

Unit Name

Gravity, Quantum Geometry and Field Theory Unit
Associate Professor Reiko Toriumi

Research Personnel

Remi Avohou, Staff Scientist
Nicolas Delporte, Postdoctoral Scholar
Cihan Pazarbaşı, Postdoctoral Scholar
Samuel Laliberte, Postdoctoral Scholar
Michael Lathwood, Postdoctoral Scholar
Nadia Flodgren, Postdoctoral Scholar
Andreani Petrou, PhD Student
Saswato Sen, PhD Student
Juan Luis Araujo Abranches, PhD Student
Giacomo La Scala, Research Intern
Noan Pierre Noel Botcazou Brasse, Research Intern

Collaborations

Ongoing

Cihan Pazarbasi (OIST) / Tatsuhiro Misumi (Kindai University), "Exact Quantization in All Sectors"
Saswato Sen (OIST), "Random and Dirac walks on Hyperbolic tessellations via geometric group theory"
Samuel Laliberte (McGill and OIST) / Deepan Betal (IISERB Bhopal), "Topological matrix quantum mechanics"(TBD)
Benoit Collins (Kyoto U) /Reiko Toriumi (OIST) / Nicolas Delporte (OIST), "Matrices, Tensors: freeness and resolvents"
Tamas Kalman (Institute of Science Tokyo) / Alex James Bene (Santa Monica College) / Remi Avohou (OIST), "Polymatroids and Tutte polynomial from embedded hypergraphs"
Cihan Pazarbasi (OIST) / Reiko Toriumi (OIST) / Juan Abranches (OIST), "Non-perturbative aspects of multi-matrix models"
Pry Kuusela (University of Sheffield) / Michael Lathwood (OIST) / Miroslava Mosso Rojas (JGU Mainz) / Michael Stepniczka (Cornell University), "Solutions of Calabi--Yau Differential Operators as Truncated p -adic Series and Efficient Computation of Zeta Functions"
Saswato Sen (OIST) / Christian Jepsen (KIAS), "Generalized symmetries, BF bound and p -adic AdS/CFT"
Andreani Petrou (OIST) / Shinobu Hikami (OIST emeritus), "Zeros of the HZ transform"
Reiko Toriumi (OIST) / Michael Lathwood (OIST) / Noan Botcazou-brass (ENS Rennes/OIST) / Joseph Ben Geloun (University of Paris 13) / Remi Avohou (OIST), "Hurwitz Numbers as Tropical Tensor Invariants"
Cihan Pazarbasi (OIST) / Tatsuhiro Misumi (Kindai University) / Syo Kamata (University of Tokyo) / Hidetoshi Taya (Keio University), "Exact Quantization of Non-hermitian systems"
Andreani Petrou (OIST) / Shinobu Hikami (OIST emeritus), "Character Expansion of the Kauffman polynomial"

Samuel Laliberte (OIST) / Juan Abranches (OIST) / Reiko Toriumi (OIST) / Dario Benedetti (Ecole Polytechnique), "Bootstrapping causal matrix models"

Dario Benedetti (Ecole Polytechnique) / Saswato Sen (OIST), "Phase co-existence in AdS"

Reiko Toriumi (OIST) / Nadia Flodgren (OIST), "Non-associative algebras in renormalization group flow"

Fedor Popov (Stony Brook University) / Reiko Toriumi (OIST) / Nadia Flodgren (OIST), "Large N conformal tensor models at finite temperature"

Cihan Pazarbasi (OIST) / Saswato Sen (OIST), "False vacuum decay in AdS"

Reiko Toriumi (OIST) / Samuel Laliberte (OIST), "Bootstrapping tensor models"

Michael Lathwood (OIST) / Daniel Platt (Imperial College London), "G2 manifolds from large complex structure limits"

Cihan Pazarbasi (OIST) / Tatsuhiko Misumi (Kindai University) / Can Kozçaz (Bogazici University) / Kemal Tezgin (Virginia Tech), "Exact quantization and resurgence relations"

Reiko Toriumi (OIST) / Joseph Ben Geloun (University of Paris 13) / Fortune Massamba (University of KwaZulu-Natal) "Smooth geometric analogue of regular embeddings/jackets"

