

## KASRA RAFI

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### ACADEMIC POSITIONS

- Professor, University of Toronto, 2018–present.
- Associate Professor, University of Toronto, 2015–2018.
- Assistant Professor, University of Toronto, 2012–2015.
- Assistant Professor, University of Oklahoma, 2008–2012.
- L.E. Dickson Instructor, University of Chicago, 2007–2008.
- Postdoctoral Fellow, University of Connecticut, 2004–2007.
- Ky Fan Visiting Assistant Professor, University of California, Santa Barbara, 2001–2004.

### VISITING POSITIONS

- Simons Visiting Professor at Mathematical Sciences Research Institute, Fall 2016.
- Hausdorff Research Institute for Mathematics, May-August 2010.
- Clay Research Scholar, University of Chicago, winter and spring 2009.
- Mathematical Sciences Research Institute, Fall 2007.
- Isaac Newton Institute for Mathematical Sciences, University of Cambridge, UK, July-August 2003.

### EDUCATION

- Ph.D., Mathematics, State University of New York at Stony Brook, 2001.

Thesis Title: *Teichmüller geodesics and hyperbolic 3-manifolds.*

Advisor: Yair Minsky.

- B.Sc., Mathematics, Sharif Institute of Technology (Tehran, Iran), 1995.

### FIELDS OF INTEREST

- Geometry and dynamical properties of Teichmüller space.
- Geometric group theory, in particular, mapping class group and the outer automorphism group of a free group.

### HONORS

- Simons Visiting Professor at MSRI, Fall 2016
- NSERC Discovery grant, RGPIN 435885, 2013–2018, RGPIN 06486, 2018-2023.
- NSF Research Grant PI, DMS-1007811, 2010–2013.
- Clay Research Scholar, University of Chicago, winter and spring 2009.
- James Simons Prize for Excellence in Research, SUNY at Stony Brook, 2001.
- Silver Medal, International Mathematics Olympiad, Moscow, 1992.

## PAPERS

## Published

- *Counting closed geodesics in a stratum*,  
with Alex Eskin and Maryam Mirzakhani,  
Invent. math. (2018). <https://doi.org/10.1007/s00222-018-0832-y>.
- *Limit sets of Weil-Petersson geodesics*,  
with Jeffrey Brock, Chris Leininger and Babak Modami,  
International Mathematics Research Notices, (2018), <https://doi.org/10.1093/imrn/rny002>.
- *Algebraic ending laminations and quasi-convexity*,  
with Mahan Mj,  
Algebr. Geom. Topol. **18** (2018), no. 4, 1883–1916.
- *Limit sets of Teichmüller geodesics with minimal non-uniquely ergodic vertical foliation*  
with Chris Leininger and Anna Lenzhen,  
J. Reine Angew. Math. (Crelle's Journal) **737** (2018), 1–32.
- *Uniform fellow traveling between surgery paths in the sphere graph*,  
with Matt Clay and Yulan Qing, Algebraic & Geometric Topology **17** (2017) 3751–3778.
- *Large scale rank of Teichmüller space*,  
with Alex Eskin and Howard Masur, Duke Math. J. **166** (2017), no. 8, 1517–1572.
- *Uniform growth rate*.  
with Jing Tao, Proc. Amer. Math. Soc. **144** (2016), no. 4, 1415–1427.
- *The shadow of a Thurston geodesic to the curve graph*,  
with Anna Lenzhen and Jing Tao, J. Topol. **8** (2015), no. 4, 1085–1118.
- *Digraphs and cycle polynomials for free-by-cyclic groups*,  
with Yael Algom-Kfir and Eriko Hironaka, Geometry & Topology **19** (2015), no 2, 1111–1154.
- *Mapping tori of small dilatation expanding train-track maps*,  
with Yael Algom Kfir, Topology and its Applications **180** (2015), 44–63.
- *Uniform hyperbolicity of the curve graph via surgery sequences*,  
with Matt Clay and Saul Schleimer, Algebraic & Geometric Topology **14** (2014), no. 6, 3325–3344.
- *Hyperbolicity in Teichmüller space*,  
Geometry & Topology **18** (2014), no 5, 3025–3053.
- *On hyperbolicity of free splitting and free factor complexes*,  
with Ilya Kapovich, Groups Geom. Dyn. **8** (2014), no. 2, 391–414.
- *Diameter of the thick part of moduli space*,  
with Jing Tao, Duke Math. J. **162** (2013), no. 10, 1833–1876.
- *Bounded combinatorics and the Lipschitz metric on Teichmüller space*,  
with Anna Lenzhen and Jing Tao, Geom. Dedicata **159** (2012), 353–371.
- *Grafting rays fellow travel Teichmüller geodesics*,  
with Young-Eun Choi and David Dumas, Int. Math. Res. Not. IMRN (2012), no. 11, 2445–2492.
- *Length of a curve is quasi-convex along a Teichmüller geodesic*,  
with Anna Lenzhen, J. Differential Geom. **88** (2011), no. 2, 267–295.
- *Curve complexes are rigid*,  
with Saul Schleimer, Duke Math. J. Volume **158** (2011), no 2, 225–246.
- *Length spectra and degeneration of flat metrics*,  
with Moon Duchin and Christopher Leininger, Inventiones Mathematicae, **182**, (2010) no. 2,  
231–277.
- *Divergence rate of geodesics in Teichmüller space and mapping class groups*,  
with Moon Duchin, Geom. Funct. Anal. **19** (2009), no. 3, 722–742.
- *Covers and the curve complex*,  
with Saul Schleimer, Geom. Topol. **13** (2009), no. 4, 2141–2162.

