

# Josh Pollitz

## Curriculum Vitae

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### Research Interests

My research interests are primarily in the homological aspects of commutative algebra. I have a particular interest in studying properties of commutative rings using theories of cohomological support and structures on resolutions. I often work with triangulated categories as they are well-suited to study such data, and it allows me to draw on ideas from a variety of other areas such as homotopy theory and representation theory.

### Academic Appointments

- 2023–current **Assistant Professor (Tenure Track)**, *Syracuse University*.
- 2020–2023 **NSF Postdoctoral Research Fellow**, *University of Utah*.  
Postdoc Mentor: Srikanth B. Iyengar
- 2019–2020 **Research Assistant Professor (RTG Postdoc)**, *University of Utah*.  
Postdoc Mentor: Srikanth B. Iyengar

### Honors

- Fall 2022 **Hausdorff Research Institute for Mathematics: Special Trimester**.  
I was invited to spend two months at the Hausdorff Research Institute in Bonn, Germany during their special trimester on Spectral Methods in Algebra, Geometry, and Topology.

### Education

- August 2019 **Ph.D. Mathematics, University of Nebraska, Lincoln**.  
Advisors: Luchezar L. Avramov and Mark E. Walker  
Thesis: The derived category of a locally complete intersection ring
- May 2015 **M.S. Mathematics, University of Nebraska, Lincoln**.
- June 2013 **M.S. Mathematics, Oregon State University**.
- December 2010 **B.S. Mathematics, California Polytechnic State University, San Luis Obispo**.

### Grants and Awards

- 2023 **NSF standard grant (3 years)**, *PI on Grant # 2302567*.
- 2022 **Don H. Tucker Postdoctoral Fellowship, University of Utah**, *This award is given to a postdoc for excellence in research*.
- 2021 **Outstanding Postdoc Award, University of Utah**, *This award is annually given to a postdoctoral scholar in recognition of their exceptional research and teaching*.
- 2020 **NSF Postdoctoral Research Fellowship (3 years)**, *Grant #2002173*.
- 2018 **NSF grant funding *Conferences on Commutative Algebra for Early Career Researchers* (2 years)**, *Co-P.I. on Grant #1802088*.
- 2018 **AMS Graduate Student Travel Grant**, *Used for the Fall 2018 AMS Sectional in Fayetteville, AR*.
- 2017 **Bill Leavitt Award, University of Nebraska, Lincoln**, *This award is given each academic year to support graduate student research based on academic success*.

- 2015 **Steven Haataja Award, University of Nebraska, Lincoln**, *This award is for outstanding exposition by a graduate student.*
- 2010 **Charles J. Hanks Excellence in Math Award, California Polytechnic State University**, *This award is given to a student who demonstrated excellence and outstanding ability.*
- 2009 **Robert P. Balles Mathematics Scholarship, California Polytechnic State University**, *A scholarship awarded to a student for excellence in undergraduate math courses.*

## Published Papers, Preprints and Packages

### Submitted preprints

- (16) **High Frobenius pushforwards generate the bounded derived category** joint with Matthew Ballard, Srikanth Iyengar, Patrick Lank, and Alapan Mukhopadhyay. arXiv:2303.18085
- (15) **Bounds on cohomological support varieties** joint with Benjamin Briggs and Eloísa Grifo. arXiv:2210.15574
- (14) **Resolutions of differential operators of low order for an isolated hypersurface singularity** joint with Rachel Diethorn, Jack Jeffries, Claudia Miller, Nick Packauskas, Hamid Rahmati, and Sophia Vassiliadou. arXiv:2209.13110

