

CURRICULUM VITAE

Personal Information:

Name	Reimundo Heluani
Birth Date	October 15, 1977
Address	Estrada Dona Castorina 110 Jardim Botânico, 22460-320 Rio de Janeiro, RJ. Brazil
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Education:

- 2006: Ph.D. in Mathematics. Massachusetts Institute of Technology. “Supersymmetric vertex algebras and supercurves.” Thesis advisor: Victor G. Kac. Cambridge, MA.
- 2002: “Licenciado” in Mathematics, FaMAF-Universidad Nacional de Cordoba, Argentina.
- 2002: “Licenciado” in Physics, FaMAF-Universidad Nacional de Cordoba, Argentina.
- 1996: “Técnico mecánico electricista”, Instituto Técnico, Universidad Nacional de Tucumán, Argentina.

Employment:

- 2014-: Pesquisador associado. IMPA, Rio de Janeiro, Brasil.
- 2010-2014: Pesquisador adjunto. IMPA, Rio de Janeiro, Brasil.
- 2009-2010: NSF Postdoctoral Fellowship. Institute for Advanced Studies, Princeton, NJ. Hosted at University of California, Berkeley.
- 2006-2009: Miller Postdoctoral Research Fellow. University of California. Berkeley, CA.

Long term visiting positions:

- Sprig 2017 Northwestern University.
- Summer 2010 IHES.
- Spring 2006 IHES.

Fields of Interest:

Representation Theory, Differential and Algebraic Geometry, Mathematical Physics.

Current research interests: Chiral Algebras and chiral homology and its applications to rationality of vertex algebras.

Super vertex algebras and its applications to conformal field theories and sigma models. Hidden symmetries of the Chiral de Rham complex and their geometric implications, in particular to Mirror Symmetry. Modular properties and connections to moduli spaces of curves.

Fellowships:

2014–2017 Jovem cientista de nosso estado (FAPERJ).

2011–: Bolsista de Produtividade em Pesquisa do CNPq - Nível 2

2009–2010: NSF Postdoctoral Fellowship. Institute for Advanced Studies, Princeton, NJ (hosted in Berkeley, CA).

2006–2009: Miller Research Fellowship. Berkeley, CA.

2003–2005: MIT Research Assistantship, Cambridge, MA.

2002–2003: MIT Teaching Assistantship, Cambridge, MA.

2002: CONICET, Ph.D. Fellowship, Physics department, Universidad Nacional de Cordoba, Argentina.

1998–2002: FOMEC Undergraduate Fellowship, Mathematics department, Universidad Nacional de Cordoba, Argentina.

Awards and Honors:

2002: “Premio Universidad” Physics, Universidad Nacional de Cordoba, Argentina.

2002: “Premio Universidad” Mathematics, Universidad Nacional de Cordoba, Argentina.

2001: XVI “Competencia Ernesto Paenza” 2nd place, Argentina.

2000: III Iberoamerican Mathematical Olympiad for College Students, Bronze Medal, Colombia.

2000: “Premio Gobierno de Cordona”, Universidad Nacional de Cordoba, Argentina.

1996: “Premio Lucas Cordoba”, Universidad Nacional de Tucumán, Tucumán, Argentina.

Graduate Students:

- Lázaro Rodríguez Días. Ph.D. student. IMPA. Dissertation *G_2 manifolds are superconformal*, 2014.
- Emilio Peixoto Assemany. Master Student. IMPA, 2014.
- Juan José Villareal Montoya. Ph.D. student. IMPA. Dissertation *Nilmanifolds and their associated non-local fields*, 2018.

Teaching Experience:

- 2010-: Diverse courses at master and Ph.D. level, IMPA.
- 2005: Lecturer, Calculus 3,4 , Project Interphase, MIT.
Recitation Instructor, Multivariate Calculus, MIT.
- 2004: Recitation Instructor, Calculus, MIT.
Lecturer, Calculus 3,4, Project Interphase, MIT.
- 2002-2004: Head of tutors, MIT.
- 2003: Lecturer, Calculus 1,2, Project Interphase, MIT.
- 1998-2002: Recitation Instructor, Algebra, Universidad Nacional de Cordoba, Argentina.
- 1995-1998: Lecturer, “Geometry for High-School teachers”, Argentinian Mathematical Olympiad, Argentina.

