

## William Fulton, Curriculum Vitae

Born August 29, 1939

### Address

Department of Mathematics, University of Michigan Ann Arbor, MI 48109-1109  
Tel (734) 763-1550  
email: wfulton@umich.edu

### Education

B.A., Brown University, 1961

Ph.D., Princeton University, 1966

Dissertation: *The tame fundamental group of an algebraic curve*,

Advisor: G. Washnitzer

### Professional Appointments

Princeton (Instructor), 1965–66

Brandeis (Instructor, Lecturer, Assistant Professor), 1966–69

Princeton (Visiting Assistant Professor), 1969–70

Brown (Associate Professor), 1970–75 (Professor), 1975–87,  
(Chairman, 1985–86)

University of Chicago (Professor), 1987–

Charles L. Hutchinson Distinguished Service Professor, 1995–98

University of Michigan (Professor), 1998–

Miner and Mary Ann Keeler Chair in Mathematics, 1998–2009

Oscar Zariski Distinguished University Professor, 2009–

National Academy of Sciences, 1997–

American Academy of Arts and Sciences, 1998–

Royal Swedish Academy of Sciences, Foreign Member, 2000–

### Visiting Positions

University of Genoa (Visiting Professor), 1969

Aarhus University (Visiting Professor), 1976-77

Institut des Hautes Etudes Scientifiques (Visiting member), 1981

Institute for Advanced Study (Visiting member), 1981-82, 1994

Orsay (Visiting Professor), May-June, 1987

Mathematical Sciences Research Institute (Visiting member) 1992-93, 2009

Centre for Advanced Study, Oslo (Visiting member), 1994  
Mittag-Leffler Institute (Erlander Professor), 1996-97  
MSRI (Simons Visiting Professor), Fall, 1998  
Columbia (Eilenberg Visiting Professor), Spring, 2007

## Publications

### Books

- [A] *Algebraic Curves*, W.A. Benjamin, Inc., Mathematics Lecture Note Series (1969). Spanish translation (1971). Sixth printing, Addison-Wesley (1990). New edition in preparation.
- [B] (WITH R. MACPHERSON), *A categorical framework for the study of singular spaces*, Memoirs Amer. Math. Soc. **243** (1981). Russian translation, MIR, 1984.
- [C] *Intersection Theory*, Ergebnisse der Mathematik und ihrer Grenzgebiete, 3. Folge, Band 2, Springer-Verlag, 1984. Russian translation, MIR, 1989. Second edition, 1998.
- [D] *Introduction to Intersection Theory in Algebraic Geometry*, Conference Board of the Mathematical Sciences regional conference series in mathematics **54**, American Mathematical Society, 1984. Second printing, 1996.
- [E] (WITH S. LANG), *Riemann-Roch Algebra*, Grundlehren der mathematischen Wissenschaften **277**, Springer-Verlag, 1985.
- [F] (WITH J. HARRIS), *Representation Theory; a first course*, Graduate Texts in Mathematics, Springer-Verlag, 1991, Fourth printing, 1999, Chinese edition, 2005.
- [G] (WITH S. BLOCH AND I. DOLGACHEV, EDITORS), *Proceedings of the US-USSR Symposium in Algebraic Geometry, Univ. of Chicago, June-July, 1989*, Lecture Notes in Mathematics **1479**, Springer-Verlag, 1991.
- [H] *Introduction to Toric Varieties*, Annals of Mathematics Studies **133**, Princeton Univ. Press, 1993. Second printing, 1997, Russian translation, 1998.
- [I] *Young Diagrams, with applications to representation theory and geometry*, Cambridge University Press, 1996, Second printing, 1999.
- [J] *Algebraic Topology; a first course*, Springer-Verlag, 1995. Second printing, 1997.
- [K] (WITH P. PRAGACZ), *Degeneracy Loci and Schubert Varieties*, Notes from Summer School, Thurnau, 1995, Springer Lecture Notes in Mathematics **1689**, 1998.
- [L] (WITH G. ELLINGSRUD AND A. VISTOLI, EDITORS), *Recent Progress in Intersection Theory*, Birkhäuser, 2000.

