

Yairon Cid-Ruiz

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CONTACT INFORMATION

Professional Address: Department of Mathematics, SAS Hall 4214, North Carolina State University,
Box 8205 Raleigh, NC 27695 USA.

WORK EXPERIENCE

- 01/2024 – **Assistant Professor**, North Carolina State University.
- 02/2024 – 03/2024 **Research Member**, SLMath (MSRI).
- 08/2022 – 12/2023 **Postdoctoral researcher**, KU Leuven.
- 10/2020 – 07/2022 **Postdoctoral researcher**, Ghent University.
- 09/2019 – 09/2020 **Postdoctoral researcher**, Max Planck Institute for Mathematics in the Sciences.
- 09/2016 – 08/2019 **Early stage researcher**, Universitat de Barcelona.
PhD candidate in the ARCADES network (<http://arcades-network.eu>)
under the Marie Skłodowska-Curie grant agreement No 675789.
- 09/2014 – 07/2015 **Graduate Teaching Assistant**, Universidad Central “Marta Abreu” de las Villas.

EDUCATION

- 09/2016 – 08/2019 **Ph.D. in Mathematics**, *summa cum laude*.
Center: Universitat de Barcelona.
Advisor: Carlos D’Andrea.
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- 09/2015 – 08/2016 **Postgraduate Diploma Programme in Mathematics**, *top student prize*.
Center: Abdus Salam International Centre for Theoretical Physics (ICTP).
Advisor: Lothar Göttsche.
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- 09/2009 – 07/2014 **Bachelor in Computer Science**, *summa cum laude*.
Center: Universidad Central “Marta Abreu” de las Villas (UCLV).
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PUBLICATIONS & PREPRINTS

1. “Bounding the degrees of a minimal μ -basis for a rational surface parametrization”, JOURNAL OF SYMBOLIC COMPUTATION 95 (2019), 134-150,
[arXiv:1611.07506](#).
2. “A D -module approach on the equations of the Rees algebra”, JOURNAL OF COMMUTATIVE ALGEBRA Vol 14 (2022), No. 2, 155-176,
[arXiv:1706.06215](#).
3. “Regularity and Gröbner bases of the Rees algebra of edge ideals of bipartite graphs”, LE MATEMATICHE Vol 73 No 2 (2018), pp. 279-296,
[arXiv:1801.06731](#).
4. (with Sepehr Jafari, Beatrice Picone and Navid Nemati), “Regularity of bicyclic graphs and their powers”, JOURNAL OF ALGEBRA AND ITS APPLICATIONS Vol. 19, No. 03, 2050057 (2020),
[arXiv:1802.07202](#).
5. (with Laurent Busé and Carlos D’Andrea), “Degree and birationality of multi-graded rational maps”, PROCEEDINGS OF THE LONDON MATHEMATICAL SOCIETY (3) 121 (2020) 743-787,
[arXiv:1805.05180](#).
6. “Multiplicity of the saturated special fiber ring of height two perfect ideals”, PROCEEDINGS OF THE AMERICAN MATHEMATICAL SOCIETY 148 (2020), no. 1, 59-70,
[arXiv:1807.03189](#).