Completed

Esther S. E. Akabassi (International Chair in Mathematical Physics and Applications, Cotonou, Benin) / Remi C. Avohou (OIST), "Hypermaps: Partial duality and polynomial invariant"

Samuel Laliberte (McGill and OIST) / Brian McPeak (McGill and Syracuse University), "Bootstrapping supersymmetric (matrix) quantum mechanics"

Alicia Castro (Heidelberg University) / Juan Abranches (OIST) / Reiko Toriumi (OIST), "An equivalence in random matrix and tensor models via a dually weighted intermediate field representation"

Nicolas Delporte (OIST) / Giacomo La Scala (OIST) / Naoki Sasakura (YITP) / Reiko Toriumi (OIST), "Spectrum of random anti-symmetric tensors"

Reiko Toriumi (OIST) / Rudrajit Banerjee (Centenary College of Louisiana) / Nicolas Delporte (OIST) / Saswato Sen (OIST), "Interacting Scalar field theories on the Bethe Lattice"

Andreani Petrou (OIST) / Shinobu Hikami (OIST emeritus), "Character Expansion of the HOMFLY--PT polynomial and the Harer-Zagier Transform"

Scholarly Contributions and Creative Productions (by Faculty)

Journal Article

1. Toriumi, R.
"Critical Phenomena on the Bethe Lattice" (with Rudrajit Banerjee, Nicolas Delporte, Saswato Sen) [arXiv:2601.01961 [hep-th]]
2. Toriumi, R.
"An equivalence in random matrix and tensor models via a dually weighted intermediate field representation" (with Juan Abranches, Alicia Castro) [arXiv:2512.16583 [math-ph]]
3. Toriumi, R.
"Real eigenvalue/vector distributions of random real antisymmetric tensors" (with Nicolas Delporte, Giacomo La Scala, Naoki Sasakura) [arXiv:2510.20398 [hep-th]]
4. Toriumi, R.
"Characteristic polynomials of tensors via Grassmann integrals and distributions of roots for random Gaussian tensors" (with Nicolas Delporte, Giacomo La Scala, Naoki Sasakura) [arXiv:2510.04068 [math-ph]]
5. Toriumi, R.

"Classification of higher grade Γ graphs for $U(N) \times O(D)$ multi-matrix models" (with Remi Cocou Avohou, Matthias Vancraeynest) Ann. Inst. Henri Poincaré Comb. D, [arXiv:2310.13789[math-ph]]

Presentation at Conference

1. Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials." "Probability & Interactions" French Japanese conference, Waseda University, Tokyo, Japan, 1-5 September 2025.
2. Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials". "Combinatorics and Arithmetic for Physics" Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France 19-21 November 2025.
3. Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials." "Women at the Intersection of Mathematics and Theoretical Physics" International Center for Theoretical Sciences (ICTS) Bengaluru, India 29 December 2025 - 2 January 2026.

Seminars

1. Toriumi, R.
Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials", Ecole Polytechnique, Palaiseau, France, 3 November 2025
2. Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials", Heidelberg University, 10 November 2025
3. Toriumi, R.
"Characteristic Polynomials for Tensors via Grassmann Integrals and Distributions of Roots of Random Tensors", "Tensor Journal Club", online, 3 December 2025
4. Toriumi, R.
"Invitation to Random Tensor Models: from random geometry, enumeration of tensor invariants, to characteristic polynomials", University of Tokyo, Hongo, Japan, 5 January 2026.
5. Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials", RIKEN iTHEMS, Wako, Japan, 6 January 2026
Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials", Keio University, Hiyoshi, Japan, 7 January 2026.
6. Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials", IPMU, Kashiwa, Japan, 8 January 2026.
7. Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials", Seoul National University, Korea, 30 January 2026.
8. Toriumi, R.
"Invitation to Random Tensor Models: From Random Geometry, Enumeration of Tensor Invariants, to Characteristic Polynomials", KIAS, Korea, 2 February 2026.

