Rodrigo San-José (Rodrigo San José Rubio)

Presidential Postdoctoral Fellow at Virginia Tech.

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Professional experience

August 2025 – August 2027 — **Presidential Postdoctoral Fellow.** Virginia Tech.
Job description: Presidential Postdoctoral Fellow with the group of Hiram H. López and Gretchen L. Matthews. This fellowship program aims to recognize and support outstanding scholars primed to make important contributions in their fields.

November 2024 – August 2025 — **Postdoctoral Researcher.** University of Valladolid.
Job description: This is a period of postdoctoral guidance included in my doctoral contract due to completing my doctorate in less than three years.

Education

2021 – 2024 — **Ph.D. in Mathematics**, University of Valladolid, Spain.
Thesis title: *Commutative Algebra and Coding Theory, with Applications to Quantum Error-Correction.*
Committee: Sudhir R. Ghorpade, Jade Nardi, Eduardo Saénz de Cabezón.

2020 – 2021 — **M.Sc. in Mathematics**, University of Valladolid, Spain.
Thesis title: *Invariantes homológicos de ideales graduades y su aplicación en Teoría de Códigos (Homological invariants of graded ideals and their application to Coding Theory).*

2015 – 2020 — **Degree in Mathematics**, University of Valladolid, Spain.

2015 – 2020 — **Degree in Physics**, University of Valladolid, Spain.

Research interests

My main research interest is **algebraic coding theory**. In particular, I am focused on studying applications of evaluation codes in **quantum error-correction** and **cryptography**. I am also interested in problems in **commutative algebra** and **algebraic geometry** motivated by applications in coding theory.
At the moment, my research is focused on **evaluation codes** and their properties: constructing quantum codes with good parameters from them, obtaining their generalized Hamming weights for applications to secret sharing, or studying alternatives for McEliece. I also study the maximum number of zeroes of polynomials over finite fields, which is related to the parameters of evaluation codes.

Journal papers

9 E. Camps-Moreno, H.H. López, G.L. Matthews, R. San-José. The weight hierarchy of decreasing norm-trace codes. Des. Codes Cryptogr. (2025). DOI: https://doi.org/10.1007/s10623-025-01619-7.

8 R. San-José. About the generalized Hamming weights of matrix-product codes. Comp. Appl. Math. 44, 186 (2025). DOI: https://doi.org/10.1007/s40314-025-03141-x.

7 D. Ruano, R. San-José. Quantum error-correcting codes from projective Reed-Muller codes and their hull variation problem. Journal of Algebra and its Applications, to appear. ArXiv 2312.15308, 12 pages (2024). DOI: https://doi.org/10.1142/s0219498825410099.

6. R. San-José. A recursive construction for projective Reed-Muller codes. IEEE Transactions on Information Theory. Volume 70, Issue 12, pages 8511-8523 (2024). DOI: https://doi.org/10.1109/tit.2024.3483998.

5. D. Ruano, R. San-José. Hulls of projective Reed-Muller codes over the projective plane. SIAM Journal on Applied Algebra and Geometry. Volume 8, Issue 4, pages 846-876 (2024). DOI: https://doi.org/10.1137/23M1626153.

4. E. Camps-Moreno, H.H. López, G.L. Matthews, D. Ruano, R. San-José, I. Soprunov. An algebraic characterization of binary CSS-T codes and cyclic CSS-T codes for quantum fault tolerance. Quantum Inf. Process. 23, 230, 24 pages (2024). DOI: https://doi.org/10.1007/s11128-024-04427-5.

3. P. Gimenez, D. Ruano, R. San-José. Subfield subcodes of projective Reed-Muller codes. Finite Fields Appl. 94, 102353, 46 pages (2024). DOI: https://doi.org/10.1016/j.ffa.2023.102353.

2. P. Gimenez, D. Ruano, R. San-José. Entanglement-assisted quantum error-correcting codes from subfield subcodes of projective Reed-Solomon codes. Comp. Appl. Math. 42, 363, 31 pages (2023). DOI: https://doi.org/10.1007/s40314-023-02506-4.

1. P. Gimenez, D. Ruano, R. San-José. Saturation and vanishing ideals. São Paulo J. Math. Sci., 17, 147-155 (2023). DOI: https://doi.org/10.1007/s40863-022-00330-y.

