

# Curriculum Vitae

## Hans Ulrich Walther

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Last updated: Apr 4, 2017.

### Research Interests

- Commutative Algebra: local cohomology, multiplier ideals, test ideals, logarithmic derivations;
- Algebraic Geometry: de Rham cohomology, Dwork cohomology, Bernstein–Sato polynomials, Milnor fibers, zeta functions, arrangements;
- $D$ -modules: Riemann–Hilbert correspondence,  $b$ -functions, GKZ-systems, irregularity and slopes; logarithmic vector fields;
- Gröbner basis theory: explicit algorithmic computations of cohomological functors, specifically in the subjects above.

### Education

- Ph.D. in Mathematics, July 1999, University of Minnesota.  
Thesis advisor: Gennady Lyubeznik.  
Thesis title: “Algorithmic Computation of Local and de Rham Cohomology - an application of  $D$ -module theory to algebraic geometry”
- Diplom in Mathematik, July 1993, Martin-Luther-Universität Halle–Wittenberg, Germany.  
Thesis advisor: Konrad Drechsler.  
Thesis title: “On Singularities on Generalized Flag Manifolds”
- M. Sc. in Pure Mathematics, September 1992, University of Sheffield, UK.  
Thesis advisor: Rodney Y. Sharp.  
Thesis title: “Local Cohomology: A Survey”
- Abitur, July 1986, Spezialklassen für Mathematik und Physik Halle–Wittenberg, Germany.

### Awards / Fellowships

- NSF grant DMS-1700748 (04/2017 – 3/2018, Co-PI, Conference grant)
- Joel and Ruth Spira Award for excellence in undergraduate teaching (2015).
- Purdue Research Foundation Grant for Arnold Yim (2015 – 2016)
- NSF grant DMS-1401392 (7/2014 – 6/2017)
- Research Professorship, Mathematical Sciences Research Institute, Berkeley, California (Spring 2013)
- NSF grant DMS-1146096 “ALGECOM (Algebra-Geometry-Combinatorics)”, with Alex Yong, Evgeny Mukhin, Hal Schenck, and Saugata Basu (1/2012 – 12/2014)
- Research in pairs, “Questions around the monodromy conjecture”, Centro Internazionale per la Ricerca Matematica, Trieste, Italy (June 2011)
- Purdue Research Foundation Grant for Jen-Chieh Hsiao (2010 – 2011)
- NSF grant DMS-0901123 (7/2009 – 6/2013)
- Structured Quartet Research Ensemble (SQuarE) on “Arrangements, logarithmic vector fields, and  $D$ -modules”, American Institute of Mathematics, Palo Alto (May 2009, Feb 2010, Feb 2011).
- NSF grant DMS-0555319 (7/2006 – 6/2009).
- NSA grant H98230-06-1-0012 (2/2006 – 2/2008).

- Purdue Research Foundation Grant for Darren Tapp (2005 – 2006).
- Alexander von Humboldt Research Fellowship at Universität Leipzig (2003).
- Deutsche Forschungsgemeinschaft (DFG) Research Fellowship at Universität Leipzig (2002 – 2003).
- NSF grant DMS-0100509 (7/2001 – 7/2005).
- Postdoctoral Fellowship, Mathematical Sciences Research Institute, Berkeley, California (1999 – 2000).
- Eugene Fabes Best Thesis Award in Mathematics, University of Minnesota (1999).
- Alfred P. Sloan Foundation Dissertation Fellowship (1998 – 1999).
- University of Minnesota “Citation for Excellence in Teaching” (1997).
- Deutscher Akademischer Austauschdienst (DAAD) Fellowship at University of Sheffield (1991 – 1992).

### Editorial Responsibilities

- Associate editor of “Communications in Algebra”, 2011 – present.