Scholarly Contributions (by Unit Members)

Name of Unit Member	Type	Title	Outlet	Publisher	Date
Cihan Pazarbasi	Journal Article	Exact WKB in all sectors. Part I. Potentials with degenerate saddles	Journal of High Energy Physics (JHEP)	Springer Nature	2025-04-15
Remi Avohou	Journal Article	On the handle slide operation and universality polynomial invariants for binary Δ -matroids	International Journal of Geometric Methods in Modern Physics	World Scientific	2025-04-24
Andreani Petrou	Journal Article	Character Expansion and the Harer-Zagier Transform of Knot Polynomials	Journal of Statistical Physics	Springer Nature	2025-06-25
Remi Avohou	Journal Article	Canonical Binary -Matroids Graphs and Combinatorics	Graphs and Combinatorics	Springer Nature	2025-08-06
Remi Avohou	Journal Article	Hypermaps: Partial duality and polynomial invariant	International Journal of Geometric Methods in Modern Physics	World Scientific	2025-08-20
Nicolas Delporte / Giacomo La Scala	Journal Article	Characteristic polynomials of tensors via Grassmann integrals and distributions of roots for random Gaussian tensors	arXiv		2025-10-05
Nicolas Delporte / Giacomo La Scala	Journal Article	Real eigenvalue-vector distributions of random real antisymmetric tensors	arXiv		2025-10-23
Remi Avohou	Journal Article	Classification of higher grade ℓ graphs for $U(N)^2 \times O(D)$ multi-matrix models	Annale de l'Institut Henri Poincaré D	EMS Press	2025-11-12
Juan Abranches	Journal Article	An equivalence in random matrix and tensor models via a dually weighted intermediate field representation	arXiv		2025-12-18
Cihan Pazarbasi	Journal Article	Exact WKB in all sectors. Part II. Potentials with non-degenerate saddles	arXiv		2025-12-25
Saswato Sen / Nicolas Delporte	Journal Article	Critical phenomena on the Bethe lattice	arXiv		2026-01-05
Samuel Laliberte	Journal Article	Bootstrapping supersymmetric (matrix) quantum mechanics	Journal of High Energy Physics (JHEP)	Springer Nature	2026-02-18
Nicolas Delporte	Poster Presentation at Conference	Tensor eigenvalues from a field theory perspective Statistical Physics (Florence)	International Conference on Statistical Physics (Florence)		2025-07-13
Samuel Laliberte	Poster Presentation at Conference	Quantum mechanics bootstrap and supersymmetry	Progress of Theoretical Bootstrap Conference (Kyoto)		2025-11-11
Saswato Sen	Poster Presentation at Conference	Critical phenomena in hyperbolic lattices.	EAJW 2025, OIST		2025-12-17

Name of Unit Member	Type	Title	Outlet	Publisher	Date
Juan Abranches	Presentation at Conference	Matrix models for matter on random geometries with causal constraints	Quantum Gravity 2025 - Penn State University		2025-07-25
Andreani Petrou	Presentation at Conference	Knots, Links and the Harer–Zagier factorisability	WPI–AIMR & WPI–SKCM2 International & Interdisciplinary Math–Materials Workshop		2025-07-25
Andreani Petrou	Presentation at Conference	Knots, Links and the Harer–Zagier factorisability	World of GroupCraft V		2025-09-01
Saswato Sen	Presentation at Conference	Critical phenomena on Bethe lattice	Lattice 2025 (Mumbai, India)		2025-11-06
Michael Lathwood	Presentation at Conference	Tutorial on computing zeta functions from Picard–Fuchs differential equations (with Pory Kuusela, Miroslava Mosso Rojas, and Michael Stepniczka)	International Center for Theoretical Physics (ICTP) Winter School on Number Theory and Physics		2025-11-26
Andreani Petrou	Presentation at Conference	A relation between the HOMFLY–PT and Kauffman polynomials	Quantum Topology Seminar, University of Illinois Chicago		2025-12-18
Cihan Pazarbasi	Presentation at Conference	Resurgence and Duality	Istanbul Stringy Meetings 2026 (Turkey)		2026-01-07
Andreani Petrou	Presentation at Conference	HOMFLY–PT and Kauffman polynomials: when are they related?	Moscow–Beijing Topology Seminar		2026-01-21
Saswato Sen	Presentation at Conference	Critical phenomena on the Bethe lattice	QFT in AdS 2026		2026-02-17
Remi Avohou	Seminars	Universality of the Tutte and Bollobás–Riordan Polynomials	University of the Ryukyus, Faculty of Science		2025-05-29
Michael Lathwood	Seminars	Mirror symmetry for non-Fano varieties via tropical scattering of Landau–Ginzburg potentials	IPMU		2025-09-10
Cihan Pazarbasi	Seminars	On Exact Quantization in Hermitian and Non-Hermitian Quantum Mechanics	Bogazici University		2025-12-10
Cihan Pazarbasi	Seminars	On Exact Quantization in Hermitian and Non-Hermitian Quantum Mechanics	Mimar Sinan University		2025-12-12
Juan Abranches	Seminars	Equivalences between complex and self-adjoint random matrix and tensor models	Heidelberg University		2025-12-18
Remi Avohou	Seminars	Ribbon graphs and deltamatroids	International Chair in Mathematical Physics and Application (ICMPA) University of Abomey Calavi, Benin		2026-01-07
Saswato Sen	Seminars	Critical phenomena on the Bethe lattice	University of Alberta, Edmonton		2026-01-23

