

Biographical Sketch of Motohico Mulase

Address.

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Areas of Expertise.

Complex Analysis, Algebraic Geometry, Integrable Nonlinear Partial Differential Equations, Differential Geometry, Global Analysis and Mathematical Physics.

Current Positions.

- Professor of Mathematics, University of California, Davis. 1991–.
- Associate Dean of the Faculty for Mathematical and Physical Sciences, College of Letters and Science, University of California, Davis. 2017–2020.
- Senior Scientist, Kavli Institute for the Physics and Mathematics of the Universe, University of Tokyo. 2013–.

Positions Held.

- Associate Professor of Mathematics, UC Davis, 1989–1991.
- Member, The Institute for Advanced Study, Princeton, 1988–1989.
- E. R. Hedrick Assistant Professor, UCLA, 1985–1988.
- Visiting Assistant Professor, Stony Brook University, 1984–1985.
- Member, Mathematical Sciences Research Institute, Berkeley, 1982–1984.
- Research Assistant Professor, Nagoya University, 1980–1985.

Professional Preparation.

- B.S. in Mathematics, University of Tokyo, 1978.
- M.S. in Mathematical Sciences, Research Institute for Mathematical Sciences, Kyoto University, 1980.
- D.Sc., Kyoto University, 1985.

Selected Visiting Positions (last 10 years).

- Visiting Professor, Institute for Basic Science Center for Geometry and Physics, Korea, 2017.
- Visiting Professor, Université Pierre et Marie Curie (Université Paris VI), 2015, 2017.
- Member, Institut Henri Poincaré, Paris, 2016, 2017.
- Member, MATRIX, Melbourne, Australia, 2016.
- Member, Max-Planck-Institut für Mathematik, Bonn, 2011, 2013, 2014, 2015, 2016.
- Visiting Professor, Osaka City University, 2015, 2016.
- Visiting Professor, University of Melbourne, 2013.
- Member, Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France, 2013.
- Member, Simons Center for Geometry and Physics, 2015.
- Visiting Professor, Hong Kong University of Science and Technology, 2015.
- Visiting Professor, the Korteweg-de Vries Institute, University of Amsterdam, 2011, 2012, 2013, 2014, 2015.
- Visiting Professor, Kobe University, 2012, 2014.
- Visiting Professor, Tsinghua University, Beijing, 2010.
- Visiting Professor, Universiti Teknologi Malaysia, 2010.
- RIMS International Project Research Visiting Professor, Kyoto University, 2007–2008.

Selected Administrative Appointments at UC Davis.

- Chair, Department of Mathematics, 1998–2001 and 2004–2007.
- Academic Senate Faculty Privilege and Academic Personnel Adviser, 2008–2010, 2011–2012.
- Faculty Advisory Committee to the Dean of Mathematical and Physical Sciences, 2009–2012.
- Chair, Faculty Personnel Committee for Mathematical and Physical Sciences, 2010–2013.
- Steering Committee, Division of Mathematical and Physical Sciences, 2012–2013.
- Chair, Academic Senate Step Plus Implementation Advisory Committee, 2014–2015.

5 Recent Publications.

- (1) O. Dumitrescu and M. Mulase, *Edge-contraction on dual ribbon graphs and 2D TQFT*, accepted for publication in Journal of Algebra (2018).
- (2) P. Dumin-Barkowski, M. Mulase, P. Norbury, A. Popolitov, and S. Shadrin, *Quantum spectral curve for the Gromov-Witten theory of the complex projective line*, Journal für die reine und angewandte Mathematik **2017-726**, 267–289 (2017).
- (3) K. Liu, M. Mulase, and H. Xu, *Recursions and asymptotics of intersection numbers*, International Journal of Mathematics **27**, No. 9, 1650072 (2016).
- (4) M. Mulase and P. Sulkowski, *Spectral curves and the Schrödinger equations for the Eynard-Orantin recursion*, Advances in Theoretical and Mathematical Physics **19**, No. 5, 955–1015 (2015).
- (5) O. Dumitrescu and M. Mulase, *Quantum curves for Hitchin fibrations and the Eynard-Orantin theory*, Letters in Mathematical Physics **104**, 635–671 (2014).

