

Jethro van Ekeren

Address

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Contact

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EDUCATION

Massachusetts Institute of Technology, Cambridge, Massachusetts, USA
Ph.D., Mathematics *Jun 2012*

- Dissertation: “Modular Invariance for Vertex Operator Superalgebras”
- Advisor: Victor G. Kac

University of Waikato, Hamilton, New Zealand
B.Sc. with 1st class honours, Mathematics and Physics *Aug 2008*

POSITIONS

Assistant Professor *May 2023 - present*
Instituto Nacional de Matemática Pura e Aplicada (IMPA)
Rio de Janeiro, RJ, Brazil

Assistant Professor *Dec 2015 – Mar 2023*
Universidade Federal Fluminense (UFF)
Departamento de Matemática Aplicada (GMA)
Niterói, RJ, Brazil

Postdoctoral Researcher *Jun 2013 – Oct 2014*
Technische Universität Darmstadt
Darmstadt, Germany (supported by a *Humboldt Foundation Fellowship*)

Postdoctoral Researcher *Sep 2012 – Mar 2013*
Instituto Nacional de Matemática Pura e Aplicada (IMPA) *Nov 2014 – Nov 2015*
Rio de Janeiro, RJ, Brazil

VISITING

POSITIONS AND GRANTS

Visiting positions:

- **CRM-Simons Scholar** *Oct 2022*
Centre de Recherches Mathématiques (CRM)
Montréal, Canada

- **Visiting Researcher** *Apr – May 2013*
Institut des Hautes Études Scientifiques (IHÉS)
Paris, France

Grants:

- **Grant from Serrapilheira Institute** *2023-2027*
Coordinator
“Representation Theory of Vertex Algebras - Phase II” *(R\$300,000.00)*

- **FAPERJ Jovem Cientista do Nosso Estado (JCNE)** *2021-2024*
No. 201.445/2021 Coordinator
“Vertex Algebras; Structure and Representations” *(R\$86,400.00)*

- **CNPq Productivity Grant, Level 2 No. 310576/2020-2** *2021-2024*
Coordinator
“Vertex Algebras and Representation Theory” *(R\$39,500.00)*

- **Grant from Serrapilheira Institute** 2020-2022
Coordinator
“Representation Theory of Vertex Algebras” (R\$100,000.00)
- **FAPERJ Support for Recently Hired Researchers (ARC)** 2020-2022
No. **211.358/2019** Coordinator
“Vertex Algebras; Representation Theory and Geometry” (R\$28,891.00)
- **CNPq Support for Scientific Event** 2022
No. **403195/2019-5** Coordinator
“School on Representation Theory, Vertex and Chiral Algebras” (R\$14,000.00)
- **FAPERJ Support for Emerging Research Groups in the State of Rio de Janeiro (No. 14/2019)** 2020-2022
Participant
“Algebra, Dynamics and Geometry at UFF” (R\$299,255.79)
- **CNPq Productivity Grant, Level 2 No. 303806/2017-6** 2018-2021
Coordinator
“Representation Theory, Vertex Algebras, and Automorphic Forms” (R\$39,500.00)
- **CNPq Universal Grant No. 409598/2016-0** 2017-2020
Participant
“Geometry and Representations of Vertex Algebras and Infinite Dimensional Lie Algebras” (R\$58,000.00)

Scholarships:

- **Humboldt Foundation Fellowship** 2013-2014
- **Fulbright Scholarship** 2008-2012
- **MIT Presidential Fellowship** 2008-2009

Academic Prizes:

- **Millennium Prize in Mathematics**, University of Waikato 2006
- **Bruce Liley Prize in Physics**, University of Waikato 2005
- **Bronze Medal** at the 45th IMO, Athens, Greece 2004
- **Top Student in New Zealand**, NCEA Mathematics with Calculus 2004

PUBLICATIONS Arakawa, T., van Ekeren, J. Moreau, A.: *On the nilpotent orbits arising from admissible affine vertex algebras*. Proc. Lond. Math. Soc. **125** (3) 681-699 (2022).

van Ekeren, J., Rodriguez Morales, B.: *Holomorphic integer graded vertex superalgebras*. J. Algebra Appl. **22** (04) 2350081 (2021)

Andrews, G., van Ekeren, J., Heluani, R.: *The singular support of the Ising model*. Internat. Math. Res. Notes (accepted)

Arakawa, T., van Ekeren, J.: *Rationality and Fusion Rules of Exceptional W-Algebras*. J. Eur. Math. Soc. (accepted)

van Ekeren, J., Heluani, R.: *Chiral Homology of Elliptic Curves and the Zhu Algebra*. Comm. Math. Phys. **386** 495-550 (2021).

van Ekeren, J., Lam, C.-H., Möller, S., Shimakura, H.: *Schellekens' List and the Very Strange Formula*. Adv. in Math. **380** (2021).

van Ekeren, J., Möller, S., Scheithauer, N.: *Construction and Classification of Holomorphic Vertex Operator Algebras*. J. Reine Angew. Math. **759** 61-99 (2020).

