SEAN LAWTON

George Mason University
Department of Mathematical Sciences
Fairfax, Virginia 22030 USA

E-mail: slawton3@gmu.edu
URLs: http://math.gmu.edu/~slawton3
http://www.cos.gmu.edu/megl
Fax: 001.703.993.1491
Phone: 001.703.993.4269

PROFESSIONAL EXPERIENCE

George Mason University (GMU): Full Professor (with Tenure), August 2020-Present

George Mason University (GMU): Associate Professor (with Tenure), August 2014-August 2020

Institute Des Hautes Études Scientifiques (IHES), Bures-sur-Yvette, France: Research Visitor, Spring 2019

Mathematical Sciences Research Institute (MSRI), Berkeley: Research Member, Spring 2015

Tata Institute Fundamental Research, Mumbai, India: Research Visitor, January 2014

University of Texas-Rio Grande Valley (UTRGV): Assistant Professor/Associate Professor (with Tenure), August 2009- August 2014

University of Maryland at College Park: Visiting Lecturer, August 2008-August 2009

Instituto Superior Técnico, Portugal: Research Fellow, August 2007-August 2009

Kansas State University: Visiting Assistant Professor, August 2006- August 2007

EDUCATION

Ph.D. Mathematics University of Maryland, May 2006. Adviser: William Goldman,
Thesis: $\mathrm{SL}(3,\mathbb{C})$-*Character Varieties and* $\mathbb{RP}^2$-*Structures on a Trinion*,
Committee: William Goldman, John Millson, Sergei Novikov, James Schafer, Dieter Brill.

M.A. Mathematics University of Maryland, May 2003. Adviser: John Millson,
Thesis: *Deformation Spaces of Polygons in the Euclidean Plane.*

B.S. with Honors in Mathematics University of Maryland, May 2000. Adviser: Lawrence Washington,
Thesis: *Puzzles, Graphs, and Permutation Groups.*

RESEARCH INTERESTS

The study of spaces of Lie group-valued representations of finitely generated groups. In particular, how non-commutative algebraic structures inform the topology of these moduli spaces, and how the persistent topological properties of these moduli spaces (quantified over Lie groups) give properties of finitely presented groups. Experimental and visual pure mathematics in general.

PUBLICATIONS[1][citations in brackets]

Refereed Articles[2]:

1. *Mapping class action on* SU(3)*-character varieties* (with W. Goldman and E. Xia), to appear *Ergodic Theory and Dynamical Systems* (accepted 2020).

2. *Wonderful Compactification of Character Varieties* (with Indranil Biswas and Dan Ramras), Pacific Journal of Mathematics (2019), Pacific J. Math. 302 (2019), no. 2, 413-435.

3. *Geometry Labs United: an invitation.* (with Jayadev Athreya, David Dumas, William Goldman, Sergey Grigorian, Rosemary Guzman, Philipp Hieronymi, Anton Lukyanenko, Jeremy Tyson, and Aaron Wilson), Notices Am. Math. Soc. 65, No. 9, 1088-1094 (2018).[3]

4. *Rank 1 character varieties of finitely presented groups.* (with Caleb Ashely and Jean-Philippe Burelle), Geom. Dedicata 192 (2018), 1–19. Mathematica, Sage, & Python companion programs available. Program has been implemented into SnapPy. [5]

5. *Varieties of Characters* (with Adam Sikora), Algebr. Represent. Theory 20 (2017), no. 5, 1133–1141. [3]

6. *Decision problems, complexity, traces, and representations* (with Lars Louder, Ben McReynolds), Groups Geom. Dyn. 11 (2017), no. 1, 165–188 [7]

7. *Invariants of pairs in* $\mathrm{SL}(4,\mathbb{C})$ *and* $\mathrm{SU}(3,1)$ (with Krishnendu Gongopadhyay), Proc. Amer. Math. Soc. 145 (2017), no. 11, 4703–4715. [5]

8. *Homotopy groups of character varieties of free groups* (with Carlos Florentino, Daniel Ramras), Ann. Sc. Norm. Super. Pisa Cl. Sci. (5) 17 (2017), no. 1, 143–185. [9]

9. *On the homotopy type of free group character varieties* (with Ana Casimiro, Carlos Florentino, André Oliveira), Boletim da Sociedade Portuguesa de Matemática, Special Issue (2016), 53-57 [1][4]

10. *Character varieties of free groups are Gorenstein, but not always factorial* (with Chris Manon), Journal of Algebra, 456 (2016), 278–293.[1]

11. *E-polynomial of the* $\mathrm{SL}(3,\mathbb{C})$*-character variety of free groups* (with Vicente Muñoz), Pacific Journal of Mathematics, 2016 [16]

12. *Topology of Moduli Spaces of Free Group Representations in Real Reductive Groups* (with Ana Casimiro, Carlos Florentino, André Oliveira), Forum Mathematicum, 2016 [12]

13. *Fundamental groups of character varieties: surfaces and tori* (with Indranil Biswas and Daniel Ramras), Mathematische Zeitschrift, 2015 [13]

14. *Covering spaces of character varieties* (with Daniel Ramras), New York Journal of Mathematics, 2015 [14]

15. *Fundamental Group of Moduli Spaces of Representations* (with Indranil Biswas), Geometriae Dedicata, 2015 [5]

[1]Research articles available on `https://arxiv.org/a/lawton_s_1.html`.
[2]Coauthors listed in alphabetical order here and as published.
[3]Not counted in citation analysis since it is not a research article.
[4]A summary of our paper: *Topology of Moduli Spaces of Free Group Representations in Real Reductive Groups*

16. *E-polynomial for* $\mathrm{SL}(2,\mathbb{C})$*-character spaces of free groups* (with Samual Cavazos), International Journal of Mathematics, 2014 [7]

17. *Topology of character varieties of Abelian groups* (with Carlos Florentino), Topology And Its Applications, 2014 [28]