Conference papers

1. E. Camps-Moreno, H.H. López, G.L. Matthews, D. Ruano, R. San-José, I. Soprunov. Binary Triorthogonal and CSS-T Codes for Quantum Error Correction. 60th Annual Allerton Conference on Communication, Control, and Computing, 6 pages (2024). DOI: https://doi.org/10.1109/Allerton63246.2024.10735332.

Preprints

5. J. Nardi, R. San-José. Maximum number of zeroes of polynomials on weighted projective spaces over a finite field. ArXiv 2507.22597, 18 pages (2025).

4. O. Campion, R. San-José. Hermitian hull of some GRS codes and new entanglement-assisted quantum MDS codes. ArXiv 2507.18361, 22 pages (2025).

3. E. Camps-Moreno, A. Fidalgo-Díaz, H.H. López, U. Martínez-Peñas, D. Ruano, R. San-José. Duals of multiplicity codes. ArXiv 2505.14472, 28 pages (2025).

2. R. San-José. An algorithm for computing generalized Hamming weights and the Sage package GHWs. ArXiv 2503.17764, 20 pages (2025).

1. R. San-José. Recursive decoding of projective Reed-Muller codes. ArXiv 2501.01692, 20 pages (2025).

Posters

2. E. Camps-Moreno, H.H. López, G.L. Matthews, D. Ruano, R. San-José, I. Soprunov. About the structure of binary CSS-T quantum codes. 2024 IEEE International Symposium on Information Theory (ISIT 2024). Athens, Greece. 07/08/24.

1. R. San-José, Generalized minimum distance functions and Reed-Muller-type codes. Graduate student meeting on Applied Algebra and Combinatorics, University of Copenhagen (online). 04/21/21.

Talks

26 "Generalized Hamming Weights of Decreasing Norm-Trace Codes", SIAM Conference on Applied Algebraic Geometry. Madison. 07/11/2025.

25 "Generalized Hamming Weights of Decreasing Norm-Trace Codes", 2025 Workshop in Coding Theory & Cryptography. Riva San Vitale. 07/03/2025.

24 "The weight hierarchy of decreasing norm-trace codes", 2025 Algebraic Applications to Coding Theory and Crypto workshop. Mexico City. 03/27/25.

23 "Generalized Hamming weights of decreasing codes", Seminar on Algebraic Geometry and Singularities, SINGACOM. Valladolid. 03/07/25.

22 "Using classical codes for quantum fault-tolerant computing", RSME's 7th Congress of Young Researchers. Bilbao. 01/16/25.

21 "Quantum fault-tolerance via classical codes", MatSI, IMAC and Singacom Day on Algebraic Applications to Information Theory. Universitat Jaume I. 10/16/24.

20 "Transversal implementation of non-Clifford gates for quantum fault tolerant computation", Follow-up meeting, Q-CAYLE project. University of Valladolid. 10/10/24.

19 "Bounds for the generalized Hamming weights of projective Reed-Muller codes and matrix-product codes", IIT Bombay - Virginia Tech Joint Workshop on Algebraic Coding Theory. 08/23/24.

18 "Algebraic coding theory and quantum codes", VT-Swiss Coding Theory & Cryptography Summer School. 07/02/24.

17 "A characterization of binary CSS-T quantum codes", IMUVa's PhD day. 06/27/24.

16 "About the hulls of projective Reed-Muller codes", EACA 2024. San Lorenzo del Escorial. 06/24/24.

15 "CSS-T codes from cyclic codes for fault tolerant computation", V MatSI network meeting 2024. Universidad de Alicante. 06/06/24.

14 "Projective Reed-Muller codes: subfield subcodes, generalized Hamming weights and hulls", Séminaire Géométrie et algèbre effectives. Institut de recherche mathématique de Rennes. 02/09/24.

13 "A recursive construction for projective Reed-Muller codes", RSME's Biennial Congress. Pamplona. 01/25/24.

12 "Quantum codes for fault-tolerant computation", Follow-up workshop secureCAT project. Aguilar de Campoo. 01/11/24.

11 "Subfield subcodes of projective Reed-Solomon codes", SIAM TX-LA 2023. University of Louisiana, Lafayette. 11/04/23.

10 "A recursive construction for projective Reed-Muller codes, Part 2", Applied Algebra Seminar, Virginia Tech, Blacksburg. 10/17/23.

9 "A recursive construction for projective Reed-Muller codes, Part 1", Applied Algebra Seminar, Virginia Tech, Blacksburg. 10/12/23.