7. (with Aron Simis), “*Degree of rational maps via specialization*”, INTERNATIONAL MATHEMATICS RESEARCH NOTICES, Volume 2022, Issue 6, March 2022, Pages 4451–4502, [arXiv:1901.06599](#).
8. “*Noetherian operators, primary submodules and symbolic powers*”, COLLECTANEA MATHEMATICA 72, p. 175–202 (2021), [arXiv:1909.07253](#).
9. (with Vivek Mukundan), “*Multiplicity of the saturated special fiber ring of height three Gorenstein ideals*”, ACTA MATHEMATICA VIETNAMICA 46, pp. 663–674 (2021), [arXiv:1909.13633](#).
10. “*Mixed multiplicities and projective degrees of rational maps*”, JOURNAL OF ALGEBRA 566 (2021), 136–162, [arXiv:2001.00547](#).
11. (with Roser Homs and Bernd Sturmfels), “*Primary ideals and their differential equations*”, FOUNDATIONS OF COMPUTATIONAL MATHEMATICS 21, pp. 1363–1399 (2021), [arXiv:2001.04700](#).
12. (with Marc Chardin and Aron Simis), “*Generic freeness of local cohomology and graded specialization*”, TRANSACTIONS OF THE AMERICAN MATHEMATICAL SOCIETY 375 (2022), no. 1, 87–109, [arXiv:2002.12053](#).
13. (with Federico Castillo, Binglin Li, Jonathan Montaña and Naizhen Zhang), “*When are multidegrees positive?*”, ADVANCES IN MATHEMATICS 374 (2020), 107382, [arXiv:2005.07808](#).
14. (with Jonathan Montaña), “*Convex bodies and graded families of monomial ideals*”, REVISTA MATEMÁTICA IBEROAMERICANA 38 (2022), no. 6, 2033–2056, [arXiv:2010.07918](#).
15. (with Jonathan Montaña), “*Mixed multiplicities of graded families of ideals*”, JOURNAL OF ALGEBRA 590 (2022) 394–412, [arXiv:2010.11862](#).
16. “*Equations and multidegrees for inverse symmetric matrix pairs*”, LE MATEMATICHE Vol. LXXVI (2021) - Issue II, pp. 369–381, [arXiv:2011.04616](#).
17. (with Justin Chen, Marc Härkönen, Robert Krone and Anton Leykin), “*Noetherian Operators in Macaulay2*”, JOURNAL OF SOFTWARE FOR ALGEBRA AND GEOMETRY, Vol. 12 (2022), 33–41. [arXiv:2101.01002](#).
18. (with Bernd Sturmfels), “*Primary decomposition with differential operators*”, INTERNATIONAL MATHEMATICS RESEARCH NOTICES, rnacl78, 2022, [arXiv:2101.03643](#).
19. (with Justin Chen), “*Primary decomposition of modules: a computational differential approach*”, JOURNAL OF PURE AND APPLIED ALGEBRA, 226, 2022, [arXiv:2104.03385](#).
20. (with Fatemeh Mohammadi and Leonid Monin), “*Multigraded algebras and multigraded linear series*”, [arXiv:2104.05397](#).
21. “*Fiber-full modules and a local freeness criterion for local cohomology modules*”, MATHEMATISCHE ZEITSCHRIFT 303, 30 (2023), [arXiv:2106.07777](#).
22. (with Ritvik Ramkumar), “*The fiber-full scheme*”, [arXiv:2108.13986](#).
23. (with Federico Castillo, Fatemeh Mohammadi and Jonathan Montaña), “*Double Schubert polynomials do have saturated Newton polytopes*”, FORUM OF MATHEMATICS, SIGMA Vol. 11:e100 1–9, [arXiv:2109.10299](#).
24. (with Oliver Clarke and Fatemeh Mohammadi), “*A study of nonlinear multiview varieties*”, JOURNAL OF ALGEBRA 620 (2023) 363–391, [arXiv:2112.06216](#).

25. (with Ritvik Ramkumar), “*A local study of the fiber-full scheme*”, JOURNAL OF ALGEBRA 636 (2023) 248–278,
arXiv:2202.06652.
26. (with Claudia Polini and Bernd Ulrich), “*Generalized Jouanolou duality, weakly Gorenstein rings, and applications to blowup algebras*”,
arXiv:2205.03837.
27. (with Alessio Caminata and Aldo Conca), “*Multidegrees, prime ideals, and non-standard gradings*”, ADVANCES IN MATHEMATICS 435 (2023) 109361,
arXiv:2208.07238.
28. (with Federico Castillo, Fatemeh Mohammadi and Jonathan Montaña), “*K-polynomials of multiplicity-free varieties*”,
arXiv:2212.13091.
29. (with Ilya Smirnov), “*Effective generic freeness and applications to local cohomology*”,
arXiv:2302.08196.
30. “*Relative mixed multiplicities and mixed Buchsbaum–Rim multiplicities*”,
arXiv:2311.15105.
31. “*Polar multiplicities and integral dependence*”,
arXiv:2401.10198.