18. *The topology of parabolic character varieties of free groups* (with Indranil Biswas, Carlos Florentino, Marina Logares), Geometriae Dedicata, 2014 [1]

19. *Character varieties and the moduli quiver representations* (with Carlos Florentino), In the tradition of Ahlfors-Bers, Papers from the 5th Ahlfors-Bers Colloquium held at Rice University, Contemporary Mathematics, American Mathematical Society, 2013 [11]

20. *Singularities of free group character varieties* (with C. Florentino), Pacfic Journal of Mathematics, Vol. 260 (2012), No. 1, 149-179. [23]

21. *Computing* $\mathrm{SL}(2,\mathbb{C})$ *Central Functions with Spin Networks* (with Elisha Peterson), Geometriae Dedicata, Volume 153, 73-105, Number 1 (August 2011) Companion Mathematica program available at `wolframlibrary.com`. [1]

22. *Algebraic independence in* $\mathrm{SL}(3,\mathbb{C})$ *character varieties of free groups*, Journal of Algebra, Volume 324, Issue 6, 1383-1391, (September 2010) [9]

23. *The topology of moduli spaces of free group representations* (with Carlos Florentino), Mathematische Annalen, 345, No. 2, 453-489 (October 2009) [34]

24. *Obtaining the One-Holed Torus from the Pair-of-Pants: Duality in an* $\mathrm{SL}(3,\mathbb{C})$*-Character Variety*, Pacific Journal of Mathematics, 242, No. 1, 131-142 (September 2009) [5]

25. *Poisson Geometry of* $\mathrm{SL}(3,\mathbb{C})$*-Character Varieties Relative to a Surface with Boundary*, Transactions of the American Mathematical Society, 361, No. 5, 2397-2429 (May 2009) [17]

26. *Spin Networks and* $\mathrm{SL}(2,\mathbb{C})$*-Character Varieties* (with Elisha Peterson), Papadopoulos, Athanase (ed.), Handbook of Teichmüller Theory Volume II, European Mathematical Society, IRMA Lectures in Mathematics and Theoretical Physics 13, 685-730 (March 2009). ISBN 978-3-03719-055-5. [7]

27. *Minimal Affine Coordinates for* $\mathrm{SL}(3,\mathbb{C})$ *Character Varieties of Free Groups*, Journal of Algebra, Volume 320, Issue 10, 3773-3810 (November 2008) [19]

28. *Generators, relations and symmetries in pairs of* 3×3 *unimodular matrices* , Journal of Algebra Volume 313, Issue 2, Pages 782-801 (July 2007) [37]

29. $\mathrm{SL}(3,\mathbb{C})$*-Character Varieties and* $\mathbb{RP}^2$*-Structures on a Trinion* (PhD Dissertation), ProQuest, 2006, ISBN 9780542910173 [8]

Submitted Research Articles:

1. *Bad Representations and Homotopy of Character Varieties* (with D. Ramras and C. Guérin), `https://arxiv.org/abs/1908.02915`[1]

Personal citation index is 10.31 (29 research articles receiving 299 citations from 137 sources & 115 authors); averaging about 1 citation per week 2015-2020[5]

[5]Citation Data available upon request.

GRANTS (Total Awards: ∼$580,000)

1. PI (co-PI's W. Goldman, A. Lukyanenko), July 2020, Institute for Computational and Experimental Research in Mathematics (ICERM) Workshop Grant to host Geometry Labs United Conferences, approximate budget $20,000 (GMU is matching funds for a total of $40,000).
2. PI, Simons Collaboration Grant, 2018-2023, $42,000,
3. PI (co-PI A. Lukyanenko), MEGL Expansion grant from COS-GMU, $150,000, Awarded Fall 2017
4. PI, Outreach and Development grant from Elsevier, $2,500, Awarded Spring 2016
5. PI (co-PI C. Manon), Research Equipment grant from GMU, $17,500, Awarded Fall 2105
6. PI, *Character Varieties: Experiments And New Frontiers*, Mathematics Research Communities, Co-PIs: Adam Sikora, Chris Manon, Event held Summer 2016 [6]
7. PI, Geometry Labs United (GLU) conference, NSF (via GEAR), $8,000, Event held Summer 2015
8. PI (with co-PI Manon), Research Experiences for Graduate Students (NSF subaward via GEAR) , $23,560 supporting 3 visiting students to work in MEGL, Event held Summer 2015
9. PI, NSF-DMS, *Applications of Non-Commutative Algebra to Character Varieties*, 2013-2016, $118,167 (award number 1309376),
10. PI (co-PI Todd Drumm), Research Workshop Grant (NSF subaward via GEAR), $35,000, Event held December 2013
11. PI, Simon's Collaboration Grant, 2012-2017, $35,000,
12. Invited "founding member" in the multi-institutional (University of Maryland, University of Illinois, Princeton, Stanford) NSF Research Networks in Mathematical Science (RNMS) program GEometric structures And Representation varieties (GEAR–NSF-RMS 1107367), Fall 2010-Spring 2019, providing approximately $10,000 in research travel support.
13. Member of Portugese research projects PTDC/MAT099275/2008 (2009-2011) and PTDC/MAT/120411/2010 (2011-2012), providing approximately $6000 in research travel support.
14. LSAMP awards to support undergraduate research in EAGL, approximately $4,000, 2010-2012
15. PI, Undergraduate Research Initiative, UTRGV, $2,000, Fall 2010 and $2,000, Fall 2011 and $4,000, Spring 2013
16. PI, Faculty Development Council Grant, UTRGV, $2400, Spring 2010 and $1,337, Spring 2012
17. PI, American Mathematical Society researcher travel grants to attend the International Congress of Mathematicians, $3050, Fall 2009 (and $3700 awarded Summer 2014 but could not accept)
18. PI on Faculty Research Council Grant, UTRGV, $5000, Fall 2009
19. PI, Research Fellowship from Fundação para a Ciência e a Tecnologia (FCT) to work at Insituto Superior Técnico (IST), 2007-2009 (approximately 25,000€)

[6] Budget handled by MRC.