5 Significant Publications.

- (1) M. Mulase, *Cohomological structure in soliton equations and Jacobian varieties*, Journal of Differential Geometry **19**, 403–430 (1984). [**Solved the 100-year open Riemann-Schottky problem in terms KP equations.**]
- (2) M. Mulase, *Solvability of the super KP equation and a generalization of the Birkhoff decomposition*, Inventiones Mathematicae **92**, 1–46 (1988). [**Established complete integrability of KP and super KP equations.**]
- (3) M. Mulase and M. Penkava, *Ribbon Graphs, Quadratic Differentials on Riemann Surfaces, and Algebraic Curves Defined over $\overline{\mathbb{Q}}$* , Asian J. Math. **2** (4), 875–920 (1998). [**Discovered the equivalence of Grothendieck’s dessins d’enfants and Strebel construction.**]
- (4) M. Mulase and B. Safnuk, *Mirzakhani’s recursion relations, Virasoro constraints and the KdV hierarchy*, Indian J. Math. **50**, 189–228 (2008). [**Proved that the differential version of Mirzakhani’s integral recursion formula is equivalent to the Virasoro constraint condition.**]
- (5) B. Eynard, M. Mulase and B. Safnuk, *The Laplace transform of the cut-and-join equation and the Bouchard-Mariño conjecture on Hurwitz numbers*, Publications of the Research Institute for Mathematical Sciences **47**, 629–670 (2011). [**Solved the conjecture of the physicists Bouchard and Mariño on Hurwitz numbers using Laplace transform.**]

URL for Other Publications.

<https://www.math.ucdavis.edu/~mulase/publication.html>

Awards.

- JMS Fellowship, Harvard University, 1982–1983.
- Member, Mathematical Sciences Research Institute, Berkeley, 1982–1984.
- Member, The Institute for Advanced Study, Princeton, 1988–1989.
- Visiting Professor, Max-Planck-Institut für Mathematik, Bonn, 1991–1992.
- RIMS International Project Research Visiting Professor, Kyoto University, 2007–2008.
- Academic Senate Distinguished Teaching Award, University of California, Davis, 2009.
- Simons Visiting Professorship, Mathematisches Forschungsinstitut Oberwolfach, 2016.

Conferences Organization (Last 3 years).

- Banff International Research Station Workshop: “*Quantum Curves and Quantum Knot Invariants*,” June 15–June 20, 2014, in Banff, Canada.
- AIM Workshop: “*Quantum curves, Hitchin systems, and new developments in the Eynard-Orantin theory*,” September 28–October 3, 2014, in Palo Alto, California.
- OCU Workshop: “*Quantization of Spectral Curves*,” November 2–6, 2015, at the Osaka City University Advanced Mathematical Institute, Osaka, Japan.
- 2016 AMS von Neumann Symposium: “*Topological Recursion and its Influence in Analysis, Geometry, and Topology*,” July 4–8, 2016, at Hilton Charlotte University Place, Charlotte, NC.
- OCAMI Meeting: “*Integrable Systems, Moduli Spaces and Non-linear PDE*,” September 3–4, 2016, at Osaka City University Advanced Mathematical Institute, Osaka, Japan.
- MATRIX@Melbourne Workshop: “*Quantum Invariants and Low-Dimensional Topology*,” December 14–17, 2016, at MATRIX@Melbourne, Australia.
- MATRIX@Melbourne Workshop: “*Topological Recursion and Modularity*,” December 19–23, 2016, at MATRIX@Melbourne, Australia.
- Banff International Research Station 5-Day Workshop: “*Geometry and Physics of Quantum Curves (18w5078)*,” September 9–14, 2018, in Banff, Canada.

Invited Addresses at International Conferences, Workshops, and Summer/Winter Schools (last 5 years).

