Luis Núñez-Betancourt

CIMAT
Matemáticas Basicas
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Employment

CIMAT - Center for Mathematical Research (Mexico)

Academic positions:

Researcher C (Full Professor), January 2023 - ...

Researcher B (Associate Professor), January 2020 - December 2022

Researcher A (Assistant Professor), June 2016 - December 2019

Administrative positions:

Chair, Department of Basic Mathematics, August 2023 - ...

University of Virginia

Whyburn Instructor of Mathematics (Postdoctoral Position), August 2013 - June 2016
Mentor: Craig Huneke

Education

Ph.D. in Mathematics

University of Michigan, September 2008 - May 2013

Advisor: Mel Hochster

Dissertation: *Finiteness properties of local cohomology*

Bachelor in Science (Mathematics)

University of Guanajuato / CIMAT, August 2003 - June 2008

Advisor: Xavier Gómez-Mont

Thesis: *Homological index of a vector field (awarded as the best in Mexico)*

Honors

- AMC-IMSA José Adem Prize for Mathematical Research in Mexico, 2024
- Mexican Academy of Sciences Research Award for Young Scientists, 2022
- Visiting Professor Fellowship "Lluís Santaló", Centre de Recerca Matemàtica, Spain, 2022.
- Member of the Mexican National System of Researchers (SNI), Level 3, January 2022 - present
- Member of the Mexican Academy of Sciences, January 2021 - present
- UMALCA Prize, Unión Matemática de América Latina y el Caribe, 2020 (to outstanding young mathematicians in the region)

- Cátedras Marcos Moshinsky, UNAM/Marcos Moshinsky Foundation 2019 (to outstanding young Mexican scientists)
- Member of the Mexican National System of Researchers (SNI), Level 2, January 2018 - December 2021
- Member of the Mexican National System of Researchers (SNI), Level 1, January 2015 - December 2017
- Sotero Prieto Award, Mexican Mathematical Society 2009 (to the best undergraduate thesis in Mexico)

Grants

- Research Grant, CONAHCYT Mexico CF 2023-2024-224, 2024-2026.
- Research Fellowship "Lluís Santaló", Centre de Recerca Matemàtica, España, 2022.
- Research Grant, CONACYT Mexico CB2016 284598, 2018-2022
- Collaborative Research Grant (AIM SQuaRE), American Institute of Mathematics, 2018-2020
- Research Grant, National Science Foundation, Algebra and Number Theory, DMS 1502282, 2015
- AMS-Simons Travel Grant, 2014
- Postdoctoral Research Grant, National Council of Science and Technology of Mexico, Summer 2014
- Fellowship for Graduate Studies, National Council of Science and Technology of Mexico, 2008-2013
- Rackham Graduate Student Research Grant, University of Michigan, 2009 & 2012.
- Fellowship for Undergraduate Studies, CIMAT, 2003-2008
- Excellence Scholarship, University of Guanajuato, 2007

Scientific Committees

- Scientific Committees Chair, National Congress of the Mexican Mathematical Society, 2025
- Scientific Advisory Board Banff International Research Station, 2024 - present
- EDI Advisory Board Banff International Research Station, 2024 - present
- Associated Editor, Orbita Mathematicae, 2022 - present
- Editor Boletín de la Sociedad Matemática Mexicana, 2023-present

Plenary Talks

- Invited Speaker (semiplenary), Mathematical Congress of the Americas, 2025
- Plenary Speaker, National Congress of Mathematics (Mexico), October 202024
- Plenary Speaker, Joint Meeting Royal Spanish Mathematical Society and Mexican Mathematical Society, Spain, 2024
- Plenary Speaker, National Congress of Mathematics (Mexico), October 2017

Research Interests

- Local cohomology: finiteness properties, and Lyubeznik numbers.
- Methods in prime characteristic: F-modules, F-thresholds, tight closure, and test ideals
- Homological invariants: projective dimension, Castelnuovo-Mumford regularity, and depth
- Rings of differential operators: Bernstein-Sato polynomials, V-filtrations, D-modules, and singularitie.
- Combinatorial commutative algebra: Stanley-Reisner rings, semigroup rings, and graph ideals
- Applications: code theory and linear optimization

Publications and Preprints

Published or accepted:

1. *"Bernstein-Sato polynomial and related invariants for meromorphic functions"* (with Josep Àlvarez Montaner, Manuel González Villa y Edwin León-Cardenal). accepted in **Trans. Amer. Math. Soc.**.

