Unit Name

Gravity, Quantum Geometry and Field Theory Unit

Research Personnel

Reiko Toriumi, Associate Professor

Remi Avohou, Staff Scientist

Nicolas Delporte, Postdoctoral Scholar

Cihan Pazarbaşı, Postdoctoral Scholar

Saswato Sen, PhD Student

Andreani Petrou, PhD Student

Juan Luis Araujo Abranches, PhD Student

Giacomo La Scala, Research Intern

Collaborations

- Prof. Reiko Toriumi (OIST) / Dr. Nicolas Delporte (OIST) / Prof. Benoit Collins (Kyoto U, Japan) "*Matrices, Tensors: freeness and resolvents*"

- Prof. Reiko Toriumi (OIST) / Dr. Nicolas Delporte (OIST) / Saswato Sen (OIST) / Prof. Rudrajit Banerjee (OIST and Centenary College of Louisiana, USA), "*Interacting Scalar field theories on the Bethe Lattice*"

- Prof. Reiko Toriumi (OIST) / Juan Abranches (OIST) / Dr. Alicia Castro (LIGM, Université Gustave Eiffel, France), "*Functional renormalization group on a causal matrix model*"

- Prof. Reiko Torumi (OIST) / Dr. Remi Avohou (OIST) / Prof. Joseph Ben Geloun (LIPN, Universite Sorbonne Paris Nord, France), "*Counting UO -tensorial invariants*"

- Prof. Reiko Toriumi (OIST) / Dr. Nicolas Delporte (OIST) / Giacomo La Scala (OIST) / Prof. Naoki Sasakura (Yukawa Institute for Theoretical Physics, Kyoto, Japan), "*Spectrum of random anti-symmetric tensors*"

- Prof. Reiko Toriumi (OIST) / Dr. Cihan Pazarbasi (OIST) / Juan Abranches (OIST), "*Non-perturbative aspects of multi-matrix models*"

- Dr. Remi Avohou (OIST) / Prof. Tamas Kalman (Institute of Science Tokyo, Japan) / Prof. Alex James Bene (Santa Monica College, USA), "*Polymatroids and Tutte polynomial from embedded hypergraphs*"

- Dr. Remi Avohou (OIST) / Prof. Mahouton N. Hounkonnou (International Chair in Mathematical Physics and Applications, Benin), "*On the handle slide operation and universality polynomial invariants for binary Δ-matroids*"

- Dr. Cihan Pazarbasi (OIST) /Prof. Tatsuhiro Misumi (Kindai U, Japan), "*Exact Quantization in All Sectors*"

- Dr. Rudrajit Banerjee (OIST) / Dr. Max Niedermaier (University of Pittsburgh, USA), "*Analytic semigroups approaching a Schrödinger group on real foliated metric manifolds*"

- Dr. Rudrajit Banerjee (OIST) / Dr. Max Niedermaier (University of Pittsburgh, USA), "*Wick rotation in the lapse, admissible complex metrics, and foliation changing diffeomorphisms*"

- Andreani Petrou (OIST) /Prof. Shinobu Hikami (OIST), "*The HOMFLY-PT polynomial and HZ factorisability*"

- Saswato Sen (OIST)/ Dr. Christan Jepsen (Korea Institute for Advanced Study, Korea), "*Generalized symmetries, BF bound and p-adic AdS/CFT*"

- Saswato Sen (OIST), "*Random and Dirac walks on Hyperbolic tessellations via geometric group theory*"

- Juan Abranches (OIST) / Dr. Christopher Chung (Xiamen University, Malaysia), "*Keeler's Futurama Permutation Problem in type B and other variations*"

Scholarly Contributions and Creative Productions (by Faculty)

Journal Article

1. Joseph Ben Geloun, Reiko Toriumi. "*One-Loop Beta-Functions of Quartic Enhanced Tensor Field Theories*", Journal of Physics A: Mathematical and Theoretical 57 015401.

2. Riccardo Martini, Reiko Toriumi. "*Trisections in Colored Tensor Models*" Annales de L'Institut Henri Poincare (D) Combinatorics, Physics and Their Interactions 11 (2024), 453-502.