- *Lines of minima and Teichmüller geodesics*,  
with Young-Eun Choi and Caroline Series, *Geom. Funct. Anal.* **18** (2008), no. 3, 698–754.
- *Lines of minima are uniformly quasigeodesic*,  
with Young-Eun Choi and Caroline Series, *Pacific J. Math.* **237** (2008), no. 1, 21–44.
- *A combinatorial model for the Teichmüller metric*,  
*Geom. Funct. Anal.* **17** (2007), no. 3, 936–959.
- *Thick-thin decomposition for quadratic differentials*,  
*Math. Res. Lett.* **14** (2007), no. 2, 333–341.
- *Comparison between Teichmüller and Lipschitz metrics*,  
with Young-Eun Choi, *J. London Math. Soc. (2)* **76** (2007), no. 3, 739–756.
- *A characterization of short curves of a Teichmüller geodesic*,  
*Geom. Topol.* **9** (2005), 179–202.

#### Refereed

- *Limit sets of Weil-Petersson geodesics with nonminimal ending laminations*,  
with Jeffrey Brock, Chris Leininger and Babak Modami to appear in *Journal of Topology and Analysis* (2017).
- *Teichmüller geodesics with  $d$ -dimensional limit sets*,  
with Babak Modami and Anna Lenzhen, to appear in *Journal of Modern Dynamics* (2016).
- *Rigidity of Teichmüller space*,  
with Alex Eskin and Howard Masur, to appear in *Geometry & Topology* (2015).
- *Isomorphisms between big mapping class groups*,  
with Juliette Bavard and Spencer Dowdall, to appear in *IMRN* (2017).
- *Non-convex balls in the Teichmüller metric*,  
with Maxime Fortier Bourque, to appear in *Journal of Differential Geometry*, (2016).
- *Limit sets of Teichmüller geodesics with minimal nonuniquely ergodic vertical foliation II*,  
with Jeffrey Brock, Chris Leininger and Babak Modami,  
to appear in *Crelle's Journal*, (2016).