### Published or accepted papers

- (13) **Cohomological jump loci and duality in local algebra** joint with Ben Briggs and Daniel McCormick. *Mathematische Zeitschrift* (2023)
- (12) **The homotopy Lie algebra of a Tor-independent tensor product** joint with Luigi Ferraro, Mohsen Gheibi, Dave Jorgensen and Nicholas Packauskas. *Illinois Journal of Mathematics* (2023)
- (11) **A comparison of dg algebra resolutions with prime residual characteristic** joint with Michael DeBellevue. *Quarterly Journal of Mathematics* (2023)
- (10) **A partial converse ghost lemma for the derived category of a commutative noetherian ring**, joint with Jian Liu. *Proceedings of the American Mathematical Society* (2023)
- (9) **Exceptional complete intersection maps of local rings** joint with Srikanth Iyengar, Janina Letz, and Jian Liu. *Pacific Journal of Mathematics* (2022)
- (8) **Locally complete intersection maps and the proxy small property**, joint with Benjamin Briggs, Srikanth Iyengar, and Janina Letz. *International Mathematics Research Notices IMRN* (2022)
- (7) **Constructing non-proxy small test modules**, joint with Benjamin Briggs and Eloísa Grifo. *Nagoya Mathematical Journal* (2022)
- (6) **Cohomological supports of tensor products of modules over commutative rings** joint with Srikanth Iyengar and William Sanders. *Research in the Mathematical Sciences* (2022)
- (5) **Support varieties over skew complete intersections via derived braided Hochschild cohomology**, joint with Luigi Ferraro and W. Frank Moore. *Journal of Algebra* (2022)
- (4) **Cohomological support over derived complete intersections and local rings**. *Mathematische Zeitschrift* (2021)
- (3) **Duality and symmetry of complexity over complete intersections via exterior homology**, joint with Jian Liu. *Proceedings of the American Mathematical Society* (2021)
- (2) **Equivariant isomorphisms of Ext and Tor modules**. *Journal of Algebra* (2020)
- (1) **The derived category of a locally complete intersection ring**. *Advances in Mathematics* (2019)

### Software

I am a co-author of the ThickSubcategories package for the software system Macaulay2 with Eloísa Grifo and Janina Letz. This is available for use at <https://github.com/eloisagrifo/levels>. (Note: This package is still under construction)

## Teaching & Mentorship

### Instructor of Record

|             |   |                         |
|-------------|---|-------------------------|
| Fall 2023   | Math 331: Linear Algebra                                | Syracuse University     |
| Spring 2023 | Math 3210: Foundations of Analysis                      | University of Utah      |
| Fall 2021   | Math 4400: Introduction to Number Theory                | University of Utah      |
| Spring 2020 | Math 3210: Foundations of Analysis                      | University of Utah      |
| Fall 2019   | Math 2200: Discrete Mathematics                         | University of Utah      |
| Spring 2019 | Math 314: Linear Algebra                                | University of Nebraska  |
| Fall 2018   | Math 208: Calculus III                                  | University of Nebraska  |
| Fall 2017   | Math 208: Calculus III                                  | University of Nebraska  |
| Summer 2017 | Math 802P: Numbers, Geometry and Algebraic Thinking II* | University of Nebraska  |
| Spring 2017 | Math 302: Mathematical Modeling*                        | University of Nebraska  |
| Fall 2016   | Math 301: Mathematics Matters*                          | University of Nebraska  |
| Spring 2016 | Math 104: Applied Calculus (Thompson Scholars)          | University of Nebraska  |
| Fall 2015   | Math 203: Contemporary Mathematics                      | University of Nebraska  |
| Summer 2015 | Math 104: Applied Calculus                              | University of Nebraska  |
| Spring 2015 | Math 101: College Algebra                               | University of Nebraska  |
| Fall 2014   | Math 101: College Algebra                               | University of Nebraska  |
| Spring 2012 | Math 111: College Algebra                               | Oregon State University |
| Summer 2012 | Math 111: College Algebra                               | Oregon State University |
| Spring 2012 | Math 251: Differential Calculus                         | Oregon State University |

### Coordinator and teaching assistant roles

Summer 2022 **Teaching Assistant**, *PASCA 2022*.

