

Luigi Ferraro

Curriculum Vitae

School of Mathematical and Statistical Sciences,
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Academic Appointments

- 2023 – present **Assistant Professor**
University of Texas Rio Grande Valley
- 2020 – 2023 **Postdoctoral Teaching Scholar**
Texas Tech University
- 2017 – 2020 **Teacher-Scholar Postdoctoral Fellow**
Wake Forest University
- 2011 – 2017 **Graduate Teaching Assistant**
University of Nebraska-Lincoln

Education

- August 2017 **Ph.D. Mathematics, University of Nebraska-Lincoln**
Advisors: Luchezar L. Avramov and Srikanth B. Iyengar
Thesis: *Stable cohomology of local rings and Castelnuovo-Mumford regularity of graded modules*
- July 2011 **M.S. Mathematics, University of Pisa**
Advisor: Aldo Conca
Thesis: *Homological properties of Noetherian rings*
- July 2009 **B.S. Mathematics, University of Pisa**
Advisor: Ilaria del Corso
Thesis: *Regular local rings are UFD*

Research Interests

- **Commutative algebra.** My research has focused on the structure of the stable cohomology of a local ring, on the Castelnuovo-Mumford regularity of graded modules, on the rigidity of Ext and Tor, on the intersection theorems, on grade 3 perfect ideals and on the homotopy Lie algebra of local rings.
- **Noncommutative algebra.** My research has focused on studying actions of groups and, more generally, actions of Hopf algebras on noncommutative rings. My research has also focused on the study of the homological properties of quotients of skew polynomial rings by ideals generated by normal elements, through the use of DG algebra resolutions.

Papers and Preprints

- [16] *The Eliahou-Kervaire resolution over a skew polynomial ring*, joint with A. Hardesty. Communications in Algebra (to appear). arXiv:2108.05812
- [15] *The Tor algebra of trimmings of Gorenstein ideals*, joint with A. Hardesty. Acta Mathematica Vietnamica (to appear). arXiv:2204.05228
- [14] *Rigidity of Ext and Tor via flat-cotorsion theory*, joint with L. W. Christensen and P. Thompson. Proceedings of the Edinburgh Mathematical Society (to appear). arXiv:2112.00103
- [13] *The Improved New Intersection Theorem revisited*, joint with L. W. Christensen. Michigan Mathematical Journal (to appear). arXiv:2206.05812
- [12] *The Taylor resolution over a skew polynomial ring*, joint with D. Martin and F. Moore. Journal of Algebra and its Applications (to appear). arXiv:2109.00111

- [11] *The InvariantRing package for Macaulay2*, joint with F. Galetto, F. Gandini, H. Huang, M. Mastroeni, X. Ni. *Journal of Software for Algebra and Geometry* (to appear). arXiv:2010.15331
- [10] *The homotopy Lie algebra of a Tor-independent tensor product*, joint with M. Gheibi, D. Jorgensen, N. Packauskas and J. Pollitz. *Illinois J. Math* **67** (2023), no. 2, 383-407.
- [9] *Support varieties over skew complete intersections via derived braided Hochschild cohomology*, joint with W. F. Moore and J. Pollitz. *J. Algebra* **596** (2022), 89-127.
- [8] *Semisimple reflection Hopf algebras of dimension sixteen*, joint with E. Kirkman, W. F. Moore and R. Won. *Algebr. Represent. Theory* **25** (2022), no. 3, 615-647.
- [7] *On the Noether bound for noncommutative rings*, joint with E. Kirkman, W. F. Moore and K. Peng. *Proc. Amer. Math. Soc.* **149** (2021), no. 7, 2711-2725.
- [6] *Differential graded algebra over quotients of skew polynomial rings by normal elements*, joint with W. F. Moore. *Trans. Amer. Math. Soc.* **373** (2020), no. 11, 7755-7784.
- [5] *Simple \mathbb{Z} -graded domains of Gelfand-Kirillov dimension two*, joint with J. Gaddis and R. Won. *J. Algebra* **562** (2020), 433-465.
- [4] *Three infinite families of reflection Hopf algebras*, joint with E. Kirkman, W. F. Moore and R. Won. *J. Pure Appl. Algebra* **224** (2020), no. 8, 106315.
- [3] *A bimodule structure for the bounded cohomology of commutative local rings*. *J. Algebra* **537** (2019), 297-315.
- [2] *Modules of infinite regularity over commutative graded rings*. *Proc. Amer. Math. Soc.* **147** (2019), no. 5, 1929-1939.
- [1] *Regularity of Tor for weakly stable ideals*, joint with K. Ansal di and N. Clarke. *Le Matematiche* **70** N. 1 (2015), 301-310.

