

# Brice Loustau

Research Postdoctoral associate – HITS / Heidelberg University

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## Academic positions

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<b>2020 – 2021</b>	Postdoctoral Associate at HITS (Heidelberg Institute of Advanced Study) and Heidelberg University, Germany. Research group of Prof. Anna Wienhard.
<b>2018 – 2020</b>	Postdoctoral Associate at TU Darmstadt, Germany.
<b>2015 – 2018</b>	Postdoctoral Associate at Rutgers University - Newark, New Jersey, USA.
<b>2014 – 2015</b>	Visiting Research Associate at IMPA, Rio de Janeiro, Brazil.
<b>2011 – 2014</b>	Postdoctoral Associate at Université Paris-Sud XI Orsay. ERC <i>HighTeich</i> program of Prof. François Labourie.

## Education

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<b>2008 – 2011</b>	Ph.D., Université de Toulouse 3. Mention Très Honorable (highest honors). <i>Ph.D. Thesis:</i> The symplectic geometry of the deformation space of complex projective structures on a surface. <i>Advisor:</i> Jean-Marc Schlenker. <i>Ph.D. Committee:</i> G. Besson (president), S. Kerckhoff (referee), F. Bonahon (referee), J.-M. Schlenker (advisor), C. Lecuire, A. Papadopoulos, S. Tan.
<b>2007 – 2008</b>	Master in Pure Mathematics, Univ. Toulouse 3. Mention Très Bien (highest honors).
<b>2007</b>	Agrégation de Mathématiques. Rank: 28/2801.
<b>2004 – 2006</b>	École Normale Supérieure de Cachan - antenne de Bretagne.
<b>2002 – 2004</b>	Classes Préparatoires, M. Montaigne, Bordeaux (MPSI, MP*).
<b>2002</b>	Baccalauréat à Option Internationale, série S. Mention Très Bien (highest honors).

## Research Interests

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Classical and higher Teichmüller-Thurston theory, hyperbolic geometry, symplectic geometry, minimal surfaces, discrete differential geometry, computational geometry, mathematical programming, mathematics education.

## Teaching

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URL: [brice.loustau.eu/teaching.html](http://brice.loustau.eu/teaching.html)

- 2018 – 2020** Teaching at TU Darmstadt, Undergraduate and Graduate level.  
Service: ~100 hours/year.  
Courses taught: *Riemann Surfaces*, *General Relativity*, *Hyperbolic geometry*, *Differential Manifolds*.  
Series of video lectures: [brice.loustau.eu/teaching/TUDarmstadt/Manifolds2020](http://brice.loustau.eu/teaching/TUDarmstadt/Manifolds2020).  
Supervising of student's Master thesis.
- 2015 – 2018** Teaching at Rutgers University, Undergraduate and Graduate level.  
Service: ~160 hours/year.  
Courses taught: *Abstract Algebra*, *Calculus III* (x3), *Complex Analysis*, *Discrete Structures* (x2), *Elementary Differential Equations*(x2), *Foundations of Modern Mathematics*, *Hyperbolic geometry*.  
Supervising of undergraduate research project.
- 2011 – 2014** Teaching at Université Paris-Sud, Undergraduate level.  
Service: ~80 hours/year.  
Courses taught: *Calculus II*, *Complex Analysis* (x3), *Linear Algebra*, *Mathematics for Engineers*, *Plane Geometry* (x2),  
Supervising of undergraduate computer project.
- 2008 – 2011** Teaching at Université de Toulouse 3, Undergraduate level.  
Service: ~80 hours/year.  
Courses taught: *Calculus II*, *Calculus III*, *Differential Geometry*, *Elementary Differential Equations*, *Linear Algebra*, *Mathematics for Biology*, *Mathematics for Engineering*.
- 2006 – 2011** Oral examinations in *classes préparatoires*. Lycée Basch, Rennes (service: ~50 hours/year) and Lycée Fermat, Toulouse (service: ~150 hours/year).
- 2006** Teaching Mathematics in lycée Chateaubriand (high school), Rennes. 2nde and TeS.  
Service: ~80 hours.