2. *"Blowup algebras of determinantal ideals in prime characteristic"* (with Alessandro De Stefani and Jonathan Montaño), **J. Lond. Math. Soc.**, , 110 (2024), No. 2, Paper No. e12969, 50 pages.

3. *"Bernstein's inequality and holonomicity for certain singular rings"* (with Josep Àlvarez Montaner, Daniel J. Hernández, Jack Jeffries, Pedro Teixeira, and Emily E. Witt), **Int. Math. Res. Not. IMRN**, 2024, No. 20, 13127-13179.

4. *"Nash blowups of toric varieties in prime characteristic"* (with Daniel Duarte and Jack Jeffries). **Collect. Math.**, 75 (2024), No. 3, 629-637.

5. *"Regularity index of the generalized minimum distance function"* (with Carlos Espinosa-Valdéz, and Yuriko Pitones), **J. Pure Appl. Algebra**, 228 (2024), No. 5, Paper No. 107567.

6. *"Purity of monoids and characteristic-free splittings in semigroup rings"* (with Alessandro De Stefani and Jonathan Montaño), **Math. Z.**, 305 (2023), No. 2, Paper No. 31.

7. *"Bernstein-Sato theory for singular rings in positive characteristic"* (with Jack Jeffries and Eamon Quinlan Gallego), **Trans. Amer. Math. Soc.** 376 (2023), No. 7, 5123-5180.

8. *"Frobenius methods in combinatorics"* (with Alessandro De Stefani and Jonathan Montaño), **São Paulo J. Math. Sci.** 17 (2023), No. 1, 387-429.

9. *"Poincaré series of multiplier and test ideals"* (with Josep Àlvarez Montaner), **Rev. Mat. Iberoam.** 38 (2022), No. 6, 1993-2009.

10. *"F-thresholds and test ideals of Thom-Sebastiani-Type polynomials"* (with Delio Jaramillo and Manuel González Villa), **Proc. Amer. Soc.** 150 (2022), No. 9, 3739-3755.

11. *"Bernstein-Sato polynomials in commutative algebra"* (con Josep Àlvarez Montaner, and Jack Jeffries), **Commutative Algebra**, 1-76, Springer, Cham, [2021].

12. *"Functional equations, V-filtrations, and multiplier ideals of direct summands "* (with Josep Àlvarez Montaner, Daniel J. Hernández, Jack Jeffries, Pedro Teixeira and Emily E. Witt), **Commun. Contemp. Math.** 24 (2022), no. 10, Paper No. 2150083, 47 pages.

13. *"Connectedness of square-free Groebner Deformations"* (with Lilia Alanís-López and Pedro Ramírez-Moreno), **Proc. Amer. Math. Soc.** 150 (2022), No. 4, 1405-1419.

14. *"Nash blowups in prime characteristic"* (with Daniel Duarte), **Rev. Mat. Iberoam.** 38 (2022), No. 1, 257-267.

15. *"F-volumes"* (with Wágner Badilla-Céspedes and Sandra Rodríguez-Villalobos), **J. Algebra**, 595 (2022), 14-37.

16. *"Bounds for the minimum distance function"* (with Yuriko Pitones, and Rafael H. Villarreal), **An. Ştiinţ. Univ. "Ovidius" Constanţa Ser. Mat.**, (2021), No. 3, 229-242.

17. *"Higher Nash blowups of normal toric varieties in prime characteristic"* (with Daniel Duarte), **Tohoku Math. J.**, , (2) 73 (2021), No. 3, 449-462.

18. *"Splittings and symbolic powers of square-free monomial Ideals"* (with Jonathan Montaño), **Int. Math. Res. Not. IMRN**, (2021), No. 3, 2304-2320.