Service:

- Organizing committee “*Workshop on Mathematical physics*”, ICM satellite. ICTP-SAIFR, São Paulo, 2018.
- Organizing committee “*Lie algebras and their representations*”. ICM satellite. Cusco, 2018.
- Organizing committee “*Dualities in string theory and geometry*”. Rio de Janeiro 2016.
- Organizing committee “*Factorization Homology*”. IMPA 2016.
- Organizing committee “*XX Colóquio latinoamericano de álgebra: sesión grupos de Lie y representaciones*”. Lima, 2014.
- Organizing committee “*Symmetries in mathematics and Physics II*”. IMPA 2013.
- Organizing committee “*Quantum Groups and three manifold invariants*” IMPA 2012.

- Referee for journals of Mathematics, including Communications in Mathematical Physics, Advances in Mathematics, Journal of Algebra, etc.
- Organizer *Joint CBPF-IMPA mathematical physics seminar*, Rio de Janeiro, 2011.
- Part of the organizing committee for the *Miller Interdisciplinary Symposium*. Tomales Bay, June 2008 and June 2009.
- Organizer *Hodge Theory*, Graduate student seminar, Berkeley, 2007.
- Organizer *D-modules*, Graduate student seminar, Berkeley, 2007.
- Organizer *Pure math. graduate students seminar*, MIT, 2004-2005.
- Organizer *Vertex algebras and algebraic curves*, Graduate student seminar, MIT, 2003.

Publications:

- *Recent advances and open questions on the susy structure of the chiral de Rham complex*. Journal of Physics A. 50 (2017). no 42.
- *On a Complex-Symplectic Mirror pair*. Joint with M. Aldi. IMRN (2017) no 83.
- *Characters of $N = 2$ topological vertex algebras are Jacobi modular forms in the moduli space of elliptic supercurves*. Joint with J. Van Ekeren. Advances in Mathematics 302 (22) 551–627 (2016).
- *The Shatavahi-Vafa algebra as the Hamiltonian reduction of $D(2, 1; \alpha)$* . Bull. Brazilian Math. Soc. 46 (3) 331–351 (2015).
- *Dilogarithms, OPE, and Twisted T-Duality*. Joint with M. Aldi. International Mathematics Research Notices 2014, no. 6, 1528–1575.
- *Chiral de Rham complex on special holonomy manifolds*. Joint with Joel Ekstrand, Johan Källén and Maxim, Zabzine. Comm. Math. Phys. 318 (2013) no. 3, 575–613.
- *Sheaves of $N=2$ supersymmetric vertex algebras on Poisson manifolds*. Joint with J. Ekstrand, J. Kallen and M. Zabzine. J. Geom. Phys. 62 (2012), no. 11, 2259-2278.
- *Superconformal structures on generalized Calabi-Yau metric manifolds*. Joint with Maxim Zabzine. Communications in Mathematical Physics 306 (2011), no 2, 333–364. Available online (math.QA) arXiv:1006.2773v1
- *Non-linear sigma models via the chiral de Rham complex*. Joint with Joel Ekstrand, Johan Källén and Maxim, Zabzine. Advances in Theoretical and Mathematical Physics 13 (2009) no. 4, 1221–1254.

- *Generalized Calabi-Yau manifolds and the chiral de Rham complex*. Joint with M. Zabzine. *Advances in Mathematics*. 223 (2010) no. 5, 1815–1844.
- *Supersymmetry of the chiral de Rham complex II. Commuting sectors*. *IMRN* (2009), no. 6, 953–987.
- *SUSY lattice vertex algebras*. Joint with V. G. Kac. *Proceedings of the International Workshop “Lie Theory and its applications in Physics VII”*. H.-D. Doebner and V. K. Dobrev editors. Heron Press, Sofia, 2008, 3–24.
- *Supersymmetry of the chiral de Rham complex*. Joint with D. Ben-Zvi and M. Szczesny. *Compos. Math.* 144 (2008) no. 2, 503–521.
- *SUSY vertex algebras and supercurves*. *Comm. Math. Phys.* 275 (2007), no. 3, 607–658.
- *Supersymmetric vertex algebras*. Joint with V. G. Kac. *Comm. Math. Phys.* 271 (2007), no. 1, 103–178.
- Appendix to *Finite vs. affine W -algebras*. Joint with A. D’Andrea, C. de Concini, A. De Sole and V. G. Kac. *Jpn. J. Math.* 1 (2006), no. 1, 254–261.

Preprints:

- *An operadic approach to vertex algebra and Poisson vertex algebra cohomology*. Joint with B. Bakalov, A. De Sole and V. Kac. arxiv 1806.08754
- *A short construction of the Zhu algebra*. Joint with Jethro van Ekeren. Arxiv 1804.00020.
- *Chiral Homology of elliptic curves and Zhu’s algebra*. Joint with Jethro van Ekeren. Arxiv 1804.00017.