PRESENTATIONS

1. *What is a Character Variety?*, TX-State University, Second Annual Jorge Acosta Memorial Lecture, April 3, 2020
2. *Bad representations and homotopy of character varieties*, University of Lisboa, Geometry Seminar, January 10, 2020
3. *Minimal generating sets for coordinate rings of representations*, GMU, Combinatorics, Algebra and Geometry Seminar (CAGS), April 12, 2019
4. *Minimal Generating Sets for Coordinate Rings of Representations*, Institut des Hautes Études Scientifiques (IHES), Séminaire Géométrie et groupes discrets, March 11, 2019
5. *The hidden non-commutative structure of representations*, Howard University, Colloquium, February 15, 2019
6. *Geometry Labs United: Welcome and Overview*, Joint Mathematics Meetings, January 2019
7. *Compactification of Character Varieties*, Current Trends in Hitchin Systems , Universidad Nacional de Buenos Aires, Argentina, December 18, 2018
8. *Rank 1 character varieties of finitely presented groups*, University of VA, Topology Conference, October 2017
9. *Compactification of Character Varieties*, University of Lisbon (Portugal), Geometry Seminar, May 2017
10. *Compactification of character varieties*, AMS NY Sectional, May 2017
11. (1) *Examples of Outreach Activities*, (2) *Invariants of pairs in SL(4,C) and SU(3,1)*, & (3) *Character Varieties of Free Groups are Gorenstein but not always Factorial*, Atlanta, GA, AMS-JMM, January 2017
12. *About the Mason Experimental Geometry Lab*, SIAM Faculty Symposium at GMU, November 4, 2016
13. *Varieties of Characters*, AMS Maine Sectional, September 24-25, 2016
14. *The Betti Moduli Space: Experiments and visualizations*, Geometries, surfaces and representations of fundamental groups (University of Maryland), June 20-25, 2016
15. *The Betti Moduli Space in Arbitrary Characteristic*, Simons Center Talk, June 16, 2016
16. *Introduction to Character Varieties I and II* and *Computations/Experiments with Character Varieties*, Snowbird Lectures, June 5-11, 2016
17. *Rank 1 Character Varieties* , TADS at GMU, May 13, 2016
18. *Homotopy of Betti Moduli Spaces*, Higgs Bundles, International Centre for Theoretical Sciences (Bangalore, India), March 2016
19. *Character Varieties of Free Groups are Gorenstein, but not always Factorial*, UMCP, Geometry and Topology Seminar, December 14, 2015

20. *Introduction to character varieties* (2 expository talks) and *Topology of the moduli space of local systems over an open surface* (1 research talk), Workshop on Geometric Structures, Hitchin Components and Representation Varieties, Korean Institute of Advanced Study (Seoul, Korea), Oct. 20-Oct. 24, 2015

21. *What is a Lie group?*, Student Research Talk, GMU, Fall 2015

22. *Conjugation classes of pairs in* $\mathrm{SL}(4,\mathbb{C})$ *and* $\mathrm{SU}(3,1)$, Geometry and Topology Seminar, Universidad Complutense de Madrid (Spain), June 3, 2015

23. *Conjugation classes of pairs in* $\mathrm{SL}(4,\mathbb{C})$ *and* $\mathrm{SU}(3,1)$, Universitat Autònoma de Barcelona (Spain), June 4, 2015

24. *Homotopy groups of character varieties*, Higgs Bundles and Character Varieties Special Session, Joint SPM-AMS Meetings, Porto, Portual, June 10, 2015

25. *Topology of Free Group Character Varieties* , Geometry-Topology Seminar, UMCP, November 10, 2014

26. *Counting Points on a Moduli Space* & *Homotopy of Character Varieties*, Topology, Arithmetic, & Dynamics Seminar, GMU, October 15 & November 12, 2014

27. *What is the Mason Experimental Geometry Lab*, SIAM Faculty Symposium at GMU, Fall 2014

28. *What is a character variety?*, Colloquium, Howard, October 24, 2014

29. *What is a character variety?*, Colloquium, IUPUI, October 10, 2014

30. *Topology of moduli spaces of representations*, ICM Satellite Workshop, *The Geometry, Topology, & Physics of Moduli Spaces of Higgs Bundles*, NUS (Singapore), Summer 2014

31. *Character Varieties and their Topology*, Workshop on the topic of Geometric Structures and Discrete Groups, University of Texas, Austin, Spring 2014

32. *Irreducibility of Abelian Character Varieties*, Algebra Seminar, Northwestern University, Spring 2014

33. *Covering Spaces of Moduli Spaces of Representations*, Topology Seminar, Purdue University, Spring 2014

34. *What is a character variety?*, Colloquium, George Mason University, Spring 2014

35. *All about SL(2,C) character varieties I, II*, Mini-Course, Workshop on Character Varieties and Geometric Structures, Howard University, Fall 2013

36. *E-Polynomial of SL(2,C)-Character Varieties of Free Groups*, National Center for Theoretical Sciences, National Cheng Kung University, Tainan, Taiwan, July 5, 2013

37. *Topology and Irreducibility of Character Varieties of Abelian Groups*, National Center for Theoretical Sciences, National Cheng Kung University, Tainan, Taiwan, July 1, 2013

38. *Classification of Irreducible Moduli Spaces of Flat G-bundles on a Torus*, University of Texas-Brownsville, April 20, 2013

39. *Results on Moduli Spaces of Representations*, Geometric Groups on the Gulf, South Padre Island, Texas, March 21-24, 2013

40. *Topology of Character Varieties of Abelian Groups*, 10 minute talk, Joint Mathematics Meetings, San Diego, CA, January 2013

41. *Topology of Character Varieties of Abelian Groups*, Workshop on Higher Teichmuller-Thurston Theory, CRM Montreal, October 15-19, 2012

42. *Topology of Character Varieties of Abelian Groups*, Geometria em Lisboa, Instituto Superior Técnico, Lisbon, Portugal, July 2012

