

VITA
Sheldon Katz

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Education

S.B. 1976 Massachusetts Institute of Technology (Mathematics)
Ph.D. 1980 Princeton University (Mathematics)

Professional Experience

University of Illinois	Professor	2001–
	Dean's Special Advisor, College of LAS	2018–
	Interim Chair, Department of Mathematics	Fall 2017
	Chair, Department of Mathematics	2006–2011
Oklahoma State University	Regents Professor	1999–2002
	Southwestern Bell Professor	1997–1999
	Professor	1994–2002
	Associate Professor	1989–1994
	Assistant Professor	1987–1989
University of Oklahoma	Assistant Professor (<i>tenure 1987</i>)	1984–1987
University of Utah	Instructor	1980–1984

Visiting Positions

MSRI	Simons Visiting Professor	2018
Simons Center		2012
Mittag-Leffler Institute, Sweden	Visiting Professor	1997
Duke University	Visiting Professor	1991–1992
University of Bayreuth, West Germany	Visiting Professor	1989
Institute for Advanced Study	Member	1982–1983

Publications

1. Degenerations of quintic threefolds and their lines. *Duke Math. Jour.* **50** (1983), 1127–1135.
2. Lines on complete intersection threefolds with $K=0$. *Math. Z.* **191** (1986), 297–302.
3. Tangents to a multiple plane curve. *Pac. Jour. Math.* **124** (1986), 321–331.
4. On the finiteness of rational curves on quintic threefolds. *Comp. Math.* **60** (1986), 151–162.

5. Hodge numbers of linked surfaces in \mathbf{P}^4 . *Duke Math. Jour.* **55** (1987), 89–95.
6. The cubo-cubic transformation of \mathbf{P}^3 is very special. *Math. Z.* **195** (1987), 255–257.
7. Iteration of Multiple point formulas and applications to conics. *Proceedings of the Algebraic Geometry Conference, Sundance, UT 1986, SLN 1311*, 147–155.
8. Varieties cut out by quadrics: Scheme theoretic versus homogeneous generation of ideals (with L. Ein and D. Eisenbud). *Proceedings of the Algebraic Geometry Conference, Sundance, UT, 1986, SLN 1311*, 51–70.
9. The genus of the intersection curve of two rational surface patches (with T. Sederberg). *Computer Aided Geometric Design* **5** (1988), 253–258.
10. Cremona transformations with smooth irreducible fundamental locus (with B. Crauder). *Amer. Jour. Math.* **111** (1989), 289–307.
11. T.W. Sederberg, H.N. Christiansen, S. Katz. An improved test for closed loops in surface intersections. *Computer Aided Geometric Design* **21** (1989), 505–508.
12. Lines on the Fermat quintic threefold and the infinitesimal generalized Hodge conjecture (with A. Albano). *Trans. AMS* **324** (1991) 353–368.
13. Small resolutions of Gorenstein Threefold Singularities. *Contemp. Math.* **116** (1991) 61–70.
14. Cremona transformations and Hartshorne’s conjecture (with B. Crauder). *Amer. Jour. Math.* **113** (1991) 269–285
15. Discriminants and limits of duals of plane curves. *Contemp. Math.* **123** (1991) 99–106.
16. Cremona transformations and syzygies (with K. Hulek and F.-O. Schreyer). *Math. Z.* **209** (1992) 419–443.
17. Gorenstein threefold singularities with small resolutions via invariant theory for Weyl groups (with D. Morrison). *J. Alg. Geom.* **1** (1992) 449–530.
18. Van Geemen’s families of lines on special quintic threefolds (with A. Albano). *Manus. Math.* **70** (1991) 183–188.
19. Recent Work on Cremona Transformations. In: *Free Resolutions in Commutative Algebra and Algebraic Geometry, Sundance 90*, 109–119. Jones and Bartlett Publishers, Boston 1992.
20. Rational curves on Calabi-Yau threefolds. *Essays on Mirror Manifolds*, 168–180. S.-T. Yau (ed.), International Press, Hong Kong 1992.
21. Arithmetically Cohen-Macaulay Curves Cut Out by Quadrics. In: *Computational Algebraic Geometry and Commutative Algebra*, D. Eisenbud and L. Robbiano (eds.), *Symposia Mathematica Volume XXXIV*, Cambridge University Press 1993, Pp. 257–263.
22. The desingularization of $\text{Hilb}^4\mathbf{P}^3$ and its Betti Numbers. In: *Zero Dimensional Schemes: Proceedings of the International Conference held in Ravello, June 8–13, 1992*. F. Orrechia, L. Chiantini (eds.), W. de Gruyter, Berlin, New York 1994.
23. Rational curves on Calabi-Yau manifolds: verifying predictions of Mirror Symmetry. In *Projective Geometry with Applications*, (E. Ballico, editor), 231–239, Marcel-Dekker 1994.