- [M] (WITH K. BEHREND, D. EDIDIN, B. FANTECHI, L. GOETTSCHKE, AND A. KRESCH), *Introduction to Stacks*, in preparation.
- [N] (WITH M. MUSTATA) *Toric Varieties*, in preparation.
- [O] (WITH D. ANDERSON) *Equivariant Cohomology in Algebraic Geometry*, in preparation.

## Papers

- [1] *Hurwitz schemes and irreducibility of moduli of algebraic curves*, Annals of Math. **90** (1969), 542–575.
- [2] *A note on weakly complete algebras*, Bull. Amer. Math. Soc. **75** (1969), 591–593.
- [3] (WITH P. BAUM AND R. MACPHERSON), *Riemann-Roch for singular varieties*, Publ. Math. I.H.E.S. **45** (1975), 101–145.
- [4] *Rational equivalence on singular varieties*, Publ. Math. I.H.E.S. **45** (1975), 147–167.
- [5] *Riemann-Roch for singular varieties*, in *Algebraic Geometry, Arcata, 1974*, Proc. Symp. Pure Math. **29**, A.M.S. (1975), 449–457.
- [6] *Ample vector bundles, Chern classes, and numerical criteria*, Inventiones math. **32** (1976), 171–178.
- [7] *A Hirzebruch-Riemann-Roch formula for analytic spaces and non-projective algebraic varieties*, Compositio Math. **34** (1977), 279–283.
- [8] *A note on residual intersections and the double point formula*, Acta mathematica **140** (1978), 92–101.
- [9] (WITH R. MACPHERSON), *Intersecting cycles on an algebraic variety*, in *Real and Complex Singularities, Oslo 1976*, P. Holm, editor, Sijthoff & Noordhoff (1977), 179–197.
- [10] (WITH D. LAKSOV), *Residual intersections and the double point formula*, in *Real and Complex Singularities, Oslo 1976*, P. Holm, editor, Sijthoff & Noordhoff (1977), 171–177.
- [11] *A fixed point formula for varieties over finite fields*, Math. Scand. **42** (1978), 189–196.
- [12] (WITH R. MACPHERSON), *Defining algebraic intersections*, in *Algebraic Geometry, Proceedings, Tromso, Norway, 1977*, Springer Lecture Notes **687** (1978), 1–30.
- [13] (WITH J. HANSEN), *A connectedness theorem for projective varieties, with applications to intersections and singularities of mappings*, Annals of Math. **110** (1979), 156–166.
- [14] (WITH P. BAUM AND R. MACPHERSON), *Riemann-Roch and topological K-theory for singular varieties*, Acta mathematica **143** (1979), 155–192.