Conferences Organized

- September 2024 **AMS Special Session on Homological Commutative Algebra**, *University of Texas San Antonio, San Antonio, TX.*
- November 2019 **AMS Special Session on Homological methods in Algebra**, *University of Florida, Gainesville, FL.*
- April 2017 **KUMUNUjr**, *University of Nebraska-Lincoln, NE*, I served as a Co-PI for this annual NSF-funded conference for graduate students and post-docs in commutative algebra in the Midwest that is held each Spring at UNL.
- April 2016 **KUMUNUjr**, *University of Nebraska-Lincoln, NE.*

Presentations

Conference Talks

- May 2024 **Trimming five generated Gorenstein ideals**, *Special Session on Commutative and noncommutative algebra, together at last, AMS, San Francisco, CA.*
- March 2023 **The Improved New Intersection Theorem Revisited**, *Southwest Local Algebra Meeting, Denton, TX.*
- January 2023 **The Improved New Intersection Theorem revisited**, *AMS Contributed Paper Session on Commutative Rings and Algebras, and Algebraic Geometry. Joint Math Meetings, Boston, MA.*
- October 2022 **The Improved New Intersection Theorem revisited**, *Special Session on Building Bridges Between Commutative Algebra and Nearby Areas, AMS, Salt Lake City, UT.*
- April 2022 **Rigidity of Ext and Tor via flat-cotorsion theory**, *AMS Special Session on Commutative Algebra. Joint Math Meetings, Seattle, WA. (Held online because of Covid-19)*
- March 2022 **A DG Algebra resolution of trimmings of pfaffian ideals**, *Special Session on Homological Methods in Commutative Algebra, AMS, Medford, MA. (Held online because of Covid-19)*
- September 2021 **The homotopy Lie algebra of a Tor-independent tensor product**, *Commutative and Homological Algebra Market Presentations*, a virtual seminar series in commutative algebra.
- March 2021 **Homological algebra over minimal intersections**, *Special Session on Commutative Algebra, AMS, Providence, RI. (Held online because of Covid-19)*