AWARDS, GRANTS & FELLOWSHIPS

- 03/2023: Awarded the *Heisenberg Programme* from the Deutsche Forschungsgemeinschaft (DFG). I declined it in favor of an Assistant Professor position at North Carolina State University.
- 11/2022 – 12/2022: *Oberwolfach Research Fellow*, MFO, Oberwolfach Research Institute for Mathematics.
- 06/2022 – 07/2022: *Professore Visitatore in Italia (Visiting Professor)*, supported by Istituto Nazionale di Alta Matematica “Francesco Severi” – Gruppo Nazionale per le Strutture Algebriche, Geometriche e le loro Applicazioni (INdAM-GNSAGA), University of Genova.
- 10/2021 – 09/2024: *Postdoctoral Fellowship Research Foundation Flanders (FWO)*, Ghent University & KU Leuven, Belgium.
- 09/2016 – 08/2019: *Marie Skłodowska-Curie Fellowship*, Universitat de Barcelona, Barcelona, Spain.
- 09/2015 – 08/2016: Awarded a *fully funded scholarship to pursue the Postgraduate Diploma in Mathematics at ICTP*, Trieste, Italy.
- Extraordinary Doctorate Award, Universitat de Barcelona, 2019.
- Winner of the top student prize in Mathematics in International Centre for Theoretical Physics, 2016.
- One of the 10 selected students in the Postgraduate Diploma Programme in Mathematics in International Centre for Theoretical Physics, 2015.
- Best graduate student in 2014 in the Universidad Central “Marta Abreu” de Las Villas, 2014.
- SILVER MEDAL in the XV Iberoamerican Mathematical Olympiad, 2012.
- BRONZE MEDAL in the XIII Iberoamerican Mathematical Olympiad, 2010.
- BRONZE MEDAL in the Caribbean Regional Final of the Latin American programming ACM-ICPC, 2012.

RESEARCH VISITS

- INRIA Sophia Antipolis, 6 months, 10/2017 – 03/2018, host: Lurent Busé.
- Johannes Kepler University Linz, 2 months, 10/2018 – 11/2018, host: Josef Schicho.
- Politecnico di Torino, 1 week, 05/11/2018 – 09/11/2018, host: Aron Simis.
- International Centre for Theoretical Physics, 1 week, 11/02/2019 – 15/02/2019, host: Tarig Abdelgadir.
- Universidad de Sevilla, 1 week, 22/04/2019 – 26/04/2019, host: Francisco Jesús Castro Jiménez.
- University of Notre Dame & Purdue University, 1 month, 03/2022, hosts: Claudia Polini & Bernd Ulrich.

- University of Genova, 1 month, 07/2022, host: Aldo Conca.
- Basque Center for Applied Mathematics, 1 week, 10/10/2022 – 15/10/2022, host: Ilya Smirnov.
- Basque Center for Applied Mathematics, 2 weeks, 16/10/2023 – 27/10/2023, host: Ilya Smirnov.