3. Juan Abranches, Antonio Pereira, Reiko Toriumi. "*Dually Weighted Multi-Matrix Models as a Path to Causal Gravity-Matter Systems*", Annales Henri Poincaré 26, 947-1008 (2025).

4. Nicolas Delporte, Saswato Sen, and Reiko Toriumi. "*Dirac Walks on Graphs*", Journal of Physics A: Mathematical and Theoretical 57 275002.

5. Remi Avohou, Joseph Ben Geloun, Reiko Toriumi. "*Counting $U(N)^{\otimes r} \otimes O(N)^{\otimes q}$ Invariants and Tensor Model Observables*", European Physical Journal C 84, 839 (2024).

Presentation at Conference

1. Reiko Toriumi. "*Random tensor models for quantum gravity (a look at tensor models with a mixed U(N) and O(D) symmetry)*", "Combinatorics in Fundamental Physics" Workshop, Youngst@rs, Mainz Institute for Theoretical Physics, Johannes Gütenburg University, Germany, 26-29 November 2024.

2. Reiko Toriumi. "*Classification and counting of multi-orientable tensor models with a mixed U(N) and O(D) symmetry*", "Noncommutative Geometry Meets Topological Recursion" Workshop, BIRS-IASM-Hangzhou, China, 22-27 September 2024.

3. Reiko Toriumi. "*Renormalisation of enhanced tensor field Theories*", "The QFT Path" Workshop, Heidelberg University, Germany, 10-14 June 2024.

Scholarly Contributions (by Unit Members)

Name of Unit Member	Type	Title	Outlet	Publisher	Year Pub
Remi Avohou	Journal Article	Counting $U(N)^{\otimes r} \otimes O(N)^{\otimes q}$ invariants and tensor model observables	European Physical Journal C (2024) 84: 839	Springer	
Rudrajit Banerjee	Journal Article	Analytic semigroups approaching a Schrödinger group on real foliated manifolds	J. Func. Anal. 289 (2025) 110898	Science Direct	
Rudrajit Banerjee	Journal Article	Wick rotation in the lapse, admissible complex metrics, and foliation changing diffeomorphisms	Class. Quant. Grav. 42 (2025) 9, 095003	IOP Science	

Name of Unit Member	Type	Title	Outlet	Publisher	Year Pub
Juan Abranches	Journal Article	Dually Weighted Multi-matrix Models as a Path to Causal Gravity-Matter Systems	Annales Henri Poincaré 26, 947-1008 (2025)	Springer	
Cihan Pazarbasi	Journal Article	Exact WKB in all sectors I: Potentials with degenerate saddles	arxiv:2410.09511[hep-th]	arXiv	
Remi Avohou	Journal Article	On a conjecture of Gross, Mansour and Tucker for Δ-matroids	arxiv:2404.13839[math.CO]	arXiv	
Andreani Petrou	Journal Article	The HOMFLY-PT polynomial and HZ factorisation	arxiv:2412.04933[math-ph]	arXiv	
Nicolas Delporte	Journal Article	The Edge of Random Tensor Eigenvalues with Deviation	Journal of High Energy Physics JHEP 01(2025) 071	Springer	
Remi Avohou	Seminar	Handle slides and canonical binary delta-matroids	Institute of Science Tokyo, Japan		2024-6-13
Remi Avohou	Seminar	Counting UO -tensorial invariants	Online Tensor Journal Club		2024-6-26
Juan Abranches	Presentation at Conference	Dually weighted multi-matrix models as a path to causal gravity-matter systems	The 33rd/35th International Colloquium on Group Theoretical Methods in Physics, Cotonou, Benin		2024-7-16
Andreani Petrou	Presentation at Conference	Towards Knot Matrix Models via the Harer-Zagier transform	The 33rd/35th International Colloquium on Group Theoretical Methods in Physics, Cotonou, Benin		2024-7-18
Remi Avohou	Poster Presentation at Conference	On the handle slide operation and universality polynomial invariants for binary $Delta$-matroids	The 33rd/35th International Colloquium on Group Theoretical Methods in Physics, Cotonou, Benin		2024-7-18
Andreani Petrou	Presentation at Conference	Towards Knot Matrix Models via the Harer-Zagier transform	The 33rd/35th International Colloquium on Group Theoretical Methods in Physics, Cotonou, Benin		2024-7-18
Nicolas Delporte	Poster Presentation at Conference	Tensor eigenvalues outliers from a field theory perspective.	"Random tensors and related topics" 2024 Institut Henri Poincaré, Paris, France		2024-10-1
Juan Abranches	Presentation at Conference	Matrix Models for Matter on Random Geometries with Causal Constraints	"Random tensors and related topics" 2024 Institut Henri Poincaré, Paris, France		2024-10-2