## Student research

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- Spring 2021** I will (co-)supervise five research projects at the [Heidelberg Experimental Geometry Lab](#):  
> Computing harmonic maps  
> Graph embeddings in the hyperbolic plane  
> Limit sets in spheres  
> Julia sets and Kleinian groups  
> Can you hear the shape of a drum?
- Spring 2020** Maximilian Racky: Master thesis at TU Darmstadt, Germany.  
*Thesis title: Cross-ratios of torsion points on elliptic curves II.*
- Summer 2019** Darja Zierau: Master thesis at TU Darmstadt, Germany.  
*Thesis title: Cross-ratios of torsion points on elliptic curves.*

## Publications and preprints

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1. The symplectic geometry of the deformation space of complex projective structures.  
*Geometry & Topology* 19 (2015), no. 3, 1737–1775.
2. Minimal surfaces and symplectic structures of moduli spaces.  
*Geometriae Dedicata* 175 (2015), 309–322.
3. Bi-Lagrangian structures and Teichmüller theory (with [A. Sanders](#)).  
*Submitted*. Preprint: [arXiv:1708.09145](#)
4. Computing discrete equivariant harmonic maps (with [J. Gaster](#) and [L. Monsaingeon](#)).  
*Submitted*. Preprint: [arXiv:1810.11932](#)
5. Computing harmonic maps between Riemannian manifolds (with [J. Gaster](#) and [L. Monsaingeon](#)).  
*Submitted*. Preprint: [arXiv:1910.08176](#)
6. The sum of Lagrange numbers (with [J. Gaster](#)).  
*Submitted*. Preprint: [arXiv:2008.07659](#)
7. Harmonic maps from Kähler manifolds.  
*Submitted*. Preprint: [arXiv:2010.03545](#)

## Works in preparation

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8. Hyper-Kähler geometry of minimal hyperbolic germs (with [F. Bonsante](#), [A. Sanders](#), and [A. Seppi](#)).  
*We study the hyper-Kähler geometry of the moduli space of minimal hyperbolic germs, extending the hyper-Kähler metric of Donaldson off almost-Fuchsian space.*
9. Complex geometry of the universal moduli space of Higgs bundles (with [A. Sanders](#) & [N. Tholozan](#)).  
*We study the complex geometry of the universal moduli space of Higgs bundles over Teichmüller space.*
10. Symplectic geometry of Wick rotations (with Carlos Scarinci).  
*We study the symplectic properties of Wick rotations between moduli spaces of Einstein 3-manifolds in relation to bi-Lagrangian structures.*
11. Discrete Bochner formula on Riemannian manifolds (with [J. Gaster](#) and [L. Monsaingeon](#)).  
*We establish a discrete Bochner formula for functions on a discretized Riemannian manifold taking values in a Riemannian manifold.*

## Notes

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Available at [brice.loustau.eu/research.html#Notes](http://brice.loustau.eu/research.html#Notes)

1. Higgs bundles and Hitchin components.  
Notes for the workshop *Higher Teichmüller-Thurston spaces* at Orsay, France, Fall 2012.
2. Minimal surfaces and quasi-Fuchsian structures.  
Notes for the NSF workshop *Higgs bundles and harmonic maps* in Asheville, NC, USA, Jan. 2015.
3. Riemann surfaces.  
Lecture notes for a Masters course at TU Darmstadt, Winter 2018-2019.

## Book

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URL: [brice.loustau.eu/research.html#Book](http://brice.loustau.eu/research.html#Book)

*Hyperbolic geometry*.  
Preprint: [arXiv:2003.11180](#) or [HAL-02518149](#).  
To be published by *Springer* in Spring 2021.

## Mathematical software development

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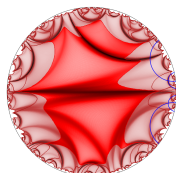


### Circle Packings

(with B. Beeker)

Computes and shows circle packings and Riemann conformal mappings.

[brice.loustau.eu/circlepackingsen.html](http://brice.loustau.eu/circlepackingsen.html)



### Harmony

(with J. Gaster)

Computes and shows equivariant harmonic maps.

[brice.loustau.eu/software.html#harmony](http://brice.loustau.eu/software.html#harmony)

## Service

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### HEGL (Heidelberg Experimental Geometry Lab)

I am part of the team creating HEGL, under the lead of Anna Wienhard. The goal of this initiative, started in the US, is to promote interaction between mathematics and computer visualization. I am in charge of the website, equipment, member coordination, and I will mentor five research projects in the Spring 2021.

