Linquan Ma

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RESEARCH INTERESTS	Commutative algebra and algebraic geometry: singularities in all characteristics, local cohomology, multiplicities, and the homological conjectures/theorems.

EDUCATION

University of Michigan, Ann Arbor, Michigan, USA   2008–2014

Ph.D., Mathematics
Advisor: Melvin Hochster

Peking University, Beijing, China   2004–2008

B.S., Mathematics
Advisor: Jiazhong Yang

EMPLOYMENT

Associate Professor, Purdue University   2021–

Assistant Professor, Purdue University   2018–2021

Research Member, MSRI   Apr–May 2019

Research Assistant Professor, University of Utah   2015–2018

Golomb Visiting Assistant Professor, Purdue University   2014–2015

HONORS & GRANTS

- NSF FRG Grant DMS–1952366: Collaborative Research: 2020–2023
  Algebraic geometry and singularities in positive and mixed characteristic
  (with Bhargav Bhatt, Christopher Hacon, Sándor Kovács, Mircea Mustaţă,
  Karl Schwede, Karen Smith and Chenyang Xu)
- Alfred P. Sloan Research Fellowship   2020–2024
- NSF Grant DMS–1901672: Singularities and multiplicities in commutative algebra   2019–2023
- NSF Grant DMS–1836867/1600198: Studies in Commutative Algebra   2016–2019
- Don Tucker Outstanding Postdoc, University of Utah   2017–2018
- AMS-Simons Travel Grant   2015–2016
- President Fellowship, Peking University   2006–2007

PAPERS & PREPRINTS

43 Lim Ulrich sequences and Boij-Söderberg cones (with Srikanth Iyengar and Mark Walker).

42 Perfectoid signature, perfectoid Hilbert-Kunz multiplicity, and an application to local fundamental groups (with Hanlin Cai, Seungsu Lee, Karl Schwede and Kevin Tucker).

41 Uniform Lech's inequality (with Ilya Smirnov).

40 A short proof of the direct summand theorem via the flatness lemma.

39 A Buchsbaum theory for tight closure (with Pham Hung Quy), *Trans. Amer. Math. Soc.*, to appear.

38 Multiplicities and Betti numbers in local algebra via lim Ulrich points (with Srikanth Iyengar and Mark Walker), *Algebra Number Theory* 16 (2022), no. 5, 1213-1257.

37 F-singularities: a commutative algebra approach (with Thomas Polstra).

36 Globally $+$-regular varieties and the minimal model program for threefolds in mixed characteristic (with Bhargav Bhatt, Zsolt Patakfalvi, Karl Schwede, Kevin Tucker, Joe Waldron and Jakub Witaszek).

35 F-stable secondary representations and deformation of F-injectivity (with Alessandro De Stefani), *Acta Math. Vietnam.* 47 (2022), no. 1, 141-150 (special issue dedicated to Nguyen Tu Cuong).

34 Lim Ulrich sequences and Lech's conjecture, *Invent. Math.*, to appear.

33 Lim Cohen-Macaulay sequences of modules (with Bhargav Bhatt and Melvin Hochster).

32 Symbolic power containments in singular rings in positive characteristic (with Eloísa Grifo and Karl Schwede), *Manuscripta Math.*, to appear.

31 An analog of adjoint ideals and PLT singularities in mixed characteristic (with Karl Schwede, Kevin Tucker, Joe Waldron and Jakub Witaszek), *J. Algebraic Geom.*, to appear.

30 Maximal Cohen-Macaulay complexes and their uses: a partial survey (with Srikanth Iyengar, Karl Schwede and Mark Walker), *Commutative Algebra*, 475-500, Springer, Cham, 2021 (dedicated to David Eisenbud).

29 Koszul and local cohomology, and a question of Dutta (with Anurag Singh and Uli Walther), *Math. Z.* 298 (2021), no. 1-2, 697-711.

28 Covers of rational double points in mixed characteristic (with Javier Carvajal-Rojas, Thomas Polstra, Karl Schwede and Kevin Tucker), *J. Singul.* 23 (2021), 127-150.

