathSciDoc 1705.03006

[7] An Huang, Bong Lian, and Xinwen Zhu, "Period integrals and the Riemann-Hilbert correspondence" *Journal of Differential Geometry* **104**, no. 2 (2016): 325–369. MathSciDoc 1608.01018

[8] Yong Huang, Erwin Lutwak, Deane Yang, and Gaoyong Zhang, "Geometric measures in the dual Brunn-Minkowski theory and their associated Minkowski problems" *Acta Mathematica* **216**, no. 2 (2016): 325–388. MathSciDoc 1702.03003

[9] Chang-Shou Lin and Chin-Lung Wang, "Mean field equations, hyperelliptic curves and modular forms: II" *Journal de l'École polytechnique–Mathématiques* **4** (2017): 557–593. MathSciDoc 1705.0300

[10] Raphaël Rouquier, Peng Shan, Michela Varagnolo, and Eric Vasserot, "Categorifications and cyclotomic rational double affine Hecke algebras" *Inventiones mathematicae* **204**, no. 3 (2016): 671–786. MathSciDoc 1707.29001

1. Ben Andrews and Haizhong Li, "Embedded constant mean curvature tori in the three-sphere" Journal of Differential Geometry 99, no. 2 (2015): 169–189. MathSciDoc 1611.10007

Abstract

We prove that any constant mean curvature embedded torus in the three dimensional sphere is axially symmetric, and use this to give a complete classification of such surfaces for any given value of the mean curvature.

Comment

The study of constant mean curvature hypersurfaces in space forms is one of the oldest subjects in differential geometry. This paper gives a complete classification of CMC embedded tori in the 3-sphere.

Haizhong Li

Haizhong Li is a Professor in Department of Mathematical Sciences at Tsinghua University, Beijing.

He received his Master's Degree in Mathematics from Zhengzhou University in 1986, and his Ph.D. Degree in Sciences from Novi Sad University in former Yugoslavia. He visited Prof. S.-T. Yau at Harvard University from 1999 to 2000. He was an Alexander von Humboldt Fellow at TU Berlin, Germany, from 2001 to 2002. He did distinguished research work in global differential geometry and has published more than 140 research papers in international journals of mathematics, including JDG, Trans. AMS, Adv. Math., Math Ann., Calc. Var. PDE, CMP, Math. Z., Indiana Univ. Math J., IMRN, MRL, CAG, J. Geom. Anal., AGAG, etc. His papers have been cited for more than 1200 times by both domestic and foreign colleagues. He was invited to visit and give talks by universities in USA, Germany, France, Spain, Brazil, Italy, Belgium, Russia, Australia, Japan, Korea, Czech Republic and Poland. In collaboration with Prof. Ben Andrews, Li solved the famous Pinkall-Sterling conjecture in the paper "Embedded constant mean curvature tori in the three-sphere". This paper was introduced by the book "What happenings in Mathematical Sciences", Vol. 9, published by AMS in 2013. He was awarded the special allowance of the State Council in 1993, and is an editor of international journals Results in Mathematics and Communications in Mathematics. He received Honorary Doctorate Degree from the University of Sarajevo, Republic of Bosnia and Herzegovina in 2012. He was invited to give a plenary talk at ICCM in 2013 and a plenary talk in "the 60th differential geometry conference at Japan" in 2013. He was invited to give lectures at the sixth differential geometry winter school at Korea Institute of Advanced Studies in 2012. He was a plenary speaker of the 13rd summer school of differential geometry at Brazil in 2004.