Graduate summer school held at CIMAT in Mexico. I served as a teaching assistant for Claudia Miller who taught a graduate course on dg algebra resolutions for students from both Latin America and the United States.

Fall 2018 **Math 106 Recitation Coordinator**, *University of Nebraska*.

One of the major duties involved observing recitation instructors for Math 106 and meeting with them to discuss their observation and ways to improve their classrooms. Also, would lead a weekly meeting for all recitation instructors.

I served as a graduate teaching assistant at University of Nebraska-Lincoln and Oregon State University; also, I was an undergraduate teaching assistant at California Polytechnic State University SLO. Here are the following courses I have been supervised in this role:

- University of Nebraska: Math 808T: Concepts of Calculus\*, Math 106: Calculus I.
- Oregon State University: Math 256: Differential Equations, Math 254: Vector Calculus, Math 245: Calculus for Management and Social Sciences, Math 241: Differential Calculus.
- California Polytechnic SLO: Math 413: Introduction to Analysis II, Math 412: Introduction to Analysis I, Math 248: Methods of Proof.

\*: These courses were for current and future K-12 educators in the Lincoln and Omaha area.

### Undergraduate Mentoring/Reading Courses

Fall 2020 **"Cohen-Macaulay Rings" by Bruns and Herzog and "Infinite Free Resolutions" by Avramov**, *mentored undergraduate Taylor Murray at the University of Utah: currently a graduate student at University of Nebraska-Lincoln.*

- Fall 2020–Spring 2022 **“Introduction to Commutative Algebra” by Atiyah and MacDonald, “Cohen-Macaulay Rings” by Bruns and Herzog, “Infinite Free Resolutions” by Avramov, and various research articles**, mentored undergraduate Mason Hart at the University of Utah. I was Mason’s honor’s thesis advisor; currently a graduate student at University of Virginia.
- Spring 2021–Summer 2022 **“Introduction to Commutative Algebra” by Atiyah and MacDonald**, mentored undergraduate Annie Giokas at the University of Utah; currently a graduate student at Purdue University.
- Summer 2021–Fall 2022 **“Introduction to Commutative Algebra” by Atiyah and MacDonald**, mentored undergraduate Ben Huenemann at the University of Utah; currently a graduate student at University of Nebraska-Lincoln.
- Fall 2022 **“Infinite Free Resolutions” by Avramov**, mentored master’s student Jorge Eduardo Gasper Lara at the Centro de Investigación en Matemáticas; currently a graduate student at University of Utah.