27 Singularities in mixed characteristic via perfectoid big Cohen-Macaulay algebras (with Karl Schwede), *Duke Math. J.* 170 (2021), no. 13, 2815-2890.

26 Cohomologically full rings (with Hailong Dao and Alessandro De Stefani), *Int. Math. Res. Not. IMRN* 2021, no. 17, 13508-13545.

25 Extended plus closure in complete local rings (with Raymond Heitmann), *J. Algebra* 571 (2021), 134-150 (special issue dedicated to Craig Huneke).

24 Asymptotic Lech's inequality (with Craig Huneke, Pham Hung Quy and Ilya Smirnov), *Adv. Math.* 372 (2020), 107296, 33 pp.

23 Filter regular sequence under small perturbations (with Pham Hung Quy and Ilya Smirnov), *Math. Ann.* 378 (2020), no. 1-2, 243-254.

22 Colength, multiplicity, and ideal closure operations (with Pham Hung Quy and Ilya Smirnov), *Comm. Algebra* 48 (2020), no. 4, 1601-1607.

21 A Kunz-type characterization of regular rings via alterations (with Karl Schwede), *J. Pure Appl. Algebra* 224 (2020), no. 3, 1124-1131.

20 Regularity, singularities and h-vector of graded algebras (with Hailong Dao and Matteo Varbaro), preprint 2019.

19 Recent applications of p-adic methods to commutative algebra (with Karl Schwede), *Notices Amer. Math. Soc.* 66 (2019), no. 6, 820-831.

18 *F*-signature under birational morphisms (with Thomas Polstra, Karl Schwede and Kevin Tucker), *Forum Math. Sigma*, 7 (2019), e11, 20 pp.

17 Lech's inequality, the Stückrad–Vogel conjecture, and uniform behavior of Koszul homology (with Patricia Klein, Pham Hung Quy, Ilya Smirnov and Yongwei Yao), *Adv. Math.* 347 (2019), 442-472. (Lech's inequality and the Stückrad-Vogel conjecture, Oberwolfach Report 6/2019, 428-429.)

16 Regular rings and perfect(oid) algebras (with Bhargav Bhatt and Srikanth Iyengar), *Comm. Algebra* 47 (2019), no. 6, 2367-2383 (special issue dedicated to Gennady Lyubeznik).

15 Maximal Cohen-Macaulay modules over certain Segre products, *Comm. Algebra* 47 (2019), no. 6, 2488-2493 (special issue dedicated to Gennady Lyubeznik).

14 Perfectoid multiplier/test ideals in regular rings and bounds on symbolic powers (with Karl

Schwede), *Invent. Math.* 214 (2018), no. 2, 913-955.

13 Big Cohen-Macaulay algebras and the vanishing conjecture for maps of Tor in mixed characteristic (with Raymond Heitmann), *Algebra Number Theory* 12 (2018), no. 7, 1659-1674.

12 D-module and F-module length of local cohomology modules (with Mordechai Katzman, Ilya Smirnov and Wenliang Zhang), *Trans. Amer. Math. Soc.* 370 (2018), no. 12, 8551-8580.

11 F-singularities under generic linkage (with Janet Page, Rebecca R.G., William Taylor and Wenliang Zhang), *J. Algebra* 505 (2018), 194-210.

10 Frobenius actions on local cohomology modules and deformation (with Pham Hung Quy), *Nagoya Math. J.* 232 (2018), 55-75.

9 The dualizing complex of F-injective and Du Bois singularities (with Bhargav Bhatt and Karl Schwede), *Math. Z.* 288 (2018), no. 3-4, 1143-1155.

8 The vanishing conjecture for maps of Tor and derived splinters, *J. Eur. Math. Soc. (JEMS)*, 20 (2018), no. 2, 315-338.

7 Lech's conjecture in dimension three, *Adv. Math.* 322 (2017), 940-970. (Lech's conjecture, Oberwolfach Report 57/2016, 3214-3216.)

6 Local cohomology of Du Bois singularities and applications to families (with Karl Schwede and Kazuma Shimomoto), *Compos. Math.* 153 (2017), no. 10, 2147-2170.

