Karl Schwede

CONTACT INFORMATION

Department of Mathematics
The University of Utah
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RESEARCH INTERESTS

I do basic research in mathematics, studying algebra, geometry and particularly singularities. Much of my work is in the setting of modular arithmetic (also known as clock arithmetic), the same setting as much of our modern communication systems. Within mathematics, I work on the boundary of the fields algebraic geometry and commutative algebra. I am also interested in number theory and computational algebra.

EDUCATION

University of Washington, Seattle, WA — **August 2006**
Ph.D., Mathematics
- Advisor: Sándor Kovács
- Dissertation: On F-injective and Du Bois singularities

Whitman College, Walla Walla, WA — **June 1999**
B.A., Mathematics (Honors)
- Minor: Computer Science

Bellevue Community College, Bellevue, WA — **June 1997**
Associate in Arts and Sciences

PROFESSIONAL EXPERIENCE

The University of Utah, Salt Lake City, UT
Professor — **Jul. 2018–present**
Associate Professor — **Jul. 2014–Jun. 2018**

The Pennsylvania State University, State College, PA
Assistant Professor — **Jan. 2011–Jun. 2014**

MSRI/SLMath, Berkeley CA
Research Member — **Jan.–Mar. 2009**
Research Member — **Apr.–May 2013**
Research Member — **Apr.–May 2019**
Research Member — **Apr.–May 2024**

University of Utah, Salt Lake City, UT
Visiting Assistant Professor — **Fall 2010**

Johannes Gutenberg University Mainz, Mainz Germany
Honorary Visiting Assistant Professor — **Jun. 2010**

University of Michigan, Ann Arbor, MI
NSF Postdoc / Postdoctoral Assistant Professor — **Sep. 2006–Jul. 2010**

University of Washington, Seattle WA
Teaching Assistant and Instructor — **Sep. 2000–Aug. 2006**

Havas Interactive (division of Vivendi), Walla Walla WA
Computer Programmer developing educational software — **May 1999–Aug. 2000**

Awards & Funding

PI – NSF, *Collaborative Research: Bridging Singularities in Algebra and Geometry Across Characteristics.* DMS-2501903	**Aug 2025–Jul 2027**
PI – Simons Foundation, Travel Support for Mathematicians *Singularities in zero, positive, and mixed characteristic.* SFI-MPS-TSM-00013051	**Sep 2025–Aug 2030**
PI – NSF, *A Unified Perspective on Singularities in Commutative Algebra and Algebraic Geometry.* DMS-2101800	**Sept 2021–Aug 2025**
American Mathematical Society, *Fellow of the AMS.*	**Nov. 2020–present**
Simons Foundation, *Simons Fellow in Mathematics.*	**Sep. 2020–May 2021**
co-PI – NSF, *FRG: Collaborative Research: Algebraic Geometry and Singularities in Positive and Mixed Characteristic*, DMS-1952522.	**Jun. 2020–May 2024**
PI – NSF, *RTG: Algebra, Geometry, and Topology at the University of Utah*, DMS-1840190.	**June 2019–May 2025**
PI – NSF, *Commutative Algebra: Singularities in All Characteristics with Geometric Applications*, DMS-1801849.	**Sep. 2018–Aug. 2021**
University of Utah, *Presidential Scholar*.	**Sep. 2017–Aug. 2020**
PI – NSF, *CAREER: Test Ideals and the Geometry of Projective Varieties in Positive Characteristic*, DMS-1252860/1501102.	**Sep. 2013–Aug. 2019**
PI – NSF, *FRG: Collaborative Research: Birational Geometry and Singularities in Zero and Positive Characteristic*, DMS-1265261/1501115.	**July 2013–June 2017**
co-PI – NSF, for conference *Macaulay2 Development workshop*, DMS-1601205.	**May 2016–April 2017**
Alfred P. Sloan Foundation, *Alfred P. Sloan Research Fellowship*.	**Sept. 2012–Sept. 2016**
co-PI – NSF, for conference *Computational Workshop on Singularities and Invariants Defined by Frobenius*, DMS-1160927.	**May 2012**
PI – NSF, *Singularities in Characteristic Zero and Singularities in Positive Characteristic*, DMS-0969145/1064485.	**Sept. 2010–Aug. 2013**
PI then co-PI – NSF, for conference *Frobenius splitting in algebraic geometry, commutative algebra, and representation theory*, DMS-0968646.	**May 2010**
PI – NSF, Postdoctoral Fellowship, DMS-0703505.	**Sept. 2007–Aug. 2010**

PUBLICATIONS
ALL HAVE BEEN REFEREED

1. *Gluing Schemes and a Scheme Without Closed Points.* Recent progress in arithmetic and algebraic geometry, 157–172, Contemp. Math. 386. 2005
2. *A simple characterization of Du Bois singularities.* Compos. Math. 143, no. 4, 813–828. 2007
3. *Rational singularities associated to pairs*, with S. Takagi. Michigan Math. J. 57, 625–658. 2008
4. *Generalized test ideals, sharp F-purity, and sharp test elements.* Math. Res. Lett. 15, no. 6, 1251–1261. 2008
5. *F-injective singularities are Du Bois.* Amer. J. Math. 131, no 2, 445-473. 2009
6. *F-adjunction.* Algebra & Number Theory. 3, no. 8, 907–950. 2009
7. *The canonical sheaf of Du Bois singularities*, with S. Kovács and K. Smith. Adv. Math. 224, no. 4, 1618–1640. 2010
8. *Globally F-regular and log Fano varieties*, with K. Smith. Adv. Math. 224, no. 3, 863–894. 2010
9. *A refinement of sharply F-pure and strongly F-regular pairs.* Journal of Commutative Algebra, 2, no. 1, 91–110, 2010
10. *Centers of F-purity.* Math. Z. 265, no. 3, 687-714. 2010
11. *Discreteness and rationality of F-jumping numbers on rings with singularities*, with M. Blickle, S. Takagi and W. Zhang. Math. Ann., 347, no. 4, 917-949. 2010.
12. *On the number of compatibly Frobenius split subvarieties, prime F-ideals, and log canonical centers*, with K. Tucker. Ann. Inst. Fourier (Grenoble) **60** (2010), no. 5, 1515–1531.
13. *Hodge theory meets the minimal model program: a survey of log canonical and Du Bois singularities*, with S. Kovács. Topology of Stratified Spaces (G. Friedman, E. Hunsicker, A. Libgober, and L. Maxim, eds.), Math. Sci. Res. Inst. Publ., vol. 58, Cambridge Univ. Press, Cambridge, 2011, pp. 51–94.
14. *Test ideals in non-$\mathbb{Q}$-Gorenstein rings*, Trans. Amer. Math. Soc. **363** (2011), no. 11, 5925–5941
15. *A note on discreteness of F-jumping numbers.* Proc. Amer. Math. Soc. **139** (2011), no. 11, 3895–3901
16. *Supplements to non-LC ideal sheaves*, with O. Fujino and S. Takagi. Higher Dimensional Algebraic Geometry, RIMS Kôkyûroku Bessatsu, B24, Res. Inst. Math. Sci. (RIMS), Kyoto, 2011, pp. 1–47.
17. *Semi-log canonical vs F-pure singularities*, with L. E. Miller. J. Alg. **349**, (2012), no. 1, 150–164.
18. *On the behavior of test ideals under finite morphisms*, with K. Tucker. J. Algebraic Geom. 23 (2014), no. 3, 399–443.
19. *Test ideals via a single alteration and discreteness and rationality of F-jumping numbers*, with K. Tucker and W. Zhang. Math. Res. Lett. 19, (2012), no. 01, 191–197.

