Curriculum Vitae

Jeremy Kahn

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1 Research Summary

Vladimir Markovic and I published four papers. The first[16] proved that the fundamental group of every closed hyperbolic 3-manifold has a surface subgroup, a long-standing open conjecture of fundamental importance to the study of 3-manifolds. The second[15] significantly improved a theorem of Joseph Masters, providing lower and upper bounds for the number of homotopy classes of immersed surfaces in a closed hyperbolic 3-manifold. A third [5] (joint with Al Fletcher), used some of the estimates in the previous paper to get upper and lower bounds for the number of balls needed to cover a large genus moduli space. The fourth[17] proved the *official* Ehrenpreis conjecture: every two compact hyperbolic surfaces have finite covers that are close in the Teichmüller metric. Vladimir Markovic and I were awarded the 2012 Clay Research Prize for our work proving the Surface Subgroup Theorem and the Ehrenpreis conjecture; we were also Invited Speakers in the 2014 International Congress of Mathematicians.

Work has continued on the construction of surface subgroups. Alex Wright and I constructed nearly geodesic surfaces in *cusped* hyperbolic 3-manifolds[19]. François Labourie, Shahar Mozes, and I constructed nearly geodesic surfaces aligned with a given immersed hyperbolic plane, in a wide variety of locally symmetric spaces[9].

With an eye towards proving geometric (Gromov) hyperbolicity statements in Teichmuller space using dynamical hyperbolicity of the geodesic flow, Alex Wright and I wrote a brief paper[20] comparing the Hodge and Teichmuller metrics.

I also have some recent work in Complex Dynamics. Kevin Pilgrim and Dylan Thurston and I proved an estimate[18] on restrictions of quadratic dif-

ferentials that served as an essential component to Dylan's positive criterion for realization of postcritically finite rational maps. Tanya Firsova, Nikita Selinger and I began a systematic study[4] of the deformation space that was originally defined (independently) by Adam Epstein and Mary Rees.

Mikhail Lyubich and I proved a Covering Lemma[10] which we then use to tame the dymanics of higher-degree unicritical polynomials[12, 1]. Using the Covering Lemma, I proved the *a priori* bounds for infinitely renormalizable quadratic polynomials of bounded-primitive type[7]; with M. Lyubich this was extended to certain kinds of unbounded primitive types[11, 13].

My dissertation was on the holomorphic removability of quadratic polynomial Julia sets[6].

Other work includes a note on laminations[14] and an article on hyperbolic volume[2]; older work includes articles on POMSET complexity[3] and Newtonian graphs[8].

References

[1] Artur Avila, Jeremy Kahn, Mikhail Lyubich, and Weixiao Shen. Combinatorial rigidity for unicritical polynomials. *Ann. of Math. (2)*, 170(2):783–797, 2009.

[2] Martin Bridgeman and Jeremy Kahn. Hyperbolic volume of manifolds with geodesic boundary and orthospectra. *Geom. Funct. Anal.*, 20(5):1210–1230, 2010.

[3] Joan Feigenbaum, Jeremy A. Kahn, and Carsten Lund. Complexity results for POMSET languages. *SIAM J. Discrete Math.*, 6(3):432–442, 1993.

[4] Tanya Firsova, Jeremy Kahn, and Nikita Selinger. On deformation spaces of quadratic rational functions. *International Mathematics Research Notices*, 2022.

[5] Alastair Fletcher, Jeremy Kahn, and Vladimir Markovic. The moduli space of Riemann surfaces of large genus. *Geom. Funct. Anal.*, 23(3):867–887, 2013.

[6] Jeremy Kahn. Holomorphic removability of Julia sets. arXiv:math.DS/9812164.

[7] Jeremy Kahn. A priori bounds for some infinitely renormalizable quadratics: I. Bounded primitive combinatorics. Submitted, arXiv:math.DS/0609045.

[8] Jeremy Kahn. Newtonian graphs for families of complex polynomials. *J. Complexity*, 7(4):425–442, 1991.

[9] Jeremy Kahn, François Labourie, and Shahar Mozes. Surface groups in uniform lattices of some semi-simple groups. *arXiv preprint arXiv:1805.10189*, 2018.

[10] Jeremy Kahn and Mikahil Lyubich. The quasi-additivity law in conformal geometry. *Ann. of Math. (2)*, 169(2):561–593, 2009.

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[12] Jeremy Kahn and Mikhail Lyubich. Local connectivity of Julia sets for unicritical polynomials. *Ann. of Math. (2)*, 170(1):413–426, 2009.

[13] Jeremy Kahn and Mikhail Lyubich. A priori bounds for some infinitely renormalizable quadratics. III. Molecules. In *Complex dynamics*, pages 229–254. A K Peters, Wellesley, MA, 2009.