Talks:

Conferences by invitation:

- Vertex algebras and arc spaces. Cusco 2018.
- Higher chiral homology and vertex algebras *CFT and vertex operator algebras*, Kyoto, 2018.
- Higher 1 point functions. *MCA*. Montreal 2017.
- Chiral de Rham complex and special holonomy. *MCA*. Montreal 2017.
- Vertex algebra cohomology. *MCA*. Montreal, 2017.
- Higher chiral homology. *Geometry and Representation theory*. Vienna, 2017.
- Vertex algebras on special holonomy manifolds. *Escola de álgebra*. Diamantina, 2016.

- Higher 1-point functions on the torus. *Integrable systems*. Natal 2016.
- Higher 1-point functions on the torus. *XXICLA*, Buenos Aires 2016.
- Vertex algebras on special holonomy manifolds. *Group 31*. Rio de Janeiro 2016
- Higher chiral homology and rationality. *Factorizable Structures in Topology and Algebraic Geometry*, BIRS, 2015
- On the N=4 Superconformal Structure of the Chiral de Rham Complex of a HyperKähler Manifold. *New moonshines, mock modular forms and string theory*, Durham 2015.
- From modular forms to Lie algebras. *VII ELENA*, La Falda, Argentina, Aug. 2014.
- (Sheaves of) vertex algebras and stringy manifold invariants. *Geometry of strings and fields*, Firenze, Italy, Sept. 2013.
- Mathieu's Moonshine. *Geometry of strings and fields*, Firenze, Italy, Sept 2013.
- Dilogarithms in vertex-algebra-like structures. *Lie Superalgebras*, Rome, Italy, December 2012.
- M24 moonshine and string theory on K3 surfaces. *Mathematical physics in Bahia*, Salvador, July 2012.
- M24 moonshine and string theory on K3 surfaces. *7th Int. conf. on Mathematical methods in Physics*, Rio de Janeiro, Apr. 2012.
- Factorization Algebras and the Geometric Satake isomorphism. *LEGAL*, minicourse, Teresópolis, Feb. 2012.
- Classical symmetries of the sigma model revisited. *Quantum fields and strings*, Stockholm, Nov 2011.
- On a complex-symplectic mirror pair. *I Escuela Latinoamericana de Geometría Algebraica y Aplicaciones*, Córdoba, Aug 2011.
- Dilogarithms, OPE and twisted T -duality. *XV Latinamerican School of Mathematics*. Córdoba, May 2011.
- On a construction of Deligne in the context of vertex algebras. Workshop *Representation Theory and Quantum Field Theory*. São Paulo, May 2011.
- Introduction to Vertex Algebras. Minicourse for *Algebras and related topics*. Goiania, Feb. 2011.

- Dilogarithms, chiral algebras and non-commutative winding. *Poisson*. IMPA, Rio de Janeiro, July 2010.
- Vertex algebras as differential operators of Loop spaces. *Lie Groups, Lie Algebras and their representations*. USC, Los Angeles, May 2009.
- Introduction to the chiral de Rham complex. Minicourse part of conference *Geometrical aspects of string theory*. Nordita, Stockholm, November 2008.
- Supersymmetry of the chiral de Rham complex: the Calabi-Yau case. Workshop on Geometric Langlands and Physics. KITP Santa Barbara, July 2008.
- Supersymmetry of the chiral de Rham complex. Workshop on the Chiral de Rham Complex and Geometry. Max Planck Institute Bonn, Germany, June 2008.
- Supersymmetry of the chiral de Rham complex. Conference “Symmetries in Mathematics and Physics” in honor of V. Kac. Palazzone della Scuola Normale Superiore, Cortona, Italy, June 2008.
- Supersymmetry of the chiral de Rham complex: Calabi-Yau case. Workshop on Representation Theory, Geometry and Combinatorics. Berkeley, June 2008.
- “Los Salieris de Witten”. Conference in celebration of the 50-th anniversary of FaMAF. Córdoba, Argentina, December 2006.