Arakawa, T., van Ekeren, J.: *Modularity of Relatively Rational Vertex Algebras and Fusion Rules of Principal Affine W -Algebras.* Comm. Math. Phys. **370** 205-247 (2019).

van Ekeren, J., Heluani, R.: *A Short Construction of the Zhu Algebra.* J. Algebra **528** 85-95 (2019).

van Ekeren, J.: *Lattices, Vertex Algebras, and Modular Categories.* J. Geom. Phys. **126** 27-41 (2018).

van Ekeren, J., Möller, S., Scheithauer, N.: *Dimension Formulae in Genus Zero and Uniqueness of Vertex Operator Algebras.* IMRN **2020** issue 2, 2145-2204 (2018).

van Ekeren, J., Heluani, R.: *Characters of topological $N = 2$ vertex algebras are Jacobi forms on the moduli space of elliptic supercurves.* Adv. in Math. **302** 551-627 (2016).

van Ekeren, J.: *Modular Invariance for Twisted Modules over a Vertex Operator Superalgebra.* Comm. Math. Phys. **322** 333-371 (2013), issue 2.

van Ekeren, J.: *Higher Level Twisted Zhu Algebras.* J. Math. Phys. **52** (2011), no. 5.

Talele, S., Gaynor, P., Cree, M., **Van Ekeran, J.:** *Modeling Single Cell Electroporation with Bipolar Pulse Parameters and Dynamic Pore Radii.* J. of Electrostatics **68** (2010), issue 3.

CONFERENCE PUBLICATIONS **van Ekeren, J.:** Superconformal Vertex Algebras and Jacobi Forms. In: *Perspectives in Lie Theory.* Springer INdAM Ser. **19** 315-330, Springer, Cham (2017).

van Ekeren, J.: Vertex Operator Superalgebras and Odd Trace Functions. In: *Advances in Lie superalgebras.* Springer INdAM Ser. **7** 223-234, Springer, Cham (2014).

PREPRINTS **van Ekeren:** *A quantum field comonad*
arXiv:2305.18223

van Ekeren, J., Heluani, R.: *The first chiral homology group.*
arXiv:2103.06322

Arakawa, T., van Ekeren, J. Moreau, A.: *Singularities of nilpotent Slodowy slices and collapsing levels of W -algebras.*
arXiv:2102.13462

ORGANISATION *Academic events:*

- Thematic Program on Vertex and Chiral Algebras *Feb – May 2022*
IMPA, Rio de Janeiro, Brazil
Program activities included:
 - *School on Representation theory, Vertex and Chiral Algebras*
 - International Workshop on Representation theory, Vertex and Chiral Algebras*
 - Short courses and seminars*
 - ICTP Workshop on Representation Theory and Applications in São Paulo*

Seminars:

- IMPA Algebra seminar *Aug 2022 - present*
(with R. Heluani)
- Vertex Office Hours (online) *Aug-Sep 2021*

- UFF Iniciação Científica Seminar 2019-2021
- UFF Seminário de Álgebra e Lógica 2019
- A Day at the Vertex (UFF)
(with S. Chiossi) Nov 2016
- MIT Pure Mathematics Graduate Student Seminar
(with D. Clausen and A. Keating) 2010-2011

TALKS

Minicourses:

- **CRM**, Montréal, Canada Oct 2022
Affine W -algebras
- **UFRN**, Natal, Brazil Sep 2022
Representations of the Virasoro algebra
- **IMPA**, Rio de Janeiro, Brazil Apr 2022
Introduction to Vertex Algebras
- **SNU**, Seoul, South Korea Oct 2021
Lectures on Chiral Homology
- **UFF**, Niterói, Brazil Jun 2021
Introduction to Vertex Algebras
- **IMPA**, Rio de Janeiro, Brazil Feb 2020
Introduction to Vertex Algebras
- **IMPA**, Rio de Janeiro, Brazil Feb 2019
Borchers Lie Algebras, Modular Forms, and Moonshine
- **RIMS**, Kyoto, Japan Jul 2018
Chiral Homology (with R. Heluani)
- **SNU**, Seoul, South Korea Feb 2017
Vertex Algebras and Representation Theory
- **KAIST**, Daejeon, South Korea Feb 2017
Modular Forms and Moonshine
- **IMPA**, Rio de Janeiro, Brazil Oct 2015
Mock Modular Forms (with L. Rodriguez Diaz)
- **Universidad de Talca**, Talca, Chile Sep 2015
Vertex Algebras
- **IMPA**, Rio de Janeiro, Brazil Oct 2012
Infinite Dimensional Algebras