- January 2021 **Support varieties and symmetry of complexity for quotients of skew polynomial rings**, *AMS Special Session on Homological Aspects of Quantum Symmetries and Related Topics, Joint Math Meetings. (Held online because of Covid-19)*
- October 2020 **The Taylor resolution over a skew polynomial ring**, *Special Session on Commutative Algebra, AMS, Chattanooga, TN. (Held online because of Covid-19)*
- October 2020 **The Taylor resolution over a skew polynomial ring**, *Special Session on Homological Methods in Algebra, AMS, University Park, PA. (Held online because of Covid-19)*
- May 2020 **The Taylor resolution over a skew polynomial ring**, *Special Session on DG Methods in Commutative Algebra and Representation Theory, AMS, Fresno, CA. (Held online because of Covid-19)*
- January 2020 **Differential graded algebra over quotients of skew polynomial rings by normal elements**, *AMS Contributed Paper Session on Algebra and Algebraic Geometry, Joint Math Meetings, Denver, CO.*
- March 2019 **A color Hopf algebra structure on the Ext algebra of quotients of skew polynomial rings**, *Special Session on Hopf Algebras and Their Applications, AMS, Auburn, AL.*
- November 2018 **Hopf algebra actions on some AS regular algebras of small GK dimension**, *Special Session on Commutative Algebra, AMS, Fayetteville, AR.*
- September 2018 **Hopf algebra actions on some AS regular algebras of small GK dimension**, *Special Session on Commutative Algebra, AMS, Newark, DE.*
- May 2018 **A bimodule structure for the bounded cohomology of commutative local rings**, *"Stable cohomology: foundations and applications", Snowbird, UT.*
- September 2017 **Modules of infinite regularity over graded commutative rings**, *Special Session on Commutative Algebra: Interactions with Algebraic Geometry and Algebraic Topology, AMS, Orlando, FL.*
- April 2017 **Modules of infinite regularity over graded commutative rings**, *Special Session on Commutative Algebra, AMS, Pullman, WA.*
- January 2017 **Modules of infinite regularity over graded commutative rings**, *AMS Contributed Paper Session on Commutative Algebra, Linear and Multilinear Algebra and Matrix Theory, Joint Mathematics Meetings, Atlanta, GA.*
- September 2016 **Modules of infinite regularity over graded commutative rings**, *Route 81 Conference, Syracuse, NY.*
- January 2016 **On the bimodule structure of bounded cohomology**, *AMS Special Session on Commutative Algebra, Joint Mathematics Meetings, Seattle, WA.*
- October 2015 **On the bimodule structure of bounded cohomology**, *Commutative Algebra, AMS, Loyola, IL.*
- April 2015 **Regularity of Tor for weakly stable ideals**, *KUMUNUjr, University of Nebraska-Lincoln.*
- April 2014 **Non-vanishing of Exts**, *KUMUNUjr, University of Nebraska-Lincoln.*

Seminar Talks

- March 2024 **Trimming five generated Gorenstein ideals**, *Syracuse University, NY.*
- February 2024 **Trimming five generated Gorenstein ideals**, *University of Texas Rio Grande Valley, TX.*
- November 2022 **The Improved New Intersection Theorem Revisited**, *Texas Tech University, TX.*
- October 2022 **The Improved New Intersection Theorem Revisited**, *Texas A&M University, TX.*
- April 2022 **Rigidity of Ext and Tor via flat-cotorsion theory**, *Texas Tech University, TX.*
- November 2021 **The homotopy Lie algebra of a Tor-independent tensor product**, *Texas Tech University, TX.*
- November 2021 **Noncommutative invariant theory**, *Northeastern University, MA.*
- February 2021 **Support varieties over skew complete intersections via derived braided Hochschild cohomology**, *Texas Tech University, TX.*
- December 2019 **Differential graded algebra over quotients of skew polynomial rings by normal elements**, *UC San Diego, CA.*
- November 2019 **Differential graded algebra over quotients of skew polynomial rings by normal elements**, *Syracuse University, NY.*
- October 2019 **Differential graded algebra over quotients of skew polynomial rings by normal elements**, *University of Texas at Arlington, TX.*
- September 2019 **Differential graded algebra over quotients of skew polynomial rings by normal elements**, *University of Utah, UT.*

- August 2018 **Hopf algebra actions on some AS regular algebras of small GK dimension**, *University of South Carolina, SC.*
- March 2018 **Hopf algebra actions on some AS regular algebras of small GK dimension**, *Clemson University, SC.*
- September 2016 **On the bimodule structure of the bounded cohomology of local rings**, *Syracuse University, NY.*
- September 2016 **Modules with infinite regularity**, *University of Nebraska-Lincoln, NE.*
- July 2016 **On the bimodule structure of the bounded cohomology of local rings**, *University of Bologna, Italy.*
- May 2016 **On the bimodule structure of the bounded cohomology of local rings**, *University of Genova, Italy.*
- May 2016 **Nuovi teoremi sulla coomologia stabile degli anelli locali**, *University of Pisa, Italy.*
- February 2016 **On the bimodule structure of the bounded cohomology of local rings**, *University of Lubbock, TX.*
- February 2016 **On the bimodule structure of the bounded cohomology of local rings**, *University of Nebraska-Lincoln.*
- April 2015 **Regularity of Tor for weakly stable ideals**, *University of Nebraska-Lincoln, NE.*
- June 2014 **Non-vanishing of Exts**, *Università di Genova, Italy.*
- May 2014 **A characterization of Gorenstein rings**, *Università di Bologna, Italy.*
- February 2014 **Non-vanishing of Exts**, *University of Nebraska-Lincoln.*