5 F-injectivity and Buchsbaum singularities, *Math. Ann.* 362 (2015), no. 1-2, 25-42.

4 Eulerian graded D-modules (with Wenliang Zhang), *Math. Res. Lett.* 21 (2014), no. 1, 149-167.

3 A sufficient condition for F-purity, *J. Pure Appl. Algebra* 218 (2014), 1179-1183.

2 The category of F-modules has finite global dimension, *J. Algebra* 402 (2014), 1-20.

1 Finiteness properties of local cohomology for F-pure local rings, *Int. Math. Res. Not. IMRN* 2014, no. 20, 5489-5509.

0 The Frobenius endomorphism and multiplicities, Thesis, University of Michigan (2014).

INVITED SPEAKER
LECTURE SERIES

- Graduate Course on Tight Closure of Ideals and its Applications, ICTP Virtual Meeting, May–Jun 2022 (online).

- MSRI graduate school, Thematic Program in Commutative Algebra and its Interaction with Algebraic Geometry, Center for Mathematics at Notre Dame, Jun 2019.

- Frobenius Action in Commutative Algebra: Recent Developments, Institute of Mathematics of the University of Barcelona, Jan 2019.

- RTG mini-course: Topics in Commutative Algebra, University of Utah, May 2018.

- Homological Conjectures in Commutative Algebra, UIC, Nov 2016.

CONFERENCE,
WORKSHOP &
COLLOQUIUM
TALKS

- Clay Mathematics Institute workshop p-adic Hodge Theory and Applications, Mathematical Institute of the University of Oxford, Sep 2022.

- AMS Special Session on Commutative Ring Theory, University of New Mexico, Albuquerque, Oct 2021 (online).

- Singularities in Positive Characteristic, CIRM, Luminy, Jul 2021 (online).

- Early Commutative Algebra Researchers, Jun 2020 (online).

- Homological trends in Commutative Algebra and Algebraic Geometry, Bucharest, Jun 2020 (canceled).

- Workshop on Commutative Algebra, National Centre for Mathematics, Center of IIT Bombay and TIFR, May 2020 (canceled).

- Morgantown Algebra Days, West Virginia University, Apr 2020 (canceled).

- JMM Special Session on Commutative Algebra, Denver, Jan 2020.

- KUMUNU–regional commutative algebra conference, University of Nebraska, Sep 2019.
- Conference on Commutative Algebra and its Interaction with Algebraic Geometry (In Honor of Bernd Ulrich), Center for Mathematics at Notre Dame, Jun 2019.
- New Mexico State University Colloquium, Mar 2019.
- Singularities and Homological Aspects of Commutative Algebra, Oberwolfach Workshop, Feb 2019.
- The 40th Japan Symposium on Commutative Algebra, LecTore Hayama, Kanagawa, Nov 2018.
- Modern Algebraic Geometry, Beijing International Center for Mathematical Research, Peking University, Beijing, Jul 2018.
- AMS Special Session on Commutative Algebra, Vanderbilt University, Nashville, Apr 2018.
- University of Minnesota Colloquium, Apr 2018.
- Mini-workshop on Commutative Algebra, University of Virginia, Mar 2018.
- The Homological Conjectures: Resolved! MSRI, Berkeley, Mar 2018.
- AMS Special Session on Homological Methods in Commutative Algebra, University of North Texas, Sep 2017.
- Local Cohomology in Commutative Algebra and Algebraic Geometry, University of Minnesota, Aug 2017.
- AMS Special Session on Commutative Algebra, Indiana University, Bloomington, Apr 2017.
- Young Mathematician Forum, Beijing International Center for Mathematical Research, Peking University, Beijing, Dec 2016.
- Asymptotic Phenomena in Local Algebra and Singularity Theory, Oberwolfach Workshop, Dec 2016.
- Purdue University Special Colloquium, Nov 2016.
- Higher Dimensional Algebraic Geometry and Characteristic p, CIRM, Luminy, Sep 2016.
- Midwest Commutative Algebra Conference, Purdue University, Aug 2015.
- Recent developments in positive characteristic techniques in commutative algebra: Frobenius Operators and Cartier Algebras, Atlanta, Mar 2015.
- AMS Special Session on Commutative Algebra, Albuquerque, Apr 2014.
- JMM Special Session on Homological and Characteristic p Methods in Commutative Algebra, Baltimore, Jan 2014.
- Birational Geometry and Singularities in Positive Characteristic, University of Tokyo, Nov 2013.