Conferences by invitation:

- **Brazil-China Joint Mathematical Meeting** July 2023
Foz de Iguaçu, Brazil
Intersections of transverse slices, and isomorphisms of W -algebras
- **Interactions between Mathematics and Physics** May 2023
Rome, Italy
Moonshine, the Leech lattice, and Victor's very strange formula
- **Algebra III** Sep 2022
Natal, Brazil
Modular tensor categories from W -algebras
- **Quantum 22** Aug 2022
Córdoba, Argentina
Modular tensor categories from W -algebras

- **Vertex Algebras and Representation Theory** *Jun 2022*
 CIRM, Luminy, France
 Chiral homology and Poisson homology of associated schemes
- **Lie Theory and Poisson Geometry** *Jan 2022*
 CIRM, Luminy, France
 Chiral homology and Poisson homology
- **Poisson Geometry, Groupoids and Quantization** *Nov 2021*
 (Virtual), Auckland, New Zealand
 Classical limits in field theory
- **Meeting of the Korean Mathematical Society** *Oct 2021*
 (Virtual), South Korea
 Chiral Homology and Classical Series Identities
- **VII School and Workshop on Lie Theory** *Sep 2021*
 UNB, Brasilia, Brazil
 Nilpotent Slodowy slices and W -algebras
- **33rd Brazilian Mathematical Colloquium (CBM)** *Aug 2021*
 IMPA, Rio de Janeiro, Brazil
 Chiral homology of elliptic curves
- **IV Mini Workshop in Symplectic Geometry** *Nov 2019*
 UFF, Niterói, Brazil
 Quantisation of Poisson Arc Spaces and Statistical Models
- **VI School and Workshop on Lie Theory** *Aug 2019*
 UNB, Brasilia, Brazil
 Rationality and Fusion Rules of Affine W -Algebras
- **1st Joint Meeting Brazil-France in Mathematics** *Jul 2019*
 IMPA, Rio de Janeiro, Brazil
 Orbifolds and the Very Strange Formula
- **Geometric and Automorphic Aspects of W -Algebras** *May 2019*
 Laboratoire Paul Painlevé, Lille, France
 Rationality and Fusion Rules of Simple Affine W -Algebras
- **XXV Escola de Álgebra** *Dec 2018*
 Unicamp, Campinas, Brazil
 Arc spaces and Associated Schemes of Vertex Algebras.
- **ICM Satellite: Workshop on Mathematical Physics** *Aug 2018*
 ICTP-SAIFR/IFT-UNESP, São Paulo, Brazil
 Rationality and Fusion Rules of Affine W -Algebras.
- **Affine, Vertex and W -algebras** *Dec 2017*
 Università Roma 3 Rome, Italy
 Uniqueness of Vertex Algebras.
- **Geometry and Representation Theory** *Jan 2017*
 Erwin Schrödinger Institute, Vienna, Austria
 Modularity of Relatively Rational Vertex Algebras
- **String Geometries and Dualities** *Dec 2016*
 IMPA, Rio de Janeiro, Brazil
 Construction and Uniqueness of Orbifolds
- **New Trends in Integrable Systems** *Oct 2016*
 International Institute of Physics, Natal, RN, Brazil
 Fusion for Principal W -Algebras
- **Workshop on Mathematical Physics** *Jun 2016*
 International Center for Theoretical Physics, SAIFR, São Paulo, Brazil
 Classification and construction of simple vertex algebras

