

Curriculum Vita and Publications (November, 2007)

Robert C. Penner

Birthdate: August 10, 1956
Birthplace: Los Angeles, California
Address: Department of Mathematics
University of Southern California
Los Angeles, CA 90089

Education:

B.A. cum laude in Mathematics and with distinction in all subjects from
Cornell University, June 1977
Ph.D. in Mathematics from Massachusetts Institute of Technology, June 1982

Employment:

Full Professor of Physics, University of Southern California, 1995-present
Full Professor of Mathematics, University of Southern California, 1992 - present
Associate Professor of Mathematics, University of Southern California, 1988 - 1992
Assistant Professor of Mathematics, University of Southern California, 1985 - 1988
Instructor of Mathematics, Princeton University, 1984-1985
Visiting Fellow, Institut Mittag-Leffler, Sweden, 1983-1984
Instructor of Mathematics, Princeton University, 1982-1983
Staff Scientist, Science Applications, Inc., La Jolla CA, 1977-1978

Visiting Positions:

Aarhus University, Fall 2006 and 2007-2008; University of Chicago April/May 2007;
Fields Institute, Canada, Sept-Nov 2004; Max Planck Inst für Math, Bonn, Germany,
May/June 1996, June 2005, Feb/Mar 2007; Institut Fourier/Univ. de Grenoble, France,
June 1996; Inst. Non-Lineaire de Nice, France, Fall 1994 (CNRS Poste Rouge) and
July 1996; Inst. des Hautes Etudes Scientifique, France, January-June, 1993 and May
1995, 1996; Stanford University, May 1990 and January - June, 1991; Université Louis
Pasteur, France, March - April 1990, Spring 1986, Summer 2002, June 2006; Institut
Mittag-Leffler, Sweden, November 1989 - February 1990; Harvard University, September -
October 1989; Eidgenössische Technische Hochschule, Switzerland, June 1986 and March
1990; University of Warwick, England, April 1986 and April 1984; Purdue University,
January 1986; University of Helsinki, Finland, May 1984.

Professional Society Memberships: Society for Industrial and Applied Math, American Physical Society

Publications

1. (with A. A. Boni) "Sensitivity analysis of a mechanism for methane oxidation kinetics", *Combustion Science and Technology* **15** (1977), 99-106.
2. "The action of the mapping class group on isotopy classes of curves and arcs in surfaces", thesis, Massachusetts Institute of Technology (1982), 180 pages.
3. "The action of the mapping class group on curves in surfaces", proceedings of the Sexta Escuela Latino Americana de Matematicas, Oaxtepec, Mexico (1982), 59-82.
4. "The action of the mapping class group on curves in surfaces", *L'Enseignement Mathematique* **30** (1984), 39-55.
5. "The theory of surface homeomorphisms", Institut Mittag-Leffler, Report number 1 (1984).
6. "An introduction to train tracks", *Low-dimensional Topology and Kleinian Groups*, London Math. Soc. Lecture Notes **112** (1986), 77-90.
7. "Extremal length on Denjoy domains", *Transactions of the American Math Society* **102** (1988), 641-645.
8. (with D. B. A. Epstein) "Euclidean decompositions of non-compact hyperbolic manifolds", *Journal of Differential Geometry* **27** (1988), 67-80.
9. "The moduli space of a punctured surface and perturbative series", *Bulletin of the American Math Society* **15** (1986), 73-77.
10. (with A. Papadopoulos) "A characterization of pseudo-Anosov foliations", *Pacific Journal of Mathematics* **130** (1987), 359-377.
11. "The moduli space of punctured surfaces", *Proceedings of Mathematical Aspects of String Theory*, Advanced Series in Mathematics Physics **1** (1987), World Scientific, 313-340.
12. "Perturbative series and the moduli space of Riemann surfaces", *Journal of Differential Geometry* **27** (1988), 35-53.
13. "The decorated Teichmüller space of punctured surfaces", *Communications in Mathematical Physics* **113** (1987), 299-339.
14. "El espacio de modulos de una superficie de Riemann (I)", (Translated to Spanish by R. M. Porter) Conferencias del Taller de Mexico Grupos Kleinianos, Taxco, Mexico (1985), 83-98.