Publications are continued on the next page.

PUBLICATIONS CONTINUED
ALL HAVE BEEN REFEREED

20. *A survey of test ideals*, with K. Tucker. *Progress in Commutative Algebra 2, Closures, Finiteness and Factorization*, Walter de Gruyter GmbH & Co. KG, Berlin, (2012), 39–99.

21. *An algorithm for computing compatibly Frobenius split subvarieties*, with M. Katzman. J. Symbolic Comput., **47**, (2012), no. 8, 996-1008.

22. *Cartier modules on toric varieties*, with J.-C. Hsiao, and W. Zhang. Trans. Amer. Math. Soc. 366 (2014), no. 4, 1773-1795.

23. *Du Bois singularities deform*, with S. Kovács. in *Minimal Models and Extremal Rays (Kyoto, 2011)*, Adv. Stud. Pure Math. (2016), 70, 49–66.

24. *A canonical linear system associated to adjoint divisors in characteristic* $p > 0$. J. Reine Angew. Math. 696 (2014), 69-87.

25. p^{-1}*-linear maps in algebra and geometry*, with M. Blickle. Commutative Algebra, Expository Papers Dedicated to David Eisenbud on the Occasion of His 65th Birthday (I. Peeva ed.), Springer New York Heidelberg Dordrecht London, 2013, pp. 123–205.

26. *F-signature of pairs and the asymptotic behavior of Frobenius splittings*, with M. Blickle and K. Tucker. Adv. Math. **231**, (2012) no. 6, 3232-3258.

27. *F-signature of pairs: Continuity, p-fractals and minimal log discrepancies*, with M. Blickle and K. Tucker. J. London Math. Soc. **87** (2013), no. 3, 802–818.

28. *Richardson varieties have Kawamata log terminal singularities*, with S. Kumar. Int. Math. Res. Not. IMRN 2014, no. 3, 842-864.

29. *Bertini theorems for F-singularities*, with W. Zhang. Proc. Lond. Math. Soc. (3) 107 (2013), no. 4, 851-874.

30. *A dual to tight closure theory*, with N. Epstein. Nagoya Math. J. 213 (2014), 41-75.

31. *Depth of F-singularities and base change of relative canonical sheaves*, with Z. Patakfalvi. Journal of the Institute of Mathematics of Jussieu. **13**, no. 1, (2014) 43–63.

32. *On the numerical dimension of pseudo-effective divisors in positive characteristic*, with P. Cascini, C. Hacon and M. Mustaţă. Amer. J. Math. 136 (2014), no. 6, 1609-1628.

33. *Appendix: F-injectivity and depth*, with A. K. Singh. Appendix to *Deformations of F-injectivity and local cohomology* by J. Horiuchi, L. E. Miller and K. Shimomoto. Indiana Univ. Math. J. 63 (2014), no. 4, 1139-1157.

34. *A Frobenius variant of Seshadri constants*, with M. Mustaţă. Math. Ann. 358 (2014), no. 3-4, 861-878.

35. *Explicitly extending Frobenius splittings over finite maps*, with K. Tucker. Comm. Algebra 43 (2015), no. 10, 4070-4079.

36. *Rings of Frobenius operators*, with M. Katzman, A. K. Singh and W. Zhang. Math. Proc. Cambridge Philos. Soc. 157 (2014), no. 1, 151-167.

Publications are continued on the next page.

PUBLICATIONS CONTINUED
ALL HAVE BEEN REFEREED

37. *Test ideals of non-principal ideals: Computations, Jumping Numbers, Alterations and Division Theorems*, with K. Tucker. J. Math. Pures Appl. (9) 102 (2014), no. 5, 891-929.

38. *F-singularities via alterations*, with M. Blickle and K. Tucker. Amer. J. Math. 137 (2015), no. 1, 61–109.

39. *The weak ordinarity conjecture and F-singularities*, with B. Bhatt and S. Takagi. Adv. Stud. Pure Math., 74, Math. Soc. Japan, Tokyo, 2017.

40. *Uniform bounds for strongly F-regular surfaces*, with Paolo Cascini and Yoshinori Gongyo. Trans. Amer. Math. Soc. 368 (2016), no. 8, 5547-5563.

41. *On rational connectedness of globally F-regular threefolds*, with Y. Gongyo, Z. Li, Z. Patakfalvi, H. Tanaka, and R. Zong. Adv. Math. 280 (2015), 47–78.

42. *Inversion of adjunction for rational and Du Bois pairs*, with S. Kovács. Algebra & Number Theory. 10 (2016), no. 5, 969–1000.

43. *Test ideals in rings with finitely generated anti-canonical algebras*, with A. Chiecchio, F. Enescu and L. E. Miller. J. Inst. Math. Jussieu 17 (2018), no. 1, 171–206.

44. *The F-different and a canonical bundle formula*, with O. Das. Ann. Sc. Norm. Super. Pisa Cl. Sci. 17 (2017), no 3, 1173–1205

45. *F-singularities in families*, with Z. Patakfalvi and W. Zhang. Algebr. Geom. 5 (2018), no. 3, 264–327.