### Publications

- “Algorithmic Computation of Local Cohomology Modules and the Local Cohomological Dimension of Algebraic Varieties”, *J. Pure Appl. Algebra*, **139**, 303–321, (1999).
- “Algorithmic Computation of de Rham Cohomology of Complements of Complex Affine Varieties”, *J. Symb. Comput.*, **29**, 795–839 (2000).
- “A Localization Algorithm for  $D$ -modules” (with T. Oaku and N. Takayama), *Journal of Symbolic Computation*, **29**, 721–728 (2000).
- “On the Lyubeznik Numbers”, *Proc. of the AMS*, **129**(6), 1631–1634, (2001).
- “Computing the cup product structure for complements of complex affine varieties”, *J. Pure Appl. Algebra*, **164**, 247–273, (2001).
- “ $D$ -modules on smooth toric varieties” (with M. Mustață, G. Smith, H. Tsai), *J. Algebra*, **240**, 744–770 (2001).
- “Switching Surfaces and Gröbner bases” (with T. Georgiou and A. Tannenbaum), *IEEE Trans. Automat. Control*, **46**, 534–540 (2001).
- “Computing homomorphisms between holonomic  $D$ -modules” (with H. Tsai), *J. Symb. Comput.*, **32**, 597–617 (2001).
- “Algorithmic Determination of the Rational Cohomology of Complex Varieties via Differential Forms”, *Contemp. Math.* **286**, 185–206 (2001).
- “ $D$ -modules and cohomology of varieties”, a chapter in *Computations in algebraic geometry with Macaulay 2*, D. Eisenbud, D. Grayson, M. Stillman, B. Sturmfels eds., Springer-Verlag (2002).
- “Gröbner Bases, de Rham Cohomology and Stratifications”, *J. Symb. Comput.*, **35**, 527–542 (2003).
- “Bernstein–Sato polynomials, integration, and Milnor fiber cohomology of generic hyperplane arrangements”, *Compositio Math.* **141** 121–145 (2005).
- “Algorithmic stratification of  $\mathbb{R}Hom(\mathcal{M}, \mathcal{N})$  for regular holonomic modules on  $\mathbb{C}^n$ ”, *J. Symb. Comput.* **39**, 493–499 (2005).
- “Duality and irreducibility of hypergeometric systems”, *Math. Ann.* **338**, 55–74 (2005).
- “Homological methods for hypergeometric systems” (with E. Miller and L. Matusevich), *JAMS* **18**, 919–941 (2005).
- “Arbitrary rank jumps of hypergeometric systems” (with L. Matusevich), *J. of the LMS* **75**, 212–242 (2007).
- “On the arithmetic rank of certain Segre products” (with A. Singh), *Contemp. Math.* **390**, 147–155 (2005).

- “Local cohomology and pure morphisms” (with A. Singh), *Illinois J. Math.* **51**, 287–298 (2007).
- “24 Hours of Local Cohomology” (with S. Iyengar, G. Leuschke, A. Leykin, C. Miller, E. Miller, A. Singh), *AMS Graduate Studies in Mathematics* **87**, xviii+282 pp. (2007).
- “A connectedness result in positive characteristic” (with A. Singh), *Trans. of the AMS* **360**, 3107–3119 (2008).
- “Regularity and slopes of hypergeometric systems” (with M. Schulze), *Duke Math. J.* **142**, 465–509 (2008).
- “Cohen–Macaulayness and computation of Newton graded toric rings”, *JPAA* **213** (8), 1522–1535 (2009).
- “Hypergeometric D-modules and twisted Gauss–Manin systems” (with M. Schulze), *JA* **322**, 3392–3409 (2009).
- “Bockstein homomorphisms in local cohomology” (with A. Singh), *Crelle’s Journal* **655**, 147–164 (2011).
- “Restriction of  $A$ -hypergeometric systems to coordinate subspaces” (with M. Fernandez-Fernandez), *Proceedings of the AMS* **139**, 3175–3180 (2011).
- “Resonance equals reducibility for  $A$ -hypergeometric systems” (with M. Schulze), *Algebra and Number Theory* **6**, 527–537 (2012).
- “A note on Bockstein homomorphisms in local cohomology”, (with A.K. Singh), *Adv. Stud. Pure Math.* **62**, 513–521 (2012).
- “Local cohomology of logarithmic forms” (with G. Denham, H. Schenck, M. Schulze, M. Wakefield), *Ann. Inst. Fourier* **63**, 1177–1203 (2013).
- “Survey on the  $D$ -module generated by  $f^s$ , with an appendix by A. Leykin, Math. Sci. Res. Inst. Publ. **67**, *Commutative algebra and noncommutative algebraic geometry*. Vol. I, 391–430, *Cambridge Univ. Press, New York* (2015).
- “Singularities and holonomicity of binomial  $D$ -modules” (with C.B. Zamaere and L.F. Matusevich), *Journal of Algebra* **439**, 360–372 (2015).
- “Local cohomology modules supported at determinantal ideals” (with G. Lyubeznik and A.K. Singh), *J. Europ. Math. Soc.* **18**, 2545–2578 (2016).
- “B-functions of determinantal ideals” (with A. Lörincz, C. Raicu, J. Weyman), *Adv. Math* **307**, 224–252 (2017).
- “The Jacobian, the Milnor fiber, and the  $D$ -module generated by  $f^s$ ”, *Inventiones Math.* **207**, 1239–1287 (2017).
- “B-functions of hypergeometric systems” (with T. Reichelt and C. Sevenheck), *Int. Mat. Res. Not. IMRN* (to appear, 2017).
- “Gauß–Manin systems of families of Laurent polynomials and  $A$ -hypergeometric systems” (with T. Reichelt), [arXiv:1703.03057](https://arxiv.org/abs/1703.03057).