## Research talks

### Invited Talks

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|----------------|---|---|
| January 2024   | TBA (2 talks)   | <i>JMM AMS Sectional, San Francisco</i>                   |
| October 2023   | TBA   | <i>AMS Sectional, Creighton University</i>                |
| April 2023     | Structural results in commutative algebra                 | <i>Math 125, University of Nebraska</i>                   |
| April 2023     | Frobenius pushforwards in the derived category            | <i>Comm. Alg. Seminar, University of Nebraska</i>         |
| March 2023     | High Frobenius pushforwards ...                           | <i>Alg. Geom. and Comm. Alg. Seminar, Notre Dame Univ</i> |
| January 2023   | Applications of support varieties in local algebra        | <i>Algebra and Topology Seminar, Copenhagen</i>           |
| December 2022  | Cohomological support varieties in local algebra          | <i>Seminar, Hausdorff Institute of Mathematics</i>        |
| November 2022  | Generation in derived categories and singularities        | <i>Colloquium, Syracuse University</i>                    |
| October 2022   | Cohomological support varieties and their applications    | <i>Fellowship of the Ring Seminar, MRSI</i>               |
| September 2022 | Bounds on cohomological support varieties                 | <i>Seminar, Syracuse University</i>                       |
| August 2022    | Cohomological jump loci in local algebra                  | <i>Conference, ICRA 2022</i>                              |
| April 2022     | Bass and Betti numbers, and cohomological jump loci       | <i>Seminar, University of Minnesota</i>                   |
| April 2022     | Cohomological jump loci and duality                       | <i>Seminar, Syracuse University</i>                       |
| February 2022  | Homotopy lie algebras of quasi-complete intersection maps | <i>Seminar, UC Berkeley/MSRI</i>                          |
| January 2022   | Cohomological supports in local algebra                   | <i>JMM AMS Special Session, Seattle, WA</i>               |
| October 2021   | Symmetries in Bass and Betti sequences over a c.i. ring   | <i>Seminar, University of Arkansas</i>                    |
| October 2021   | Symmetries in Bass and Betti sequences over a c.i. ring   | <i>IIT Bombay Virtual Seminar</i>                         |
| October 2021   | Cohomological support in local algebra                    | <i>Comm. Algebra Seminar, University of Nebraska</i>      |
| October 2021   | A comparison of dg algebra resolutions with prime...      | <i>AMS Sectional, Creighton University</i>                |
| May 2021       | The derived category of a complete intersection ring      | <i>Comm. Algebra Seminar, UC Riverside</i>                |
| March 2021     | Homological algebra of exceptional c.i. maps              | <i>AMS Sectional, Georgia Tech University</i>             |
| March 2021     | Homological algebra of exceptional complete intersections | <i>Seminar, Texas Tech University</i>                     |
| October 2020   | A characterization of relative complete intersections     | <i>AMS Sectional, Univ of Tennessee</i>                   |
| November 2019  | Cohomological support of a local ring                     | <i>AMS Sectional, University of Florida</i>               |
| July 2019      | The derived category of a complete intersection           | <i>Seminar, University of Genova (Italy)</i>              |
| March 2019     | Cohomological support over derived complete int...        | <i>AMS Sectional, Auburn University</i>                   |
| November 2018  | The derived category of a complete intersection           | <i>Seminar, University of Michigan</i>                    |
| November 2018  | The derived category of a complete intersection           | <i>AMS Sectional, University of Arkansas</i>              |

|               |   |  |
|---------------|---|--|
| October 2018  | The derived category of a complete intersection | <i>AMS Sectional, SF State University</i>  |
| February 2018 | A characterization of complete intersections... | <i>Algebra Seminar, University of Utah</i> |

## Local Talks

|                |   |   |
|----------------|---|---|
| September 2019 | <i>Cohomological support of a local ring</i>        | <i>Algebra Seminar, University of Utah</i>        |
| October 2018   | The derived category of a complete intersection     | <i>Algebra Seminar, University of Nebraska</i>    |
| February 2018  | A characterization of complete intersections...     | <i>Algebra Seminar, University of Nebraska</i>    |
| October 2017   | Koszul varieties and a derived category application | <i>Algebra Seminar, University of Nebraska</i>    |
| October 2017   | Cohomological properties of the Koszul DGA          | <i>Algebra Seminar, University of Nebraska</i>    |
| March 2015     | Hilbert's third problem and the Dehn invariant      | <i>Graduate Student Seminar, Univ of Nebraska</i> |

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## Funded Conferences, Workshops and Summer Schools