[14] Jeremy Kahn, Mikhail Lyubich, and Lasse Rempe. A note on hyperbolic leaves and wild laminations of rational functions. *J. Difference Equ. Appl.*, 16(5-6):655–665, 2010.

[15] Jeremy Kahn and Vladimir Marković. Counting essential surfaces in a closed hyperbolic three-manifold. *Geom. Topol.*, 16(1):601–624, 2012.

[16] Jeremy Kahn and Vladimir Markovic. Immersing almost geodesic surfaces in a closed hyperbolic three manifold. *Ann. of Math. (2)*, 175(3):1127–1190, 2012.

[17] Jeremy Kahn and Vladimir Markovic. The good pants homology and the Ehrenpreis Conjecture. *Ann. of Math. (2)*, 182(1):1–72, 2015.

[18] Jeremy Kahn, Kevin M Pilgrim, and Dylan P Thurston. Conformal surface embeddings and extremal length. *Groups, Geometry, and Dynamics*, 16(2):403–435, 2022.

[19] Jeremy Kahn and Alex Wright. Nearly Fuchsian surface subgroups of finite covolume Kleinian groups. *Duke Mathematical Journal*, 170(3):503–573, 2021.

[20] Jeremy Kahn and Alex Wright. Hodge and Teichmüller. *Journal of Modern Dynamics*, 18:149–160, 2022.

2 Invited Talks

2.1 Special Invited Talks

- On July 25, 2017, I gave a semi-plenary lecture at the Mathematical Congress of the Americas in Montreal.
- On May 7, 2017, I gave an AMS Invited Address at the Spring Eastern Sectional Meeting at Hunter College, New York.
- I was a plenary speaker at the 2014 Ahlfors-Bers Colloquium at Yale on October 23.
- Vladimir Markovic and I gave a Invited Sectional Lecture at the 2014 ICM in Korea on August 18.
- I gave five talks on the Ehrenpreis conjecture for an intensive program on Teichmuller theory in Pisa, June 2–6, 2014.
- Mikhail Lyubich and I gave a series of five talks on our progress toward MLC at the conference "MLC: Status and Quo Vadis" (September 27–30, 2013) sponsored by the University of Roskilde.
- Vladimir Markovic and I gave twenty forty-five minute talks on our work at a Master Class ("The Ehrenpreis Conjecture") for the Center for the Quantum Geometry of Moduli Spaces at Aarhus University, Denmark.
- I gave two talks at the Current Developments in Mathematics conference at Harvard, November 19, 2011.
- Vladimir Markovic and I gave five talks on our work in a special conference held at Stony Brook and the Simons Center for Geometry and Physics, April 21–23, 2011.

2.2 Conference Talks

29 December 2022: *Action Now Wandering Seminar*, Tel Aviv University
"Sullivan's Dictionary, Limits of deformations, and Modular Laminations"
4 June 2019: *Analytic Low-Dimensional Dynamics: a celebration of Misha Lyubich's 60th birthday*, Fields Institute
"Misha, Me, and MLC"
3 August 2018: *The 14th William Rowan Hamilton Geometry and Topology Workshop*, Trinity College Dublin
"Nearly geodesic surfaces in finite volume hyperbolic 3-manifolds"
18 November 2017: *58th Texas Geometry and Topology Conference*, University of Texas at Austin
"Surface Subgroups in Nonuniform Lattices"
10 August 2017: *GEAR Retreat*, Stanford
"Surface Subgroups in Nonuniform Lattices"
23 May 2017: *Georgia International Topology Conference*, University of Georgia at Athens
"Applications and Frontiers in Surface Subgroups"
7 October 2015: *Workshop on Geometric Structures on 3-manifolds*, Institute for Advanced Studies
"Finding cocompact Fuchsian groups of given trace field and quaternian algebra"
18 October 2014: *Yamabe Symposium*, University of Minnesota
"Surface Subgroups, Cube Complexes, and the Virtual Haken Theorem"
20 May 2014: *Sixth Iberoamerican Congress on Geometry*, CUNY Graduate Center
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
15 August 2013: *Geometric Topology in New York*, Columbia University
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
5 August 2013: *Rolf Nevalinna Colloquium*, University of Helsinki
"Two Compactifications of Universal Teichmuller Space"
10 April 2013: *Dynamics of Groups and Rational Maps*, IPAM/UCLA
"Geometric Limits and Renormalization"
21 March 2013: *Hot Topics: Surface Subgroups and Cube Complexes*, MSRI
"Surface Subgroups of Isometries of Hyperbolic 3-Space"
15 September 2012: *Hyberbolic Geometry and Teichmuller Theory*, CUNY Graduate Center
"The good pants homology and the Ehrenpreis conjecture"