19. "Local cohomology and Lyubeznik numbers of *F*-pure rings" (with Alessandro De Stefani, and Eloísa Grifo), **J. Algebra**., Vol. 571, (2021), 316-338.

20. *"Q-Hilbert functions of multiplier and test ideals"*, (con Josep Àlvarez Montaner). Extended abstracts GEOMVAP 2019-geometry, topology, algebra, and applications; women in geometry and topology, $1-6$, **Trends Math. Res. Perspect. CRM Barc.**, 15, Birkhüser/Springer, Cham, (2021).

21. *"b-vectors of chordal graphs"* (with Luis Pedro Montejano), **J. Commut. Algebra**. Vol. 12 (2020), No. 4, 539-557.

22. *"Hilbert-Kunz multiplicities and F-thresholds"* (with Ilya Smirnov), **Bol. Soc. Mat. Mex. (3)**, Vol. 26 (2020), No. 1, 15–25.

23. *"Quantifying singularities with differential operators"* (with Holger Brenner, and Jack Jeffries), **Adv. Math.**, Vol. 358 (2019), No. 106843, 89 pp.

24. *"Connectedness and Lyubeznik numbers"* (with Sandra Spiroff and Emily E. Witt), **Int. Math. Res. Not. IMRN**, (2019), No. 13, 4233-4259.

25. *"Lyubeznik numbers and injective dimension of local cohomology modules"* (with Daniel J. Hernández, Felipe Pérez and Emily E. Witt), **Trans. Amer. Math. Soc.**, Vol. 371 (2019), No. 11, 7533-7557.

26. *"Cohomological dimension, Lyubeznik numbers, and connectivity in mixed characteristic"* (with Daniel J. Hernández, Felipe Pérez, and Emily E. Witt), **J. Algebra**, Vol. 514 (2018) 442–467.

27. *"Symbolic powers of ideals"* (with Hailong Dao, Alessandro De Stefani, Craig Huneke and Eloísa Grifo), Singularities and foliations. geometry, topology and applications, 387-432, **Springer Proc. Math. Stat.**, 222 (2018), Springer, Cham.

28. *"On the existence of F-thresholds and related limits"* (with Alessandro De Stefani and Felipe Pérez), **Trans. Amer. Math. Soc.**, Vol. 370 (2018), No. 9, 6629-6650.

29. *"Footprint and minimum distance functions"* (with Yuriko Pitones and Rafael Heraclio Villarreal), **Commun. Korean Math. Soc**, Vol. 33 (2018), No. 1, 85–101.

30. *"Local m-adic constancy of F-pure thresholds and test ideals for hypersurfaces with isolated singularities"* (with Daniel J. Hernández and Emily E. Witt), **Math. Proc. Cambridge Philos. Soc.**, Vol. 164 (2018), No. 2, 285-295.

31. *"F-thresholds of graded rings"* (with Alessandro De Stefani), **Nagoya Math. J.**, Vol. 229 (2018), 141-168.

32. *"D-modules, Bernstein-Sato polynomials, and F-invariants of direct summands"* (with Josep Àlvarez-Montaner and Craig Huneke), **Adv. Math.**, Vol. 321 (2017) 298-325.

33. *"Support of local cohomology over hypersurfaces and rings with FFRT"* (with Mel Hochster), **Math. Res. Lett.**, Vol. 24 (2017), 401–420.

34. *"Graph connectivity and binomial edge ideals"* (with Arindam Banerjee), **Proc. Amer. Math. Soc.**, Vol. 145 (2017), No. 2, 487-499.

35. *"On the hyperhomology of the small gobelin for codimension 2"* (with Xavier Gómez-Mont), **Bol. Soc. Mat. Mex. (3)**, Vol. 23 (2017), No. 2, 623-–651.

36. *"Frobenius Betti numbers and modules of finite projective dimension"* (with Alessandro De Stefani and Craig Huneke), **J. Commut. Algebra**, Vol. 9 (2017), No. 4, 455-490.

37. *"F-pure thresholds of homogeneous polynomials"* (with Daniel J. Hernández, Emily E. Witt and Wenliang Zhang), **Michigan Math. J.**, 65 (2016), No. 1, 57-87.