Seminars by invitation:

- Higher chiral homology and rationality. *Infinite dimensional Lie algebras*. MIT, May 2017.
- De formas modulares a álgebras de Lie. *COLGA* Rio de Janeiro, May, 2014.
- On mirror symmetry for the Kodaira Surface. Uppsala, Dec, 2013.
- Mathieu’s moonshine and K3 surfaces. *Seminário de geometría algébrica*, Niteroi, May, 2012.
- Dilogarithms, OPE and twisted T-duality, *Infinite dimensional Lie algebras*, MIT, Cambridge, April 2012.
- Dilogarithms, OPE and twisted T-duality. *Geometry, Symmetry and physics*, Yale, New Haven, April 2012
- Dilogarithms, OPE and twisted T-duality. *Geometry and Physics Seminar*, Geneva, March 2012.

- Superconformal structures on generalized Calabi-Yau metric manifolds. Campinas, Brasil, October 2010.
- Dilogarithms, chiral algebras and non-commutative windings. USP, Sao Paulo, Brasil, October 2010.
- On non linear sigma-models with non-commutative windings. IAS, Princeton, April 2010.
- On non linear sigma-models with non-commutative windings. Discrete Mathematics seminar, UC. Davis, March 2010.
- On non linear sigma-models with non-commutative windings. Geometry and physics seminar, Northwestern University, January 2010.
- On a complex-symplectic mirror pair. Geometry Seminar, Córdoba, April 2009.
- Vertex Algebras as differential operators on Loop spaces. IMPA, Rio de Janeiro, April 2009.
- Generalized complex manifolds and the chiral de Rham complex. Infinite-Dimensional Algebra Seminar, MIT, October 2008.
- Generalized complex manifolds and conformal supersymmetry. RTGC seminar, Berkeley, September 2008.
- Simetría especular, geometrías generalizadas complejas y álgebras de vértices. Lie Theory Seminar, Famaf, Córdoba, Argentina, September 2008.
- Supersymmetry of the chiral de Rham complex. Lie Theory Seminar. UC Riverside, March 2008.
- Supersymmetry of the chiral de Rham complex. Lie Theory seminar, UC San Diego, May 2007.
- Supersymmetry of the chiral de Rham complex. RTGC seminar, Berkeley, April 2007.
- Super vertex algebras and supercurves. Infinite-Dimensional Algebra Seminar, MIT, December 2005.
- Super vertex algebras and super curves. Geometry seminar, Boston University, October 2005

Misc. Talks:

- Simetría especular, o como robarle artículos a los físicos. Master students seminar, Tucumán, Argentina, September 2008.

- Twistings. Talbot conference. Massachusetts, April 2008.
- Period map and domain. Hodge Theory graduate student seminar. Berkeley, April 2008.
- The Weil conjecture for morphisms. Perverse Sheaves learning seminar. Berkeley, October 2007.
- Baby Introduction to Chiral and Factorization Algebras. Student RTGC seminar. Berkeley, April 2007.
- Categories of Hecke eigensheaves on the affine Grassmannian. Topics in the Geometric Langlands Program student seminar. Berkeley, April 2007.
- Vertex Algebras. Talbot Conference. New Hampshire, March 2005.
- Hitchin's Integrable system. Pre-Talbot seminar. MIT, February 2005.
- Slodowy slices. BAGS seminar, MIT, May 2004.
- Octonionic Projective plane. Pure Math. Grad. Students seminar. MIT, April 2004.
- Representations of the Canonical Commutation Relations. Pure Math. Grad. Students seminar. MIT, March 2003.

Grants and subsidies

- Faperj JCNE E_25/2014.
- CAPES-STINT 26582013. *Algebraic methods in string theory*. Collaboration with Uppsala Universitet. IMPA 2013.
- Faperj APQ2 - 112.369/2012. Organization of the conference *Symmetries in Mathematics and Physics II*. IMPA 2013.
- CNPq 456396/2012-8 - Chamada MCTI/CNPq/FINEP 06/2012. Organization of the conference *Symmetries in Mathematics and Physics II*. IMPA 2013.
- CNPq 471864/2012-9 - Universal 14/2012. "Geometria Geralizada. Teoria de Lie e métodos Algébricos".
- CNPq 302735/2010-0. Produtividade em Pesquisa.

Other academic experience:

- Workshop *The Geometric Langlands Program*. Lorentz Center, Leiden, Netherlands, June 2008.
- Conference on *Algebraic Geometric derived categories and applications*. Princeton, New Jersey, March 2008.

- Summer School *Affine Hecke Algebras, the Langlands Program, Conformal Field Theories and Matrix Models*, CIRM, Luminy, France, June 2006.
- Summer School *Vertex algebras and applications* Erwin Schrödinger Institute, Wien, Austria. June 2005.
- Workshop “*Algebra*”, Córdoba, Argentina, June 2002.