Seminar Talks
- Purdue University Commutative Algebra Seminar and Algebraic Geometry Seminar, Feb 2022 (online), Sep 2021, Jan 2020, Feb 2019, Nov 2018, Sep 2018, Oct 2015, Apr 2015, Jan 2015, Dec 2014, Nov 2014, Oct 2014.
- Zoom Algebraic Geometry Seminar, Dec 2021 (online).
- Northwestern Algebraic Geometry Seminar, Oct 2021 (online).
- Purdue Bridge to Research Seminar, Oct 2021.
- CUNY Commutative Algebra & Algebraic Geometry Seminar, Apr 2021 (online).
- UIC Algebraic Geometry Seminar and Commutative Algebra Seminar, Mar 2021 (online), Oct 2016, Oct 2013.
- IIT Bombay Virtual Commutative Algebra seminar, Aug 2020 (online).
- Joint NU/UIC/UofC algebraic geometry and commutative algebra seminar, May 2020 (online).
- Fellowship of the Ring, National Seminar, Apr 2020 (online).
- BICMR/Peking University Algebraic Geometry Seminar, Dec 2019.

- University of Utah Commutative Algebra Seminar and Algebraic Geometry Seminar, Nov 2019, Mar 2019, Nov 2018, Sep 2017, Nov 2015, Nov 2015, Oct 2014.
- University of Michigan Commutative Algebra Seminar, Dec 2018, Nov 2015, Nov 2014, Feb 2014, Oct 2013, Oct 2012, Jan 2012, Dec 2011.
- University of Kentucky Algebra Seminar, Oct 2018.
- University of Minnesota Algebra Seminar, Apr 2018.
- Princeton Algebraic Geometry Seminar, Feb 2018, Apr 2017.
- University of Tokyo Algebraic Geometry Seminar, Dec 2017.
- UCSD Algebraic Geometry Seminar, Apr 2017.
- University of Kansas Algebra Seminar, Oct 2016.
- University of Virginia Algebra Seminar, May 2016.
- University of Arkansas Algebra Seminar, Oct 2015.
- UIUC Commutative Ring Theory Seminar, Feb 2015.
- University of Notre Dame Algebraic Geometry/Commutative Algebra Seminar, Dec 2014.
- University of Nebraska Commutative Algebra Seminar, Jan 2014.
- MSRI/UC Berkeley Commutative Algebra Seminar, May 2013.
- Penn State University Algebra and Number Theory Seminar, Feb 2013.