In preparation:

- “Mixed Hodge modules and hypergeometric systems” (with T. Reichelt).
- “On the non-reconstructible locus” (with M. Burkhart, D. Knott, A. Kommanduru).
- “Torus equivariant  $D$ -modules and hypergeometric systems” (with C. Berkesch and L.F. Matusevich).
- “Holonomicity and regularity of Horn systems” (with C. Berkesch and L.F. Matusevich).

#### Invited talks

- Algebraic Geometry Seminar, Northeastern University, Boston, MA (February 2017).
- Commutative Algebra Seminar, University of Nebraska, Lincoln, NE (January 2017).
- Conference on Hyperplane Arrangements, Sapporo, Japan (August 2016).
- Special session on Commutative Algebra, Salt Lake City, UT (April 2016).
- Special session on Singularities and Hyperplane Arrangements, Stony Brook, NY (March 2016).

- Stockholm University, Stockholm, Sweden (September 2015).
- “SinKLarities” conference on combinatorial aspects in singularities, Kaiserslautern, Germany (August 2015).
- D-modules in Commutative Algebra Conference, Guanajuato, Mexico (August 2015).
- “Computational Geometric Topology in Arrangement Theory”, ICERM, Providence, RI (July 2015).
- “Mirror Symmetry, Hodge Theory and Differential Equations” workshop, Mathematisches Forschungsinstitut Oberwolfach, Germany (April 2015).
- Algebraic geometry seminar, University of Notre Dame, South Bend, IN (March 2015).
- RTG Workshop in “Local cohomology”, UIC, Chicago, IL (February/March 2015).
- Special session on Commutative Algebra, Washington, DC (March 2015).
- Special session on Commutative Algebra, Halifax, Canada (October 2014).
- Special session on Commutative Algebra, Eau Claire, WI (October 2014).
- Colloquium, U. Western Ontario, London, Canada (March 2014).
- SIAM conference on Applied Algebraic Geometry, Fort Collins, CO (August 2013).
- Conference on Motivic Invariants and Singularities, South Bend, IN (June 2013).
- Local Cohomology Focus Period, Mathematical Sciences Research Institute Berkeley, CA (April 2013).
- MSRI Colloquium, Mathematical Sciences Research Institute, Berkeley, CA (March 2013).
- 3rd Bluegrass Algebra Conference, Lexington, KY (June 2012).
- Distinguished Visiting Professor Lecture Series, US Naval Academy, Annapolis, MD (April 2012).
- Workshop on Singularities, Madison, WI (March 2012).
- Workshop on Algebraic and Analytic  $D$ -modules, E. Schrödinger Institut, Vienna, Austria, (November 2011).
- Special session on Hypergeometric systems, Salt Lake City, UT (October 2011).
- Algebra seminar, University of Utah, Salt Lake City, UT (Oct 2011).
- Special session on Arrangements, Worcester, MA (April 2011).
- Special session on Geometric Commutative Algebra and Applications, Iowa City, IA (March 2011).
- Algebra/Topology seminar, Georgia Tech, Atlanta, GA (November 2010).
- Special session on Singularities in algebraic geometry, Notre Dame, IN (November 2010).
- MSJ-SI Conference on Hyperplane Arrangements, Sapporo, Japan (August 2009).
- Algebra/Topology seminar, Georgia Tech, Atlanta, GA (April 2009).
- Special session in Theor. and Alg. Aspects of  $D$ -modules, AMS Sectional Meeting in Raleigh, NC (April 2009).
- Algebraic Geometry Seminar at Georgia Inst. of Technology, Atlanta, GA (April 2009).
- Alg. Geom. Seminar, Univ. of Illinois at Chicago, Chicago IL (March 2009).
- Comm. Alg./ Alg. Geom. Seminar at Univ. of Notre Dame, South Bend, IN (February 2009).
- Sequence of plenary lectures at the “Summer School on Hypergeometric Functions”, Kleinwalsertal, Austria (September 2007).
- Special Session in Comb. and Geom. Aspects of Comm. Alg., AMS Sectional Meeting Bloomington, IN (April 2008).
- Conference on Macaulay2, Ithaca, NY (March 2008).
- Workshop on “ $D$ -modules and  $F$ -singularities”, Ann Arbor, MI (August 2007).
- Representation theory, systems of differential equations, and related topics, Hokkaido University, Sapporo, Japan (July 2007).