#### Preprints

- *Geodesics in the Mapping Class Group*. with Yvon Verberne, (2018).
- *The shape of a generic translation surface in the minimal stratum*,  
with Howard Masur and Anja Randecker, (2018).
- *Renormalizing an infinite rational IET*,  
with W. Patrick Hooper and Anja Randecker, (2018).
- *Local maxima of the systole function*,  
with Maxime Fortier Bourque, (2018).
- *Quasi-geodesics in  $\text{Out}(\mathbb{F}_n)$  and their shadows in sub-factors*,  
with Yulan Qing, (2018).
- *Geodesics Currents and Counting Problems*,  
with Juan Souto, (2017).
- *Convexity of balls in the outer space*,  
with Yulan Qing, (2017).
- *Coarse and fine geometry of the Thurston metric*,  
with David Dumas and Anna Lenzhen and Jing Tao, (2016).

See “<http://www.math.toronto.edu/~rafi/>” for electronic versions of all papers.

## INVITED TALKS

## Conferences

- Fields Institute, Workshop on Geometry of Teichmüller Space, August 2018.
- Peking University, Beijing, China, A conference on Geometric Group Theory, July (2018).
- Fields Institute, 2018 Fields Institute Annual General Meeting, June (2018).
- Stanford University, The Mathematical Legacy of Maryam Mirzakhani, May (2018).
- University of Warwick, Geometry of Teichmüller space and mapping class groups, April (2018).
- ICTS, Bangalore, India, Surface group representation and geometric structures, November (2017).
- Ventotene, Italy, Moduli Space, September (2017).
- Trinity College, Dublin, Ireland, Geometry and Dynamics of Moduli Spaces, August (2017).
- Newton Institute, Cambridge, UK, Group actions and cohomology in non-positive curvature, June, (2017).
- Vanderbilt University, Shank Conference, May (2017).
- University of Arkansas, Redbud Topology Conference, April (2017).
- CIRM, Marseille, France, Dynamics and Geometry in the Teichmüller Space, February (2017).
- MSRI, Berkeley, Geometry of mapping class groups and  $\text{Out}(F_n)$ , October (2016).
- KAIST, Daejeon, Korea, Geometric Topology Fair, July (2016).
- ICERM, Providence, RI, Effective and Algorithmic Methods in Hyperbolic Geometry and Free Groups, May (2016).
- Casa Matemática Oaxaca, Oaxaca, Mexico, Flat Surfaces and Dynamics of Moduli Space, May (2016).
- African Institute for Mathematical Sciences, Cape Town, South Africa, Quadratic Differentials, January (2016).
- Mathematical Institute of the University of Oxford, Oxford, UK, Geometry and Dynamics on Moduli Spaces, September, (2015).
- Inter-University Centre Dubrovnik, Croatia, Dubrovnik VIII - Geometric Topology, Geometric Group Theory & Dynamical Systems, June (2015), scheduled.
- University of Texas at Austin, Workshop on Mapping Class Groups and  $\text{Out}(F_n)$ , May (2015).
- Yale University, Ahlfors-Bers Colloquium, plenary talk, October (2014).
- Centro De Giorgi, Pisa, Italy, Teichmüller theory and surfaces in 3-manifolds, June (2014).
- ICERM, Providence, Geometric Structures in Low-Dimensional Dynamics, November (2013).
- Marseille, France, The Geometry of Outer Space, July (2013).
- ESI, Vienna, Austria, Advances in Teichmüller theory, February (2013).
- Osaka, Japan, Riemann surfaces and Discontinuous groups, January (2013).
- Salt Lake City, Utah, Wasatch Topology Conference, December (2012).
- CRM, Barcelona, Spain, Automorphisms of free groups: Algorithms, Geometry and Dynamics, November (2012).
- Pensacola Beach, Florida, G3 conference, April (2012).
- Trinity College, Dublin, Ireland, The 7th William Rowan Hamilton Geometry and Topology Workshop, August (2011).
- Warwick Mathematics Institute, Coventry, England, Aspects of Hyperbolicity in Geometry, Topology and Dynamics, July (2011).
- MFO, Oberwolfach, Germany, Arithmetic Groups vs. Mapping Class Groups: Similarities, Analogies and Differences, June (2011).
- MFO, Oberwolfach, Germany, Billiards, Flat Surfaces, and Dynamics on Moduli Spaces, May (2011).
- Institute for Research in Fundamental Sciences, Tehran, Iran, Workshop on Arithmetic and Geometry, December (2010).
- Pucón, Chile, V Iberoamerican Congress on Geometry, December (2010).
- American Institute of Mathematics, Palo Alto, The Geometry of the Outer Automorphism Group of a Free Group, October (2010).
- HIM, Bonn, Germany, Subgroups of Mapping Class Group, May (2010).