- (1) IHÉS Conference: *Algebraic Analysis “Quantum Curves.”* Institut des Hautes Études Scientifiques, Bures-sur-Yvette, June 6, 2017.
- (2) LJAD Conference: *Higgs Bundles and Related Topics “An Invitation to Quantum Curves and 2D TQFT.”* Laboratoire J.A. Dieudonné, Nice, May 31, 2017.
- (3) IST Austria: *Algebraic Geometry Seminar “Ribbon graph formulation of CohFT and 2D TQFT.”* Institute of Science and Technology, Austria, March 22, 2017.
- (4) IHP Workshop: *Enumerative Geometry and Combinatorics of Moduli Spaces “From Cayley to Hurwitz to Hitchin.”* Institut Henri Poincaré, Paris, March 15, 2017.
- (5) QUANTMOD: *Quantization and Moduli Spaces “Holomorphic quantization of Higgs bundles.”* Université du Luxembourg, January 12, 2017.
- (6) MATRIX Conference: *Topological recursion and modularity “Category of cell graphs and a new set of axioms for 2D TQFT.”* MATRIX, Creswick, Australia, December 22, 2016.
- (7) Kobe 2016 International Conference: *Algebraic Geometry and Integrable Systems “Algebraic geometry of quantum curves andopers.”* Kobe University, Japan, December 8, 2016.
- (8) The 15th Oka Symposium: “*Quantization of Hitchin spectral curves and holomorphic Lagrangians.*” Oka Mathematical Institute, Nara, Japan, December 4, 2016.
- (9) BIRS Workshop: *Painlevé Equations and Discrete Dynamics “Quantization of Hitchin spectral curves asopers.”* Banff International Research Station, Banff, Canada, October 4, 2016.
- (10) RIMS Workshop: *Studies on Integrable Systems: State of the Art and Perspective for Future “Quantization of Higgs bundles andopers.”* Research Institute for Mathematical Sciences, Kyoto University, September 6, 2016.
- (11) OCAMI Meeting: *Integrable Systems, Moduli Spaces and Non-linear PDE “Quantization of Hitchin spectral curves,opers, and their WKB analysis via topological recursion.”* Osaka City University Advanced Mathematical Institute, Osaka, September 3, 2016.
- (12) Infinite Analysis 2016 Summer School: *Integrable Hierarchies and Beyond* A series of three 1-hour talks. 1 “*World of character varieties.*” 2 “*Quantization of Higgs bundles.*” 3 “*Opers and quantum curves.*” Graduate School of Mathematics, Nagoya University, August 30, 31, September 1, 2016.
- (13) SCGP Workshop: *New perspectives on Higgs bundles, branes and quantization “Algebraic geometry of Gaiotto correspondence and quantization of Higgs bundles.”* Simons Center for Geometry and Physics, Stony Brook, June 17, 2016.

- (14) ICTS-TIFR Conference: *Higgs Bundles* “Quantum Curves and Gaiotto’s Conjecture.” International Center for Theoretical Sciences, Tata Institute of Fundamental Research Bangalore, India, March 23, 2016.
- (15) IMAR Lecture Series: *Algebraic Geometry* “A family of deformations that connects Higgs bundles and opers.” Institute de Matematica “Simion Stoilow” al Academiei Romane, Bucharest, Romania, February 25, 2016.
- (16) MFO Workshop: *Topological Recursion and TQFTs* “Solution to Gaiotto Conjecture and Quantum Curves.” Mathematisches Forschungsinstitut Oberwolfach, Germany, February 14, 2016.
- (17) University of Luxembourg: *RMATH General Mathematics Seminar* “A formula for Non-Abelian Hodge theory through Gaiotto’s conjecture.” Mathematics Research Unit, University of Luxembourg, Luxembourg, February 9, 2016.
- (18) Warsaw Advanced School: *Topological Quantum Field Theory* A series of four lectures. Faculty of Physics, University of Warsaw, Poland, December 7 - 10, 2015.
- (19) OCU Workshop: *Quantization of Spectral Curves* “Opers and quantum curves.” Osaka City University Advanced Mathematical Institute, Osaka, Japan, November 4, 2015.
- (20) GEOQUANT 2015: *School and International Conference on Geometry and Quantization* “Topological recursion, 2D TQFT, and quantization of Hitchin spectral curves.” Instituto de Ciencias Matemáticas (ICMAT), Madrid, Spain, September 14, 2015.
- (21) MPIM-Bonn: *Mathematische Arbeitstagung 2015* “The topological recursion – an inductive mechanism of counting on the moduli of curves.” Max-Planck-Institut für Mathematik, Bonn, Germany, June 27, 29, 2015.
- (22) Kolloquium des Graduiertenkollegs 1463: *Analysis, Geometrie und Stringtheorie* “The story that a graph on a surface weaves.” Leibniz Universität, Hannover, Germany, June 8, 2015.
- (23) Lorentz Center Workshop: *Geometric Invariants and Spectral Curves* “2D TQFT from cellular graphs and a TQFT-valued topological recursion.” Lorentz Center, Leiden, the Netherlands, June 5, 2015.
- (24) SCGP Program: *Knot homologies, BPS states, and SUSY gauge theories* “Topological recursion and quantization.” Simons Center for Geometry and Physics, May 14, 2015.
- (25) HKUST *Seminar on Geometry* (A series of 10 lectures): “Introduction to the topological recursion and quantum curves.” Hong Kong University of Science and Technology, March 24 - April 20, 2015.
- (26) WAGS Spring 2015: *Western Algebraic Geometry Symposium* “Topological recursion and quantum curves.” University of California, Davis, March 1, 2015.
- (27) MPIM Workshop: *Geometric quantization and topological recursion* “Quantum curves and Hitchin fibrations.” Max-Planck-Institut für Mathematik, Bonn, November, 2014.
- (28) EIMI International Conference: *Embedded Graphs* “Enumeration of embedded surface graphs and quantum curves.” Euler International Mathematical Institute, St. Petersburg, Russia, October 2014.
- (29) AIM Workshop: *Quantum curves, Hitchin systems, and the Eynard-Orantin theory* “An introductory remark on quantum curves.” American Institute of Mathematics, Palo Alto, California, September 2014.
- (30) Advanced Summer School: *Modern Trends in Gromov-Witten Theory* “Quantum curves, topological recursion, and Hitchin systems.” A series of three 1-hour lectures, Leibniz Universität Hannover, September 2014.
- (31) Kobe Summer School: *Advanced Science and Technology Graduate Course 2014* “A mathematical theory of quantum curves: what they are, and what they do.” A series of eight 1.5-hour lectures, Kobe University, July 2014.
- (32) IMS Summer Research Institute: *The Geometry, Topology and Physics of Moduli Spaces of Higgs Bundles* “Quantization of spectral curves of Higgs bundles via a B-model topological recursion.” (Lecture I, 7/10/2014) (Lecture II, 7/11/2014) Institute for Mathematical Sciences, National University of Singapore, July 2014.