Ben Andrews

Ben Andrews is a professor and ARC Laureate fellow at Centre for Mathematics and its Applications of the Australian National University. He is Fellow of the Australian Academy of Science, Fellow of the American Mathematical Society and Fellow of the Australian Mathematical Society. He is a member of the Applied and Nonlinear Analysis Research Group of the Mathematical Sciences Institute. His research involves Differential Geometry, Partial Differential Equations and Applications

2. Kwokwai Chan, Siu-Cheong Lau, and Naichung Conan Leung, "SYZ mirror symmetry for toric Calabi-Yau manifolds" Journal of Differential Geometry 90, no. 2 (2012): 177–250. MathSciDoc 1608.34009

Abstract

We investigate mirror symmetry for toric Calabi-Yau manifolds from the perspective of the SYZ conjecture. Starting with a non-toric special Lagrangian torus fibration on a toric Calabi-Yau manifold X, we construct a complex manifold $\check{X}$ using T-duality modified by quantum corrections. These corrections are encoded by Fourier transforms of generating functions of certain open Gromov-Witten invariants. We conjecture that this complex manifold $\check{X}$, which belongs to the Hori-Iqbal-Vafa mirror family, is inherently written in canonical flat coordinates. In particular, we obtain an enumerative meaning for the (inverse) mirror maps, and this gives a geometric reason for why their Taylor series expansions in terms of the Kähler parameters of X have integral coefficients. Applying the earlier results, we compute the open Gromov-Witten invariants in terms of local BPS invariants and give evidences of our conjecture for several 3-dimensional examples including $K_{\mathbb{P}^2}$ and $K_{\mathbb{P}^1\times\mathbb{P}^1}$.

Comment

This work makes a significant progress in the study of mirror symmetry for toric Calabi-Yau manifolds from the perspective of SYZ conjecture. They explicitly construct a family of complex manifolds (the mirror family). This geometric construction sheds light on the mirror map in a particularly appealing way.

Naichung Conan Leung

Professor Naichung Conan Leung joined the Institute of Mathematical Sciences (IMS) at The Chinese University of Hong Kong in 2004, where he is currently a Professor of Mathematics. Prior to that, he taught at University of Minnesota from 1994 to 2004 and the Courant Institute of Mathematical Sciences in New York University from 1993 to 1994. Professor Leung obtained his PhD from MIT under the supervision of Professor S.-T. Yau in 1993. He was awarded a Chern Prize in Mathematics in 2010 for his significant contributions in the research of Mirror Symmetry and Quantum Cohomology, and he was named a Fellow of the American Mathematical Society (AMS) in the Inaugural Class in 2013.

Kwokwai Chan

Professor Kwokwai Chan joined the Department of Mathematics at The Chinese University of Hong Kong (CUHK) in 2011, where he is currently an Associate Professor. Prior to that, he did postdoctoral research at Harvard University from 2008 to 2010 (under the supervision of Professor S.-T. Yau), and then at IHÉS and the Kavli IPMU at the University of Tokyo from 2010 to 2011. Professor Chan obtained his PhD from CUHK under the supervision of Professor N. C. Leung in 2008. He was awarded a Croucher Foundation Postdoctoral Fellowship (Aug 2008–Jul 2010) and a William Hodge Fellowship (Aug 2010–Jul 2011) for his postdoctoral studies, and a Silver Medal for PhD Thesis in the New World Mathematics Awards 2010.

Siu-Cheong Lau

Professor Siu-Cheong Lau joined the Department of Mathematics and Statistics at Boston University in 2015, where he is currently an Assistant Professor. Prior to that, he served as a Research Associate at the Kavli IPMU of the University of Tokyo from 2011 to 2012 and a Benjamin Peirce Lecturer at Harvard University from 2012 to 2015. He obtained his PhD from CUHK under the supervision of Professor N. C. Leung in 2011. He was awarded a Gold Medal for PhD Thesis in the New World Mathematics Awards 2013.

3. Chieh-Yu Chang and Matthew A. Papanikolas; with an appendix by Brian Conrad, "Algebraic independence of periods and logarithms of Drinfeld modules" *Journal of the American Mathematical Society* 25, no. 1 (2012): 123–150. MathSciDoc 1611.24010

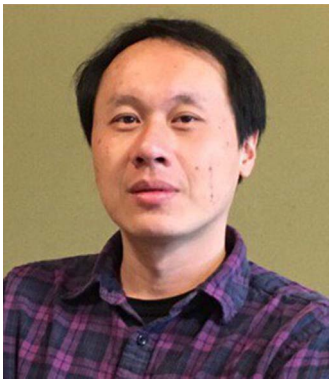
Abstract

Let ρ be a Drinfeld A-module with generic characteristic defined over an algebraic function field. We prove that all of the algebraic relations among periods, quasiperiods, and logarithms of algebraic points on ρ are those coming from linear relations induced by endomorphisms of ρ.