43. *Topology of Parabolic Character Varieties of Free Groups*, Workshop: Geometry of surface group representations, Centre de Recerca Matemàtica, Barcelona, Spain, May 2012

44. *What is a character variety?*, New Mexico State University, Colloquium, April 2012

45. *Topology of Character Varieties of Abelian Groups*, Purdue University, Topology Seminar, March 2012

46. *Character Varieties of Finitely Generated Abelian Groups*, University of Texas-Brownsville, Mathematics Seminar, November 2011

47. *Parabolic Character Varieties of Free Groups*, University of Texas-Pan American, Algebra & Geometry Seminar, November 2011

48. *Character Varieties of Finitely Generated Abelian Groups*, University of Texas-Pan American, Algebra & Geometry Seminar, October 2011

49. *Character Varieties and Group-Valued Quiver Representations*, Discrete Groups & Geometric Structures with Applications IV, Oostende, Belgium, May 2011

50. *Local and Global Topology of Group-Valued Quiver Representations*,The Triennial Ahlfors-Bers Colloquium, Rice University, March 2011

51. *Singularities of free group character varieties*, International Congress of Mathematicians (ICM), Hyderabad, India, August 2010

52. *Singularities of free group character varieties*, Vector Bundles and Algebraic Curves at Instituto Superior Técnico, Lisboa, Portugal, June 2010

53. *Singularities of free group character varieties*, ICM satellite Workshop at National University of Singapore on Geometry, Topology and Dynamics of Character Varieties, July 2010

54. *Mapping class group ergodicity on moduli spaces (parts I and II)* , Algebra & Geometry Seminar, UTRGV, Feb. and March 2010

55. *Singularities of free group character varieties*, South Texas Algebra Colloquium in South Padre Island (jointly organized by UT-Pan American and UT-Brownsville), November 7, 2009

56. *Singularities of free group character varieties*, Geometry/Topology Seminar at University of Chicago, November 19, 2009

57. *Singularities of free group character varieties*, American Mathematical Society Special Session on Lie Groups, Lie Algebras, and Representations at Waco, Texas, October 16-18, 2009

58. *Singularities of free group character varieties*,Topology Seminar at University of Texas at Austin, September 28, 2009

59. *A survey of free group character varieties*, Seminar Series at University of Texas at Pan American, Sept. 25, Oct. 2, Oct. 9 2009

60. *The topology of the moduli of free group representations*, Geometry-Topology Seminar, University of Maryland, 6 October 2008

61. *Algebraic Independence in* $\mathrm{SL}(3,\mathbb{C})$*-Character Varieties of Free Groups*, Algebra Seminar, Instituto Superior Técnico, 15 July 2008

62. *On the topology of the moduli of free group representations*, Geometry-Topology Special Session, Encontro Nacional da Sociedade Portuguesa de Matemática, 26 June 2008

63. *A picture book of the topology of some character varieties*, seminar, Brooklyn College, 7 April 2008

64. *Some recent results on character varieties of surface groups*, colloquium, Saint Louis University, 10 March 2008

65. *Obtaining the One-Holed Torus from Pants: Duality in an* $\mathrm{SL}(3,\mathbb{C})$*-Character Variety*, Geometria em Lisboa, Instituto Superior Técnico, 20 November 2007

66. *Poisson structures on moduli of surface group representations into* $\mathrm{SL}(3,\mathbb{C})$ Geometry Seminar, Universidade do Porto, 9 November 2007

67. *Minimal Affine Coordinates for* $\mathrm{SL}(3,\mathbb{C})$ *Character Varieties of Free Groups*, Algebra Seminar, Instituto Superior Técnico, 11 October 2007

68. *Generators of* $\mathrm{SL}(2,\mathbb{C})$*-Character Varieties of Arbitrary Rank Free Groups* (1 hour lecture), 7th Korean Advanced Institute Science Technology Geometric Topology Fair (Daejeon, Korea), 9 July 2007

69. *Central Functions and*$\mathrm{SL}(2,\mathbb{C})$*-Character Varieties* (1 hour lecture), 7th Korean Advanced Institute Science Technology Geometric Topology Fair (Daejeon, Korea), 10 July 2007

70. *Minimal Generators for* $\mathrm{SL}(3,\mathbb{C})$*-Character Varieties of Free Groups*, Algebra Seminar, Kansas State University, 23 April 2007

71. *Algebraic Independence and Symmetry in* $\mathrm{SL}(3,\mathbb{C})$*-Character Varieties of Free Groups*, Algebra Seminar, Kansas State University, 30 April 2007

72. *Obtaining the One-Holed Torus from Pants: Duality in an* $\mathrm{SL}(3,\mathbb{C})$*-Character Variety*, Geometry, Topology & Physics Seminar, Kansas State University, 9 April 2007

73. *Poisson structures on moduli of surface group representations into* $\mathrm{SL}(3,\mathbb{C})$, Geometry & Topology Seminar, McMaster University, 27 February 2007

74. *Symmetry in* $\mathrm{SL}(3,\mathbb{C})$*-Character Varieties* (25 minute talk), American Mathematical Society Special Session on Invariant Theory, New Orleans, LA, 6 January 2007

75. *Symplectic Foliation on* $\mathrm{SL}(3,\mathbb{C})$*-Character Varieties*, Geometry, Topology & Physics Seminar, Kansas State University, 6 November 2006

76. *On the Moduli of* $\mathrm{SL}(3,\mathbb{C})$*-Bundles over a Surface of Euler Characteristic -1* (40 minute talk), American Mathematical Society Special Session on Algebraic Geometry and Moduli Spaces, Storrs, CT, 29 October 2006

77. *Poisson Structure on* $\mathrm{SL}(3)$*-Character Varieties Relative to a Punctured Surface* (20 minute talk), American Mathematical Society Special Session on Low Dimensional Topology and Geometry, Salt Lake City, UT, 8 October 2006