- [15] (WITH P. BAUM AND G. QUART), *Lefschetz-Riemann-Roch for singular varieties*, Acta mathematica **143** (1979), 193–211.
- [16] *A note on the arithmetic genus*, Amer. J. Math. **101** (1979), 1355–1363.
- [17] *On the fundamental group of the complement of a node curve*, Annals of Math. **111** (1980), 407–409.
- [18] (WITH K. JOHNSON), *Canonical classes on singular varieties*, Manuscripta mathematica **32** (1980), 381–390.
- [19] *On the fundamental group of the complement of a plane curve*, in *Proceedings of the 18th Scandinavian Congress of Mathematicians, Aarhus, Denmark, 1980*, Progress in Math. **11**, Birkhäuser (1981), 39–55.
- [20] (WITH R. LAZARSFELD), *Connectivity and its applications in algebraic geometry*, Springer Lecture Notes **862** (1981), 26–92.
- [21] (WITH R. LAZARSFELD), *On the connectedness of degeneracy loci and special divisors*, Acta mathematica **146** (1981), 271–283.
- [22] *On the irreducibility of the moduli space of curves*, Inventiones math. **67** (1982), 87–88.
- [23] (WITH R. LAZARSFELD), *Positivity and excess intersection*, in *Enumerative and classical algebraic geometry, Nice, 1981*, Progress in Math. **24**, Birkhäuser, 1982, 97–105.
- [24] (WITH R. LAZARSFELD), *Positive polynomials for ample vector bundles*, Annals of Math. **118** (1983), 35–60.
- [25] (WITH H. GILLET), *Riemann-Roch for general algebraic varieties*, Bull. Soc. Math. France **111** (1983), 287–300.
- [26] (WITH S. KLEIMAN AND R. MACPHERSON), *About the enumeration of tangents*, in *Algebraic Geometry - Open Problems, Ravello 1982*, Springer Lecture Notes **997** (1983), 156–196.
- [27] *On Nodal Curves*, in *Algebraic Geometry - Open Problems, Ravello, 1982*, Springer Lecture Notes **997** (1983), 146–155.
- [28] (WITH J. HARRIS AND R. LAZARSFELD), *Excess linear series on an algebraic curve*, Proc. Amer. Math. Soc. **92** (1984), 320–322.
- [29] (WITH S. KLEIMAN, R. PIENE, AND H. TAI), *Some intrinsic and extrinsic characteristics of the projective space*, Bull. Soc. Math. France **113** (1985), 205–210.
- [30] *Some aspects of positivity in algebraic geometry*, in *Proceedings of the International Congress of Mathematicians, 1983*, Vol I (1984), 711–718.
- [31] (WITH R. MACPHERSON), *Classes caractéristiques des images directes des fibrés vectoriels pour les revêtements*, C.R. Acad. Sc. Paris **299** (1984), 379–382.
- [32] (WITH R. MACPHERSON), *Characteristic classes of direct image bundles for covering maps*, Annals of Math **125** (1987), 1–92.

- [33] *On the topology of algebraic varieties*, in *Proceedings of the AMS Bowdoin conference in Algebraic Geometry, 1985*, Proc. Symp. in Pure Mathematics **46** (1987), 15–46.
- [34] (WITH A. COLLINO) *On the space of plane triangles*, Mém. Bull. Soc. Math. France **117** (1989), 75–117.
- [35] (WITH P. DIACONIS), *A growth model, a game, an algebra, Lagrange inversion, and characteristic classes*, Rend. Sem. Mat. Univ. Pol. Torino **49** (1991), 95–119.
- [36] *Flags, Schubert polynomials, degeneracy loci, and determinantal formulas*, Duke Math. J. **65** (1991), 381–420.
- [37] (WITH R. MACPHERSON), *A compactification of configuration spaces*, Annals of Math. **139** (1994), 183–225.
- [38] (WITH R. MACPHERSON, F. SOTTILE, AND B. STURMFELS), *Intersection theory on spherical varieties*, J. of Algebraic Geometry **4** (1995), 181–193.
- [39] (WITH A. LASCoux), *A Pieri formula in the Grothendieck ring of a flag bundle*, Duke Math. J. **76** (1994), 711–729.
- [40] (WITH B. STURMFELS), *Intersection theory on toric varieties*, Topology **36** (1997), 335–353.
- [41] *Determinantal formulas for orthogonal and symplectic degeneracy loci*, J. of Differential Geometry **42** (1996), 276–290.
- [42] *Schubert varieties in flag bundles for the classical groups*, *Proceedings of Conference in Honor of Hirzebruch’s 65th birthday, Bar Ilan, 1993*, Israel Math. Conf. Proc. **9** (1996), 241–262.
- [43] *Positive polynomials for filtered ample vector bundles*, Amer. J. Math. **117** (1995), 627–633.
- [44] (WITH R. PANDHARIPANDE), *Notes on stable maps and quantum cohomology*, Santa Cruz Summer School in Algebraic Geometry, AMS, 1995, Proc. Symp. Pure Math. **62** (1997), vol. 2, 45–96.
- [45] (WITH I. CIOCAN-FONTANINE), *Quantum Double Schubert polynomials*, Mittag-Leffler Preprint 1996-97, appeared in book [K].
- [46] *Universal Schubert polynomials*, Duke Math. J. **96** (1999), 575–594.
- [47] (WITH A. BERTRAM AND I. CIOCAN-FONTANINE), *Quantum multiplication of Schur polynomials*, J. of Algebra **219** (1999), 728–746.
- [48] (WITH A. BUCH), *Chern class formulas for quiver varieties*, Inventiones math. **135** (1999), 665–687.
- [49] *Eigenvalues of sums of Hermitian matrices (after A. Klyachko)*, Séminaire Bourbaki **845**, Astérisque **252** (1998), 255–269.
- [50] *A bijection between hives and Littlewood-Richardson skew tableaux*, Appendix to *The saturation conjecture*, by A. Buch, l’Enseignement Math. **46** (2000), 43–60.