46. *Positive characteristic algebraic geometry*, with Z. Patakfalvi and K. Tucker. Surveys on recent developments in algebraic geometry, 33–80, Proc. Sympos. Pure Math., 95, Amer. Math. Soc., Providence, RI, 2017.

47. *On the behavior of singularities at the F-pure threshold*, with E. Canton, D. Hernández and E. Witt. Appendix by Alessandro De Stefani, Jack Jeffries, Zhibek Kadyrsizova, Robert Walker, George Whelan. Illinois J. Math. 60 (2016), no. 3–4, 669–685

48. *The dualizing complex of F-injective and Du Bois singularities*, with B. Bhatt and L. Ma. Math. Z. 288 (2018), no. 3–4, 1143–1155.

49. *Discreteness of F-jumping numbers at isolated non-$\mathbb{Q}$-Gorenstein points*, with P. Graf. Proc. Amer. Math. Soc. 146 (2018), no. 2, 473–487.

50. *Local cohomology of Du Bois singularities and applications to families.*, with L. Ma and K. Shimomoto. Compos. Math. 153 (2017), no. 10, 2147–2170.

51. *Fundamental groups of F-regular singularities via F-signature*, with J. Carvajal-Rojas and K. Tucker. Ann. Sci. Éc. Norm. Supér. (4) 51 (2018), no. 4, 993–1016.

52. *Étale fundamental groups of strongly F-regular schemes*, with B. Bhatt, J. Carvajal-Rojas, P. Graf and K. Tucker. Int. Math. Res. Not. IMRN 2019, no. 14, 4325–4339.

53. *Divisor package for Macaulay2*, with Z. Yang. J. Softw. Algebra Geom. 8 (2018), 87—94.

Publications are continued on the next page.

PUBLICATIONS CONTINUED
ALL HAVE BEEN REFEREED

54. *Perfectoid multiplier/test ideals in regular rings and bounds on symbolic powers*, with L. Ma. Invent. Math. 214 (2018), no. 2, 913–955.

55. *F-signature under birational morphisms*, with L. Ma., T. Polstra, K. Tucker. Forum Math. Sigma 7 (2019), e11.

56. *The TestIdeals package for Macaulay2*, with A. F. Boix, D. J. Hernández, Z Kadyrsizova, M. Katzman, S. Malec, M. Robinson, D. Smolkin, P. Teixeira, E. E. Witt. J. Softw. Algebra Geom. 9 (2019), no. 2, 89–110.

57. *Recent applications of p-adic methods to commutative algebra*, with L. Ma. Notices Amer. Math. Soc. 66 (2019), no. 6, 820—831.

58. *Seminormalization package for Macaulay2*, with B. Serbinowski. J. Softw. Algebra Geom. 10 (2020), no. 1, 1–7.

59. *A Kunz-type characterization of regular rings via alterations*, with L. Ma J. Pure Appl. Algebra 224 (2020), no. 3, 1124–1131.

60. *Singularities in mixed characteristic via Perfectoid big Cohen-Macaulay algebras*, with L. Ma. Duke Math. J. 170 (2021), no. 13, 2815–2890.

61. *The FrobeniusThresholds package for Macaulay2*, with D. J. Hernández, P. Teixeira, E. E. Witt. J. Softw. Algebra Geom. 11 (2021), no. 1, 25–39.

62. *Bertini Theorems for F-signature*, with J. Carvajal-Rojas and K. Tucker. Math. Z. 299 (2021), no. 1-2, 1131–1153.

63. *Covers of rational double points in mixed characteristic*, with J. Carvajal-Rojas, L. Ma, T. Polstra, K. Tucker. Covers of rational double points in mixed characteristic. J. Singul. 23 (2021), 127–150.

64. *Maximal Cohen-Macaulay complexes and their uses: A partial survey*, with S. Iyengar, L. Ma, M. Walker. `arXiv:2106.08173`. Commutative algebra, 475-500, Springer, Cham, (2021).

65. *An analog of adjoint ideals and PLT singularities in mixed characteristic*, with L. Ma, K. Tucker, J. Waldron, J. Witaszek. J. Algebraic Geom. 31 (2022), no. 3, 399–443.

66. *RationalMaps, a package for Macaulay2*, with C.J. Bott, S. H. Hassanzadeh, D. Smolkin. J. Softw. Algebra Geom. 12 (2022), no. 1, 17-26.

67. *Symbolic power containments in singular rings in positive characteristic*, with E. Grifo and L. Ma. Manuscripta Math. 170 (2023), no. 3-4, 471-496.

68. *Compatible ideals in Gorenstein rings*, with T. Polstra. Proc. Amer. Math. Soc. 151 (2023), no. 10, 4099-4112.

69. *Finding points on varieties with Macaulay2*, with S. Bisui, S. Maitra, T. T. Nguyên. J. Softw. Algebra Geom. 13 (2023), no. 1, 33-43.

70. *FastMinors package for Macaulay2*, with B. Martinova, M. Robinson, Y. Yao. `arXiv:2002.05758`. J. Softw. Algebra Geom. 13 (2023), no. 1, 13-31.

71. *Globally +-regular varieties and the minimal model program for threefolds in mixed characteristic*, with B. Bhatt, L. Ma, Z. Patakfalvi, K. Tucker, J. Waldron, J. Witaszek. Publ. Math. Inst. Hautes Études Sci.138(2023), 69-227.

Publications are continued on the next page.

PUBLICATIONS CONTINUED
ALL HAVE BEEN REFEREED

72. *Global generation of test ideals in mixed characteristic and applications*, with C. Hacon, A. Lamarche. Algebr. Geom.11(2024), no.5, 676–711.

73. *Finite generation of split F-regular monoid algebras*, with R. Datta, K. Tucker. J. Lond. Math. Soc. (2) 112 (2025), no. 1, Paper No. e70234, 55 pp.

ACCEPTED PAPERS

74. *The Briançon-Skoda Theorem via weak functoriality of big Cohen-Macaulay algebras*, with S. Rodríguez-Villalobos. To appear in Michigan Math. J., `arXiv:2406.02433`.

75. *Plus-pure thresholds of some cusp-like singularities in mixed characteristic*, with H. Cai, S. Pande, E. Quinlan-Gallego, K. Tucker. To appear in J. Comm. Algebra, `arXiv:2501.07528`.