24. Mirror Symmetry for Two Parameter Models - I (with P. Candelas, X. de la Ossa, A. Font and D.R. Morrison). Nuclear Physics **B416** (1994) 481–538; Mirror Symmetry, II, Greene and Yau (eds.), 1996.
25. Mirror Symmetry for Two Parameter Models - II (with P. Candelas, A. Font and D.R. Morrison). Nuclear Physics **B429** (1994) 626–674.
26. Mirror symmetry for hypersurfaces in weighted projective space and topological couplings (with P. Berglund). Nuclear Physics **B420** (1994) 289–314.
27. Mirror Symmetry Constructions: A Review (with P. Berglund). In: “Mirror Symmetry II”, 87–113, Greene and Yau (eds.), AMS-IP Studies in Advanced Mathematics Vol. 1, 1997.
28. Mirror Symmetry for Calabi-Yau hypersurfaces in weighted \mathbf{P}^4 and extensions of Landau-Ginzburg theory (with P. Candelas and X. de la Ossa), Nuclear Physics **B450** (1995) 267–292.
29. Mirror Symmetry and the moduli space for generic hypersurfaces in toric varieties (with P. Berglund and A. Klemm). Nuclear Physics **B456** (1995) 153–204.
30. Gromov-Witten Invariants via algebraic geometry. Nuclear Physics **B** Proc. Supp. (1996).
31. Enhanced Gauge Symmetry in Type II String Theory (with D.R. Morrison and M.R. Plesser). Nuclear Physics **B477** (1996) 105–140.
32. New Higgs transitions between dual $N = 2$ string models (with P. Berglund, A. Klemm, and P. Mayr), Nuclear Physics **B483** (1997) 209–228.
33. Matter from geometry (with C. Vafa), Nuclear Physics **B497** (1997) 146–154.
34. Small instantons, del Pezzo surfaces and type I' theory (with M. Douglas and C. Vafa), Nuclear Physics **B497** (1997) 155–172.
35. Geometric engineering of quantum field theories (with A. Klemm and C. Vafa) Nuclear Physics **B497** (1997) 173–195.
36. Geometric engineering of $N = 1$ quantum field theories (with C. Vafa), Nuclear Physics **B497** (1997) 196–204.
37. Mirror symmetry and Exact Solution of 4D $N=2$ Gauge Theories I (with P. Mayr, C. Vafa), Adv. Theor. Math. Phys. **1** (1998) 53–114.
38. Enumeration of Nodal Genus 2 Plane Curves with Fixed Complex Structure (with Z. Qin and Y. Ruan). J. Alg. Geom. **7** (1998) 569–587.
39. M-theory, topological strings and spinning black holes (with A. Klemm and C. Vafa), Adv. Theor. Math. Phys. **3** (1999) 1445–1537.
40. Open string instantons and superpotentials, (with S. Kachru, A. Lawrence, and J. McGreevy), Phys. Rev. **D62** (2000) 026001.
41. Multiple covers and the integrality conjecture for rational curves in Calabi-Yau threefolds (with J. Bryan and N.C. Leung), Jour. Alg. Geom. **10** (2001) 549–568.
42. Lie groups, Calabi-Yau threefolds, and F-theory (with P. Aspinwall and D. Morrison), Adv. Theor. Math. Phys. **4** (2001) 95–126.
43. Mirror symmetry for open strings (with S. Kachru, A. Lawrence, and J. McGreevy), Phys. Rev. **D62** (2000) 126005, hep-th/0006047.
44. Virtual fundamental classes of zero loci (with D. Cox and Y.P. Lee), Advances in algebraic geometry motivated by physics (Lowell, MA, 2000), 157–166, Contemp. Math., **276**, Amer. Math. Soc., Providence, RI, 2001.