38. *"A survey on the Lyubeznik numbers"* (with Emily E. Witt and Wenliang Zhang), **ontemp. Math., 657, Aportaciones Mat.** Vol. 657 (2016), 154-181.

39. *"A sufficient condition for strong F-regularity"* (with Alessandro De Stefani), **Proc. Amer. Math. Soc.**, Vol. 144 (2016), No. 1, 21-29.

40. *"F-jumping and F-Jacobian ideals for hypersurfaces"* (with Felipe Pérez), **J. Pure Appl. Algebra**, Vol. 220 (2016), Issue 1, 292-318.

41. *"Properties of Lyubeznik numbers under localization and polarization"* (with Arindam Banerjee and Kohji Yanagawa), **J. Pure Appl. Algebra**, Vol. 219 (2015), No. 11, 4872-4888.

42. *"Generalized Lyubeznik numbers"* (with Emily E. Witt), **Nagoya Math. J.**, Vol. 215 (2014), 168-202.

43. *"Associated primes of local cohomology of flat extensions with regular fibers and Σ-finite D-modules"*, **J. Algebra**, Vol. 399 (2014), 770-781.

44. *"Lyubeznik numbers in mixed characteristic"* (with Emily E. Witt), **Math. Res. Lett.**, Vol. 20, (2013), No. 6, 1125-1143.

45. *"Local cohomology modules of polynomial or power series rings over rings of small dimension"*, **Illinois J. Math.**, Volume 57 (2013), No. 1, 279-294.

46. *"On certain rings of differentiable type and finiteness properties of local cohomology"*, **J. Algebra**, Volume 379 (2013), 1-10.

47. *"Local cohomology properties of direct summands"*, **J. Pure Appl. Algebra**, Vol. 216 (2012), Issue 10, 2137-2140.

48. *"Ideals with Larger Projective Dimension and Regularity"* (with Jesse Beder, Jason McCullough, Alexandra Seceleanu, Bart Snapp and Branden Stone), **J. Symbolic Comput.**, Vol. 46 (2011), Issue 10, 1105-1113.

Submitted:

49. *"Jumping numbers of F-pure submodules"* (with Alessandro De Stefani, Daniel J. Henández, and Emily E. Witt).

50. *"Ladder determinantal varieties and their symbolic blowups"* (with Alessandro De Stefani, Jonathan Montaño, Lisa Seccia, and Matteo Varbaro), preprint available at arXiv:2305.18167 [math.CA].

51. *"The defect of the F-pure threshold"* (with Alessandro De Stefani and Ilya Smirnov), preprint available at arXiv:2501.13613 [math.CA].

52. *"F-singularities of polynomials with square-free support"* (with Aldo Conca, Alessandro De Stefani and Ilya Smirnov), preprint available at arXiv:2501.16198 [math.CA].

Mentoring

Postdocs

- Diego Rodríguez Gúzman, CIMAT $2018 - 2020$ (supported by CONACyT).

Doctoral students

- Wagner Badilla Céspedes, *"F-thresholds in singular varieties"*, CIMAT 2020
- Rene Gonzalez, *"Homological properties of binomial edge ideals"*, IMATE-UNAM 2020
- Carlos Espinosa Váldez, *"Regularity index of the generalized minimum distance function"*, CIMAT 2023, coadvisor Yuriko Pitones.
- Pedro Ramírez Moreno, *"Symbolic F-splitness of binomial edge ideals"*, CIMAT 2024
- Ghazaleh Fakhrivaighan, CIMAT 2027 (expected)
- Marvin Ferman Bell, CIMAT 2028 (expected)