78. *Poisson Structures on Moduli of* SL(3)*-Bundles over a Punctured Surface* (1 hour lecture), Park City Mathematics Insitute, Park City, UT, 7 July 2006

79. *Poisson Structure of Flat* SL(3)*-bundles over a Thrice Punctured Sphere*, Geometria em Lisboa, Instituto Superior Técnico, 7 June 2006

80. *Poisson Structure on* $\mathrm{SL}(3) \times \mathrm{SL}(3)//\mathrm{SL}(3)$ *Relative to a Trinion*, Colloquium, Kansas State University, 11 May 2006

81. *Symmetries in the* $\mathrm{SL}(3,\mathbb{C})$*-Character Variety of a Rank 2 Free Group*, Knots in Washington XXII, George Washington University, Washington DC 7 May 2006

TEACHING EXPERIENCE

1. Associate/Full Professor, George Mason University, Department of Mathematical Sciences, Fall 2014-Present

    - Created and directed the Mason Experimental Geometry Lab (MEGL)
    - Created and chaired the Student Research Talks (StReeTs) seminar series
    - Taught Quantitative Reasoning (Math 106)
        (a) Partially Flipped & Hybrid Classroom where students are expected to come to the board and work problems with real-time feedback (math coaching)
        (b) Used hands-on activities to create enrichment: (1) candy proof that the real numbers are uncountable, (2) balloons to teach spherical geometry, (3) dance to teach the complex numbers, (4) paper clocks to teach modular arithmetic, (5) play-doh & magic tricks to teach topology, (6) hyperbolic paper and crochet to teach hyperbolic geometry.
        (c) Used (optional) reading of *How not to be wrong* by J. Ellenberg to get students thinking about the bigger role mathematics plays in life.
    - Taught Calculus II (Math 114)
        (a) Partially Flipped & Hybrid Classroom where students are expected to come to the board and work problems with real-time feedback (math coaching).
        (b) Supervised Teaching Assistants and Learning Assistants.
    - Taught graduate courses: Algebra I (Math 621), Algebra II (Math 721), Lie Groups (Math 689), Moduli Spaces & Invariant Theory (Math 639), Topology (Math 631), Algebraic Geometry (Math 697), Differential Topology (Math 740), Thesis Supervision (Math 998/999)
    - Taught upper level undergraduate courses: Algebra I (Math 321-In person and Online), Galois & Ring Theory (Math 494), Differential Geometry (Math 494-Online), Advanced Linear Algebra (Math 322), Lie Groups (Math 494), Honors Thesis (Math 405/406), Reading & Problems (Math 491).

2. Assistant/Associate Professor, University of Texas, Mathematics Department, Fall 2009-Fall 2014

    - Created and direct the Experimental Algebra & Geometry Lab
        (a) Collaborated with the International Museum of Art and Science, Gear Up, AVID, IDEA, and STC to create outreach activities promoting math and art in the community and local secondary schools (intersecting with 1000's of pre-collegiate students)
        (b) Advised undergraduate research projects (8+ student projects) and undergraduate outreach projects (3+ multi-year projects to date)
        (c) Press: Scientific American (2 online articles), Loc Arcos, Panorama, Pan American, Monitor

- Created and chair the Secret Student Seminar (supervised 14 student presentations to date)
- Created the Pure Math Track to the undergraduate math degree
- Created undergraduate courses Differential Geometry and Algebraic Geometry (and co-created Linear Algebra, Real Analysis II, Modern Algebra II)
- Created graduate courses Algebraic Geometry and Differential Geometry
- Taught Modern Geometry, Modern Algebra, Number Theory, Algebraic Geometry (graduate & undergraduate), Topology (graduate & undergraduate), Differential Geometry, Real Analysis, Algebraic Topology, Differential Topology
  (a) Developed and created online proof based homework, visualizations in Mathematica & GeoGebra
- Taught Business Calculus I, Calculus I, Calculus II, Calculus III, Linear Algebra
  (a) Set up online homework
  (b) Used BLOG to interact with students and webcast solutions and assistance
  (c) Introduced group work activities and "collaborative" lectures
  (d) Flipped course with video lectures as HW and student led, professor guided problems in class

3. Visiting Lecturer, University of Maryland, Mathematics Department, Fall 2008–Summer 2009

   - Taught Calculus I (large lecture) and managed 5 teaching assistants [Fall]
   - Taught Honors Calculus I (small class) [Fall]
   - Taught Calculus II (large lecture) and managed 5 teaching assistants [Spring]
   - Taught Honors Calculus II (small class) [Spring]
   - Taught senior level Euclidean and Non-Euclidean Geometry course (used Geometer's Sketchpad to explore concepts) [Fall and Spring]
   - Co-director of Experimental Geometry Lab [summer]

4. Visiting Assistant Professor, Kansas State University, Mathematics Department, Fall 2006–Spring 2007

   - Taught Experimental College Algebra (small class, innovative curriculum using Excel spreadsheets to explore concepts)
   - Taught Traditional College Algebra (large lecture with standard curriculum)
   - Received Dean's citation for good teaching (response to student praise) within 2 weeks of starting (fall 2006)
   - Fellow of the Center of Quantative Education at Kansas State University: assisting in the developement of a new College Algebra course at Kansas State University under the supervision of Professor Andrew Bennett.