### Organization of conferences, seminars, workshops

- > Co-organizer of the Workshop *Quantization of moduli spaces* at Sisteron, France, April 2021.
- > Co-organizer of informal seminar of differential geometry, TU Darmstadt, winter-spring 2020.
- > Organizer of the *Mathematics Colloquium* at Rutgers University - Newark, 2015-2016 and 2017-2018.
- > Co-organizer of the NSF GEAR Workshop [Analytic Aspects of Higher Teichmüller Theory](#) at Rutgers University - Newark, September 2016. NSF Funding received through GEAR: \$25,000.
- > Co-organizer of the *Mathematics Colloquium* at Rutgers University - Newark, 2016-2017.
- > Co-organizer of the *Teichmüller Theory seminar* at Rutgers University - Newark, 2015-2018.
- > Co-organizer of the *Parabolic complex projective structures* workshop at IMPA, Rio de Janeiro, 2014.
- > Organizer of the *Geometry and Structures* workshop at Université Paris XI, 2013.
- > Co-organizer of the *Higher Teichmüller theory* workshop at Université Paris XI, 2012.

### Referee for mathematics journals

- > Referee for *American Journal of Mathematics*, 2020.
- > Referee for *Differential Geometry and its Applications*, 2019.
- > Referee for *Forum Mathematicum*, 2019.
- > Referee for *European Mathematical Society Surveys*, 2018.
- > Referee for *Annales Scientifiques de l'École Normale Supérieure*, 2018.
- > Referee for *Geometriae Dedicata*, 2017.
- > Referee for *Inventiones Mathematicae*, 2016.
- > Referee for *Geometry & Topology*, 2015.
- > Referee for *Journal of Symplectic Geometry*, 2015.
- > Referee for *Geometry & Topology*, 2013.

### Outreach

- > Interview for the magazine *Science & Vie* (#1 science magazine in France) for the article *On ne saura jamais si nous vivons à l'extérieur ou à l'intérieur de la Terre*, July 2016.
- > Creator of the YouTube channel for the Teichmüller theory seminar at Rutgers-Newark, 2015-2018: [youtube.com/channel/UCQNCJq16e9LZNdxJ2PVPVw](https://youtube.com/channel/UCQNCJq16e9LZNdxJ2PVPVw).

## Invited talks

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### Conferences

- > *Hyper-Kähler geometry of minimal hyperbolic germs*. Harmonic maps, Higgs bundles, and special surface classes. DMV meeting, Chemnitz, Germany, September 2020.
- > *Computing harmonic maps between Riemannian manifolds*. ICERM (Brown University), Geometry Labs United Conference, online conference. July 2020.
- > *Computing equivariant harmonic maps*. Higher-Teichmüller theory and geometric structures, scientific meeting. Pavia, Italy, June 2019.
- > *Harmonic maps and Kähler geometry*. Harmonic maps and rigidity, *Projet Jeunes Géomètres* workshop. Sisteron, France, April 2019.
- > *Computing discrete equivariant harmonic maps*. Geometry and Approximation. AG seminar retreat, Höchst, Germany, February 2019.
- > *Bi-Lagrangian structures and Teichmüller theory*. Teichmüller Theory and its Connections to Geometry, Topology and Dynamics. Thematic Program, Fields Institute, University of Toronto, August 2018.
- > *Relative character varieties and their symplectic structure*. Parabolic Higgs bundles and relative character varieties, NSF GEAR Workshop. Palm Springs, California, February 2018.
- > *Computing discrete equivariant harmonic maps*. Analytic Aspects of Higher Teichmüller Theory, NSF GEAR Workshop. Rutgers University - Newark, September 2016.
- > *Harmonic maps*. Workshop on  $Sp(4, \mathbb{R})$  Anosov representations, NSF GEAR Network. Granby, Colorado, January 2016.
- > *Minimal surfaces in hyperbolic 3-manifolds and deformation spaces*. AMS Sectional Meeting. Rutgers University, New Brunswick, November 2015.
- > *Computing equivariant harmonic maps*. Higher Teichmüller theory and Higgs bundles: interactions and new trends. Hengstberger Symposium, European Research Council. University of Heidelberg, November 2015.
- > *Minimal surfaces in  $\mathbb{H}^3$  and quasi-Fuchsian representations*. Higgs Bundles and Harmonic Maps Workshop, NSF GEAR Network. Asheville, USA, January 2015.
- > *Geometric structures and character varieties*. Journées nancéiennes de géométrie. Département de mathématiques de Nancy, Université de Lorraine, January 2013.
- > *The hyperkähler geometry of the deformation space of complex projective structures on a surface*. NSF GEAR Retreat. University of Illinois at Urbana-Champaign, USA, August 2012.
- > *Minimal surfaces in almost-Fuchsian manifolds and symplectic structures*. Senior seminar, Geometry and analysis of surface group representations. Institut Henri Poincaré, Paris, March 2012.
- > *Symplectic geometry of deformation spaces*. Geometry, Topology and Dynamics of Character Varieties. Tokyo Institute of Technology and NSF, National University of Singapore, 18 June- 15 August 2010.