Comment

The authors prove three important theorems on the transcendence in Drinfeld modules. These theorems are function-field analogues of the hard transcendence conjectures for elliptic logarithms for elliptic curves over number fields.

Chieh-Yu Chang



Dr. Chieh-Yu Chang was born in 1978 in Kaohsiung county, Taiwan. He obtained his bachelor's degree in 2000, master's degree in 2002 and Ph.D. in 2007 from National Tsing Hua University, Taiwan. He wrote his Ph.D. thesis, "Algebraic relations among special values in characteristic p," under the supervision of Prof. Jing Yu. He worked as a four-year post-doctor related to military service at National Center for Theoretical Sciences and National Central University, Taiwan. He joined the Department of Mathematics, National Tsing Hua University, as an assistant professor in 2011, and he has held the rank of professor at NTHU since the summer of 2017.

Matthew A. Papanikolas

Dr. Matthew A. Papanikolas was born in 1970 in Tucson, USA. He obtained his bachelor's degree in 1992 from Amherst College, and Ph.D. in 1998 from Brown University. He wrote his Ph.D. dissertation "Canonical heights in characteristic p," under the direction of Prof. Joseph H. Silverman. He worked as a post-doctor at Penn State University (1998–2000) and Brown University (2000–2003). He joined the Department of Mathematics, Texas A&M University, as an assistant professor in 2003, and he has held the rank of professor at TAMU since 2010.

4. Bingyi Chen, Dan Xie, Shing-Tung Yau, Stephen Yau, and Huaiqing Zuo, "4d N=2 SCFT and singularity theory Part II: complete intersection" ***Advances in Theoretical and Mathematical Physics*** **21, no. 1 (2017): 121–145. MathSciDoc 1712.01001**

Abstract

We classify three dimensional isolated weighted homogeneous rational complete intersection singularities, which define many new four-dimensional $N = 2$ superconformal field theories. We also determine the mini-versal deformation of these singularities, and therefore solve the Coulomb branch spectrum and Seiberg-Witten solution.

Comment

This paper gives a complete classification of three dimensional rational weighted homogeneous isolated complete intersection singularities. This gives us a large number of new four dimensional $N = 2$ SCFTs. Many highly non-trivial physical questions such as Coulomb branch spectrum and the Seiberg-Witten solution can be easily found by studying the mini-versal deformations of these singularities.

Huaiqing Zuo

Professor Huaiqing Zuo is an assistant professor at the Mathematical Sciences Center of Tsinghua University from 2013. In 2012, he received his Ph.D. degree from University of Illinois at Chicago, where he was also a research associate from 2012 to 2013. His research interests are singularity theory, algebraic geometry and algebraic geometric codes.

Bingyi Chen

Bingyi Chen is now a Ph.D. graduate student in the Department of Mathematical Sciences, Tsinghua University. His research field is algebraic geometry and singularity theory.

Dan Xie

Dan Xie is a postdoctoral at Harvard University from 2014. In 2011, he received his PhD degree in physics from Texas A&M University. From 2011 to 2014, he was a member at Institute for advanced study, Princeton.

Shing-Tung Yau

Professor Shing-Tung Yau is the William Casper Graustein Professor of Mathematics at Harvard University. He is the inaugural Director of the Yau Mathematical Sciences Center of Tsinghua University. Professor Yau has made fundamental contribution to differential geometry, differential equations and mathematical physics. Professor Yau is honored by numerous prestigious prizes and awards, including Oswald Veblen Prize (1981), John J. Carty Award for the Advancement of Science (1981), Fields Medal (1982), Humboldt Research Award (1991), Alexander von Humboldt Foundation (1991), Crafoord Prize (1994), United States National Medal of Science (1997), China International Scientific and Technological Cooperation Award (2003), and Wolf Prize in Mathematics (2010). He is a member of the United States National Academy of Sciences, a member of Russian Academy of Sciences, a foreign member of the Chinese Academy of Sciences, and a member of Academia Sinica.