45. Enumerative geometry of stable maps with Lagrangian boundary conditions and multiple covers of the disc (with M. Liu), *Adv. Theor. Math. Phys.* **5** (2002) 1–49, [math.AG/0103074](#).
46. F. Cachazo, S. Katz, and C. Vafa, Geometric Transitions and N=1 Quiver Theories, [hep-th/0108120](#).
47. F. Cachazo, B. Fiol, K. Intriligator, S. Katz, and C. Vafa, A Geometric Unification of Dualities, *Nucl. Phys.* **B628** (2002) 3–78, [hep-th/0110028](#).
48. Versal deformations and superpotentials for rational curves in smooth threefolds, In: *Cont. Math.* **312** (2002) 129–136.
49. S. Katz and E. Sharpe, D-branes, open string vertex operators, and Ext groups, *Adv. Theor. Math. Phys.* **6** (2002) 979–1030.
50. A. Caldararu, S. Katz, and E. Sharpe, D-branes, B fields, and Ext groups, [hep-th/0302099](#), *Adv. Theor. Math. Phys.* **7** (2003) 381–405
51. D-branes, orbifolds, and Ext groups, (with T. Pantev and E. Sharpe), [hep-th/0212218](#), *Nucl. Phys.* **B673** (2003) 263–300
52. Spectra of D-branes with Higgs vevs, (with R. Donagi and E. Sharpe), *Adv. Theor. Math. Phys.* **8** (2005) 815–860, [hep-th/0309270](#).
53. B-branes and the Derived Category, *Quantum theory and symmetries*, 538–547, World Sci. Publ. Hackensack, NJ 2004, [hep-th/0402059](#).
54. Notes on Certain (0,2) Correlation Functions (with E. Sharpe), *Comm. Math. Phys.* **262** (2006) 611–644, [hep-th/0406226](#).
55. Gromov-Witten, Gopakumar-Vafa, and Donaldson-Thomas invariants of Calabi-Yau threefolds, *Cont. Math.* **401** (2006) 43–52, [math.AG/0408266](#).
56. P. Aspinwall and S. Katz, Computation of Superpotentials for D-Branes, *Comm. Math. Phys.* **264** (2006) 227–253, [hep-th/0412209](#).
57. Geometric Transitions, Flops and Non-Kähler Manifolds: II (with M. Becker, K. Dasgupta, A. Knauf, and R. Tatar), *Nucl. Phys.* **B738** (2006) 124–183, [hep-th/0511099](#).
58. Gauge-Gravity Dualities, Dipoles and New Non-Kähler Manifolds (with K. Dasgupta, M. Grisaru, R. Gwynn, A. Knauf, and R. Tatar), *Nucl. Phys.* **B755** (2006) 21–78, [hep-th/0605201](#).
59. On certain moduli spaces of ideal sheaves and Donaldson-Thomas invariants (with W.-P. Li and Z. Qin), *Math Research Letters*, **14** (2007), 403–411, [math.AG/0508133](#).
60. Dipole-Deformed Bound States and Heterotic Kodaira Surfaces (with K. Dasgupta, J. Guffin, and R. Gwyn), *Nucl. Phys.* **B769** (2007) 1–30, [hep-th/0610001](#).
61. Genus zero Gopakumar-Vafa invariants of contractible curves. *J. Differential Geom.* **79** (2008), 185–195.
62. Deformed Quantum Cohomology and (0,2) Mirror Symmetry (with J. Guffin), *Jour. High Energy Phys.* **109** (2010), 109–135, [arXiv:0710.2354](#).
63. Supersymmetric Configurations, Geometric Transitions and New Non-Kähler Manifolds (with F. Chen, K. Dasgupta, P. Franche, and R. Tatar), *Nucl. Phys.* **B852** (2011) 553–591, [arXiv:1007.5316](#).
64. Tate’s algorithm and F-theory (with D. Morrison, S. Schäfer-Nameki, and J. Sully), *JHEP* **94** (2011) 1108; [arXiv:1106.3854](#).
65. A Mathematical Theory of Quantum Sheaf Cohomology (with R. Donagi, J. Guffin, and E. Sharpe), *Asian J. Math* **18** (2014) 387–417, [arXiv:1110.3751](#), 32 pages