76. *Perfectoid signature, perfectoid Hilbert-Kunz multiplicity, and an application to local fundamental groups*, with H. Cai, S. Lee, L. Ma, K. Tucker. To appear in Inventiones `arXiv:2209.04046`, `https://doi.org/10.1007/s00222-025-01399-w`.

SUBMITTED PAPERS /PREPRINTS

77. *Test ideals in mixed characteristic: a unified theory up to perturbation*, with B. Bhatt, L. Ma, Z. Patakfalvi, K. Tucker, J. Waldron, J. Witaszek. `arXiv:2401.00615`.

78. *Perfectoid pure singularities*, with B. Bhatt, L. Ma, Z. Patakfalvi, K. Tucker, J. Waldron, J. Witaszek. `arXiv:2409.17965`.

79. *BCM-thresholds of non-principal ideals*, with S. Rodríguez-Villalobos. `arXiv:2501.16773`.

80. *Closure operations induced via resolutions of singularities in characteristic zero*, with N. Epstein, P. M. McDonald, R. R.G. `arXiv:2504.05554`.

81. *Variants on Frobenius Intersection Flatness and Applications to Tate Algebras*, with with N. Epstein, R. Datta, K. Tucker. `arXiv:2504.06444`.

82. *Bounds on the plus-pure thresholds of some hypersurfaces in (ramified) regular rings*, M. Benozzo, V. Jagathese, V. Pandey, P. Ramírez-Moreno, P. Sridhar. `arXiv:2509.07217`.

83. *The Briançon-Skoda theorem for pseudo-rational and Du Bois singularities and uniformity in excellent rings*, with L. Ma, P McDonald, R. R.G. `arXiv:2510.11540`.

BOOK DRAFT

84. *Singularities defined by Frobenius and applications*, with K. E. Smith. Book draft. The latest version is available here: `https://github.com/kschwede/FrobeniusSingularitiesBook`.

SOFTWARE

- RationalMaps package for Macaulay2, a package for checking whether a rational map is birational/regular/an embedding. With C.J. Bott, H. Hassanzadeh, and D. Smolkin. The current version is in the Macaulay2 build tree: `https://github.com/Macaulay2/M2/tree/master/M2/Macaulay2/packages` **2016–present**

SOFTWARE CONTINUED

- Seminormalization package for Macaulay2, a package for computing seminormalizations. With B. Serbinowski. The current version is in the Macaulay2 build tree: `https://github.com/Macaulay2/M2/tree/master/M2/Macaulay2/packages` **2018–present**
- Pullback package for Macaulay2, a package for computing pullbacks in the category of rings. With D. Ellingson. It is part of the current Macaulay2 build tree: `https://github.com/Macaulay2/M2/tree/master/M2/Macaulay2/packages` **2015–present**
- Divisor package for Macaulay2, a package for computations with Weil divisors on normal varieties. With Z. Yang. It is part of the current Macaulay2 build tree: `https://github.com/Macaulay2/M2/tree/master/M2/Macaulay2/packages` **2014–present**
- Macaulay2 function for computing compatibly split subvarieties, With Mordechai Katzman. Download the current version: `http://www.math.utah.edu/~schwede/M2/FSplitting.m2` **2012–present**
- TestIdeals package for Macaulay2, a package for computing F-singularities (test ideals, F-rationality, etc.). With E. Bela, A. F. Boix, J. Bruce, D. Hernandez, Z. Kadyrsizova, M. Katzman, S. Malec, M. Robinson, D. Smolkin, P. Teixeira and E. Witt. The latest stable version of `TestIdeals` is in the Macaulay2 build tree: `https://github.com/Macaulay2/M2` **2012–present**
- FrobeniusThresholds package for Macaulay2, a package for computing F-thresholds and related invariants. With J. Bruce, D. Hernandez, D. Smolkin, P. Teixeira and E. Witt. The latest stable version of `FrobeniusThresholds` is in the Macaulay2 build tree: `https://github.com/Macaulay2/M2` **2018–present**
- FastMinors package for Macaulay2, faster function field linear algebra (with applications to singularities). With B. Martinova, M. Robinson, Y. Yao. The stable version is in the Macaulay2 build tree: `https://github.com/Macaulay2/M2` **2019–present**
- RandomPoints package for Macaulay2, a package for finding rational points on varieties over finite fields. With Sankhaneel Bisui, Sarasij Maitra, Thai Nguyen, Zhan Jiang. The latest stable version of `RandomPoints` is in the Macaulay2 build tree: `https://github.com/Macaulay2/M2` **2020–present**
- NonPrincipalTestIdeals package for Macaulay2, a package for computing test ideals of non-principal ideals. With Trung Chau and Hunter Simper, and the contributions of Rahul Ajit and Matthew Bertucci. The latest stable version of `NonPrincipalTestIdeals` is in the Macaulay2 build tree: `https://github.com/Macaulay2/M2` **2024–present**

ORGANIZATIONAL ACTIVITIES

- Organizer for the conference *Notions of Singularity in Different Characteristics*, Banff Canada (BIRS) **Oct. 2025**
- Organizer for the conference *Singularities in Algebra and Geometry*, CIMAT, Guanajuato City, Mexico **Jun. 2025**
- Organizer for the Conference *Moduli of Varieties*, University of Utah **Nov. 2024**
- Organizer for the Fall School *Methods in Mixed Characteristic Geometry*, Mainz Germany **Oct. 2024**
- Faculty co-organizer of BRIDGES (Building Relationships for an Inclusive and Diverse Group of Emerging Students), Organized by the U. of Utah chapter of the AWM, funded by the RTG grant, DMS-1840190. **July 2024**
- On the scientific committee for the conference *Epiga 2024*, Sorbonne Université, Paris **Jun. 2024**
- Organizer for the conference and summer school *Macaulay2, Computational Algebraic Geometry and String Theory*, to be held at the University of Utah **May-Jun. 2024**
- Lead organizer for the workshop *Recent Developments in Commutative Algebra*, to be held in MSRI During the special Commutative Algebra Semester **Apr. 2024**
- On the organizing committee of *The Fellowship of the Ring*, national commutative algebra online seminar. `https://sites.google.com/view/fellowship-of-the-ring` **Apr. 2020 – present**
- Co-organizer of an AMS Special Session, held at the University of Utah **Oct. 2022**
- Co-organizer of the conference: *Advances in Mixed Characteristic Commutative Algebra and Geometric Connections*, at Oaxaca (BIRS) **May 2022**
- Co-organizer of the virtual special month on Singularities and K-stability at the University of Utah, `https://sites.google.com/view/special-month-on-singularities` **May-Jun. 2021**
- Co-organizer of an AMS Special Session, held at the University of Michigan **Oct. 2018**
- Co-organizer of an AMS Special Session, held at Portland State University **Apr. 2018**
- Co-organizer of an AMS Special Session, held that the Joint Mathematics Meetings in San Diego **Jan. 2018**
- Co-organizer of the conference: *Higher dimensional algebraic geometry and characteristic $p > 0$*, held at CIRM / Luminy **Sept. 2016**
- Co-organizer of the summer school and conference: *Higher Dimensional Algebraic Geometry* held at the University of Utah **Jul. 2016**
- Co-organizer of the workshop: *Intensive Workshop for Macaulay2 Development*, held at the University of Utah **May 2016**
- Co-organizer of the AMS special session: *Algebraic Geometry*, held at the University of Utah **Apr. 2016**