- International Conference on Theoretical Effectivity and Practical Effectivity of Gröbner Bases, RIMS Kyoto, Japan (January 2007).
- Workshop on computational and combinatorial commutative algebra, Toronto, Canada (August 2006)
- Workshop on Gröbner bases, RISC Linz, Austria (May 2006).
- Plenary Speaker, JSPS Conference on Theoretical Effectivity and Practical Effectivity of Gröbner Bases, Tokyo, Japan (August 2005).
- Plenary Speaker, D-Modules and Hypergeometric Functions Workshop, Lisbon, Portugal (July 2005).
- Colloquium, University of Illinois at Urbana-Champaign (January 2004).
- Special session in Hypergeometric Functions, AMS Sectional Meeting, Pittsburgh, PA (November 2004).
- Lipman-Fest, West Lafayette, Indiana (May 2004).
- Algebra/Geometry/Topology Seminar, Georgia Tech, Atlanta, Georgia (March 2004).
- Special session in Computational Methods in Algebra and Analysis, RSME-AMS Joint Meeting Sevilla, Spain (June 2003).
- MEGA 2003 Conference on Algorithmic Algebraic Geometry, Kaiserslautern, Germany (June 2003).
- Instituto de Matemáticas de la Universidad de Sevilla, Spain (June 2003).
- 3-City Algebra Day, Jena, Germany (November 2002).
- Plenary Speaker, EACA Conference, Valladolid, Spain (September 2002).
- Special Session in Hyperplane Arrangements, AMS Sectional Meeting, Madison, Wisconsin (October 2002).
- CBMS Conference on “Solving systems of polynomial equations”, College Station, Texas (June 2002).
- Special Session in Commutative Algebra and Algebraic Geometry, AMS Sectional Meeting, Montreal, Canada (May 2002).
- Special Session in Commutative Algebra, AMS Sectional Meeting, Ann Arbor, Michigan (March 2002).
- ACA Conference, Albuquerque, New Mexico (June 2001).
- Shape Seminar, Brown University, Providence, Rhode Island (August 2001).
- AMS Sectional Meeting, Columbia University, New York, New York (October 2000).
- Special Session in Commutative Algebra and Algebraic Geometry, Mathematics Joint Meeting, Washington, DC (January, 2000).
- Commutative and Noncommutative Algebra Seminar, University of California, Berkeley (November 1999).
- Conference on Local Cohomology, CIMAT, Guanajuato, Mexico (November 1999).
- Colloquium, North Dakota State University, Fargo (April 1999).
- Workshop on Gröbner bases, CIMAT, Guanajuato, Mexico (February 1999).
- Colloquium, University of Arizona, Tucson (January 1999).
- Midwest Algebraic Geometry Conference, Columbia (October 1999).
- Symbolic Computation Seminar, MSRI, Berkeley (October 1998).
- Commutative Algebra, Algebraic Geometry and Combinatorics Seminar, University of California at Berkeley (September 1998).
- MEGA 98 Conference on Algorithmic Algebraic Geometry, St. Malo, France (June 1998).
- MITO Seminar, Research Institute of the Mathematical Sciences, Kyoto, Japan (April 1998).
- Colloquium, Department of Mathematics, Kobe University, Kobe, Japan (May 1998).

- Special Session on Commutative Algebra, Mathematics Joint Meeting in Baltimore, Maryland (January, 1998).
- Poster session at the Conference in Honor of David Buchsbaum, Northeastern University, Boston, Massachusetts (October 1997).

## Teaching Experience

PURDUE UNIVERSITY	
• Professor	2011 – present
• Associate Professor	2006 – 2011
• Assistant Professor	2000 – 2006
UNIVERSITY OF MINNESOTA	
• Resource Teaching Assistant	1993 – 1999
• Co-instructor	1997, 1998
• Co-instructor for the University of Minnesota “Topics of Elementary Mathematics” program.	1997 – 1998
• Course Supervisor	Spring 1997
• Course Supervisor for the University of Minnesota course “Excursions in Mathematics”.	
• Teaching Assistant	1993 – 1997

## Other Experience

- “Opponent” at PhD defense of K. Tveiten, Stockholm University (September 2015).
- Mathematisches Forschungsinstitut Oberwolfach (April 2015).
- SYSIPH (“Mirror SYmmetry and irregular SIngularities coming from PHysics”) CIRM Luminy, France (April 2017).
- Research Fellow, Mathematical Sciences Research Institute, Berkeley, California (February – March 2003).
- Research Fellow, Mathematical Sciences Research Institute, Berkeley, California (August – September 2002).
- Research Fellow, Mathematical Sciences Research Institute, Berkeley, California (August – October 1998).
- Research Visitor, Kobe University, Kobe, Japan (March-May 1998).
- Summer School in Commutative Algebra, Centre de Recerca Matemàtica, Barcelona, Spain (July–August 1996).