- (33) International Conference: *The Mathematics of Quantum Theory in Honor of Professor Albert Schwarz at his 80th Birthday* “A mathematical approach to quantum curves.” UC Davis, California, May 2014.
- (34) MPIM Yuri Manin Seminar: *Algebra, Geometry and Physics* “Algebraic geometry of quantum curves and classical differential equations.” Max-Planck-Institut für Mathematik, Bonn, May 2014.
- (35) Oxford Lecture: *Mathematical Institute Geometry and Analysis Seminar* “Quantum curves for Higgs bundles and quantum invariants.” Mathematical Institute, University of Oxford, May 2014.
- (36) Cortona Conference: *Mirror Symmetry and Spin Curves* “Quantum curves: what they are, and what they do.” Palazzone di Cortona, Italy, April 2014.
- (37) SMS Spring Conference: *Quantization of Moduli Spaces* “Construction of quantum spectral curves for Higgs bundles via a new topological recursion.” Villa Battelle, University of Geneva, Switzerland, April 2014.
- (38) KdV Workshop: *Moduli of curves and mathematical physics* “Quantum curves for Hitchin fibrations.” Korteweg-de Vries Institute, Amsterdam, the Netherlands, January 2014.
- (39) IHÉS Lecture: *Séminaire de Mathématiques Organisé par Mikhail Gromov, Laurent Laforgue, Maxim Kontsevich* “Quantum curves for Hitchin systems and the Eynard-Orantin theory.” l’Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France, November 2013.
- (40) SISSA Workshop: *Hamiltonian PDEs, Frobenius Manifolds, and Deligne-Mumford Moduli Spaces* “Quantum curves for Hitchin fibrations.” La Scuola Internazionale Superiore di Studi Avanzati, Trieste, Italy, September 2013.
- (41) BIRS Workshop: *Integrable Systems and Moduli Spaces* (13w5064) “Quantum curves and topological recursion.” Banff International Research Station, Canada, August 2013.
- (42) *5th IST Lectures on Algebraic Geometry and Physics – 2013* “The Eynard-Orantin recursion, algebraic geometry, and quantum invariants (Series of two 1.5 hour lectures),” Instituto Superior Técnico, Lisbon, Portugal. February 2013.
- (43) QGM Conference: *Topological recursion and quantum algebraic geometry* “Quantum curves for geometric enumeration problems.” Center for Quantum Geometry of Moduli Spaces, Aarhus University, Denmark, January-February 2013.
- (44) BIRS Workshop: *Integrable systems, growth processes and KPZ universality* (12w5015) “The Eynard-Orantin recursion and quantum invariants in geometry.” Banff International Research Station, Canada, September 2012.
- (45) XXXI Workshop: *Geometric Methods in Physics* “The Laplace Transform, Mirror Symmetry, and the Topological Recursion of Eynard-Orantin.” Białowieża, Poland, June 2012.
- (46) BICMR Conference: *Symplectic Geometry and Mathematical Physics* “The Laplace transform of the Catalan numbers and the Eynard-Orantin recursion.” The Beijing International Center for Mathematical Research, Beijing, June 2012.
- (47) The Hausdorff Research Institute for Mathematics Workshop: *Integrability in Topological String Theory* “Laplace transform of Catalan Numbers and Topological Recursion.” The Hausdorff Research Institute for Mathematics, Bonn, April 2012.