

# Yairon Cid-Ruiz

Nationality: Spanish | Cuban; Date of Birth: 26/08/1990

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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 under a Marie Skłodowska-Curie grant.
- 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  $\mu$ -basis for a rational surface parametrization”, JOURNAL OF SYMBOLIC COMPUTATION 95 (2019), 134–150,  
[arXiv:1611.07506](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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 Montaño and Naizhen Zhang), “When are multidegrees positive?”, ADVANCES IN MATHEMATICS 374 (2020), 107382,  
arXiv:2005.07808.
14. (with Jonathan Montaño), “Convex bodies and graded families of monomial ideals”, REVISTA MATEMÁTICA IBEROAMERICANA 38 (2022), no. 6, 2033–2056,  
arXiv:2010.07918.
15. (with Jonathan Montaño), “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, rnac178, 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”, JOURNAL OF THE LONDON MATHEMATICAL SOCIETY, Volume 109, Issue 3, 2024,  
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 Montaño), “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 Montaño), “*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*”, INTERNATIONAL MATHEMATICS RESEARCH NOTICES  
2024, 00(0), 1–18,  
arXiv:2401.10198.
32. (with Jack Jeffries), “*Uniformity in nonreduced rings via Noetherian operators*”,  
arXiv:2404.02057.
33. (with Claudia Polini and Bernd Ulrich), “*Multidegrees, families, and integral dependence*”,  
arXiv:2405.07000.

## 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

- *“Numerical criteria for integral dependence and their behavior in families”*, Seminar on Commutative Algebra and Algebraic Geometry, UC Berkeley, March 2024.
- *“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  $\mu$ -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  $\mu$ -basis for a rational surface parametrization*”, Effective Methods in Algebraic Geometry MEGA 2017, Nice, France, June 2017.
- “*Bounding the degrees of a minimal  $\mu$ -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

- Program Committee of the conference “*Computer Algebra in Scientific Computing 2024*”, Rennes, France, September 2024.
- 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

<b>North Carolina State University</b> Computer Algebra I	01/2024 – Fall 2024
<b>KU Leuven</b> Supervisor of three Bachelor Projects in Pure Mathematics	08/2022 – 12/2023 Fall 2022
<b>Ghent University</b> Calculus	10/2020 – 07/2022 Spring 2021
<b>Universidad Central “Marta Abreu” de las Villas</b> Topology Differential Geometry of Curves and Surfaces	09/2014 – 07/2015 Fall 2014 Spring 2015

## LANGUAGES

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

## COMPUTER SKILLS

C/C++, JAVA,  $\text{\LaTeX}$ , Linux, Wolfram Mathematica, MACAULAY2, SINGULAR.