Organizational activities are continued on the next page.

ORGANIZATIONAL ACTIVITIES CONTINUED

- Co-organizer of the AMS-AWM special session: **Jan. 2016**
  Commutative Algebra and Its Interactions with Algebraic Geometry, held at the Joint Mathematical Meetings
- Co-organizer of the *Mathematical Research Communities Workshop on Commutative Algebra* held at Snowbird Utah **Jun. 2015**
- Co-organizer of the *Positive Characteristic Algebraic Geometry Workshop* held at the University of Illinois at Chicago **Mar. 2014**
- Co-organizer of the AMS special session: **Jan. 2014**
  Homological and characteristic p methods in commutative algebra, held at the Joint Mathematical Meetings, Baltimore
- Co-organizer of the AMS special session: **Oct. 2013**
  Special Session on The Geometry of Algebraic Varieties, held at Temple University
- Organizer/co-organizer of the Penn State algebra and number theory seminar. **2013-2014**
- Co-organizer of a mini-symposium at: **Aug. 2013**
  SIAM conference on Applied Algebraic Geometry, held at Colorado State University
- Co-organizer of the conference: **May 2012**
  Computational workshop on Frobenius singularities and invariants, held at the University of Michigan, see
  `http://sites.google.com/site/computingfinvariantsworkshop/`
- Co-organizer of the AMS Special Session: **Mar. 2012**
  Singularities in Commutative Algebra and Algebraic Geometry, held at the University of Kansas
- Co-organizer of the conference: **Aug. 2011**
  Relating test ideals and multiplier ideals, held at the American Institute of Mathematics
- Co-organizer of the conference: **May 2010**
  Frobenius splitting in algebraic geometry, commutative algebra, and representation theory, see
  `http://sites.google.com/site/frobeniussplitting/`
- Assistant to the organizers of *Commutative algebra* AMS MRC summer conference/school in Snowbird Utah **Jun. 2010**
- Organizer/co-organizer of the University of Michigan commutative algebra seminar. **2008–2010**
- Local organizer for Mel Hochster's 65th birthday conference. **Aug. 2008**
- Organizer/co-organizer of the University of Michigan topics in algebraic geometry seminar. **2007–2008**
- Organizer of the University of Washington algebraic geometry seminar. **2004–2005**
- Co-organizer of the University of Washington undergraduate mathematical sciences seminar **2004–2005**

Professional activities are continued on the next page.

Editorial professional activities

- Associate editor for the Journal of Singularities. **2024–present**
  `https://epiga.episciences.org/`
- Editor for the journal Épijournal de Géométrie Algébrique. **2021–present**
  `https://epiga.episciences.org/`
- Series Editor for the RSME Springer Series. **2015–present**
  `http://www.springer.com/series/13759`

University service activities

- Mathematics Department RPT (Retention, Promotion, Tenure), Elected Chair **2023–2025**
- Special Assistant to the Dean of the College of Science, University of Utah. **2020–2022**
- Director of Graduate Studies, University of Utah. **2015–2017**
- Member of the following committees at the University of Utah:

Mathematics Computing Committee.	**2025-2026**
Mathematics tenured faculty review subcommittee.	**2025-2026**
Pre-tenure informal review committee.	**2024-2025**
Pre-tenure informal review committee.	**2024-2025**
Postdoc Hiring Committee.	**2023–2024**
Faculty Review Committee, Mathematics Department	**2022–2023**
Executive Committee, Mathematics Department	**2017–2019, 2022–2024**
Senate IT Committee (SACIT).	**2021–present**
Hiring committee.	**2021–2022, 2024-2025**
Mathematics EDI committee.	**2021–2022**
College of Science EDI committee.	**2021–2022**
Graduate Recruitment Committee.	**2014–2017, 2019**
Graduate Committee.	**2014–2017**
Outstanding Graduate Student & Instructor Award Committee.	**2015–2017**
Outstanding dissertation award committee (Graduate School)	**Summer 2016**
Ad hoc committee on thesis formatting (Graduate School)	**2016–2019**
University TAship award committee (Graduate School)	**Spring 2017**
Bachelor of Undergraduate Studies (BUS) Committee	**2018–2020**
Departmental Thesis Standards Committee	**2018–2020**
Various ad hoc committees (ie, promotion and tenure).	**Various years**

- Member of the following committees at Penn State: Qualifying Exam Committee, Graduate Student Teaching Committee, Library Committee, Eberly College Outreach Council. **2011–2014**

Other professional activities

- Ran a research group for the *Apprenticeship program in commutative algebra*, Fields Institute, Toronto — **Jan. 2025**
- Ran a 3-week long math camp for high school students, *Explorations in Number Theory and Cryptography*, University of Utah — **June 2016**
- Ran a week-long math camp for high school students, *Spy Games: the math of secret messages*, within Penn State's *Science-U* camp program. — **June 2013 and July 2014**
- Helped build and maintain *Situs Geometriae Algebraicae*, a website designed to help students in algebraic geometry find references. — **2004–2008**
- (Now somewhat) active participant on `http://www.mathoverflow.net`. — **2010–present**
- Reviewed papers for AMS Math Reviews and Zentralblatt Math. — **2006–present**
- Helped develop the University of Washington VIGRE website. — **2002–2003**
- Panelist for NSF grant applications (various sorts) — **Various years**
- Referee for NSA grant applications. — **Various years**
- Referee for Simons Foundation grant applications. — **Various years**
- Referee for grant/fellowship applications from other institutions/foundations (ERC/DFG/etc.). — **Various years**