- Clay Mathematics Institute, Boston, Geometry of Outer Space, October (2009).
- CIRM, Luminy, France, Dynamics and Geometry of Teichmüller Space, June (2009).
- Cornell University, Topology Festival, May (2009).
- NEHU, Shillong, India, International Workshop and Conference on Surface Mapping Class Groups and Related Topics, June (2008).
- Rutgers University-Newark, The Fourth Ahlfors-Bers Colloquium, May (2008).
- MSRI, Berkeley, Introduction to Teichmüller Theory and Kleinian Groups, August (2007).
- Warwick Mathematics Institute, Coventry, England, Workshop on Hyperbolic Structures on 3-Manifolds and Large-Scale Geometry of Teichmüller Space, July (2007).
- Center of Mathematical Science, Zhejiang University, International Conference on Geometric Topology and Geometric Analysis, July (2007).
- Peking University, Beijing, China, Geometric Topology Conference, June (2007).
- Brown University, Geometry and Dynamics in Surfaces and 3-Manifolds, May (2007).
- Warwick Mathematics Institute, Coventry, England, Workshop on Analytic Aspects of Low Dimensional Geometry, August (2006).
- Fields Institute, Toronto, Hyperbolic Geometry Workshop, May (2006).
- University of Michigan, Ahlfors-Bers Colloquium, May (2005).
- University of Connecticut, Ahlfors-Bers Colloquium, October (2001).

#### AMS/CMS Meetings

Stony Brook, New York, March (2016); Montreal, Québec, December (2015); Chicago, Illinois, October (2015); Ottawa, Ontario, December (2013); Temple University, Pennsylvania, October (2013); University of Nevada, Las Vegas, April (2011); University of Illinois at Urbana-Champaign, April (2009); Joint Mathematics Meeting, Washington DC, January (2009); Northwestern University, AMS Section Meeting, October (2004); University of Southern California, AMS Section Meeting, April (2004); University of Michigan, AMS Section Meeting, March (2002).

#### Colloquia (Excluding job talks)

Pittsburgh University (2017), University of Michigan (2017), University of Oklahoma (2014), University of Indiana (2014), University of Arkansas (2011), Rice University (2011).

#### Seminars

Brown University, California Institute of Technology, Cornell University, CUNY Graduate Center, Columbia University, Harvard University, Institut des Hautes Études Scientifiques, Joint USC-UCLA-Caltech, Kyoto University, McGill University, Osaka University, Oklahoma State University, Princeton University, Rutgers University, Stanford University, SUNY at Stony Brook, Tufts University, Université de Rennes, Université Paris-Sud, University of Connecticut, University of Maryland, University of California at Davis, University of California at Santa Barbara, University of Chicago, University of Illinois at Chicago, University of Illinois at Urbana-Champaign, University of Michigan, University of Southern California, University of Seoul, University of Texas Austin, University of Toronto, University of Utah, University of Warwick, Yale University.