66. Physical aspects of quantum sheaf cohomology for deformations of tangent bundles of toric varieties (with R. Donagi, J. Guffin, and E. Sharpe), *Adv. Theor. Math. Phys.* **17** (2013) 1255–1301, arXiv:1110.3752.
67. $(0, 2)$ Quantum Cohomology (with R. Donagi, J. Guffin, and E. Sharpe), *Proc. Symp. Pure Math* **85** (2012) 83–103.
68. The refined BPS index from stable pair invariants (with J. Choi and A. Klemm), *Comm. Math. Phys.* **328** (2014) 903–954, arXiv:1210.4403.
69. Weak Coupling, Degeneration and Log Calabi-Yau Spaces, (with R. Donagi and M. Wijnholt), *Pure Appl. Math. Quart.* **9** (2013)655–738, special volume dedicated to the memory of Andrey Todorov, arXiv:1212.0553.
70. T-branes and geometry (with Lara Anderson and Jonathan Heckman) *J. High En. Phys.* 2014, no. 5, 080, arXiv 1310.1931.
71. On the motivic stable pairs invariants of K3 surfaces (with A. Klemm and R. Pandharipande), in: *K3 Surfaces and Their Moduli*, Faber, Farkas, and van der Geer (eds.), *Prog. Math* **315**, Birkhäuser, arXiv:1407.3181.
72. Topological String on elliptic CY 3-folds and the ring of Jacobi forms (with Minxin Huang and Albrecht Klemm), *J. High En. Phys.* 10 (2015) 125–202, arXiv:1501.04891.
73. Elliptically fibered Calabi-Yau manifolds and the ring of Jacobi forms (with Minxin Huang and Albrecht Klemm), *Nuclear Phys.* **B898** (2015), 681–692.
74. $SU(N)$ transitions in M-theory on Calabi-Yau fourfolds and background fluxes (with H. Jockers, D.R. Morrison, and M.R. Plesser), *Comm. Math. Phys.* **351** (2017) 837–871, arXiv:1602.07693.
75. T-Branes at the Limits of Geometry (with L. Anderson, J. Heckman, and L. Schaposnik), *J. High Energ. Phys.* (2017) 2017: 58, arXiv:1702.06137.
76. On Geometric Classification of 5d SCFTs (with P. Jefferson, H.-C. Kim, and C. Vafa), *J. High Energ. Phys.* (2018) 2018: 103, [https://doi.org/10.1007/JHEP04\(2018\)103](https://doi.org/10.1007/JHEP04(2018)103).
77. Local BPS Invariants: Enumerative Aspects and Wall-Crossing (with J. Choi, M. van Garrel, and N. Takahashi), *IMRN* (2018) <https://doi.org/10.1093/imrn/rny171>.
78. Swampland constraints on 5D $N = 1$ supergravity, (with H.-C. Kim, H. Tarazi and C. Vafa), *J. High Energ. Phys.* 2020, 80 (2020). [https://doi.org/10.1007/JHEP07\(2020\)080](https://doi.org/10.1007/JHEP07(2020)080).
79. Log BPS numbers of log Calabi-Yau surfaces, (with J. Choi, M. van Garrel, and N. Takahashi), *Trans. Amer. Math. Soc.* **374** (2021), 687–732.
80. Towards Refining the Topological Strings on Compact Calabi-Yau 3-folds Minxin Huang, Sheldon Katz, Albrecht Klemm arXiv:2010.02910, *J. High Energ. Phys.* 2021, 266 (2021). [https://doi.org/10.1007/JHEP03\(2021\)266](https://doi.org/10.1007/JHEP03(2021)266), 89 pages.

Books

- Mirror Symmetry and Algebraic Geometry (with D. Cox), Mathematical Surveys and Monographs vol. **68**, 469 pages, American Mathematical Society, Providence RI 1999. Russian translation 2013.
- Enumerative Geometry and String Theory, Student Mathematical Library vol. **32**, American Mathematical Society, Providence RI, 2006. Japanese translation 2011.

Book Chapters

- Mirror symmetry (with K. Hori, A. Klemm, R. Pandharipande, R. Thomas, C. Vafa, R. Vakil and E. Zaslow). Clay Mathematics Monographs, American Mathematical Society, Providence, RI; Clay Mathematics Institute, Cambridge, MA, 2003.