- **Quántum 2016** *Mar 2016*
FaMAF, Córdoba, Argentina
Fusion for Principal W -Algebras
- **Vertex Operator Algebras and Quantum Groups** *Feb 2016*
Banff Research Station, Banff, Canada
Generalised Trace Functions and W -Algebras
- **Quántum 2015** *Mar 2015*
FaMAF, Córdoba, Argentina
Cyclic Orbifold Theory
- **Perspectives in Lie Theory** *Dec 2014*
CRM Ennio di Giorgi, Pisa, Italy
Jacobi Invariance of SUSY Vertex Algebras
- **Algebras, Groups and Geometries** *Jul 2014*
University of Tokyo, Tokyo, Japan
Classification and Construction of Holomorphic VOAs of Central Charge 24
- **Conformal Field Theory** *Jun 2014*
Emmy-Noether Zentrum, Erlangen, Germany
Superconformal Blocks
- **Lie Superalgebras** *Dec 2012*
Sapienza, Rome, Italy
Odd Traces on Vertex Superalgebras and Modular Forms
- **Infinite dimensional Lie Theory** *Aug 2012*
CRM, Montreal, Canada
Modular Invariance for \mathbb{Q} -graded, and Nonrational Vertex Superalgebras
- **Student Research Conference** *Jun 2007*
University of Auckland, Auckland, New Zealand
A Combinatorial Construction of the Lie Algebra F_4

Seminars by invitation:

- **IMPA**, Rio de Janeiro, Brazil *Apr 2023*
Lattices, algebras and moonshine
- **UBA**, Buenos Aires, Argentina *Nov 2022*
Vertex algebras, the Leech lattice, and Kac's very strange formula
- **U. Ottawa**, Ottawa, Canada *Oct 2022*
Unimodular lattices and vertex algebras of rank 24
- **IMPA**, Rio de Janeiro, Brazil *Aug 2022*
Translation Functors
- **MIT**, Cambridge, MA, USA *Feb 2022*
Chiral homology, the Zhu algebra and identities of Rogers-Ramanujan type
- **Uni. Hamburg**, Hamburg, Germany *Nov 2021*
Chiral homology of tori.
- **University of Denver**, Denver, Colorado, USA *Oct 2021*
Chiral homology of elliptic curves.
- **UFRJ**, Rio de Janeiro, Brazil *Jun 2021*
Álgebras de Lie e álgebras de Kac-Moody.
- **RIMS**, Kyoto, Japan *May 2021*
Chiral homology of elliptic curves.
- **Illinois State University**, Bloomington, USA *Mar 2021*
Schellekens list, the Leech lattice and the very strange Formula.

- **RU-Bochum**, Bochum, Germany *Dez 2020*
Singular support of the Ising model and a new modular Nahm sum.
- **UFF**, Niterói, Brazil *Nov 2020*
Campos quânticos, álgebras de Lie e álgebras de vértices
- **University of Colorado**, Denver, USA *Oct 2020*
Schellekens list, the Leech lattice and the very strange Formula.
- **UFF**, Niterói, Brazil *June 2019*
Arc Spaces, Virasoro Algebra, and Rogers-Ramanujan Identities.
- **RIMS**, Kyoto, Japan *Feb 2019*
Arc Spaces, Virasoro Algebra, and Rogers-Ramanujan Identities.
- **University of Melbourne**, Melbourne, Australia *Jan 2019*
Root systems and Lie algebras, Lattices and Vertex Algebras.
- **University of Waikato**, Hamilton, New Zealand *Jan 2019*
Arc Spaces, Virasoro Algebra, and Rogers-Ramanujan Identities.
- **University of Auckland**, Auckland, New Zealand *Jan 2019*
Arc Spaces, Virasoro Algebra, and Rogers-Ramanujan Identities.
- **UFF**, Niterói, Brazil *Nov 2018*
Arc Spaces, Rogers-Ramanujan Identities, and Schubert Varieties.
- **UFF**, Niterói, Brazil *Oct 2018*
O Jogo de Mutação
- **IMPA**, Rio de Janeiro, Brazil *Mar 2018*
Minimal Models and Arc Spaces.
- **UFF**, Niterói, Brazil *Nov 2017*
Conformal Blocks and Chiral Homology I, II, III.
- **IMPA**, Rio de Janeiro, Brazil *Oct 2017*
Dimension Formulae and Uniqueness of Vertex Algebras
- **UFF**, Niterói, Brazil *Nov 2016*
(JOGA talk) Derived Conformal Blocks
- **UFRJ**, Rio de Janeiro, Brazil *Jun 2016*
(COLGA talk) Indicators for Heisenberg Groups
- **University of Auckland**, Auckland, New Zealand *Apr 2016*
Lattices and Construction of Vertex Algebras
- **University of Waikato**, Hamilton, New Zealand *Apr 2016*
Lattices and Construction of Vertex Algebras
- **SUNY Albany**, New York, USA *Feb 2016*
Classification of Simple Vertex Algebras in Rank 24
- **UFRJ**, Rio de Janeiro, Brazil *Nov 2015*
From Ramanujan Differential Equations to Formal Geometry
- **IMPA**, Rio de Janeiro, Brazil *Sep 2015*
Niemeier Lattices and Generalisations
- **UFRJ**, Rio de Janeiro, Brazil *May 2015*
Vertex Algebras and Jacobi Forms
- **IMPA**, Rio de Janeiro, Brazil *Nov 2014*
Fusion of Fixed Point Vertex Algebras
- **RIMS**, Kyoto, Japan *Jun 2014*
Vertex Algebras and Moduli of Supercurves
- **Universität Köln**, Cologne, Germany *Oct 2013*
Superconformal Blocks and Automorphic Forms