### Seminars and Colloquia

- > *Discrete Riemannian geometry via the Laplace-Beltrami operator*.
  - Differential Geometry Group Meeting, Heidelberg University, November 2020.
- > *The sum of Lagrange numbers*.
  - Geometry seminar, University of Strasbourg, November 2020.
- > *Planar graphs, circle packings, and conformal maps*.
  - HITS Lab Meeting, Heidelberg, September 2020.
- > *The hyper-Kähler geometry of minimal hyperbolic germs*.
  - Geometry seminar, University of Wisconsin at Milwaukee, November 2020.
  - Geometry seminar, University of Luxembourg, June 2020.
- > *GIT quotients and symplectic reduction*. Differential geometry seminar, TU Darmstadt, March 2020.
- > *Computing harmonic maps between Riemannian manifolds*.
  - Geometry seminar, National University of Singapore, November 2019.
- > *Computing equivariant harmonic maps*.

- Séminaire HORUS, Université de Strasbourg, September 2019.
- Geometry seminar, Stanford University, June 2019.
- Geometry seminar, Heidelberg University, December 2018.
- > *Bi-Lagrangian structures and Teichmüller theory.*
  - Geometry and discrete groups seminar, IHES (Paris), June 2018.
  - Complex analysis and dynamics seminar, CUNY graduate center, May 2018.
  - Geometry seminar, McGill University, Canada, April 2018.
  - Colloquium, Korea Advanced Institute of Science and Technology, April 2018.
  - Colloquium, Minnesota State University at Mankato, March 2018.
  - Symplectic geometry seminar, Stony Brook University, February 2018.
  - Geometry seminar, University of Texas at Austin, November 2017.
  - Geometry seminar, University of Virginia, September 2016.
- > *Computing discrete equivariant harmonic maps.*
  - Geometry seminar, Korea Advanced Institute of Science and Technology, April 2018.
  - Geometry seminar, Minnesota State University at Mankato, March 2018.
  - Geometry and dynamics seminar, Université de Paris 7, March 2017.
  - Geometry and dynamics seminar, Université de Lille 1, March 2017.
  - Topology/Geometry seminar, Rutgers University - New Brunswick, January 2017.
  - Analysis seminar, Fordham University, December 2016.
- > *Introduction to Teichmüller theory.* Graduate students seminar, Rutgers University, November 2016.
- > *Generalized Weil-Petersson metrics on character varieties.* Hyperbolic geometry seminar, City University of New York, November 2016.
- > *(Hyper-)Kähler geometry of character varieties.* Geometry seminar, University of Luxembourg, May 2016.
- > *Hyperkähler geometry of character varieties.*
  - Geometry and Dynamics/ GEAR seminar, University of Illinois at Urbana-Champaign, April 2016.
  - Complex Analysis and Geometry seminar, Université de Paris 7, March 2016.
  - Geometry and Topology seminar, Université de Grenoble 1, March 2016
  - Geometry and Topology seminar, Université de Nice Sophia Antipolis, March 2016
  - Complex Analysis and Geometry seminar, Université de Paris 6, March 2016.
- > *Complex Bi-Lagrangian structures.*
  - Geometry and Topology seminar, University of Maryland, February 2016.
  - Geometry and Topology seminar, Boston College, February 2016.
  - Mathematics Colloquium, Rutgers University - Newark, December 2015.
- > *Computing equivariant harmonic maps.* Teichmüller Theory seminar, Rutgers University - Newark, September 2015.
- > *Minimal surfaces and quasi-Fuchsian structures.* Geometry seminar, UFRJ, Rio de Janeiro, June 2015.
- > *Bi-Lagrangian and hyperkähler structures.*
  - Geometry seminar, University of Luxembourg, December 2014.
  - Geometry seminar, Université de Strasbourg, December 2014.
  - Geometry seminar, Université de Lorraine, December 2014.
  - Geometry seminar, Université de Rennes 1, December 2014.
  - Geometry seminar, Université de Bordeaux 1, December 2014.
- > *Introduction to Higgs bundles.* Postdoctoral seminar, Université Paris-Sud XI, October 2013.
- > *Representations of surface groups and Higgs bundles.* Graduate Students seminar, University of Illinois at Chicago, June 2013.
- > *Circle packings and Riemann mappings.* Geometry seminar, Université d'Avignon, May 2013.
- > *Complex projective structures and the  $SL(2, \mathbb{C})$ -character variety.* Topology and Dynamics seminar, Université Paris-Sud XI, December 2012.
- > *Higgs bundles and Hitchin components.* Postdoctoral seminar, Université Paris-Sud XI, November 2012.
- > *La géométrie symplectique des structures projectives complexes.* Geometry and Spectral Theory seminar, Université de Grenoble 1, June 2011.
- > *Complex projective structures.* Thematic Workshop, Université de Toulouse III, October 2010.
- > *Géométrie non euclidienne.* Graduate Students seminar, Université de Toulouse III, September 2010.