Stephen Yau

Professor Stephen S.-T. Yau (F'03) received the Ph.D. degree in mathematics from the State University of New York at Stony Brook, NY, USA, in 1976. In 2012, he joined Tsinghua University, where he is a Full-time Professor with the Department of Mathematical Science. His research interests include nonlinear filtering, bioinformatics, complex algebraic geometry, CR geometry and singularities theory. Dr. Yau is the Managing Editor and founder of the Journal of Algebraic Geometry from 1991, and the Editor-in-Chief and founder of Communications in Information and Systems from 2000 until now. He was awarded the Sloan Fellowship in 1980, the Guggenheim Fellowship in 2000, and the AMS Fellow Award in 2013. In 2005, he was entitled the UIC Distinguished Professor.

5. Jianqing Fan, Xu Han, and Weijie Gu, "Estimating false discovery proportion under arbitrary covariance dependence" ***Journal of the American Statistical Association*** **107, no. 499 (2012): 1019–1035. MathSciDoc 1707.33001**

Abstract

Multiple hypothesis testing is a fundamental problem in high-dimensional inference, with wide applications in many scientific fields. In genome-wide association studies, tens of thousands of tests are performed simultaneously to find if any single-nucleotide polymorphisms (SNPs) are associated with some traits and those tests are correlated. When test statistics are correlated, false discovery control becomes very challenging under arbitrary dependence. In this article, we propose a novel method—based on principal factor approximation—that successfully subtracts the common dependence and weakens significantly the correlation structure, to deal with an arbitrary dependence structure. We derive an approximate expression for false discovery proportion (FDP) in large-scale multiple testing when a common threshold is used and provide a consistent estimate of realized FDP. This result has important applications in controlling false discovery rate and FDP. Our estimate of realized FDP compares favorably with Efron's approach, as demonstrated in the simulated examples. Our approach is further illustrated by some real data applications. We also propose a dependence-adjusted procedure that is more powerful than the fixed-threshold procedure. Supplementary material for this article is available online.

Comment

The authors proposed a technique named principal factor analysis which essentially consists in rewriting the Gaussian model as an approximate factor model with weakly dependent Gaussian error terms, for high-dimensional multiple testing, which can handle any arbitrary dependence structure and fully incorporate the covariance information. This is a very interesting and thought-provoking article. Their ideas can be useful in solving other problems within the area of high-dimensional data analysis.

Jianqing Fan

Jianqing Fan is Frederick L. Moore Professor of Finance, Professor of Statistics, former Chairman of Department of Operations Research and Financial Engineering, and Director of Committee of Statistical Studies, Princeton University, where he directs both financial econometrics and statistics labs. He was the past president of the Institute of Mathematical Statistics and International Chinese Statistical Association, and was an invited speaker at the 2006 International Congress of Mathematicians. He is co-editing Journal of Econometrics and is an associate editor of Journal of American Statistical Association, and was the co-editor of The Annals of Statistics, Probability Theory

and Related Fields and Econometrics Journal. After receiving his Ph.D. from the University of California at Berkeley in 1989, he has been appointed as assistant, associate, and full professor at the University of North Carolina at Chapel Hill (1989–2003), professor at the University of California at Los Angeles (1997–2000), professor and Chairman at Chinese University of Hong Kong (2000–2003), and professor at Princeton University (2003–). His published work on statistics, machine learning, computational biology, economics and finance has been recognized by the 2000 COPSS Presidents' Award, the Myrto Lefkopoulou distinguished lecture of Harvard School of Public Health, the 2007 Morningside Gold Medal of Applied Mathematics, Guggenheim Fellow in 2009, P.L. Hsu prize in 2013, Guy Medal in Silver in 2014, and election to Academician of Academia Sinica and follow of American Associations for Advancement of Science, Institute of Mathematical Statistics, and American Statistical Association.