Master students

- Veasna Chum, *"Singularities in prime characteristic"*, CIMAT 2017, coadvisor Xavier Gómez-Mont
- Lizda Moncada, *"Rings of differential operators"*, CIMAT 2018
- Delio Jaramillo Vélez, *"On F-pure thresholds: computations and relations to other invariants"*, CIMAT 2019, coadvisor Manuel González Villa
- Carlos Espinosa Váldez, *"Stanley-Reisner Theory: Simplicial Complexes, Hochster's Formula and Terai's Theorem"*, CIMAT 2019, coadvisor Abraham Martín del Campo
- Pedro Ramírez Moreno, *"Connectedness dimension of the spectrum of a ring and local cohomology"*, UANL 2020, coadvisor Lilia Alanis López
- Luis Palacios Vela, *"Morita equivalence and the generators of localization as a module over differential operators"*, CIMAT 2020, coadvisor Jack Jeffries
- Shalom Echalaz Alvarez, *"Characteristic p structure of local cohomology"*, CIMAT 2022
- Marvin Ferman Bell, *"On Castelnuovo–Mumford Regularity and F-Thresholds"*, CIMAT 2023, coadvisor Javier Carvajal-Rojas
- Andrés Montesionos Penagos, CIMAT 2025 (expected)
- Carlos Yeddiel Cortés Ruelas, CIMAT 2025 (expected)
- Roberto Alexandro Sepúlveda Rodríguez, CIMAT 2026 (expected)

Undergrad students

- Iván Pérez Cabrera, *"Max algebras"*, UGTO 2017, coadvisor Martha Takane Imay.
- Andrés Martínez Servellón, *"Frobenius actions on local cohomology"* UGTO 2019.
- Sandra Sandoval Gómez, *"Symbolic powers of ideals"*, UGTO 2020, coadvisor Jack Jeffries (awarded a honorable mention for Premio Sotero Prieto).
- Sandra Rodríguez Villalobos, *"Invariantes en característica prima"* , UNAM 2020 (awarded Premio Sotero Prieto as the best thesis in Mexico).
- Shalom Echalaz Alvarez, *"Frobenius over valuation rings"*, UJAT 2021, coadvisor Carlos Pompeyo (awarded a honorable mention for Premio Sotero Prieto).
- Edy Serrano Méndez, *"Ideales de aristas"*, UJED 2023.
- Roberto Alexandro Sepúlveda Rodríguez, UANL 2025 (expected).

Teaching Experience

CIMAT / University of Guanajuato

Abstract Algebra I	Undergraduate program	Spring 2024
Commutative Algebra I	Graduate Program	Fall 2020
Algebra and its applications	Undergraduate program (MSSG)	Fall 2019 & 2021
Integral Closure of Rings and Ideals	Graduate Program	Spring 2019
Linear Algebra II	Undergrand Program	Fall 2018, 2023
Linear Algebra I	Undergrand Program	Spring 2018
Commutative Algebra II	Graduate Program	Fall 2017 & Spring 2021
D-modules	Graduate Program	Spring 2017 & Fall 2024
Linear Algebra	Graduate Program	Fall 2016

University of Virginia

MATH 3000	Transition to Higher Mathematics	Spring 2016
MATH 8600	Commutative Algebra (Local Cohomology)	Spring 2015
MATH 3354	Survey of Algebra	Fall 2013, 2015 & Spring 2014, 2016
MATH 3351	Linear Algebra	Spring 2014 & Fall 2014

University of Michigan

MATH 115	Calculus	Fall 2011 & 2012
M-STEM Program	Calculus	Summer 2012

Selected Research Talks

- Colloquium , Virginia Tech, Blacksburg VA, February 2025
- International Congress on Complex Geometry, Singularities and Dynamics: In honor of José Seade, Cuernavaca, June 2024
- $70 + 2$ en honor de Xavier Gómez-Mont, Guanajuato, October 2023
- PRAGMATIC: Cohomology and Frobenius Catania, Italia, June 2023
- GTM Seminar, Genova, Italia, Junio 2023
- Colloquium, University of Nebraska-Lincoln, October 2022
- Pan-American School in Commutative Algebra, Barranquilla, Colombia, June 2022
- Colloquium, Instituto de Matemáticas, UNAM-Cuernavaca, December 2021
- Latin American Virtual Colloquium of Mathematics, online, December 2020
- TWAS Virtual Workshop on Algebra, online, November 2020
- Colloquium Mexican Mathematical Society, online, November 2020
- IT Bombay Virtual Commutative Algebra Seminar, online, August 2020
- Fellowship of the Ring, MSRI, online, July 2020
- Colloquium, Instituto de Matemáticas, UNAM-Juriquilla, February 2020
- Colloquium, Centro de Ciencias Matemáticas, UNAM, December 2018
- Primera Escuela de verano en aritmética, análisis p-ádico y física matemática", en honor de Víctor S. Albis G., Bogota, Colombia, Junio 2018
- Winter School on Geometry, Sun Yat-Sen University, Guangzhou, China, Enero 2018
- Mathematical Congress of the Americas, Session in Cobinatorial Commutative Algebra, July 2017
- Joint Meeting RSME- SMM, Sessions on Commutative algebra & Algebraic Geometry, June 2017
- National Congress of Algebraic Geometry, Oaxaca, Mexico, October 2016