Appendices

- Intersection theory over moduli spaces of degenerate instantons. Appendix to “Holomorphic anomalies in topological field theories” by M. Bershadsky, S. Cecotti, H. Ooguri, and C. Vafa. Nuclear Physics **B405** (1993) 279–304.
- Verification of Gopakumar-Vafa invariants. Appendix to “Solving the Topological String on K3 Fibrations” by B. Haghighat and A. Klemm, Jour. High Energy Phys. **1001** (2010) 9.
- Heterotic string and the duality group (with G. Oberdieck), appendix to “CHL Calabi–Yau threefolds: curve counting, Mathieu moonshine and Siegel modular forms” by J. Bryan and G. Oberdieck, arXiv:1811.06102, Commun. Number Theory Phys. **14** (2020), 785–862.

Volumes Edited

- (with R. Donagi, A. Klemm, and D.R. Morrison) String-Math 2012, Proc. Symp. Pure Math. **90**, AMS.

Software

- SCHUBERT: A Maple package for Intersection Theory (with S.A. Strømme), <https://faculty.math.illinois.edu/~katz/schubert/>.

Recent Invited Lectures

1. Refined BPS Invariants for local del Pezzos and representations of affine E_8 , MSRI, April 2018
2. Refined BPS Invariants for local surfaces and representations of affine E_8 , Stanford, May 2018
3. Affine Lie algebra representations and moduli spaces of sheaves on surfaces, Conference in Geometry and Representations, Haevichi Resort, Korea, January 2019.
4. Lie algebra representations and moduli spaces of sheaves on surfaces, Institute for Basic Sciences, Postech, Pohang Korea, January 2019.
5. A geometric realization of the affine E_8 global symmetry of the E-string, February, 2019, Simons Foundation Conference on Number Theory, Geometry, Moonshine, and Strings III, New York.
6. Moduli of F-theory from IIB, Geometry and String 2019, Oxford, September 2019
7. Lie algebra representations and BPS numbers, Moduli and Invariants Workshop, BIRS-CMO, November 2019
8. BPS Invariants and their Refinements, Harvard-MIT algebraic geometry seminar, November 2019
9. Generalized Kac-Moody Lie algebras and moduli spaces of 1-dimensional sheaves on surfaces, Algebraic Geometry and Moduli Zoominar, ETH, April 2020
10. D-critical locus on Hilb^n of local P^2 , Bogota, Columbia (by Zoom), Sept 2020.
11. Gopakumar-Vafa invariants and their refinements, Virginia Tech (by Zoom), November 2020

Grants

1. NSF Focused Research Group Grants, 2000–2010
2. NSF individual investigator grants, 1986–1989, 1993–1998, 2006–2022; AGEP supplement 2016–2018
3. NSA Individual Investigator Grants, 1989–1992, 1996–2002, 2003–2005
4. Scientific Computing Research Environments in the Mathematical Sciences (co-PI), 1988–1990, 1993–1995, 1998–1999 NSF.
5. Special year in algebraic geometry, 1998–1999, American Institute of Mathematics.
6. Mountain West Algebraic Geometry Research Group. NSF, 1987–1996, co-PI's Rick Miranda (Colorado State University) and Bob Speiser (Brigham Young University).
7. Workshop on Mirror Symmetry, NSF, Division of Theoretical Physics, 1995.
8. Special Year in Algebraic Geometry, NSF 1994–1995.
9. Research Experiences for Undergraduates, NSF 1993–1995.

Recent Professional Service

1. Scientific Advisory Board, Simons Center for Geometry and Physics, 2021–2024
2. Steering Committee, annual String Math conference series, 2010–
3. Organizing Committee, Graduate Summer School on the Mathematics and Physics of Hitchin Systems, Simons Center for Geometry and Physics, May 27–31, 2019
4. Editorial Board, Illinois Journal of Mathematics, 2020–
5. Editorial Board, Advances in Theoretical and Mathematical Physics, 2003–

Academic Honors

2021	Arthur Coble Scholar, University of Illinois
2013	Fellow, American Mathematical Society
1999–2002	Regents Professor, Oklahoma State University
1997–1999	Southwestern Bell Professor, Oklahoma State University
1973	First Place, USA Math Olympiad

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