Xu Han

Xu Han received the Ph.D. degree in Statistics from the Wharton School, University of Pennsylvania, Philadelphia, 2009. He is an Assistant Professor in the Department of Statistical Science of Fox Business School at Temple University, Philadelphia, PA. Prior to his position at Temple University, he was an Assistant Professor at University of Florida and a Postdoctoral Research Fellow at Princeton University. His research interests include high dimensional inference and large-scale multiple testing.

Weijie Gu

Weijie Gu graduated from Department of Operations Research & Financial Engineering, Princeton University.

6. Xiangdi Huang, Jing Li, and Zhouping Xin, "Global well-posedness of classical solutions with large oscillations and vacuum to the three-dimensional

isentropic compressible Navier-Stokes equations" ***Communications on Pure and Applied Mathematics*** **65, no. 4 (2012): 549–585. MathSciDoc 1705.03006**

Abstract

We establish the global existence and uniqueness of classical solutions to the Cauchy problem for the isentropic compressible Navier-Stokes equations in three spatial dimensions with smooth initial data that are of small energy but possibly large oscillations with constant state as far field, which could be either vacuum or nonvacuum. The initial density is allowed to vanish, and the spatial measure of the set of vacuum can be arbitrarily large; in particular, the initial density can even have compact support. These results generalize previous results on classical solutions for initial densities being strictly away from vacuum and are the first for global classical solutions that may have large oscillations and can contain vacuum states.

Comment

The authors prove the global existence and uniqueness of classical solutions to the initial value problem of compressible Navier-Stokes equations for isentropic flows in 3-d under the condition of small initial energy, which have made important contributions to the understanding of compressible Navier-Stokes equations in multiple dimensions.

Xiangdi Huang

Dr. Xiangdi Huang is now an associate professor of Institute of Mathematics from the Chinese Academy of Mathematics and Systems Science. His main research interest is mathematical analysis of nonlinear partial differential equations, especially in equations arising from fluid mechanics. Dr. Huang graduated in the University of Science and Technology of China in 2004 and got his Ph. D. degree in the Chinese university of Hong Kong in 2009. Later, he was a postdoc of Professor Didier Bresch in the Université de Savoie. In 2011, he got an assistant professor position in the institute of mathematics from the Chinese Academy of Mathematics and Systems Science and was promoted to associate professor in 2015. He has done many excellent works on compressible Navier-Stokes equations, including existence, uniqueness and regularity criteria of smooth solutions. His research reveals deep results on the blowup mechanism of smooth solutions of both isentropic and non-isentropic fluids allowing vacuum states, which gives a definite answer to a problem proposed by J. Nash in 1960s. Based on these new observations, he and his collaborators establish global existence theory of classical solutions with large oscillations of three-dimensional isentropic and heat-conducting fluids in the presence of vacuum.

Jing Li

Professor Jing Li is now a full professor of Institute of Applied Mathematics from the Chinese Academy of Mathematics and Systems Science. His main research interest lies in the nonlinear partial differential equations arising from fluid dynamics, especially the compressible Navier-Stokes equations and their related models. He is an expert on the stability theory of nonlinear waves, existence and regularity of weak and smooth solutions as well as long time asymptotic behaviors. Besides, he has established a plenty of important progress on the solutions allowing vacuum states which reveals a sharp contrast to the classical theory in the absence of vacuum. Professor Li received his B. S. and M. S. degrees from Xiamen University in 1993 and 1996. In 2004, he got his Ph. D. degree in the Chinese University of Hong Kong. In 2006, he got an assistant professor position in Institute of Applied Mathematics from the Chinese Academy of Mathematics and Systems Science and was promoted to full professor in 2013.