Workshops and Seminars [Organized and Hosted by Faculty/Units]

Type	Event Title	Speaker Name(s)	Title	Location	Date
Lecture		Prof. Andrew Lobb (Durham University)	Khovanov homology	L4F01	2026-02-27
Lecture		Prof. Andrew Lobb (Durham University)	TQFT	L4F01	2026-02-20
Seminar		Prof. Paul Romatschke (TU Wien)	What is Negative Coupling Field Theory?	L4F15	2026-02-10
Seminar		Dr. Abhiram Kidambi (Max Planck Institute Leipzig)	Sato-Tate Conjecture and Random Matrix Theory	L4F15	2026-01-19
Seminar		Prof. Igor Boettcher (University of Alberta)	Walking on Archimedean and hyperbolic lattices	L4F01	2025-12-05
Seminar		Prof. Karel Van Acoleyen (University of Ghent)	Real-time bubble nucleation and growth for false vacuum decay on the lattice	L4F15	2025-10-09
Seminar		Dr. Fedor Popov (Stony Brook University)	Non-perturbative defects in tensor models from melonic trees	L4F01	2025-10-06
Seminar		Prof. Andrew Lobb (Durham University)	Peg problems and peg progress	L4E48	2025-08-04
Seminar		Prof. Louis H Kauffman (University of Illinois Chicago)	An Introduction to the Kauffman Bracket Polynomial and Khovanov Homology (as a topological back-story to reconnections of vortices)	L5D23	2025-07-22
Mini-Symposium	Afternoon on Quantum Gravity	Prof. Sumati Surya (Raman Research Institute in Bengaluru)	A Quantum Random Walk on Causal Sets	L4F01	2025-07-01
Mini-Symposium	Afternoon on Quantum Gravity	Prof. Kristina Giesel (FAU Erlangen-Nürnberg)	Open quantum systems from the perspective of loop quantum gravity	L4F01	2025-07-01
Mini-Symposium	Afternoon on Quantum Gravity	Prof. Silke Weinfurter (Nottingham University)	Quantum Simulators for Fundamental Physics	L4F01	2025-07-01
Seminar		Ryan Barouki (University of Oxford)	Conformal Dimensions On Causal Random Geometry	L4F01	2025-06-25
Seminar		Dr. Christy Kelly (iTHEMS, RIKEN)	Quantum Gravity and the Coarse Geometry of the Brownian Continuum Random Tree	L4F01	2025-05-21
Seminar		Nadia Flodgren (Stockholm University)	An algebraic perspective on the RG flow of ϕ^4 -theory at large N	L4E01	2025-05-19
Seminar		Davide Laurenzano (Oxford)	Renormalization Group analysis of the Ising Model on Causal Dynamical Triangulations	L4F01	2025-04-30
Seminar		Dr. Shota Komatsu (CERN)	QFT in AdS	L4E01	2025-04-04