#### Workshops

- CMO-BIRS, Oaxaca, Mexico, Flat Surfaces and Dynamics of Moduli Space, May (2016).
- CIRM, Marseille, France, Dynamics and Geometry in the Teichmüller Space, July (2015).
- The Lipschitz metric on Teichmüller space and its generalizations, AIM, Paolo Alto, October (2012).
- Geometric Group Theory, PCMI, Park City, July (2012).
- Dynamics of the Weil-Petersson geodesic flow, AIM, Paolo Alto, June (2012).
- Summer School on Moduli Spaces of Riemann Surfaces, PCMI, Park City, July (2011).
- The geometry of the outer automorphism group of a free group, AIM, Paolo Alto, October (2010).

## SUPERVISION

## Graduate students

- Thomas Dykes (current)
- Assaf Bar-Natan (current)
- Pooya Honaryar (current)
- Yvon Verberne (current)
- Ivan Telpukhovskiy (current)
- Funda Gültepe, University of Oklahoma (2013)
- Yoe Alexander Herrera Jaramillo, University of Oklahoma (2013)

## Undergraduate

- Ci Zhang (2018)
- Jordan Hofmann (2018)
- Adriano Pacifico (2017)

## Highschool Mentorship

- Clare Radnoff (2017)
- Gemma Zhang (2016)
- Abtin Ameri (2015)
- Andrey Khesin (2015)
- Coco Zhang (2014)

## TEACHING EXPERIENCE

## Undergraduate courses

Problem-solving, pre-calculus, single and multivariable calculus at all levels, honors calculus, ordinary and partial differential equations, physical mathematics, discrete mathematics, logic and proofs, linear algebra, probability, abstract algebra, graph theory, complex analysis, topology, knot theory and seminar in mathematics.

## Graduate courses

Algebra for teachers, Geometry for teachers, Algebraic topology, Introduction to Hyperbolic Geometry, Kleinian groups, Introduction to Teichmüller Space, Currents and Counting problems and Geometric Literacy.

## PROFESSIONAL ACTIVITIES

- Co-organizer of the Thematic Program on Teichmüller Theory and its Connections to Geometry, Topology and Dynamics in the Fields institute (2018).
- Co-organizer for the Fields Symposium in honor of Maryam Mirzakhani, November (2018).
- Associate Editor for The Journal of the Ramanujan Mathematical Society, (2016)–present.
- Mentor for Association for Women in Mathematics (AWM) Mentor Network since (2005).
- Co-organizer of AIM workshop on Lipschitz metric on Teichmüller space, October (2012).
- Co-organizer of AMS special sessions:
  - Lawrence, KS, “Geometric topology and group theory”, March (2012).
  - Albuquerque, NM, “Kleinian groups and Teichmüller theory”, April (2010).
  - Storrs, CT, “Teichmüller theory and hyperbolic geometry,” October (2006).

## COLLABORATORS

Yael Algom-Kfir (University of Haifa), Juliette Bavard (Université de Rennes), Mladen Bestvina (University of Utah), Jeffery Brock (Brown University), Mathew Clay (University of Arkansas), Camille Horbez (Orsay) Young-Eun Choi, Spencer Dowdall (Vanderbilt University), Moon Duchin (Tufts University), David Dumas (University of Illinois at Chicago), Alex Eskin (University of Chicago), Maxime Fortier Bourque (University of Glasgow), W Patrick Hooper (CUNY City College), Eriko Hironaka (Florida State University), Fanny Kassel (Lille), Ilya Kapovich (Hunter College), Misha Kapovich (University of California Davis), Christopher J. Leininger (University of Illinois at Urbana-Champaign), Anna Lenzhen (Rennes), Kathryn Mann (Brown University), Howard Masur (University of Chicago), Babak Modami (Yale University), Maryam Mirzakhani (Stanford University), Mahan Mj (Tata Institute), Yulan Qing (University of Toronto) Anja Randecker (University of Toronto), Saul Schleimer (University of Warwick), Caroline Series (University of Warwick), Juan Souto (Université de Rennes), Jing Tao (University of Oklahoma), Yvon Verberne (University of Toronto).