- Commutative Algebra and Its Interactions with Algebraic Geometry (in honor of Craig Huneke's Birthday), Ann Arbor, MI, July, 2016
- Encuentro Nacional de Jovenes Investigadores en Matemáticas, Instituto de Matemáticas, UNAM, Mexico City, December 2015
- Multiplier ideals, Test ideals and Bernstein-Sato polynomials, Universitat Politècnica de Catalunya, Barcelona, Spain, September 2015
- Commutative Algebra Seminar, University of Michigan, Ann Arbor, MI, January 2015
- AMS Sectional Meeting AMS Session in Commutative Algebra, Albuquerque, NM April, 2014
- Mathematical Congress of the Americas, Session on Commutative Algebra and Algebraic Geometry, Guanajuato, GTO, Mexico, August 2013
- SIAM Conference on Applied Algebraic Geometry, Fort Collins, CO, August 2013
- Workshop on Representation Theory, Homological Algebra, and Free Resolutions, MSRI, Berkeley, CA, February 2013
- Commutative Algebra Seminar, University of Minnesota, Twin Cities, MN, October 2012
- Mexican Young Mathematicians Workshop, Guanajuato, GTO, Mexico, August 2012
- Commutative Algebra Seminar, University of Minnesota, Twin Cities, MN, February 2012
- Algebraic Geometry Seminar, CIMAT, Guanajuato, GTO, Mexico, December 2011
- Session on Commutative Algebra at the Eighth Joint International Meeting of the AMS ant the SMM, Berkeley, CA, June 2010

Organization

- School in Commutative Algebra, November 2017, 2018, 2019, and 2023 Guanajuato, GTO
- Third Meeting of Mexican Women in Mathematics, November 2021
- Special Session Commutative Algebra, Congress of the Mexican Mathematical Society, October 2021
- Special Session "Differential Operators in Commutative Algebra", Matemathical Congress of the Americas, July 2021
- Differential Operators in Commutative Algebra, online, Summer 2020 & 2021
- Special Session Commutative Algebra, Congress of the Mexican Mathematical Society, October 2019
- Special Session "Álgebra Conmutativa, Geometría Algebraica y Aritmética ", Latinamerican Colloquium in Mathematics, Mexico City, August 2019
- Special Session Commutative Algebra, Congress of the Mexican Mathematical Society, October 2018.
- Special Session "Álgebra Conmutativa, Geometría Algebraica y Aritmética ", Primer Encuentro SCM - SMM, Mayo 2018, Barranquilla, Colombia
- Miniworkshop on Commutative Algebra, Charlottesville Virginia, Abril 2018
- Special Session in Commutative Algebra, Third Congress of the Pacific Rim Mathematical Association, August 2017, Oaxaca, OAX
- Workshop "D-modules in Commutative algebra", Guanajuato, GTO, Mexico, August 2015
- Special Session "Matemáticos Duranguenses" of the National Congress of Mathematics of the Mexican Mathematical Society, October 2014, Durango, Mexico

Popularizing Math

- Several blog post for Científicos Duranguenses
- Multiple talks for high school students organized by CIMAT and by Científicos Duranguenses
- Special Session, Durango atraves de las matematicas, National Congress of Math, Octubre 2024 - Radio interviews at Lorena Portillo's Show, December 2015, March 2016, and September 2016
- Keynote Speaker, Hispanic Heritage Month Colloquium Series, Youngstown State University, Youngstown,

Ohio, October 2015
- Science Club Instructor, Clubes de Ciencias México, August 2014