Colloquia

- September 2019 **Noncommutative invariant theory**, *Wake Forest University, NC.*

Posters

- April 2014 **Non-vanishing of Exts**, *University of Nebraska-Lincoln, Graduate Research Fair.*

Funded Conferences, Workshops and Summer Schools

- November 2020 **"Workshop and International Conference on Representations of Algebras (ICRA 2020)"**, *ICTP, Trieste, Italy. (Held online because of COVID-19)*
- August 2020 **"Free Resolutions and Representation Theory"**, *ICERM, Providence, RI. (Held online because of COVID-19)*
- May 2020 **"Macaulay2 Workshop and Conference at Cleveland State University"**, *Cleveland, OH. (Held online because of COVID-19)*
- August 2019 **"Structure of length 3 resolutions"**, *San Diego, CA.*
- May 2018 **"Stable cohomology: foundations and applications"**, *Snowbird, UT.*
- March 2018 **"Hot topics: the homological conjectures"**, *MSRI, Berkeley, CA.*
- October 2017 **"Structures on Free Resolutions"**, *Lubbock, TX.*
- May 2016 **"Homological and computational methods in commutative algebra"**, *INdAM meeting, Cortona, Italy.*
- June 2015 **Mathematics Research Communities**, *Snowbird, Utah.*
- February 2015 **"Homological bonds between Commutative Algebra and Representation Theory"**, *Universitat de Barcelona, Barcelona, Spain.*
- February 2015 **"(Re)emerging methods in Commutative Algebra and Representation Theory"**, *Centre de Recerca Matemàtica, Bellaterra, Spain.*
- June 2014 **Pragmatic 2014, Research school in Algebraic Geometry and Commutative Algebra, "Local cohomology and syzygies of affine algebras"**, *Catania, Italy.*
- May 2012 **Pan American Advanced Studies Institute, "Commutative algebra and its interactions with Algebraic Geometry, Representation Theory, and Physics"**, *Guanajuato, Mexico.*

Grants and Awards

- 2017 **KUMUNUjr**, I served as a Co-PI for this annual NSF-funded conference for graduate students and post-docs in commutative algebra in the Midwest that is held each Spring at UNL.
- 2016 **KUMUNUjr**, Co-PI.
- 2016 **AMS Graduate Student Travel Grant**.
- 2012 **INdAM final prize**, winner of the final prize for the scholarship of the National Institute of Advanced Mathematics (INdAM) Francesco Severi, for obtaining a Master's Degree with a high GPA.
- 2010 **INdAM Scholarship**, scholarship for ranking second place in the contest for 6 scholarships for the students of Master's Degree awarded by the National Institute of Advanced Mathematics Francesco Severi. The contest was open to all the students in Italy at the beginning of their Master's Degree and consisted in two sets of problems (abstract algebra and real analysis) to be solved in 6 hours.
- 2006 **International Pythagoras Prize**, third place, for writing the essay "The curvature: from geometry to the Einsteinian relativity going through non-Euclidean geometries up to the definition of the characteristics of a real time machine". This prize is awarded annually in the Italian city of Crotona, where Pythagoras lived. There are four prizes, one for a University professor and one for three high school students.

Research with Students

PhD Students

- Aug. '20 – Aug '23 **Alexis Hardesty**, *TTU*, worked on the papers
The Eliahou-Kervaire resolution over a skew polynomial ring, *Communications in Algebra* (to appear).
arXiv:2108.05812.
The Tor algebra of trimmings of Gorenstein ideals, *Acta Mathematica Vietnamica* (to appear).
arXiv:2204.05228.