Zhouping Xin

Professor Zhouping Xin is an expert in the areas of partial differential equations, mathematical physics, fluid mechanics, nonlinear waves, numerical analysis and numerical methods for PDEs and applied mathematics. He has made some substantial contributions to the stability theory linear and nonlinear waves, boundary layer theory, multi-dimensional shock wave theory, vortex methods and relaxation methods, and Navier-Stokes systems with more than one hundred publications in leading international research journals. After got his Ph. D in mathematics from the University of Michigan (Ann Arbor) in 1988. Professor Xin became a Courant instructor at The Courant Institute

of New York University, where he was promoted to be a full professor of mathematics in 1995. In 2000, Professor Xin moved from New York University to the Chinese University of Hong Kong where he has been the William M. W. Mong Professor of Mathematics and the associate director of the Institute of Mathematical Sciences until now. Professor Xin got many honors including: Sloan Research Fellow (1991–1993, USA), Presidential Fellow (1993, NYU, USA); ICM invited speaker (2002); and Morningside Gold Medalist in Mathematics (2004). Professor Xin is the co-editor-in-chief of MAA, associated editor of M2as, and member of the editorial boards for many journals such as SIMA, M3AS, Kyoto J. Math., and Sciences China Mathematics, etc.

7. An Huang, Bong Lian, and Xinwen Zhu, "Period integrals and the Riemann-Hilbert correspondence" Journal of Differential Geometry 104, no. 2 (2016): 325–369. MathSciDoc 1608.01018

Abstract

A tautological system, introduced in earlier works of Lian-Song-Yau and Lian-Yau, arises as a regular holonomic system of partial differential equations that governs the period integrals of a family of complete intersections in a complex manifold X, equipped with a suitable Lie group action. A geometric formula for the holonomic rank of such a system was conjectured by Bloch-Huang-Lian-Srinivas-Yau, and was verified for the case of projective homogeneous space under an assumption. In this paper, we prove this conjecture in full generality. By means of the Riemann-Hilbert correspondence and Fourier transforms, we also generalize the rank formula to an arbitrary projective manifold with a group action.

Comment

The authors prove a geometric rank formula for tautological systems in full generality. The formula was first conjectured by Bloch-Huang-Lian-Srinivas-Yau. This lays the groundwork for several subsequent major applications. The conjecture gives a topological description for the solution sheaf of the tautological systems associated CY hypersurfaces in a general homogeneous variety, in terms of the middle de Rham cohomology of complements.

An Huang

An Huang has recently joined Brandeis University as an Assistant Professor. He received his PhD in Mathematics from the University of California at Berkeley in 2011. He had been a postdoctoral fellow at the

Harvard University Mathematics Department. His research spans many branches of mathematics, including Algebraic Geometry, Number Theory, Graph Theory, mathematical physics. His work in recent years focused on the interplay between Algebraic Geometry, the theory of Special Functions and Mirror Symmetry, and he has helped settle many important problems in Mirror Symmetry and Physics using techniques from Geometric Representation Theory.

Bong Lian

Bong Lian is a Professor at Brandeis University. He joined the Brandeis Mathematics Department in 1995, and has remained on their faculty since. Professor Lian's research is at the interface between Mathematics and Physics, and has been interested in questions about the geometry of a class of spaces known as Calabi-Yau manifolds. His research interests also include representation theory and string theory. Professor Lian was awarded a John Simon Guggenheim Research Fellowship in 2003, and he received a Chern Prize in 2013.

Xinwen Zhu

Xinwen Zhu is a professor of mathematics at Caltech. He works in Geometric Representation Theory. His research focuses on geometric aspects of the Langlands program, with applications to both Number Theory and Quantum Physics. He has made important contributions to the classical Langlands program, most notably establishing a conjecture of Pappas and Rapoport, and a conjecture of Kottwitz on local models of Shimura varieties, the latter work joint with Pappas. More recently, he settled a long-standing open problem in algebraic geometry, on the representability of the affine Grassmanian.