15. “El espacio de modulos de una superficie de Riemann (II)”, (Translated to Spanish by R. M. Porter) Conferencias del Taller de Mexico Grupos Kleinianos, Taxco, Mexico (1985), 99 - 112.
16. “Calculus on moduli space”, *Geometry of Group Representations*, AMS Contemporary Mathematics **74** (1988), 277 - 293.
17. “The Schottky problem on pants”, *Transactions of the American Math Society* **309** (1988), 1 -19.
18. “A construction of pseudo-Anosov homeomorphisms”, *Proceedings of the American Math Society* **104** (1988), 1-19.
19. (with A. Papadopoulos) “Enumerating pseudo-Anosov conjugacy classes”, *Pacific Journal of Math* **142** (1990), 159-173.
20. “Integration over the moduli space of Riemann surfaces”, *Proceedings of Superstring TAMU 1989*, Advanced Series in Mathematical Physics, World Scientific (1989), 346-353.
21. “Bounds on least dilatations”, *Transactions of the American Math Society* **113** (1991), 443-450.
22. (with A. Papadopoulos) “The Weil-Petersson symplectic structure at Thurston’s boundary”, *Transactions of the American Math Society* **335** (1993), 891-904.
23. “Weil-Petersson volumes”, *Journal of Differential Geometry* **35** (1992), 559-608.
24. (with M. Näätänen) “The convex hull construction for compact surfaces and the Dirichlet polygon”, *Bulletin London Math Society* **23** (1991) 568-574.
25. (with A. Papadopoulos) “La forme symplectique de Weil-Petersson et le bord de Thurston de l’espace de Teichmüller”, *Comptes Rendus Acad. Sci. Paris* **312** Série I (1991), 871-874.
26. “Universal constructions in Teichmüller theory”, *Advances in Mathematics* **98** (1993), 143-215.
27. “The Poincaré dual of the Weil-Petersson Kähler form”, *Communications in Analysis and Geometry* **1** (1993), 43-70.
28. (with M. S. Waterman) “Spaces of RNA secondary structures”, *Advances in Mathematics* **101** (1993), 31-49.
29. (with R. J. Milgram) “Riemann’s moduli space and the Symmetric Groups”, *Mapping Class Groups and Moduli Spaces of Riemann Surfaces*, AMS Contemporary Math **150** (1993), 247-290.

30. “An arithmetic problem in surface geometry”, *The Moduli Space of Curves*, Birkhäuser (1995), eds. R. Dijkgraaf, C. Faber, G. van der Geer, 427-466.
31. “The universal Ptolemy group and its completions”, *Geometric Galois Actions II*, London Math Society Lecture Notes **243**, Cambridge University Press (1997), eds. P. Lochak and L. Schneps.
32. (with P. Glezen) “Some harmonic functions in Minkowski space”, *Transactions of the American Mathematical Society* **125** (1997), 1659-1665.
33. “The geometry of the Gauss product”, Algebraic Geometry 4, *Journal of Mathematical Science* **81** (1996) (Festschrift for Yuri Manin), 2700-2718.
34. “The simplicial compactification of Riemann’s moduli space”, Proceedings of the 37th Taniguchi Symposium, World Scientific (1996), 237-252.
35. (with F. Malikov) “The Lie algebra of homeomorphisms of the circle”, *Advances in Mathematics* **140** (1999), 282-322.
36. “On the Hilbert, Fourier, and wavelet transforms”, *Communications on Pure and Applied Mathematics* **55** (2002), 772-814.
37. (with R. Kaufman, M. Livernet), “Arc operads and arc algebras”, *Geometry and Topology* **7** (2003), 511-568.
38. (with A. Papadopoulos), “Broken hyperbolic structures”, *Annals of Global Analysis and Geometry* **27** (2005), 53-77.
39. (with L. Chekhov), “On the quantization of Teichmüller and Thurston theories”, in *Handbook of Teichmüller theory I* (2006), European Math Society, ed. Athanase Papadopoulos.
40. “Decorated Teichmüller space of bordered surfaces”, *Communications in Analysis and Geometry* **12** (2004), 793-820.
41. “Cell decomposition and compactification of Riemann’s moduli space in decorated Teichmüller theory”, *Woods Hole Mathematics-perspectives in math and physics*, editors Nils Tongring and R. C. Penner, World Scientific Publishing Company (2004).
42. (with L. Chekhov) “Introduction to Thurston’s quantum theory” (Russian. Russian summary) *Uspekhi Mat. Nauk* **58** (2003), 93–138; translation in *Russian Math. Surveys* **58** (2003), 1141-1183
43. “Surfaces, circles, and solenoids” in *Handbook of Teichmüller theory I* (2006), European Math Society, ed. Athanase Papadopoulos.