## Synergistic Activities:

- Organizer (with K. Altman, C. Sevenheck) of “Hodge Theory and Differential equations”, Chemnitz, Germany (March 2018).
- Organizer (with C. Berkesch, W. Zhang) of “Local Cohomology in Commutative Algebra and Algebraic Geometry”, Minneapolis, MN (August 2017).
- Co-Organizer of Midwestern biannual conference “Algebra, Geometry and Combinatorics”, April/October 2009-present (Co-Founder with S. Basu, H. Schenck, A. Yong).
- Organizer (with G. Denham, M. Schulze, C. Sevenheck) of “SinKLarities” conference on combinatorial aspects in singularities, Kaiserslautern, Germany (August 2015).
- Organizer of Special Session in “Effective Methods in D-modules and singularities” at SIAM Conference in Fort Collins, CO, with K. Schwede, C. Raicu, Aug. 1-4 2013.
- Organizer of Special Session in “Computations and Effective Bounds in Commutative Algebra” at SIAM Conference in Fort Collins, CO, with K. Schwede, C. Raicu, Aug. 1-4 2013.

- Organizer of Special Session in “D-modules” at AMS Sectional Meeting in Bloomington, IN, with M. Schulze, Apr. 5–6 2008.
- Organizer of AMS-IMS-SIAM Summer School in “Commutative Algebra: Local Cohomology and its interactions with Algebra, Analysis and Geometry” at Snowbird, UT, with A. Singh, June 19 – July 1 2005.
- Organizer of Special Session in “D-modules” at Joint AMS Meeting in Atlanta, GA, with S. Sperber, Jan. 5–8 2005.
- Organizer of “Workshop in Computational Algebraic Analysis”, at MSRI, with B. Sturmfels and N. Takayama, Jan. 5–7 2000.
- Referee for Acta Mathematica, Adv. Math., AJM, ANT, Comm. Alg., Compositio Math., Duke M. J., Electronic J. Comb., Hacettepe, Illinois J. Math., IMRN, Indagationes, ISSAAC, JAMS, J. AAEC, J. Algebra, J. Comb. Th. J. Complexity, J. LMS, J. Optimization, JPAA, JSC, Kyushu J. Math., Math. Ann., Math. Z., Math. Res. Lett., PAMS, Rev. Mat. Iberoamericana, Sigma, TAMS,
- Reviewer for “Mathematical Reviews”.
- Referee for NSF, NSA, Netherlands Organisation for Scientific Research, Marie Curie Foundation of the European Community, Humboldt Foundation

### Advisorial

- Postdoctoral fellows
  - Mathias Schulze (2005/6)
  - Peter Scheiblechner (co-advisor with Saugata Basu)
  - Emily Witt (2013, at MSRI)
  - Linqun Ma (2014/5)
  - Andras Lörincz (2016-19)
- Graduate students
  - Darren Tapp (PhD 2007)
  - Maria-Cruz Fernandez-Fernandez (visiting from Sevilla, Fall 2009)
  - Christine Berkesch (PhD 2010)
  - Jen-Chieh Hsiao (PhD 2012)
  - Arnold Yim, (PhD 2016)
  - Jim Vaught (PhD 2016 in ECE, co-advisor with M. Boutin)
  - Michael Kaminski, Avi Steiner, Dan Bath (current)
- Summer REU Projects
  - Jamie Gennis, Sam Vaughn (2003)
  - John Berlakovich, Matt Davis (2009)
  - Mike Burkhart, David Knott (2010)
  - David Knott, Abi Kommanduru (2011)
  - Katie Marsh (2012)
  - Alan Min, Colin Ford (2015).
  - Steven Kidd, Yang Mo (2016).
- Exchange Programs
  - Gabriel Esteban Perico Monsalve via Colombia Purdue Institutes Undergraduate Research Experience (2015)

### Committees

- Computer: 2007-2013
- Campus Grievance Appeals: 2004-2006
- University Student Cases: 2007-2012
- Undergraduate: 2011-2017, Chair 2012-18
- CoS Undergraduate Curriculum and Academic Policy Committee (2011-2018)
- Calculus: 2010-2017
- Promotions: 2011/12, 2013/14