8. Yong Huang, Erwin Lutwak, Deane Yang, and Gaoyong Zhang, "Geometric measures in the dual Brunn-Minkowski theory and their associated Minkowski problems" ***Acta Mathematica*** **216, no. 2 (2016): 325–388. MathSciDoc 1702.03003**

Abstract

A longstanding question in the dual Brunn–Minkowski theory is "What are the dual analogues of Federer's curvature measures for convex bodies?" The answer to this is provided. This leads naturally to dual versions of Minkowski-type problems: What are necessary and sufficient conditions for a Borel measure to be a dual curvature measure of a convex body? Sufficient conditions, involving measure concentration, are established for the existence of solutions to these problems.

Comment

In this paper, the authors introduce a number of new concepts, which include the dual curvature measure, the dual Brunn-Minkowski theory, and the associated Minkowski problem and conceptually extend the classical theory of convex geometry substantially, which contains a deep insight into the theory of convex geometry.

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Yong Huang is Professor of Institute of Mathematics, Hunan University, China. He obtained his bachelor's degree from Chongqing Normal University in 2001 and his master's degree in mathematics from Chongqing University in 2004. After receiving his PhD degree from Tsinghua University in 2007, he worked in the Wuhan Institute of Physics and Mathematics of Chinese Academy of Sciences (2007.07–2015.02). He was a visiting researcher at McGill University (2009.09–2009.12), Universidad Autónoma de Madrid (2010.03–2010.06), New York University (2011.12–2012.06, 2013.01–2014.08). His main areas of research are partial differential equations and geometric analysis.

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Gaoyong Zhang

Gaoyong Zhang is Professor of Department of Mathematics, New York University, USA. He obtained his bachelor's degree in mathematics from Wuhan University of Science and Technology, China in 1982. He obtained his Ph.D. degree in mathematics from Temple University, USA in 1995. His research interests are convex geometry and geometric analysis. In the theory of convex geometry, the area and curvature measures are basic concepts, the Brunn-Minkowski theory is a main ingredient, and the Minkowski problem is a fundamental problem, which bridges the two subjects of convex geometry and partial differential equations.

9. Chang-Shou Lin and Chin-Lung Wang, "Mean field equations, hyperelliptic curves and modular forms: II" Journal de l'École polytechnique–Mathématiques 4 (2017): 557–593. MathSciDoc 1705.0300

Abstract

A *pre-modular form* $Z_n(\sigma;\tau)$ of weight $\frac{1}{2}n(n+1)$ is introduced for each $n\in\mathbb{N}$, where $(\sigma,\tau)\in\mathbb{C}\times\mathbb{H}$, such that for $E_\tau=\mathbb{C}/(\mathbb{Z}+\mathbb{Z}\tau)$, every non-trivial zero of $Z_n(\sigma;\tau)$, namely $\sigma\notin E_\tau$, corresponds to a (scaling family of) solution to the mean field equation (MFE)

$$\Delta u+e^u=\rho\delta_0$$

on the flat torus E_τ with singular strength $\rho=8\pi n$.

In Part I, a hyperelliptic curve $\bar{X}_n(\tau)\subset \mathrm{Sym}^n E_\tau$, the *Lamé curve*, associated to the MFE was constructed. Our construction of $Z_n(\sigma;\tau)$ relies on a detailed study on the correspondence $\mathbb{P}^1\leftarrow\bar{X}_n(\tau)\to E_\tau$ induced from the hyperelliptic projection and the addition map.

As an application of the explicit form of the weight 10 pre-modular form $Z_4(\sigma;\tau)$, a counting formula for Lamé equations of degree $n=4$ with finite monodromy is given in the appendix (by Y.-C. Chou).

Comment

In this remarkable work, the authors construct a pre-modular form such that its non-trivial zero corresponds to a solution of the mean field equation. Their construction is from the aspect of algebraic geometry and also solves a long-standing problem concerning the degree of the covering map from the Lame curve to the elliptic curve.