Refereed & reviewed papers for the journals:

Journal of the American Mathematical Society, Forum of Math: Pi, Annales Scientifiques de l'École Normale Supérieure, American Journal of Mathematics, Inventiones Mathematica, Duke Mathematical Journal, Journal of the European Mathematical Society, Advances in Mathematics, Journal of Algebraic Geometry, Compositio Mathematica, Mathematische Annalen, Journal für die reine und angewandte Mathematik, Algebraic Geometry, Transactions of the American Mathematical Society, Mathematical Research Letters, International Mathematics Research Notices, Proceedings of the American Mathematical Society, Mathematische Zeitschrift, Discrete Math, Israel Journal of Mathematics, Journal of Symbolic Computation, Scuola Normale Superiore (Annali di Scienze), the Illinois Journal of Mathematics, Algebra and Number Theory, the Journal of Algebra, Journal of Pure and Applied Algebra, Annales de l'institut Fourier, Communications in Algebra, Journal of Commutative Algebra, the Michigan Mathematical Journal, AMS Contemporary Mathematics, Pure and Applied Mathematics Quarterly, Manuscripta Mathematica, Central European Mathematics Journal, Canadian Journal of Mathematics, Nagoya Mathematical Journal, Journal of the London Mathematical Society, the Kyoto Journal of Mathematics, American Mathematical Monthly, Periodica Mathematica Hungarica, Mathematical Proceedings of the Cambridge Philosophical Society, miscellaneous proceedings volumes. — **2007–present**

Teaching

Instructor: I have been an instructor for:

- high school level algebra, University of Washington.
- precalculus, University of Washington.
- calculus, University of Washington, University of Michigan, University of Utah.
- multivariable calculus (Stokes theorem etc.), University of Washington.
- topology, University of Washington.
- linear algebra, University of Michigan.
- honors calculus (essentially introduction to real analysis), University of Michigan.
- introduction to topology, University of Washington.
- introduction to schemes and cohomology, University of Michigan..
- topics course on algebraic geometry and commutative algebra, University of Utah.
- undergraduate abstract algebra, Penn State University & University of Utah.
- graduate-level commutative algebra, Penn State University & University of Utah.
- discrete mathematics (intro. proofs), Penn State University & University of Utah.
- honors multivariable calculus, University of Utah.
- graduate abstract algebra I & II, University of Utah & Penn State University.
- cryptography, University of Utah.
- topics in commutative algebra, University of Utah.
- introductory algebraic geometry, University of Utah.
- introduction to real analysis, University of Utah.
- undergraduate abstract algebra I & II, University of Utah.

Students & Mentoring

Ph.D. students.

- Andrew Bydlon (Summer 2017, University of Utah, transferred from PSU)
- Javier Carvajal-Rojas (Summer 2018, University of Utah)
- Daniel Smolkin (Summer 2019, University of Utah)
- Marcus Robinson (Summer 2020, University of Utah)
- Seungsu Lee (Summer 2023, University of Utah)
- Peter McDonald, joint with Srikanth Iyengar (Summer 2024, University of Utah, expected)
- Hanlin Cai, joint with Sean Howe (Summer 2024, University of Utah)
- Sandra Rodríguez-Villalobos (Summer 2026, University of Utah, expected)
- Rahul Ajit, joint with Christohper Hacon (Summer 2026, University of Utah, expected)
- Yotam Svoray (Summer 2026, University of Utah, expected)
- Anne Fayolle (Summer 2027, University of Utah, expected)
- Gari Chua (Summer 2029, University of Utah, expected)

Masters students.

- Faith Pearson (Spring 2021, University of Utah)
- Ruyi Ma (Fall 2022, University of Utah)

Postdocs.

- Linquan Ma (2015-2018)
- Thomas Polstra (2017-2020)
- Alicia Lamarche, co-mentored with Aaron Bertram, (2020-2024)
- Eamon Quinlan, co-mentored with Anurag Singh, (2021-2025 expected)
- Quentin Posva, co-mentored with Christopher Hacon, (2022-2023)
- Suchitra Pande, (2024-2027 expected)

SELECTED TALKS

- University of Washington algebra seminar — **Febrary 2004**
- University of Michigan algebraic geometry seminar — **November 2005**
- University of Washington algebra seminar — **January 2006**
- Bellingham algebraic geometry seminar (BAGS) — **February 2006**
- Recent Trends in Higher Dimensional Geometry, conference in Banff Canada (BIRS) — **April 2006**
- Rice algebraic geometry seminar — **March 2006**
- University of Michigan algebraic geometry seminar — **November 2006**
- Davidson College AMS meeting, special session in commutative algebra — **March 2007**
- F-singularities and D-modules conference in Ann Arbor — **August 2007**
- University of Illinois at Chicago algebraic geometry seminar — **February 2008**
- Purdue University working algebraic geometry seminar — **February 2008**
- University of Georgia algebraic geometry seminar — **April 2008**
- Conference in honor of Mel Hochster's 65th birthday — **August 2008**
- University of Washington algebra seminar — **September 2008**
- Vancouver British Columbia AMS Meeting, special session in algebraic geometry — **October 2008**
- University of Illinois at Urbana-Champaign algebraic geometry seminar — **October 2008**
- University of Utah commutative algebra seminar — **November 2008**
- Western algebraic geometry seminar (WAGS conference) — **November 2008**
- Syracuse University, colloquium — **January 2009**
- University of North Carolina, colloquium — **February 2009**
- University of Illinois at Urbana Champaign AMS meeting, special session in commutative algebra — **March 2009**
- University of Illinois at Urbana-Champaign, colloquium — **April 2009**
- Purdue University algebraic geometry seminar — **April 2009**
- Commutative Algebra and its Connections to Geometry (honoring Wolmer Vasconcelos), Pan-American Advanced Study Institute, Olinda Brazil — **August 2009**
- University of Kansas, algebra seminar — **September 2009**
- Higher Dimensional Algebraic Geometry conference, Research Institute for Mathematical Sciences, Kyoto University, Japan — **December 2009**
- Joint mathematical meetings in San Francisco, special session on commutative algebra — **January 2010**
- Corcordia University, colloquium — **January 2010**
- Washington University, colloquium — **January 2010**
- Indiana University Bloomington, algebra seminar — **January 2010**
- Indiana University Bloomington, colloquium — **January 2010**
- University of Missouri, colloquium — **January 2010**
- Louisiana State University, colloquium — **February 2010**
- Wayne State University, colloquium — **February 2010**
- Penn State University, colloquium — **February 2010**
- Rice University, colloquium — **February 2010**
- Sheffield University, lecture series — **March 2010**

Talks are continued on the next page.