44. “Probing mapping class groups using arcs” in *Problems on Mapping Class Groups and Related Topics, Proceedings of Symposia in Pure Mathematics* **74** (2006), American Math Society, ed. Benson Farb.
45. (with R. Kaufmann) “Closed/open string diagrammatics”, *Nuclear Physics B* **748** (2006) 335-379.
46. (with D. Saric) “Teichmüller theory of the punctured solenoid”, math.DS/0508476, to appear *Geometrica Dedicata*.
47. (with S. Morita) “Torelli groups, extended Johnson homomorphisms, and new cycles on the moduli space of curves”, math.GT/0602461, to appear *Mathematical Proceedings Cambridge Philosophical Society*.
48. (with S. Bonnot and D. Šarić) “A presentation for the baseleaf preserving mapping class group of the punctured solenoid”, math.DS/0608066, to appear *Algebraic and Geometric Topology*.
49. “The structure and singularities of arc complexes” (2004), math.GT/0410603, preprint (2006).
50. “Mapping class actions on completions of surface groups”, to appear *Proceedings GD2006*, eds. Y. Mitsumatsu et al..
51. (with A. Bene and N. Kawazumi) “Fatgraph Magnus expansions and groupoid Johnson maps”, math.GT/0707.2984, preprint (2007).
52. (with G. McShane) “Stable curves and screens on fatgraphs”, math.GT/0707.1468, preprint (2007)
53. (with J. Andersen and A. Bene) “Groupoid Lifts of Mapping Class Representations for Bordered Surfaces”, math.GT/0710.2651, preprint (2007).

Monographs

1. (with the assistance of J. L. Harer) *Combinatorics of Train Tracks*, Annals of Mathematical Studies **125**, Princeton Univ. Press (1992); second printing (2001).
2. *Perspectives in Mathematical Physics*, International Press, edited by R. C. Penner and S. T. Yau (1994).
3. *Discrete Mathematics—proof techniques and mathematical structures*, World Scientific Publishing Company (1999); second printing (2001).
4. *Woods Hole Mathematics—perspectives in math and physics*, edited by Nils Tongring and R. C. Penner, foreward by R. Bott, World Scientific Publishing Company (2004).
5. *Decorated Teichmüller theory* (2006) in preparation, draft of first 100 pages available at www.ctqm.au.dk/research/MCS/lambdalengths.pdf.
6. *GD 2006*, Proceedings of the Geometry and Dynamics 2006 Conference, co-editor with Yoshi Mitsumatsu et al.

Patents

1. “Methods of Digital Filtering and Multi-Dimensional Data Compression Using the Farey Quadrature and Arithmetic, Fan, and Modular Wavelets”, US Patent 7,158,569 (2Jan07).

Grants

Preuss Foundation Grant - 7/2005 "Protein Structure", Principal Investigators: Robert Penner, Michael Waterman - amount awarded \$ 15,000 - Grant awarded at USC

Oberwolfach Math Institute Conference on 5/2006, Organizers: Shigeyuki Morita, Athanase Papadopoulos, Robert Penner

NRC Grant 9/1/02-8/31/03 (CORISA grant) "Curves, Matrix Models and Quantization" - amount awarded \$9,530 - Grant Awarded at USC

NSF Grant - 7/1/98 - 6/30/00 - DMS 9610041 (3-year grant) "Geometry and Arithmetic of Riemann's Moduli Space" - amount awarded \$89,400 - Grant Awarded at USC