## Skills

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<b>Languages</b>	French (native speaker), English (bilingual), Spanish (conversational), Portuguese (conversational), German (conversational).
<b>Computer science</b>	Development in C++/Qt. Web development (HTML, CSS, PHP, etc.) Programming in C, Python, Matlab, Julia, Pascal, Maple, Mathematica, Octave, etc. 3D printing and other technology. $\LaTeX$ , GNU/Linux, desktop tools. Advocate of <i>libre software</i> .
<b>Music</b>	I am a proficient piano player and I love classical and jazz music. My husband Benjamin Velez is a musical theater (Broadway) composer.
<b>Sports</b>	Hiking, swimming, table tennis.
<b>Hobbies</b>	Cooking, reading, Greek mythology, TV shows.

## References

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Note: My references have all written letters of recommendation for me; feel free to reach out directly to them.

### References for research

- > Ara Basmajian, Professor, CUNY Graduate Center. [ABasmajian@gc.cuny.edu](mailto:ABasmajian@gc.cuny.edu)
- > Francis Bonahon, Professor, University of Southern California. [fbonahon@math.usc.edu](mailto:fbonahon@math.usc.edu)
- > David Dumas, Professor, University of Illinois at Chicago. [david@dumas.io](mailto:david@dumas.io)
- > William Goldman, Professor, University of Maryland. [wmg@math.umd.edu](mailto:wmg@math.umd.edu)
- > Steven Kerckhoff, Professor, Stanford University. [spk@math.stanford.edu](mailto:spk@math.stanford.edu)
- > Jean-Marc Schlenker, Professeur, Université de Luxembourg. [jean-marc.schlenker@uni.lu](mailto:jean-marc.schlenker@uni.lu)
- > Anna Wienhard, Professor, Heidelberg University. [wienhard@mathi.uni-heidelberg.de](mailto:wienhard@mathi.uni-heidelberg.de)

### References for teaching and academic service

- > Jane Gilman, Professor, Rutgers University. [gilman@rutgers.edu](mailto:gilman@rutgers.edu)
- > Karsten Grosse-Brauckmann, Professor, TU Darmstadt. [kbg@mathematik.tu-darmstadt.de](mailto:kbg@mathematik.tu-darmstadt.de)
- > Dominique Hulin, Maître de conférences, Université Paris-Sud XI. [dominique.hulin@math.u-psud.fr](mailto:dominique.hulin@math.u-psud.fr)
- > John Loftin, Professor, Rutgers University. [loftin@newark.rutgers.edu](mailto:loftin@newark.rutgers.edu)

## Details & Contact

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### Civil status

Date of birth: 5 December 1984  
Citizenship: French  
Marital status: married to U.S. citizen ([Benjamin Velez](#))

### Contact

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