- [51]  $QH^*(\text{flag})$ , *Quantum Schubert polynomials, Quantum double Schubert polynomials*, in *Quantum cohomology at the Mittag-Leffler Institute*, P. Aluffi, editor, Scuola Normale Superiore, Pisa, 1997, 39–41, 61–67, 90–92.
- [52] *Eigenvalues, invariant factors, highest weights, and Schubert calculus*, Bull. Amer. Math. Soc. 37 (2000), 209–249.
- [53] *Eigenvalues of majorized Hermitian matrices and Littlewood-Richardson coefficients*, Linear Alg. Appl. 319 (2000), 23–36.
- [54] *Adjoint and Max Noether’s Fundamental Theorem*, in *Algebra, arithmetic and geometry with applications*, Springer-Verlag, 2004, 301–313.
- [55] (WITH C. WOODWARD), *On the quantum product of Schubert classes*, J. Alg. Geom. 13 (2004), 641–661.
- [56] *On the quantum cohomology of homogeneous varieties*, in *The legacy of Niels Henrik Abel*, Springer-Verlag, 2004, 729–736.
- [57] *What is a stack?*, Notes and Video, from MSRI workshop on stacks, 2001–2002.
- [58] (WITH S. FOMIN, C.-K. LI, AND Y.-T. POON), *Eigenvalues, singular values, and Littlewood-Richardson coefficients*, Amer. J. Math. 127 (2005), 101–127.
- [59] *Lectures on quantum cohomology*, notes by A. Craw, in *Quantum Field Theory, Supersymmetry, and Enumerative Geometry*, IAS/Park City Mathematics Series, 2006.
- [60] (WITH M. OLSSON), *The Picard group of  $M_{1,1}$* , Algebra Number Theory 4 (2010), 87–104.

## Invited Lectures (partial list)

Oberwolfach, 1975, 1977, 1978, 1981, 1985, 1987, 1989, 1997, 1998.  
 Harvard-Brandeis-MIT Colloquium 1975, 1978, 1980, 1985, 1999, 2001.  
 Eighteenth Scandinavian Mathematical Congress, 1980.  
 A.M.S. one hour invited lecture, Providence, 1980.  
 Italian National Research Council Summer Course (20 Lectures), Cortona, 1980.  
 Arbeitstagung, Bonn, 1981.  
 Open Problems in Algebraic Geometry, Ravello, 1982.  
 Midwest Algebraic Geometry Conferences, 1980, 1984.  
 NSF-AMS regional conference in Intersection Theory (10), George Mason University, 1983.  
 International Congress, Warsaw 1983, Algebraic Geometry section.  
 Conference on Algebraic Geometry (2), Vancouver, 1984.  
 AMS Bowdoin Conference in Algebraic Geometry (3), 1985.  
 Adrian Albert Lectures (3), University of Chicago, 1986.  
 Crafoord Conference (in honor of Deligne and Grothendieck), Stockholm, 1988.