ORGANIZATION & SERVICE

- Co-organizer, Recent Developments in Commutative Algebra, MSRI, Berkeley, Apr 2024.
- Co-organizer, Algebraic Geometry and Singularities Learning Workshop & Conference, University of Washington, Seattle, Jun 2022.
- Co-organizer, Advances in Mixed Characteristic Commutative Algebra and Geometric Connections, BIRS program, Casa Matematica Oaxaca (CMO) Mexico, May 2022 (hybrid conference).
- Co-organizer, AMS Special Session on Recent Developments in Commutative Algebra, West Lafayette, Mar 2022 (online).
- Co-organizer, D-modules, Group Actions, and Frobenius: Computing on Singularities, Topical Workshop at ICERM, Providence, Aug 2021 (online).
- Co-organizer, AMS Special Session on Advances in Commutative Algebra, Ann Arbor, Oct 2018.
- Assistant, Commutative Algebra and Related Topics, MSRI Summer School, Okinawa Institute of Science and Technology, May 2017.
- Co-organizer, AMS Special Session on Commutative Algebra, Salt Lake City, Apr 2016.
- Co-organizer, JMM Special Session on Commutative Algebra, Seattle, Jan 2016.
- Assistant, MRC Commutative Algebra Program, Snowbird, Utah, Jun 2015.
- Local organizer, Computational workshop on Frobenius singularities and invariants, University of Michigan, May 2012.
- Referee for: Advances in Mathematics, Algebra and Number Theory*, Annales Scientifiques de l'École Normale Supérieure*, Annali della Scuola Normale Superiore di Pisa Classe di Scienze, Annals of Mathematics*, Colloquium Mathematicum*, Communications in Algebra, Compositio Mathematica, Duke Mathematical Journal, International Mathematics Research Notices, Journal für die reine und angewandte Mathematik*, Journal of Algebra, Journal of Algebraic Geometry, Journal of the American Mathematical Society, Journal of the European Mathematical Society, Journal of Pure and Applied Algebra, Manuscripta Mathematica, Mathematical Proceedings of the Cambridge Philosophical Society*, Mathematische Zeitschrift, Memoirs of the American Mathematical Society*, Michigan Mathematical Journal, Nagoya Mathematical Journal*, Pacific Journal of Mathematics, Proceedings of the American Mathematical Society, Research in the Mathematical Sciences, Transactions of the American Mathematical Society. (*=quick opionion)

- Reviewer for AMS Mathematical Reviews and Zentralblatt Math.

DEPARTMENTAL SERVICE	• Graduate committee, 2022– • Co-organizer, Commutative Algebra Seminar at Purdue University, 2022–

MENTORING

Graduate students:
- Cheng Meng (co-advised with Giulio Caviglia)
- Qiurui Li

Postdocs:
- Farrah Yhee (co-mentored with Irena Swanson)

Others:
- Primary advisor for "Passion for Mathematics" (an undergraduate Math Club), Spring 2022.
- Host for Luis Duarte (visiting from University of Genova), Feb–Mar 2022.
- Reading course for Kyle Flanagan 2019–2020, and Josiah Banks 2019.

Thesis committee:

2022: Anna-Rose Wolff, Yevgeniya Tarasova, Vinh Nguyen, Yihui Liang, Vaibhav Pandey (Utah), McKinley Gray (UIC)

2021: Daniel Bath

2020: Edward Price, Monte Cooper, Tan Dang, Roberto Ulloa Esquivel

2019: Alessandra Costantini, Avi Steinea

2018: Christina Jamroz

Oral exam committee:

2021: Qiurui Li

2020: Peter McDonald (Utah), Adam LaClair

2019: Josiah Banks, Kyle Flanagan, Hunter Simper

TEACHING EXPERIENCE

Teaching at Purdue:
- Math 69000 Topics in Commutative Algebra: Complete intersections (Fall 2022).
- Math 35100 Elementary Linear Algebra (Spring 2022).
- Math 45000 Algebra Honors (Fall 2021, Fall 2020, Fall 2019).
- Math 69000 Topics in Commutative Algebra: Positive characteristic methods (Spring 2021).
- Math 69000 Topics in Commutative Algebra: Homological conjectures/theorems and perfectoid spaces (Spring 2020).
- Math 26500 Linear Algebra (Fall 2018, Spring 2015, Fall 2014).

Teaching at Utah:

- Math 7830 Topics in Commutative Algebra: Perfectoid spaces and the homological conjectures (Spring 2018).
- Math 2210 Calculus 3 (Fall 2017, Spring 2016).
- Math 2200 Introduction to Discrete Mathematics (Spring 2017, Fall 2016).
- Math 2250 Differential Equations and Linear Algebra (Fall 2015).

Teaching at Michigan:

- TA for a course on Fibonacci numbers (Summer 2014).
- TA for Math 215 Calculus 3 (Spring 2014, Fall 2013, Fall 2012, Spring 2012).
- Math 116 Calculus 2 (Spring 2011).
- Math 115 Calculus 1 (Spring 2010, Fall 2009).
- Math 105 Data, Functions and Graphs (Spring 2009, Fall 2008).