14 May 2012: *Rigidity and Flexibility in Dimensions 2, 3, and 4*, Luminy
"The good pants homology and the Ehrenpreis conjecture"
9 May 2012: *Panorama of Topology: A Conference in Honor of William Browder*, Princeton
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
28 March 2012: *Immersed Surfaces in 3-Manifolds*, Institute Henri Poincare
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
3 November 2011: *The hyperbolic and Riemannian geometry of surfaces and other manifolds*, Monte Verita
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
21 February 2011: *Frontiers in Complex Dynamics*, Banff International Research Station
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
21 October 2010: *Conformal Dyamics and Hyperbolic Geometry*, CUNY Graduate Center
"Counting Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
3 September 2010: *Hamilton Conference on Geometry and Topology*, Trinity College, Dublin
"Counting Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
9 May 2010: *Topology Festival*, Cornell
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
22 April 2010: *Virtual Properties of 3-Manifolds*, Montreal
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
4 April 2010: *Geometry Festival*, New York University
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
29 October 2009: *Workshop in Dynamical Systems*, Penn State
"Mixing of geodesic flow and almost geodesic immersions of hyperbolic surfaces"

2.3 Departmental Colloquia

29 November 2022: University of Fribourg
"Magic Mirrors and Modular Laminations"
4 December 2020: University of Indiana at Bloomington
"Postcritically Finite Rational Maps in Polynomial Time?"
21 April 2017: Rutgers New Brunswick
"Applications and Frontiers in Surface Subgroups"

2 December 2015: Yale
"Surface Subgroups, the Ehrenpreis conjecture, and Quaternian Algebras"
26 November 2012: New York University
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
7 March 2012: Princeton
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
14 December 2011: Columbia
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
5 December 2011: Temple
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
5 May 2011: Stanford
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
29 September 2010: Brown
"Theorems and Conjectures for Three-Manifolds"

2.4 Seminar Talks

8 December 2022: Einstein Institute of Mathematics
"Modular laminations and compactness"
30 November 2022: University of Fribourg
"Modular Laminations and Hyperbolic Components"
28 September 2022: Brown University
"Magic Mirrors and Hyperbolic Components"
27 April 2022: MSRI
"Hyperbolic Components and Extremal Length"
15 April 2022: MSRI
"The Asymptotic Theory of Extremal Length"
17 October 2011: Harvard
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
10 February 2011: Stony Brook University
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
26 January 2011: University of California at Berkeley
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
25 January 2011: Stanford
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"
21 January 2011: Caltech
"The Surface Subgroup Theorem and the Ehrenpreis conjecture"

15 November 2010: MIT
"Constructing Incompressible Surfaces in Closed Hyperbolic 3-Manifolds"
8 November 2010: University of Maryland
"Building immersed hyperbolic surfaces in hyperbolic 2- and 3-manifolds"
26 February 2010: Harvard
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
2 February 2010: Yale
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
20 November 2009: Columbia
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
12 November 2009: Boston College
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
5 November 2009: CUNY Graduate Center
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
15 October 2009: Princeton
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
11 September 2009: CUNY Graduate Center
"*A Priori* Bounds for Bounded-Primitive Renormalization"
9 October 2009: Michigan
"Essential Immersed Surfaces in Closed Hyperbolic 3-Manifolds"
15 October 2009: Princeton
"*A Priori* Bounds for Bounded-Primitive Renormalization"

3 Positions Held

Spring, 2022 Research Member, MSRI
2017–2018 Visiting Professor, Stanford University
2016– Professor, Brown University
2015–2016 Member, Institute for Advanced Study
2013–2016 Distinguished Professor, Graduate Center of the City University of New York
2011–2013 Professor, Brown University
2009–2011 Assistant Professor, Stony Brook University
2006–2009 Lecturer, Stony Brook University
Spring 2006 Visiting Professor, Fields Institute
2005 Analyst, Highbridge Capital Management

Fall 2004 Postdoctoral Fellow, University of Toronto
Spring 2004 Visiting Professor, Institute for Mathematical Sciences
2002-2003 Postdoctoral Fellow, University of Toronto
1998–1999, 2000–2002 Visiting Professor, Institute for Mathematical Sciences
1994–1998 Assistant Professor, California Institute of Technology

4 Education

1995 PhD in Mathematics, *University of California at Berkeley*
1991 BA in Mathematics, *Harvard College*

5 Awards and Grants

I have received two NSF grants, the first, DMS 0905812, "Estimating the Geometry of Riemann Surfaces in Dynamical Systems and Hyperbolic Geometry". was awarded with a start date of June 15, 2009, and the second, DMS 1206982, "Finding surface subgroups and virtual immersions", was awarded with a start date of July 1, 2012.

Vladimir Markovic and I were awarded the 2012 Clay Research Prize for our work proving the Surface Subgroup Theorem and the Ehrenpreis conjecture.

I was a Simons Fellow in Mathematics (sabbatical year grant) for the period 7/2017-8/2018.

I was a Simons Fellow in Mathematics for the calendar year 2022.