Master Students

- Aug '23 – present **Raul Alvarez**, *UTRGV*.
- Jan. '19 – Sept. '21 **Desiree Martin**, *WFU*, worked on the paper
The Taylor resolution over a skew polynomial ring, *Journal of Algebra and its Applications* (to appear). arXiv:2109.00111.

Undergraduate Students

- May '18– May '19 **Kewen Peng**, *WFU*, worked on the paper
On the Noether bound for noncommutative rings, *Proc. Amer. Math. Soc.* **149** (2021), no. 7, 2711–2725.

Software

Macaulay2 is a software system devoted to supporting research in algebraic geometry and commutative algebra. Here is a list of packages I co-wrote, the documentations can be found at <http://www2.macaulay2.com/Macaulay2/>

- **InvariantRing**
(with F. Galetto, F. Gandini, H. Huang, T. Hawes, M. Mastroeni and X. Ni).
A package to compute invariants of group actions.
- **ResLengthThree**
(with L. W. Christensen, F. Gandini, F. Moore and O. Veliche).
A package to compute multiplicative structures on free resolutions of length three.

Teaching

Courses Developed

At Wake Forest University, Professor Moore, Professor Kirkman and I developed the undergraduate course *Linear Algebra II*. This was a course geared towards the applied math majors focused on studying vector spaces over the complex numbers. Topics included: Spectral Theorem, Quadratic Forms, Singular Value Decomposition, Matrix Norms, Gersgorin's Circle Theorem, The Frobenius-Perron Theorem and (sub)stochastic matrices, Analytic functions of matrices.

Instructor of Record, Graduate Courses, Face to Face

Spring 2019	MST 722: Abstract Algebra II	<i>Wake Forest University</i>
Fall 2018	MST 721: Abstract Algebra I	<i>Wake Forest University</i>

Instructor of Record, Graduate Courses, Hybrid

Spring 2024	MATH 6632: Algebra II	<i>University of Texas Rio Grande Valley</i>
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Instructor of Record, Undergraduate Courses, Face to Face

Fall 2022	MATH 2450: Calculus III with Applications	<i>Texas Tech University</i>
Summer 2022	MATH 4354: Differential Equations II	<i>Texas Tech University</i>
Summer 2022	MATH 3350: Higher Mathematics for Engineers and Scientists I	<i>Texas Tech University</i>
Spring 2022	MATH 3351: Higher Mathematics for Engineers and Scientists II	<i>Texas Tech University</i>
Spring 2022	MATH 3350: Higher Mathematics for Engineers and Scientists I	<i>Texas Tech University</i>
Fall 2021	MATH 2450: Calculus III with Applications	<i>Texas Tech University</i>
Summer 2021	MATH 3310: Introduction to Mathematical Reasoning and Proof	<i>Texas Tech University</i>
Fall 2020	MATH 1452: Calculus II with Applications	<i>Texas Tech University</i>
Spring 2020	MST 113: Multivariable Calculus	<i>Wake Forest University</i>
Spring 2020	MST 225: Linear Algebra II	<i>Wake Forest University</i>
Fall 2019	MST 251: Ordinary Differential Equations	<i>Wake Forest University</i>
Summer 2019	MST 251: Ordinary Differential Equations	<i>Wake Forest University</i>
Summer 2019	MST 121: Linear Algebra I	<i>Wake Forest University</i>
Spring 2019	MST 112: Calculus with Analytic Geometry II	<i>Wake Forest University</i>
Fall 2018	MST 251: Ordinary Differential Equations	<i>Wake Forest University</i>
Summer 2018	MST 251: Ordinary Differential Equations	<i>Wake Forest University</i>
Summer 2018	MST 112: Calculus with Analytic Geometry II	<i>Wake Forest University</i>
Spring 2018	MST 321: Modern Algebra I	<i>Wake Forest University</i>
Spring 2018	MST 121: Linear Algebra I	<i>Wake Forest University</i>
Fall 2017	MST 111: Calculus with Analytic Geometry I	<i>Wake Forest University</i>
Summer 2017	Math 221: Differential Equations	<i>University of Nebraska-Lincoln</i>
Spring 2017	Math 221: Differential Equations	<i>University of Nebraska-Lincoln</i>
Fall 2016	Math 103: College Algebra and Trigonometry	<i>University of Nebraska-Lincoln</i>
Spring 2016	Math 221: Differential Equations	<i>University of Nebraska-Lincoln</i>
Fall 2015	Math 103: College Algebra and Trigonometry	<i>University of Nebraska-Lincoln</i>
Fall 2014	Math 203: Contemporary Mathematics	<i>University of Nebraska-Lincoln</i>