NSF Grant - 6/1/95 - 5/31/97 - DMS 9322042 (36 month grant) "Geometry and Topology of Riemann's Moduli Space" - amount awarded \$31,000 FY '94, \$30,999 FY '95, \$ 31,001 FY '96 - Grant Awarded at USC

NSF Grant - 7/1/92 - 6/30/93 - DMS 9204878 (1 year SCREMS grant) "Mathematical Sciences Computing Research Environments" - amount awarded \$24,400 - Grant awarded at USC

NSF Grant - 6/1/91 - 5/31/94 - DMS 9101235 (3 year continuing grant) "Moduli Spaces of Riemann Surfaces" - amount awarded \$28,400 FY '91, \$29,800 FY '92 , \$31,300 FY '93 - Grant awarded at USC

NSF Grant - 6/15/91 - 11/30/91 - DMS 8801160 (3 year continuing grant) "Geometry and Topology of Surfaces"- amount awarded \$22,400 FY '88, \$33,500 FY '89 , \$41,550 FY '90 - Grant awarded at USC

NSF Grant - 6/15/86 - 11/30/88 - DMS 8601162 "Geometry and Topology of Surfaces" amount awarded \$34,800, additional funding of \$5,900 for computer awarded 8/18/87 Total amount of award \$40,700 - Grant awarded at USC

NSF Grant - DMS 8504984 Principal Investigator John Moore, et. al.
amount awarded: large amount awarded to entire Topology Dept.
-Grant awarded at Princeton

NSF Grant - (number of grant unavailable) Principal Investigators: William Thurston, Robert Penner, Daryl Cooper -Grant awarded at Princeton

Selection of Invited Lectures:

- Principal speaker at CRM conference on moduli space,
University of Montreal (2007)
- Principal speaker at “Geometry and Dynamics 2006”,
Tokyo University (2006)
- Master’s Class on decorated Teichmüller theory, Aarhus University,
Aarhus, Denmark (2006)
- Plenary speaker at the Cambridge Computational Biology Institute Symposium,
Cambridge, England (2006)
- Series of Lectures, London Math Society workshop on Cluster algebras
and Teichmüller theory, Leicester, England (2006)
- Series of Lectures at Tokyo University, Tokyo, Japan (2004)
- Principal Speaker at 74th Rencontre des mathématiciens et physiciens,
Strasbourg, France (2004)
- Plenary Speaker at the “Workshop on String Topology”, Stonybrook,
New York (2003)
- Principal Speaker at the Conference “RNA Secondary Structures”,
Dijon, France (2002)
- Principal Speaker at Conference “Mike Waterman’s 60th Birthday”,
Los Angeles, CA (2002)
- Speaker at the Nevanlinna Colloquium at Helsinki, Finland (2000)
- Speaker at the Nevanlinna Colloquium at EPFL Lausanne, Switzerland (1997)
- Series of Lectures at Inst. Fourier, Grenoble, France (1996)
- Series of Lectures at Max Planck Inst. für Math, Bonn, Germany (1996)
- Principal Speaker at the 37th Taniguchi Symposium, Katinkulta, Finland (1995)
- Principal Speaker at Math Society of Japan Meeting on the Topology
of Moduli Space, Kyoto, Japan (1994)
- Series of Lectures at University of Bern, Switzerland (1993)
- Principal Speaker at the Program in Mathematics and Molecular Biology
Annual Meeting in Santa Fe (1992)
- Principal Speaker at Mathematical Sciences Research Institute (1991)
- Principal Speaker at the Stanford Topology Symposium (1991)
- Series of Institute Lectures at Institut Mittag-Leffler, Stockholm, Sweden (1990)
- Address to Finnish Mathematical Society at University of Helsinki (1990)
- Series of Lectures at CEN Saclay, France (1990)
- Series of Lectures in the Valley Geometry Seminar, Amherst, Hampshire,
Mount Holyoke and Smith Colleges and Univ. of Mass Amherst (1989)
- Hour Address at Superstrings TAMU 1989, Texas A&M Univ. (1989)
- Address in the Mathematics of String Theory Conference at UCSD (1986)
- Principal Speaker at the Fourth CIEAIPN Taxco, Mexico; series (1985)
- Principal Speaker at the Conference on Geometric Topology at the University
of Warwick, England; series (1984)