Selected Talks Continued

- Lexington Kentucky AMS Meeting, special session in commutative algebra — **March 2010**
- Harvard-MIT algebraic geometry seminar — **April 2010**
- Frobenius splitting conference — **May 2010**
- Algebra seminar, Johannes Gutenberg-Universität Mainz — **June 2010**
- Commutative Algebra in the Southeast, Conference, Atlanta Georgia — **September 2010**
- University of Utah, Colloquium — **September 2010**
- Purdue University working algebraic geometry seminar — **October 2010**
- Purdue University commutative algebra seminar — **October 2010**
- CIRM, Luminy, Commutative algebra and its interactions with algebraic geometry — **November 2010**
- Western algebraic geometry seminar (WAGS conference) — **November 2010**
- Joint mathematical meetings in New Orleans, special session on commutative algebra — **January 2011**
- Penn State University, algebra and number theory seminar — **February 2011**
- Berkeley-Davis-Stanford Algebraic Geometry Colloquium — **March 2011**
- University of Michigan commutative algebra seminar — **March 2011**
- Midwest Commutative Algebra and Geometry Conference — **May 2011**
- University of Washington, algebra and algebraic geometry seminar — **May 2011**
- Workshop on Almost Purity, University of Michigan — **May 2011**
- University of Osnabrück, college seminar - combinatorial structures in algebra and topology — **June 2011**
- Johannes Gutenberg-Universität Mainz - algebra seminar — **July 2011**
- University of Nebraska - algebraic geometry seminar — **August 2011**
- Route 81 Conference on Commutative Algebra and Algebraic Geometry - Cornell University — **September 2011**
- Stony Brook University, algebra, geometry and physics seminar — **September 2011**
- University of Michigan commutative algebra seminar — **October 2011**
- University of Utah AMS meeting, special session in commutative algebra — **October 2011**
- Sheffield University, lecture series — **January 2012**
- Universitat de Barcelona / Universitat Politécnica de Catalunya (joint seminar), Seminari de Geometria Algebraica — **January 2012**
- Penn State University, GAP Seminar — **February 2012**
- University of Illinois at Chicago, algebraic geometry seminar — **March 2012**
- Penn State University, algebra and number theory seminar — **March 2012**
- Princeton University, algebraic geometry seminar — **March 2012**
- Johns Hopkins University, algebraic geometry/number theory seminar — **March 2012**
- ACC for minimal log discrepancies and termination of flips conference, American Institute of Mathematics — **May 2012**
- char-p & p-adic geometry conference, Mainz Germany — **June 2012**

Talks are continued on the next page.

Selected Talks Continued

- University of Utah, algebraic geometry seminar **September 2012**
- Ohio State University, algebraic geometry seminar **September 2012**
- Georgia State University, colloquium **October 2012**
- Georgia State University, commutative algebra seminar **October 2012**
- Johns Hopkins University, algebraic geometry/number theory seminar **November 2012**
- Princeton University, algebraic geometry seminar **November 2012**
- Trends in Arithmetic Geometry, Lorentz Center, Leiden, the Netherlands **January 2013**
- Penn State, algebra and number theory seminar **February 2013**
- University of Washington, algebra and algebraic geometry seminar **March 2013**
- Columbia University, algebraic geometry seminar **March 2013**
- Imperial College of London, 6 lectures, Workshop: Characteristic p methods in algebraic geometry **April 2013**
- Southern California Algebraic Geometry Seminar, a joint meeting of Caltech, UC Los Angeles, UC San Diego, and the University of Southern California **April 2013**
- American Institute of Mathematics, conference on The minimal model program in characteristic p. **May 2013**
- Math Science Research Institute, Conference: The Commutative Algebra of Singularities in Birational Geometry: Multiplier Ideals, Jets, Valuations, and Positive Characteristic Methods **May 2013**
- CIRM Luminy, Commutative algebra and its interactions with algebraic geometry **July 2013**
- Penn State University, algebra and number theory seminar **August 2013**
- University of Georgia, algebraic geometry seminar **September 2013**
- Georgia State University, commutative algebra seminar **September 2013**
- Johns Hopkins University, algebraic geometry/number theory seminar **October 2013**
- Birational Geometry and Singularities in Positive Characteristic, a conference at the University of Tokyo **November 2013**
- Mini-workshop on Cremona groups – University of Utah **November 2013**
- University of Illinois at Chicago algebraic geometry seminar **November 2013**
- Joint mathematical meetings in Baltimore, special session on algebraic geometry **January 2014**
- University of California at Irvine, colloquium **January 2014**
- University of California at Davis, colloquium **January 2014**
- University of Utah, colloquium **February 2014**
- University of California at Utah, algebraic geometry seminar **February 2014**
- Birational Geometry and Foliations workshop – Hausdorff Research Institute for Mathematics **February 2014**
- Queens University, algebraic geometry seminar **March 2014**

Talks are continued on the next page.