5. Teaching Assistant, University of Maryland, College Park, Mathematics Department, Fall 2000–Spring 2006

   - Departmental Adviser for undergraduate Math Club, (Fall 2005)
   - Taught Calculus I Course as Lecturer, (Summer 2005)
   - Undergraduate Academic Adviser, (Fall 2004- Spring 2005)
   - Organized William Goldman's Research Interaction Team on Moduli Spaces, (Spring 2004)
   - Teaching Assistant for Undergraduate Topology & Differential Geometry Courses, (Fall 2004)

- Experimental Geometry Lab Manager, (Fall 2004)
- Graded Graduate Algebra Course, (Fall 2003)
- Taught Recitation Courses: Linear Algebra (Spring 2003), Calculus I (Fall 2002), Calculus II (Spring 2001, Fall 2000)
- Graded Senior Complex Analysis Course, (Spring 2002)
- Graded Senior Linear Algebra Course & Senior Abstract Algebra Course (Fall 2001)

6. Instructor, Montgomery County Community College, Rockville Campus, Mathematics Department, Fall 2004–Spring 2006, and Summer 2009

   - Taught Linear Algebra Course, (Spring 2006)
   - Taught Multi-Variable Calculus Course, (Fall 2005)
   - Taught Calculus II Course, (Summer 2005)
   - Taught Calculus I Course, (Spring 2005)
   - Taught Pre-Calculus Course, (Fall 2004)
   - Taught Differential Equations, (Summer 2009)
   - Prepared and evaluated: homework, quizzes, MATLAB & calculator projects, tests, lectures

7. Instructor, Center for Talented Youth, South Hadley, MA, Summers 2002, 2003, 2004

   - Developed course exploring inductive & deductive reasoning in sentential logic as conjecture & proof in math
   - Taught logic, algebra, number theory, and non-Euclidean geometry to children from 10-12 years old
   - Supervised teaching assistant

8. Teaching Assistant, Center for Talented Youth, Los Angeles, CA, Summer 2001

9. Math Intern, Academic Achievement Programs, Summer 1998 - Spring 2000

   - Taught Pre-Calculus Course (Fall 1999 - Spring 2000)
   - Taught Recitation Course for Pre-Calculus (Fall 1998 - Spring 1999)
   - Worked with students "who display the potential to be successful...even though their academic profile may be less competitive."

MENTORING

PhD Students Supervised:

1. Jack Love, 2015-2019, Graduated Summer 2019: Thesis *Stability And Classification Of Polygon Spaces*
   Awards: Dean's Award for Excellence (Spring 2018), Excellence in Teaching Award (Spring 2017)
   First job: Assistant Professor and Outreach Director at the Department of Mathematical Sciences, GMU

2. Cigole Thomas, 2016-Present (PhD candidate, working on thesis)
   Awards: Provost Summer Research Fellowship (Summer 2020), TC Lim Award for Excellence in Teaching (Spring 2018)

Masters Students Supervised:

1. Stephanie Mui, Summer 2015-Spring 2017, accepted into PhD program Courant Institute, NYU
   Awards: First place award from American Mathematics Society at the Intel International Science and Engineering Fair (2016)

Students Supervised via Experimental Geometry Labs:[7]

1. Matthew Kearney, Fall 2019-Spring 2020, won Genevieve G. Feinstein Award in Cryptography (Spring 2020)
2. George Andrews (Fall 2019-Spring 2020), won Amer Beslagic Award for outstanding performance in math (Spring 2020)
3. Savannah Crawford, Fall 2019-Spring 2020, won the Genevieve G. Feinstein Award in Cryptography (Spring 2019), accepted to PhD program GMU
4. Julian Benali, Fall 2018, won Klaus Fischer Award for Academic Achievement in Mathematics (Spring 2019), won Amer Beslagic Award for outstanding performance in math (Spring 2018)
5. Marvin Castellon, Summer 2017-2018, accepted into PhD program at UC, Berkeley (with Chancelor's Fellowship), won the Mary K. Cabell Award to the Outstanding Mathematics Student (Spring 2018), won best poster/presentation at the Undergraduate Research Colloquium at GMU (Spring 2018)
6. Cole Miller, Fall 2017
7. Kira Wolpert, Summer 2017
8. Seth Lee, Spring 2017-Summer 2017, Fall 2018, won Genevieve G. Feinstein Award in Cryptography (Spring 2018)
9. Orton Babb, Spring 2016-Summer 2016
10. Jermain McDermott, Summer 2015-Spring 2016, accepted into PhD program at University of MD, College Park, won Genevieve G. Feinstein Award in Cryptography (Spring 2016)
11. Robert Argus, Summer 2015-Fall 2015, won Klaus Fischer Award for Academic Achievement in Mathematics (Spring 2016)
12. Patrick Brown, Summer 2015-Fall 2015
13. Tim Reid, Summer 2015-Spring 2017, accepted to PhD program North Carolina State University, won an OSCAR grant to do research (Fall 2016), won OSCAR Student Excellence Award (Spring 2017)
14. Patrick Bishop, Summer 2015-Spring 2017, accepted into PhD program at GMU
15. Joe Frias, Spring 2016-Summer 2017
16. Mary Leskovec, Summer 2015-Summer 2016, won Genevieve G. Feinstein Award in Cryptography (Spring 2017)
17. Mae Markowski, Fall 2015-Fall 2016, accepted into PhD program at Rice University, won Mary K. Cabell Award to the Outstanding Mathematics Student (Spring 2017), NSF-GRF honorable mention (2018)

[7] undergraduate at the time of supervision unless otherwise indicated

18. Donnelly Phillips, Summer 2015-Spring 2016
19. Vishal Mummareddy (high school), Summer 2015
20. Clément Guérin (graduate student), Summer 2015
21. Diaaeldin Taha (graduate student), Summer 2015
22. Alex Aguilar, Fall 2013-Spring 2014
23. Jose Espinoza, Fall 2013-Spring 2014
24. Carlos Salinas, Fall 2012 - Spring 2014, accepted to PhD program Purdue University
25. Julian A Caballero, Fall 2012 & Fall 2013-Spring 2014
26. Samuel Cavazos, Spring 2011-2013, NSF Graduate Research Fellowship (GRF) winner 2013, accepted in PhD program Northwestern University
27. Marisabel Rodriguez, Fall 2010-Spring 2011
28. Raul Mercado Jr., Summer 2010
29. Michael Fischer, Summer 2010
30. Rodrigo Wong, Summer 2010
31. Jaime Lopez (high school), Summer 2010

Experimental Research/Visualization Projects Mentored:

1. *Topology of the Space of Chains*, with undergraduates at UMCP, Summer 2009
2. *Counting Points on Moduli Spaces*, with S. Cavazos at UTRGV, Spring 2011 - Summer 2013 (results published in Int. Journal of Mathemtics)
3. *Finding and Classifying Special Words in Free Groups*, with undergraduates at UTRGV, Fall 2012 - Summer 2014); and with undergraduates at GMU, Summer 2015-Spring 2017.
4. *Visualization in VR*, with undergraduates at GMU, Fall 2015-Summer 2017 (VR program published as companion program to the article by Pengelley, David; Ramras, Daniel *How efficiently can one untangle a double-twist? Waving is believing!*, Math. Intelligencer 39 (2017), no. 1, 27–40).
5. *Visualizing Nash-Spheres and Flat Tori Using Sine and Cosine*, with S. Mui at GMU, Fall 2015-Spring 2017.
6. *Asymptotic Ergodicity on Moduli Spaces over Finite Fields*, with undergraduates at GMU, Summer 2015-Fall 2018.
7. *Statistics in Deformations of Large Knots*, with undergraduates at GMU, Fall 2019-Spring 2020.

CONFERENCES ORGANIZED

1. Geometry Lab's United Summer 2020 Conference, ICERM, Summer 2020 (with A. Lukyanenko and J. Love)
2. Special Session on Experimental Geometry Labs, Joint Mathematics Meetings, January 2019, Baltimore, MD (co-organized with A. Lukyanenko, M. Korten)

3. Special Session on Geometry of representation spaces, Joint Mathematics Meetings, January 2019, Baltimore, MD (co-organized with C. Manon, D. Ramras)

4. Geometry Lab's United Summer 2017 Conference, University of Washington, Summer 2017 (with J. Athreya, A. Lukyanenko)

5. Mathematics Research Communities program *Character Varieties: Experiments and New Frontiers*, Snowbird, Utah, June 5– 11, 2016 (with C. Manon, and A. Sikora)

6. Geometry Lab's United Summer 2015 Conference, UIUC, Summer 2015 (with J. Athreya, A. Lukyanenko, G. Work, R. Guzman)

7. Workshop on Geometric Structures and Moduli Spaces of Representations, Howard University, Fall 2013 (with Todd Drumm)

8. AMS special Session on *Real Projective Geometry* at the 2012 Joint Mathematics Meetings, Boston (with Jeffrey Danciger, Kelly Delp, Kathryn Mann)

9. Invited participant, and organizational assistant at the Mathematics Research Communities program *The Geometry of Real Projective Structures*, Snowbird, Utah, June 2011

10. AMS Special Session on *Geometry, Topology, and Algebra of Character Varieties* at Joint Mathematics Meeting 2009, Washington, D.C. (with Elisha Peterson)

SUMMER REU PROGRAMS ORGANIZED

1. Experimental Mathematics Summer Program at GMU, June-August 2017, 7 participants

2. Experimental Mathematics Summer Program at GMU, June-August 2016, 17 participants

3. Experimental Mathematics Summer Program at GMU, June-August 2015, 20 participants

4. Experimental Mathematics Summer Program at UTRGV, June-August 2010, 5 participants

5. Experimental Mathematics Summer Program at UMCP, June-August 2009, 8 participants

HONORS & ACKNOWLEDGMENT

1. Teaching Excellence Award Winner, GMU Spring 2020

2. OSCAR Mentoring Excellence Award Winner, GMU, Spring 2020

3. Dean's Award for Faculty Achievement, UTRGV, Fall 2013

4. Math Reviews Acknowledgement:

> "Dear Professor Lawton,This is a short note to thank you for your excellent review of the article "Mixed Hodge polynomials of character varieties" by Tamas Hausel and Fernando Rodriguez-Villegas which is now available as item MR2453601 on MathSciNet and has appeared as item 2010b:14094 in the February issue of Mathematical Reviews. We at MR are well aware of the effort that it requires to write such reviews and are very proud to be able to publish them. Such reviews are of great value to the mathematical community and are first class works of scholarship also. Best regards, Graeme Fairweather"

PRESS

1. GMU Youtube, https://youtu.be/aIgkHn2fpMw, Spring 2016
2. UTRGV Youtube, https://www.youtube.com/watch?v=VAUbGCrTQOM, Spring 2014
3. FOX Channel 2 News, http://foxrio2.s3.amazonaws.com/wp-content/uploads/2013/08/Good-Day-Valley_0828-UTRGV-INTERVIEW.m4v, Summer 2013
4. Featured article "The Beauty of Numbers" in *Los Arcos* magazine, Summer 2012
5. Featured article "Deep Spaces: Geometry Labs Bring Beautiful Math to the Masses" in *Scientific American* website, Summer 2012
6. Featured article "A Mathematical Yarn: How to Stitch a Hyperbolic Pseudosphere" in *Scientific American* website, Summer 2012
7. Featured article "Experimental lab shows beauty in math through hyperbolic crochet" in *The Pan American* newspaper, Summer 2011
8. Featured article "Beautiful Principles" in *Panorama* magazine, Spring 2011