Chin-Lung Wang

Chin-Lung Wang received his PhD degree from Harvard University in 1998. He had worked in National Taiwan University (NTU), National Tsing-Hua University, and National Central University, and became a professor at NTU in 2008. Wang's major research interests lie in algebraic geometry and related topics in quantum geometry and non-linear analysis. His earlier works focused on K-equivalence relation in birational geometry and geometry of Calabi–Yau moduli spaces. Currently he works on two projects: (1) analytic continuations of quantum cohomology under birational maps and transitions, (2) periodic singular Liouville equations at critical parameters by establishing a link with pre-modular forms via algebraic geometry.

Chang-Shou Lin

Chang-Shou Lin received his PhD degree from New York University in 1983. His research interests lie in non-linear analysis of partial differential equations and related topics in differential geometry and integrable systems. Lin made fundamental contributions on local isometric embeddings of surfaces, uniqueness theorems, degree theory, geometry of Green functions, multi-bubbling phenomenon of non-linear elliptic equations on Riemann surfaces, and relations with the Painlevé equations. Lin was the founding director of National Center of Theoretic Sciences in 1997, the director of Taida Institute for Mathematical Sciences in 2006, and became the director of Center for Advanced Studies in Theoretic Sciences at National Taiwan University since 2012.

10. Raphaël Rouquier, Peng Shan, Michela Varagnolo, and Eric Vasserot, "Categorifications and cyclotomic rational double affine Hecke algebras" ***Inventiones mathematicae*** **204, no. 3 (2016): 671–786. MathSciDoc 1707.29001**

Abstract

Varagnolo and Vasserot conjectured an equivalence between the category $\mathcal{O}$ for CRDAHA's and a subcategory of an affine parabolic category $\mathcal{O}$ of type A. We prove this conjecture. As applications, we prove a conjecture of Rouquier on the dimension of simple modules of CRDAHA's and a conjecture of Chuang–Miyachi on the Koszul duality for the category $\mathcal{O}$ of CRDAHA's.

Comment

This paper is on the relationship between two important categories in representation theory: category O for a rational Cherednik algebra, and parabolic category O for the affine Lie algebra of type A. The authors proved a conjecture of Varagnolo–Vasserot on an equivalence between these categories. This result has especially important consequences for the structure of the Cherednik category, such as the existence of a Koszul grading, and the ability to compute decomposition numbers, in particular proving a long standing and influential conjecture of Rouquier on these decomposition numbers.

Peng Shan

Peng Shan is a professor at Tsinghua University. Her research interest is in geometric representation theory and categorifications. She studied at Tsinghua

University and Ecole Normale Supérieure. After receiving her PhD from University Paris-Diderot in 2011, she worked as a researcher at the French National Scientific Research Centre (CNRS, 2011–2017) and as a CLE Moore Instructor at MIT (2012–2013). She received the "thousand talent" for young professionals in 2016 and Qiu Shi outstanding young scholar in 2017.

Raphaël Rouquier

Raphaël Rouquier is a professor at University of California Los Angeles whose research interest is in representation theory and categorifications. He was a student at Ecole Normale Supérieure in Paris. He became a researcher at the French National Scientific Research Centre (CNRS) in 1992, and was appointed as director of research in 2002. He was professor at University of Leeds in 2005–2006, then Waynflete Professor at University of Oxford before moving to UCLA in 2011. He was an invited speaker at the ICM in Madrid in 2006, and winner of several distinguished prizes.

Michela Varagnolo

Michela Varagnolo is a professor at University Cergy Pontoise. Her research interest is in representation theory and categorifications. She obtained her PhD at University of Pisa in 1992. After, she became researcher at University of Ferrara (1992–1994) and University of Roma Tor Vergata (1994–1997) in Italy and then professor at University of Cergy Pontoise in France since 1997. She was an invited speaker at the ICM in Seoul in 2014.

Eric Vasserot

Eric Vasserot is a professor at University Paris Diderot. His research interest is in geometric representation theory and categorifications. He was a student at the Ecole Normale Supérieure in Paris, and then a researcher at the French National Scientific Research Centre (CNRS) in Paris. He became a professor at University of Cergy-Pontoise in 1995, and moved to University Paris-Diderot in 2005. He was an invited speaker at the ICM in Seoul in 2014.

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