INVITED TALKS

- “*Duality and blow-up algebras*”, Algebra and Combinatorics seminar, North Carolina State University, January 2024.
- “*Multidegrees, polymatroids and Schubert polynomials*”, Complex Geometry Seminar, Institut de Mathématiques de Toulouse Université Paul Sabatier, November 2023.
- “*Some lectures on multidegrees*”, 28th National School on Algebra Interactions between Algebra and Geometry, Bucharest, Romania, June 2023.
- “*Duality and blow-up algebras*”, Foundations of Computational Mathematics, Sorbonne Université, June 2023.
- “*Duality and blow-up algebras*”, Algebra Seminar, Institute of Mathematics, Osnabrück University, April 2023.
- “*Multidegrees at the crossroads of Algebra, Geometry, and Combinatorics*”, Colloquium, Department of Mathematics, Auburn University, January 2023.
- “*Multidegrees at the crossroads of Algebra, Geometry, and Combinatorics*”, Colloquium (online), Department of Mathematics, New Mexico State University, January 2023.
- “*Multidegrees at the crossroads of Algebra, Geometry, and Combinatorics*”, Colloquium, Department of Mathematics, North Carolina State University, January 2023.
- “*K-polynomials of multiplicity-free varieties*”, Conference: “Written Geometry: Commutative Algebra”, CIRM, Luminy, France, January 2023.
- “*Double Schubert polynomials do have saturated Newton polytopes*”, Geometry meets Combinatorics in Bielefeld, Germany, September 2022.
- “*The fiber-full scheme and applications*”, Algebra & Geometry Seminar, University of Genova, Italy, July 2022.
- “*Describing non-reduced schemes with differential operators*”, Workshop on Differential Algebra, MPI Leipzig, Germany, June 2022.
- “*Double Schubert polynomials do have saturated Newton polytopes*”, AMS 2022 Spring Western Virtual Sectional Meeting (online), May 2022.
- “*A local study of the fiber-full scheme*”, AMS Spring Central Virtual Sectional Meeting, Purdue University, USA, March 2022.
- “*Differential primary decomposition of modules*”, Congreso Bienal de la Real Sociedad Matemática Española 2022, Universidad de Castilla - La Mancha, Ciudad Real, Spain, January 2022.
- “*Double Schubert polynomials do have saturated Newton polytopes*”, Congreso Bienal de la Real Sociedad Matemática Española 2022, Universidad de Castilla - La Mancha, Ciudad Real, Spain, January 2022.
- “*An invitation to the fiber-full scheme*”, Seminar Number Theory and Algebraic Geometry, KU Leuven, Leuven, Belgium, November 2021.
- “*An invitation to the fiber-full scheme*”, Jornada de Jóvenes Doctores en Geometría Algebraica, Universitat de Barcelona, Barcelona, Spain, November 2021.
- “*The fiber-full scheme*”, Fellowship of the Ring seminar (online), October 2021.
- “*Convex bodies and graded families of ideals*”, Society for Industrial and Applied Mathematics, Applied Algebraic Geometry Conference (online), August 2021.
- “*Primary decomposition with differential operators*”, ICERM conference (online): D-modules, Group Actions, and Frobenius: Computing on Singularities, August 2021.
- “*Primary decomposition with differential operators*”, Simon Fraser University Number Theory and Algebraic Geometry Seminar (online), July 2021.
- “*Primary decomposition with differential operators*”, Mathematical Congress of the Americas (online), July 2021.

- “*Convex bodies and graded families of monomial ideals*”, IIT Bombay Virtual Commutative Algebra Seminar (online), July 2021.
- “*Multigraded algebras and multigraded linear series*”, Technische Universität Berlin (online), June 2021.
- “*Equations and multidegrees for inverse symmetric matrix pairs*”, Effective Methods in Algebraic Geometry MEGA 2021 (online), May 2021.
- “*Primary decomposition with differential operators*”, Seminari de Geometria Algebraica de Barcelona (online), April 2021.
- “*Primary ideals and differential operators*”, The MAX computer algebra seminar (online), February 2021.
- “*When are multidegrees positive?*”, Ghent Algebra and Geometry Seminars Weekly Research Seminars, Ghent, Belgium, November 2020.
- “*Ehrenpreis-Palamodov theorem in commutative algebra*”, Differential Operators in Commutative Algebra Seminar (online), July 2020.
- “*Specialization of graded modules and generic freeness of local cohomology*”, Nonlinear Algebra Seminar Online, March 2020.
- “*Noetherian operators, primary submodules and symbolic powers*”, V congreso de jóvenes investigadores RSME, Castellón, Spain, January 2020.
- “*Noetherian operators, primary submodules and symbolic powers*”, Algebra Seminar, Osnabrück, Germany, November 2019.
- “*Rational maps, syzygies and specialization*”, Seminar on Nonlinear Algebra, Leipzig, Germany, September 2019.
- “*Ehrenpreis – Palamodov Theorem*”, Second edition of the conference: Computing with D-modules, Leipzig, Germany, September 2019.
- “*Specialization of rational maps*”, Society for Industrial and Applied Mathematics, Applied Algebraic Geometry Conference, Bern, Switzerland, July 2019.
- “*Rational maps and syzygies*”, Seminario de Álgebra de la Universidad de Sevilla, Sevilla, Spain, April 2019.
- “*Saturated special fiber ring and rational maps*”, Seminari de Geometria Algebraica de Barcelona, Barcelona, Spain, March 2019.
- “*Saturated special fiber ring and rational maps*”, Mathematics Seminar, International Centre for Theoretical Physics, Italy, February 2019.
- “*Rational maps and the saturated special fiber ring*”, Joint Meeting of the Czech, Slovenian, Austrian, Slovak and Catalan Mathematical Societies, Bratislava, Slovakia, September 2018.
- “*Degree and birationality of multi-graded rational maps*”, ARCADES Doctoral School II and ESR Days in Barcelona, Barcelona, Spain, September 2018.
- “*Regularity and Gröbner bases of the Rees algebra of edge ideals of bipartite graphs*”, XVI Encuentro de Álgebra Computacional y Aplicaciones (EACA), Zaragoza, Spain, July 2018.
- “*Regularity of bicyclic graphs and their powers*”, IPPI Workshop 2018 (post-Pragmatic 2017 event), Turin, Italy, March 2018.
- “*Regularity and Gröbner bases of the Rees algebra of edge ideals of bipartite graphs*”, Journées Nationales de Calcul Formel, CIRM, Luminy, France, January 2018.
- “*A D-module approach on the equations of the Rees algebra*”, Séminaire d’algèbre, topologie et géométrie, University of Nice, France, November 2017.
- “*Bounding the degrees of a minimal μ -basis for a rational surface parametrization*”, Society for Industrial and Applied Mathematics, Applied Algebraic Geometry Conference, Atlanta, United States, August 2017.
- “*Bounding the degrees of a minimal μ -basis for a rational surface parametrization*”, Effective Methods in Algebraic Geometry MEGA 2017, Nice, France, June 2017.
- “*Bounding the degrees of a minimal μ -basis for a rational surface parametrization*”, Seminari de Geometria Algebraica de Barcelona, Barcelona, Spain, March 2017.