Instructor of Record, Undergraduate Courses, Hybrid

Fall 2023	MATH 3361: Applied Discrete Mathematics	<i>University of Texas Rio Grande Valley</i>
Spring 2021	MATH 3351: Higher Mathematics for Engineers and Scientists II	<i>Texas Tech University</i>
Spring 2021	MATH 3354: Differential Equations I	<i>Texas Tech University</i>

Instructor of Record, Undergraduate Courses, Online, Asynchronous

Summer 2023	MATH 4350: Advanced Calculus I	<i>Texas Tech University</i>
Spring 2023	MATH 1452: Calculus II with Applications	<i>Texas Tech University</i>

Instructor of Record, Undergraduate Courses, Online, Synchronous

Summer 2020	STA 111: Elementary Probability and Statistics	<i>Wake Forest University</i>
Summer 2020	MST 113: Multivariable Calculus	<i>Wake Forest University</i>

Instructor of Record, Online Graduate Certificate Courses, Asynchronous

Fall 2020 MATH 5368: Abstract Algebra Applied I

Texas Tech University

Computer Laboratories

Summer 2020 R lab for STA 111: Elementary Probability and Statistics

Wake Forest University

Recitations

Spring 2014 Math 107: Analytic Geometry and Calculus II

University of Nebraska-Lincoln

Fall 2013 Math 107: Analytic Geometry and Calculus II

University of Nebraska-Lincoln

Spring 2013 Math 106: Analytic Geometry and Calculus I

University of Nebraska-Lincoln

Fall 2012 Math 106: Analytic Geometry and Calculus I

University of Nebraska-Lincoln

Tutoring

Aug. '11 – May '17 The Mathematics Resource Center

University of Nebraska-Lincoln

Service

Jan. '24 – present **Co-organizer of the Algebra and Number Theory Seminar at UTRGV.**

Jan. '24 – present **Instructor for the Putnam Prep Class at the University of Texas Rio Grande Valley.**

Aug. '23 – present **Putnam Supervisor at the University of Texas Rio Grande Valley.**

Aug. '23 – present **Member of the Scholarship Committee at the University of Texas Rio Grande Valley.**

Aug. '23 – present **Member of the Recruitment and Outreach Committee at the University of Texas Rio Grande Valley.**

Nov. '21 – Jul. '23 **PhD Committee Member**, member of the PhD Committee of Alexis Hardesty at Texas Tech University.

Aug. '19 – July '20 **Member of the Colloquia and Gentry Lectures Committee at Wake Forest University.**

Aug. '17 – present **Reviewer for zBMATH.**

Aug. '17 – Aug. '18 **Member of the Undergraduate Committee at Wake Forest University.**

Aug. '11 – May '17 **Volunteer for Math Day, University of Nebraska-Lincoln**, Math Day is a competition for high school students and exceptional middle school students.

Professional Memberships

American Mathematical Society.

Gruppo Nazionale per le Strutture Algebriche, Geometriche e le loro Applicazioni, *National Group for the Geometric, Algebraic Structures and their Applications*, This is a group of the National Institute of Advanced Mathematics Francesco Severi (INdAM).

Computer Skills

Macaulay2, an open source computer algebra system for research in commutative algebra and algebraic geometry.

R, taught a class on Statistics and Probability at Wake Forest University with an R lab.

L^AT_EX.

C, attended a course at the University of Pisa. The course content included: programming in C, automaton theory, computational complexity theory, cryptography, dynamic programming.

HTML.

Languages Known

Italian, fluent.

English, fluent.

French, basic knowledge.