- **TU Darmstadt**, Darmstadt, Germany *May 2013*
Conformal Blocks for Vertex Superalgebras
- **CBPF**, Rio de Janeiro, Brazil *Apr 2013*
Lie Conformal Algebras, and Nonlinear Lie Conformal Algebras
- **USP**, São Paulo, Brazil *Mar 2013*
Vertex Superalgebras and Modular Forms
- **University of Waikato**, Hamilton, New Zealand *Jul 2012*
Vertex Algebras and Affine Lie Algebras at Admissible Level
- **MIT**, Cambridge, Massachusetts, USA *Apr 2012*
Some Generalisations of Zhu's Theorem
- **Université Laval**, Quebec City, Canada *Feb 2012*
Modular Invariance for Vertex Algebras
- **Northeastern University**, Boston, Massachusetts, USA *Jan 2012*
Vertex Algebras and Kac-Wakimoto Characters

Miscellaneous talks:

- **UFF**, Rio de Janeiro, Brazil *Mar 2015*
– Moonshine in Mirror Symmetry
- **IMPA**, Rio de Janeiro, Brazil *Oct 2016*
– Cluster Algebras Seminar
– Path Integrals in Quantum Theory *Feb 2013*
- **MIT**, Cambridge, Massachusetts, USA *Apr 2011*
– The Six Vertex Model and $\widehat{\mathfrak{sl}}_2$
– Vertex Algebras and Number Theory *Mar 2011*
– The Weyl-Kac Character Formula *Nov 2010*
– The Mutation Game and Lie Algebra Representations *Oct 2008*

TEACHING

Advanced Courses:

IMPA, Rio de Janeiro, RJ, Brazil

- Algebra I *2023-1*
- Vertex Algebras *Summer 2023*
- Lie Algebras *2022-2*
- Lie Algebras *Summer 2016*

UFF, Niterói, RJ, Brazil

- Algebra (Masters) *2019-2*
- Lie Algebras and Representation Theory (PhD) *2018-2*

Undergraduate Courses:

UFF, Niterói, RJ, Brazil *2015 - 2021*

- Cálculo 1A
- Cálculo 2A
- Cálculo 2B
- Cálculo 3A
- Equações Diferenciais

- MIT, Cambridge, Massachusetts, USA
- Teaching Assistant for Differential Equations *Fall 2009, Spring 2011*
 - Course Administrator for Differential Equations *Fall 2011*
 - Leader of Math Learning Center *Spring 2012*
- University of Waikato, Hamilton, New Zealand
- Teaching Assistant for Calculus, Algebra *Mar 2006 - Jun 2008*

**OTHER
PROFESSIONAL
ACTIVITIES**

Student Advising

- Igor Alarcon Blatt (Doctorate, IMPA, in progress)
- Bely Morales (Posdoc PNPd, UFF, 2019-2021)
- Igor Alarcon Blatt (Masters, UFF, defended May 2022)
- Anne Albuquerque (Masters, UFF, defended August 2021)

Administration

- Gender Commission (IME-UFF) *2019-2022*
- Collegiate of Electrical Engineering *2018-2022*
- Collegiate of Production Engineering *2017*
- Selection Committee Substitute Professors

Thesis Defense Committees

- Martina Negrin Barcellos (PhD, IMPA) *Sep 2022*
- Oscar Hernández (PhD, USP) *Mar 2021*
- Christopher Raymond (PhD, University of Queensland, Australia) *Jun 2020*
- Bely Rodríguez Morales (PhD, IMPA) *Dec 2018*
- Juan José Villarreal Montoya (PhD, IMPA) *Nov 2017*

Referee

CNPq *ad hoc* referee

2018-present

Referee

For several high ranking mathematics journals

2013-present

**PERSONAL
DATA**

Place of Birth: Auckland, New Zealand *Dec 1986*

Citizenship: New Zealand, Ireland, Brazil

Languages: English (native), Portuguese (fluent)

Erdős number: ≤ 3