CONFERENCES & WORKSHOPS

- Conference: “Written Geometry: Commutative Algebra”, CIRM, Luminy, France, January 2023.
- Workshop on Differential Algebra, MPI Leipzig, Germany, June 2022.
- Mathematical Congress of the Americas 2021 (online), July 2021.
- Summer School on Randomness and Learning in Non-Linear Algebra, Leipzig, Germany, July 2019.
- Thematic Program in Commutative Algebra and its Interaction with Algebraic Geometry. In Honor of Bernd Ulrich. Notre Dame University, United States, June 2019.
- Learning Week III in ARCADES, Nice, France, March 2019.
- Second ARCADES Software & Industrial Workshop, Cambridge, UK, January 2019.
- Frobenius Action in Commutative Algebra: Recent Developments, Barcelona, Spain, January 2019.
- Macaulay2 Workshop, Leipzig, Germany, June 2018.
- Learning Week II in ARCADES, Nice, France, March 2018.
- Workshop on Commutative Algebra, Syzygies and Singularities, Nice, France, December 2017.
- First Software & Industrial Workshop, and Midterm Review ARCADES, Athens, Greece, November 2017.
- Research school in Algebraic Geometry and Commutative Algebra, Pragmatic 2017, Catania, Italy, June 2017.
- Learning Week I in Algebraic Representations in Computer-Aided Design for complex Shapes (ARCADES), Nice, France, March 2017.
- 1st Doctoral School ARCADES, Oslo, Norway, December 2016.
- Workshop in Algebra, Algebraic Geometry, Algebraic Topology and Applications sponsored by Centro de Investigaciones en Matemáticas(CIMAT, Guanajato, México) in Ciego de Avila, Cuba, 2014.

ORGANIZATIONAL ACTIVITIES

- Member of the Organizing Committee of the minisymposia “*Differential Equations in Algebraic Geometry and Beyond*”, 2021 SIAM Conference on Applied Algebraic Geometry (online), August 2021.
- Member of the Organizing Committee of the minisymposia “*Syzygies and applications to Geometry*”, 2019 SIAM Conference on Applied Algebraic Geometry, Bern, Switzerland, July 2019.

TEACHING EXPERIENCE

KU Leuven	08/2022 – 12/2023
Supervisor of three Bachelor Projects in Pure Mathematics	Fall 2022
Ghent University	10/2020 – 07/2022
Calculus	Spring 2021
Universidad Central “Marta Abreu” de las Villas	09/2014 – 07/2015
Topology	Fall 2014
Differential Geometry of Curves and Surfaces	Spring 2015

LANGUAGES

Spanish: Mother tongue.
English: Fluent.
Dutch: Intermediate (level B1).

COMPUTER SKILLS

C/C++, JAVA, L^AT_EX, Linux, Wolfram Mathematica, MACAULAY2, SINGULAR.