Name of Unit Member	Type	Title	Outlet	Publisher	Year Pub
Saswato Sen	Poster Presentation at Conference	Field theories on the Bethe lattice	"Random tensors and related topics" 2024 Institut Henri Poincaré, Paris, France		2024-10-17
Cihan Pazarbasi	Seminar	Exact WKB in all sectors	University of Tokyo, Japan		2024-10-21
Cihan Pazarbasi	Seminar	Exact WKB in all sectors	Tokyo institute of Technology, Japan		2024-10-23
Nicolas Delporte	Seminar	Tensor eigenvalues and pseudospectrum from a field theory perspective.	Institute for Theoretical Physics, Heidelberg, Germany		2024-10-28
Saswato Sen	Seminar	Field theories on the Bethe lattice	Departmental Seminar: School of Physical Sciences, IACS, Kolkata, India		2024-12-10
Andreani Petrou	Presentation at Conference	Knot Polynomials and the Harer–Zagier Transform	2024 Winter School at WPI-SKCM^2, Hiroshima University & Kyushu Unversity, Japan		2024-12-12
Nicolas Delporte	Seminar	Towards quantum field theory on random structures.	University of Tübingen, Germany		2024-12-12
Cihan Pazarbasi	Seminar	Exact WKB in all sectors	SISSA, Italy		2024-12-12
Cihan Pazarbasi	Seminar	Exact WKB in all sectors	Central European Institute for Cosmology and Fundamental Physics (CEICO), Czechia		2024-12-16
Remi Avohou	Seminar	Maps and delta-matroids	Weekly seminar at International Chair in Mathematical Physics and Applications, Benin		2024-12-18
Andreani Petrou	Presentation at Conference	Knots, Links and the Harer–Zagier factorisability	The 20th East Asian Conference on Geometric Topology, University of Tokyo, Japan		2025-2-4
Saswato Sen	Poster Presentation at Conference	Field theories on the Bethe lattice	2024 APCTP Winter school on Fundamental Physics, Pohang, Korea		2025-2-10
Cihan Pazarbasi	Seminar	Exact WKB in all sectors	Keio University, Japan		2025-3-24

Outreach Activities (For Unit Members Only)

2025-2-15	Andreani Petrou, OkiDen science festival "Knots: What can they tell us?", The Okinawa Electric Power Company

Workshops and Seminars (Organized and Hosted by Faculty/Units)

Speaker Name(s)	Title	Location	Date
Prof. David Croydon (RIMS, Kyoto University, Japan)	Collisions of multiple random walks	Online & OIST L4F01	2025-03-17

Speaker Name(s)	Title	Location	Date
Prof. Andrew Lobb (Durham University, UK)	Handles and surgery	OIST L4E01&L4F01	2025-02-14
Prof. Dr. Dmitry Feichtner-Kozlov (University Bremen, Germany / Adjunct Professor at OIST)	Algebraic Topology and combinatorics	OIST L5EF11	2024-11-21
Dr. Christian Baadsgaard Jepsen (KIAS, School of Physics, Korea)	An Atlas of p-adic AdS-CFT	OIST L5D23	2024-11-11
Prof. Andrew Lobb (Durham University, UK)	A beginner's introduction to basic Algebraic Topology	OIST L4F01	2024-08-29
Dr. Faedi Loulidi (OIST)	A Max-Flow approach to Random Tensor Networks	OIST L4F01	2024-08-02
Dr. Samuel Crew (Imperial College London, UK)	The quantum path signature	OIST L4F01	2024-07-16