Selected Talks Continued

- University of South Carolina, colloquium **March 2014**
- Texas Algebraic Geometry Symposium (TAGS) **March 2014**
- George Mason University, colloquium **April 2014**
- George Mason University, combinatorics and algebra seminar **April 2014**
- Penn State University, algebra and number theory seminar **April 2014**
- Introduction to Cartier modules (3 lectures), Special Month on "Birational Geometry and Singularities in Zero and Positive Characteristic" held at the University of Michigan. **June 2014**
- Research presentation, Special Month on "Birational Geometry and Singularities in Zero and Positive Characteristic" held at the University of Michigan. **June 2014**
- University of Utah, algebraic geometry seminar **September 2014**
- Route 81 conference – Cornell University **September 2014**
- Western algebraic geometry seminar (WAGS conference) – University of Idaho **October 2014**
- Georgia algebraic geometry symposium (GAGS conference) – University of Georgia **October 2014**
- Georgia Tech, algebra seminar **October 2014**
- University of Michigan, algebraic geometry seminar **January 2015**
- Georgetown University AMS Meeting, Special Session on Closure Operations in Commutative Algebra **March 2015**
- Conference on Frobenius Operators and Cartier Algebras – Georgia State University **March 2015**
- AMS summer institute in Algebraic Geometry – University of Utah **July 2015**
- Mini-course at the Multiplier ideals, Test ideals and Bernstein-Sato polynomials, conference – Universitat Politécnica de Catalunya, Barcelona **September 2015**
- Joint mathematical meetings in Seattle, special session on commutative algebra, **January 2016**
- University of Illinois at Chicago, algebraic geometry seminar **April 2016**
- Differential forms in algebraic geometry (conference) – University of Freiburg, Germany **September 2016**
- KUMUNU – regional commutative algebra conference **October 2016**
- Nihon University Singularities Seminar **November 2016**
- University of Tokyo Algebraic Geometry Seminar **November 2016**
- SLAM (Southwest Local Algebra Meeting) – University of New Mexico **March 2017**
- AGNES (Algebraic Geometry Northeastern Series) – Stony Brook University **April 2017**
- London Geometry and Topology Seminar **May 2017**
- Higher Dimensional Algebraic Geometry 2017, Taipei, Taiwan **June 2017**
- The Prospects for Commutative Algebra, Osaka, Japan **July 2017**

Talks are continued on the next page.

Selected Talks Continued

- University of North Texas AMS Meeting, Special Session on Commutative Algebra, Denton, Texas — **September 2017**
- EPFL Lausanne, Algebraic Geometry Seminar — **September 2017**
- Algebraic Geometry: Birational Classification, Derived Categories, and Moduli Spaces, Oberwolfach, Germany — **September 2017**
- University of Arizona, Algebraic Geometry Seminar — **November 2017**
- Mexican National Congress of Algebraic Geometry, Plenary Lecture — **February 2018**
- Math Science Research Institute, Hot Topics Workshop: The Homological Conjectures, MSRI, Berkeley — **March 2018**
- Lecture Series, Tianyuan Advanced Seminar on Moduli Spaces in Algebraic Geometry — **April 2018**
- University of Washington, Algebraic Geometry Seminar — **May 2018**
- University of Illinois at Chicago, Commutative Algebra Seminar — **October 2018**
- Purdue University, Commutative Algebra Seminar — **October 2018**
- University of Arkansas AMS Meeting, Special Session on Advances in Birational Geometry, Fayetteville Arkansas — **November 2018**
- University of Michigan, Commutative Algebra Seminar — **November 2018**
- University of Michigan, Algebraic Geometry Seminar — **November 2018**
- Lecture Series, Introductory Workshop: Derived Algebraic Geometry and Birational Geometry and Moduli Spaces, Math Science Research Institute (MSRI), Berkeley — **January 2019**
- University of Hawaii AMS Meeting, Special Session on Commutative Algebra and its Environs, Honolulu Hawaii. — **March 2019**
- Workshop on Algebraic Geometry, Fudan University, Shanghai, China. — **July 2019**
- University of Michigan, Algebraic Geometry Seminar — **October 2019**
- Johns Hopkins University, Algebraic Geometry Seminar — **October 2019**
- Joint mathematical meetings in Denver, special session on commutative algebra — **January 2020**
- Virtual joint mathematical meetings, special session on commutative algebra in positive characteristic — **January 2021**
- Geometry Seminar, Roma Tres (Virtual) — **April 2021**
- ZAG (Zoom Algebraic Geometry) Seminar (Virtual) — **April 2021**
- Tata Institute for Fundamental Research, Colloquium (Virtual) — **August 2021**
- University of Washington, Algebra and Algebraic Geometry Seminar — **October 2021**
- University of Illinois at Chicago, Algebraic Geometry Seminar — **October 2021**
- Michigan State University, Algebraic Geometry Seminar — **November 2021**
- Georgia Algebraic Geometry Symposium, Emory University — **April 2022**

Talks are continued on the next page.

Selected Talks Continued

- Algebraic geometry and singularities workshop and conference, University of Washington — **June 2022**
- CIMAT, Guanajuato Mexico, colloquium and two seminars — **August 2022**
- MMP and Moduli Conference, Simons Center, NY — **October 2022**
- Algebra Seminar, George Mason University — **May 2023**
- Algebraic geometry and cohomology in mixed characteristic Conference, Northwestern University — **May 2023**
- Lecture series, Special Month on Singularities, University of Michigan — **May 2023**
- Joint mathematical meetings in San Fransisco, special session on Recent Developments in Commutative Algebra — **January 2024**
- Taters (Topics in Algebra, Topology etc) Seminar at Boise State (Virtual) — **January 2024**
- University of Washington, Algebra and Algebraic Geometry Seminar — **March 2024**
- Workshop on p-adic Arithmetic Geometry (Spring), IAS School of Mathematics, Princeton — **March 2024**
- Algebra and Number Theory Day, University of Maryland — **April 2024**
- CAAGTUS (Commutative Algebra and Algebraic Geometry in TUcSon), University of Arizona — **May 2024**
- SLMath Programmatic Seminar, SLMath, Berkeley, CA — **May 2024**
- Commutative Algebra and Singularity Theory Conference (in Honor of the 80th Birthday of Professor Kei-ichi Watanabe), Osaka Japan — **September 2024**
- Methods in Mixed Charateristic Geometry, Fall School, Mainz, Germany — **October 2024**
- Higher Du Bois and higher rational singularities, American Institute of Mathematics — **October 2024**
- Moduli of Varieties conference, University of Utah — **November 2024**
- University of Arkanas, Algebra Seminar — **February 2025**
- CA+, Conference at Iowa State University — **March 2025**
- Perfection Conference, Simons Center, NY — **March 2025**
- Rayfest (conference in honor of Ray Heitmann's retirement), Conference at University of Nebraska — **April 2025**
- P-adic and Characteristic p Methods in Algebraic Geometry, EPFL, Switzerland — **June 2025**
- Plenary talk, Summer Research Institute in Algebraic Geometry, Colorado State University — **July 2025**
- Joint mathematical meetings in Washington D.C., special session on commutative algebra — **January 2026**

Upcoming talks

- University of Missouri, Algebra Seminar — **February 2026**
- PASCA 2 conference, Lecture Series, CIMAT, Guanjuato Mexico — **May 2026**