- 2022 **Spectral Methods in Algebra, Geometry, and Topology.**  
I will spend October-December at the Hausdorff Research Institute for Mathematics (HIM) in Bonn, Germany during this special trimester.
- 2022 **Rank Conjectures in Algebraic Topology and Commutative Algebra.**  
A workshop at the Banff International Research Station from September 11 - 16.
- 2022 **ICRA 2022.**  
Attended, and spoke in this biannual conference in Montevideo and Buenos Aires, respectively, from August 3-12.
- 2019 **Recent Developments in Commutative Algebra.**  
A workshop for graduate students and postdocs in commutative algebra. There were four lecture series that ran July 1-5 in Levico Terme, Trento, Italy.
- 2019 **Morgantown Algebra Days.**  
A two-day Commutative Algebra conference which was held at the West Virginia University in Morgantown, WV during April 13-14 (Saturday-Sunday).
- 2018 **Derived Categories, MSRI Summer School.**  
MSRI 2018 A two week summer school held at the MSRI June 25-July 6. This consisted of four week long courses building towards Orlov's theorem.
- 2018 **Stable Cohomology: Foundations and Applications.**  
The workshop was supported by the National Science Foundation and the Department of Mathematics at the University of Nebraska. Took place in Snowbird, Utah May 28-June 1.
- 2018 **RTG Graduate Summer School: Topics in commutative algebra.**  
Took place at the University of Utah May 7-11. There were fourteen lectures and problems sessions, covering aspects of the following: limits in positive characteristic, symbolic powers and differential operators, and syzygies and free resolutions
- 2017 **Structures on Free Resolutions.**  
A workshop-style conference on "Structures on Free Resolutions" held at Texas Tech University from October 26-28
- 2017 **Local Cohomology in Commutative Algebra and Algebraic Geometry, Minnesota.**  
A week long conference focused on recent advances in commutative algebra centered around topics influenced by the contributions of Gennady Lyubeznik.
- 2017 **Commutative Algebra and Related Topics, MSRI Summer School, OIST.**  
A two week summer school held at the Okinawa Institute of Science and Technology from May 22-June 2. This consisted of four week long courses
- 2017 **Stillman's Conjecture and other Progress on Free Resolutions.**  
A conference and workshop at UC Berkeley, July 17-21, on regularity and Stillman's problem.
- 2016 **RTG Workshop on the Homological Conjectures in Commutative Algebra.**  
The University of Illinois at Chicago hosted an RTG Workshop, November 18-20, consisting of three mini-courses on the Homological Conjectures.

## Other Conferences

- 2015-2019, 2022 **KUMUNU.**  
An annual NSF-funded conference for commutative algebraists in the Great Plains region since 1999.
- 2015-2019 **KUMUNU JR.**  
An annual NSF-funded conference for graduate students and postdocs in commutative algebra in the Midwest that is held each Spring at UNL.

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## Leadership and Service

- April 2023 **Co-organizer, AMS Special Session.**  
Co-organizing *Homological methods in commutative algebra* at the University of Cincinnati in April 2023 with Michael DeBellevue.
- Summer 2020 **Online course.**  
I organized a virtual course on Zoom where I lectured on the singularity category of Gorenstein rings for twelve weeks; there were two hour-long lectures a week. There were twelve other participants from universities such as: Utah, Nebraska, Wake Forest, University of Texas-Arlington, UC Riverside.
- May 2020 **Online Conference Organizer.**  
Organized *Dg Methods in Commutative Algebra and Representation Theory* with Benjamin Briggs and Janina Letz.
- 2017-2019 **Conference Co-Organizer (Co-P.I.), KUMUNU JR.**  
Served as a co-organizer and co-P.I. for this annual conference for graduate students and postdocs.
- 2017-2018 **Commutative Algebra Reading Seminar Organizer.**  
I organized this graduate student seminar devoted to a wide range of talks in commutative algebra and related areas.
- 2017-2020 **Panelist for graduate students.**  
I have served on several panels for graduate students at both the University of Nebraska and the University of Utah for topics including: choosing a research area and advisor, applying for academic jobs, applying for the NSF postdoc, and teaching.
- Summer 2016 **WebWork development.**  
I wrote 80 hours of WebWork code for the math department at the University of Nebraska during the Summer of 2016; these are homework problems for Math 106 and 107 (calculus I & II).
- 2013-2019 **Math Day Volunteer.**  
For Math Day, held annually at the University of Nebraska Lincoln, I held positions such as proctor, head proctor, local command center leader, and score keeper.