PROFESSIONAL SERVICE

1. External grant reviewer for *Swiss National Science Foundation*.
2. Consultant on starting geometry labs around USA and internationally, and on scientific board of 4-year college geometry lab proposal.
3. Letter writer for undergraduates going to graduate school, and/or jobs, and/or applying for NSF-GRF[8], letter writer for graduate students getting post-docs, letter writer for post-docs applying for tenure-track jobs, letter writer for tenure-track faculty applying for new jobs and/or tenure, letter writer for faculty applying for NSF grants. Overall, writing at least 10 per year.
4. Calculus II Course coordinator, GMU Fall 2018 & Fall 2019: (1) Met with all lectures to discuss course progress and checked all exams before given, (2) Evaluated teaching of all TAs and Lectures (formal write-ups), Made uniform online HW available for all lecturers.
5. Proposed new graduate courses at GMU and new course rotation (passed all levels of approval and implemented Spring 2020). Also, proposed/implemented new method of giving PhD "qualifying exam".
6. Topology Prelim Exam Committee, GMU 2018-2020 (chair): began process to change syllabus (working with topology/geometry faculty)
7. Algebra Prelim Exam Committee, GMU 2017-2020 (chair),& 2018-2019
8. Masters committee (chair) Stephanie Mui, GMU, 2016-2017
9. PhD committees at GMU: Jack Love (chair), Cigole Thomas (chair), Hannah Klawa, 2016-Present
10. Promotion and Tenure Committee, 2016-Present
11. Policy & Hiring Committee, GMU, 2016-2017, & 2017-2018
12. Thesis Examiner, PhD Thesis Committee for Clement Guerin, Université de Strasbourg, Spring 2016
13. Founder of Mason Experimental Geometry Lab (MEGL) at George Mason University, Director (Fall 2014-Spring 2020)
14. Founder of *Topology, Algebraic Geometry, & Dynamics Seminar* (TADS) at George Mason University, Chair (Fall 2014-Fall 2019)
15. Natural Sciences and Engineering Research Council of Canada (NSERC) Research Grant Evaluator, 2015

[8] I also participate in phone interviews and security clearance interviews on behalf of former students.

16. National Science Foundation (NSF) Research Grant Evaluator,2014
17. Elected Member of Faculty Senate at UTRGV, Fall 2013-Spring 2014
18. Executive Member of Geometry Labs United (consortium of experimental pure math labs including University of Maryland, and University of Illinois), Fall 2013-Present
19. Invited to judge Undergraduate Research Posters, Joint Mathematics Meetings, San Diego, CA, January 2013 & Baltimore, MD, January 2019
20. Invited AMS Panelist *Starting a Successful Research Career*, Joint Mathematics Meetings, San Diego, CA, January 2013
21. Director of Experimental Algebra & Geometry Lab at UTRGV, Fall 2009-Summer 2014
22. Chair of *Pure Mathematics Seminar* at University of Texas-Pan American, Fall 2009-Spring 2014
23. Chaired Calculus: organized common final (written and online versions), helped faculty with WebAssign, managed text book orders, helped with departmental assessment, Fall 2011- Fall 2012
24. Administrator of the online discussion forum for the Mathematics Department at UTRGV, Fall 2010-Fall 2012
25. Member of Departmental level committees at UTRGV: Library, Undergraduate Curriculum, Graduate Curriculum, Colloquium, Chair Search, Lecturer Search, Faculty Search

    Notable Contributions:
    - Created Pure Mathematics concentration for undergraduate mathematics major
    - Created 5 new senior level pure mathematics undergraduate courses
    - Create 2 new pure mathematics graduate courses
    - Precipitated the use of mathjobs.org for hiring
26. Member of University level committees at UTRGV: Email Outsourcing, and Academic Policy (elected vice-chair, Fall 2013)
27. Member of College level committees at UTRGV: College Science and Mathematics Research Council
28. Referee: *Crelles Journal*, *Bull. des Sci Mathematiques*, *Experimental Mathematics*, *Canadian Journal of Mathematics*, *New York Journal of Mathematics*, *Journal de l'École polytechnique - Mathématiques*, *Journal of Math and the Arts*, *Journal of Group Theory*, *Geometriae Dedicata*; *Involve*; *Journal of Differential Geometry*; *Proceedings of the American Mathematical Society*; *The International Journal of Mathematics*; *Proceedings of the Edinburgh Mathematical Society*; *Institute of Mathematical Sciences Lecture Notes*; *Prentice Hall*; *Communications in Algebra*; *Groups, Geometry, and Dynamics*; *Revista Matemática Complutense*; *Mathematische Zeitschrift*; *Compositio Mathematica*; *Duke Mathematical Journal*; *Journal of Algebra*; *Transactions of the American Mathematical Society*; *Annales de l'Institut Fourier*; *Algebraic and Geometric Topology*; *Geometry and Topology*; *Journal of Geometry and Physics*, and others.
29. Reviewer for American Mathematical Society Mathematical Reviews (42 reviews published), 2007 - 2016
30. Reviewer for Zentralblatt Mathematical Reviews (27 reviews published), 2009-2016
31. Contributor to MathOverFlow (over 6500 reputation), 2017-2019
32. Co-directed the Experimental Geometry Lab at the University of Maryland Summer 2009
33. Created and organized a funded weekly Student Geometry-Topology Seminar, Spring 2005–Spring 2006

MATHEMATICS OUTREACH

1. Nifty Fifty speaker, 2018-2019, & 2017-2018, & 2016-2017 (4 events, including one at the Department of Homeland Security for 100 kids)
   `https://usasciencefestival.org/explore/school-programs/nifty-fifty/speakers/`

2. Created two experimental geometry labs (one in TX and one in VA). Developed extensive network for outreach in both states.
3. Developed six outreach activities/scripts that have been implemented by me or my students at over 150 events in VA and 62 events in TX. Over 5530 participants in VA and over 5000 in TX (and counting). See `http://meglab.wikidot.com/outreach` for a list of events with dates, locations, and numbers of participants.
4. Trained approximately 10 undergraduates, 2 masters, and 1 PhD student to implement outreach activities. Trained Jack Love to be an outreach expert and MEGL Outreach Director (he is presently conducting most of the outreach in MEGL).
5. Trained faculty at UVA and UTRGV to conduct outreach and to use the outreach materials/scripts that I developed.
6. Personally conducted 62 outreach events in TX impacting over 5000 students (venues include: libraries, elementary schools, middle schools, high schools, museums, colleges, universities)
7. Personally conducted approximately 50 events in VA impacting over 1000 students (venues include: girl scout troops, elementary schools, middle schools, high schools, libraries, math circles, DOHS)

PROFESSIONAL MEMBERSHIPS

1. American Mathematical Society (AMS)
2. European Mathematical Society (EMS)
3. Association for Women in Mathematics (AWM)
4. National Association of Mathematicians (NAM)