J. Hahn Lectures (3), Yale University, April, 1988.  
Roever Lectures (5), Washington University, St. Louis, 1989.  
Rademacher Lectures (4), University of Pennsylvania, 1994.  
London Math. Society Spitalfields Day, 1995  
British Mathematical Colloquium 1997  
Danish Mathematical Society 1997  
Bourbaki seminar, 1998  
Program in Mathematics and Mathematical Biology, Sante Fe, 1999  
Cairns Lectures (3), University of Illinois, 1999  
American and Mexican Mathematical Societies Joint Meeting, 1999  
XXIII Scandanavian Congress and AMS–Scandinavian International Mathematics Meeting, Odense, Denmark, 2000  
Symmetric Functions 2001 (Newton Institute) (3)  
Park City Mathematics Institute, 2001 (4)  
Abel 200 Anniversary Conference, Oslo, 2002, plenary address  
Red Raider Mini-Symposium, Texas, 2002  
Zassenhaus Lectures (2), Ohio State University, 2003  
Oberwolfach Workshop on Stacks (3), October, 2006  
Marston Morse Lectures (3), Institute for Advanced Study, Spring, 2007  
Gustafsson Lectures (3), Stockholm, Spring, 2007  
Moursand Lectures (3), University of Oregon, Spring, 2008  
Abel Symposium, 2009  
Cantrell Lectures (3), University of Georgia, Spring, 2011

## Honors, Fellowships, Grants

Bourbaki seminars on my work by Verdier (#465, 1975) and Deligne (#543, 1979)  
Guggenheim Fellowship 1980–81.  
Sloan Foundation Grant at IAS, 1981–82.  
National Science Foundation Grants 1976–2007.  
Erlander Professorship, Swedish Science Foundation, 1996–97.  
Steele Prize for Mathematical Exposition (for book [C]), Amer. Math. Soc., 1996.  
Special Volume of Michigan Mathematical Journal, Vol. 48, 2000, dedicated to me for my 60th birthday.  
Henry Russel Lectureship, University of Michigan, 2005.  
Eilenberg Visiting Professorship, Columbia University, 2007.  
Steele Prize for Lifetime Achievement, Amer. Math. Soc., 2010.  
Honorary Doctorate, Royal Institute of Technology (KTH), Stockholm, 2010.

## Editing

Associate Editor, Duke Math. Journal, 1984–93.

Associate Editor, Journal of Algebraic Geometry, 1992–93.  
Editor, Journal of the American Mathematical Society, 1993–99,  
Managing Editor, 1995–98.  
Editorial board, Cambridge Studies in Advanced Mathematics, Cambridge University Press, 1994–.  
Editorial board, Chicago Lectures in Mathematics, University of Chicago Press, 1994–2001.

## **Organizing and Fellowship Committees; Advisory Boards**

Special Year in Algebraic Geometry, Institute for Advanced Study, 1981–82.  
AMS Bowdoin Conference in Algebraic Geometry, 1985.  
US–USSR Symposium in Algebraic Geometry, Univ. of Chicago, June–July, 1989.  
Special Year in Algebraic Geometry, MSRI, 1992–93.  
Workshop Tromsø in Enumerative Geometry, June, 1994.  
Special year on Enumerative Geometry and Algebraic Geometry Influenced by Physics, Mittag-Leffler, 1996–97.  
Oberwolfach meeting on Schubert Varieties, 1997.  
Conference on Intersection Theory, Bologna, 1997, 1999.  
Conference on Algebraic Geometry and Symplectic Geometry, Nordfjordeit, Norway, 2001.  
Program at MSRI: Algebraic stacks, intersection theory, and non-Abelian Hodge theory, 2002.  
Sloan Dissertation Fellowship Committee, 1989–94.  
Scientific Advisory Board for Mittag-Leffler Institute, 1997–2006.  
Council of American Mathematical Society, 2000–2003.  
AMS Summer Institute on Algebraic Geometry, Seattle, 2005.  
Algebraic Geometry Program, MSRI, 2009.  
MSRI Scientific Advisory Committee, 2008–2012.  
AIM Workshop on Toric Geometry and Polytopes, 2009.

## **Ph. D. Students Supervised**

at Brown University: K. Johnson, G. Quart, J. Hansen, R. Lazarsfeld, T. Garrity, P. Aluffi. Masters degrees leading to publications: E. Hironaka, S.K. Tin.  
at University of Chicago: S. Kimura, S. Keel, D. Perkinson, J. Pommersheim, F. Sottile, J. Cheah, H. Tamvakis, A. Kresch, Y. Zha, P. Belorousski, A. Buch, L. Chen, H. Thomas.  
at University of Michigan: L. Mihalcea, M. Hering, S. Payne, D. Anderson.