8 "Vanishing ideals and evaluation codes", ACA 2023. Instytut Informatyki Technicznej, Warsaw. 07/17/23.

7 "Entanglement-assisted quantum error-correcting codes from subfield subcodes of projective Reed-Solomon codes", IMUVa's PhD day. 06/28/23.

6 "Entanglement-assisted quantum error-correcting codes from subfield subcodes of projective Reed-Solomon codes", Postgraduate International Coding theory Seminar (PICS). 05/11/23.

5. "Subfield subcodes of projective Reed-Muller codes", RSME's 6th Congress of Young Researchers. Universidad de León. 02/09/23.

4. "Codes over the projective space and applications", Kick-Off Meeting secureCAT project. Aguilar de Campoo. 01/25/23.

3. "About the computation of vanishing ideals with applications to coding theory", Fourth BYMAT Conference. Universitat de València and Universitat Politècnica de València (online). 11/11/22.

2. "Saturation and vanishing ideals", IMUVa's PhD day. 06/30/22.

1. "Saturation and vanishing ideals", XVII Meeting on Computer Algebra and Applications. EACA 2022. Universidad Jaume I de Castellón. 06/22/22.

Professional service

01/13/25 – 01/17/25 — **Conference.** Organizer of the "Coding Theory" Parallel Session, "RSME's 7th Congress of Young Researchers", Bilbao. Webpage.

11/04/24 – 11/07/24 — **Conference.** Organizing committee, "6th BYMAT Conference", University of Valladolid. Webpage.

05/23/22 – 05/27/22 — **School.** Local committee, "International School on Tropical Geometry", University of Valladolid. Webpage.

Teaching experience

Spring 2025 — **Undergraduate course:** "Error-correcting codes", 30h. University of Valladolid, Mathematics Degree.

Spring 2024 — **Undergraduate course:** "Error-correcting codes", 30h. University of Valladolid, Mathematics Degree.

Spring 2023 — **Undergraduate course:** "Error-correcting codes", 30h. University of Valladolid, Mathematics Degree.

Fall 2022 — **Undergraduate course:** "Linear algebra and geometry 1", 30h. University of Valladolid, Mathematics Degree.

Spring 2022 — **Undergraduate course:** "Error-correcting codes", 25h. University of Valladolid, Mathematics Degree.

Projects (Spanish and European)

September 2023 – August 2027 — **National project.** Member of the work team of the project "Singularities. Valuative and combinatorial methods. Algebraic and network coding". PI's: F. Delgado, D. Ruano. Reference: PID2022-138906NB-C21. 200,000.00€.

September 2023 – August 2027 — **National project.** Member of the work team of the project "Algebraic combinatorics and its connections to geometry". PI's: P. Gimenez, K. Knauer. Reference: PID2022-137283NB-C22. 150,000.00€.

December 2022 – November 2024 — **National project.** Member of the work team of the project "Coding theory and Algebraic Trends for Cryptography, Distributed Data Storage, Machine Learning and Quantum Information (secureCAT)". PI's: E. Martínez-Moro, D. Ruano. Reference: TED2021-130358B-100. 174,225.00€.

January 2021 – August 2025 — **European project.** Member of the research team of the project "Secure Quantum Communications in Castilla y León (QCAYLE)". PI: L.M. Nieto. 2,076,496.00€.

June 2020 – May 2023 — **National project.** Member of the work team of the project "Commutative Algebra and Interactions (ALCOIN)". PI's: P. Gimenez, S. Zarzuela. Reference: PID2019-104844GB-I00. 46,343.00€.

January 2019 – December 2022 — **National project.** Member of the work team of the project "Singularities and Algebraic Geometry. Semigroups and AG-codes". PI: F. Delgado. Reference: PGC2018-096446-B-C21. 60,379.00€.

Courses

04/26/23 – 04/27/23 — **Formation Course.** "Introduction to quantum computing (without the physics)", 5 hours, University of Valladolid.

03/04/22 – 03/21/22 — **Formation Course.** "Gradebook in Moodle", 10 hours, VirtUVa, University of Valladolid.

12/09/21 – 12/19/21 — **Formation Course.** "Bibliometrics in the Evaluation of Research Output", 12 hours, Doctorate School of University of Valladolid.

10/01/21 – 01/31/22 — **Graduate Course.** "Moduli of n points on the projective line", Faculty of Mathematics of the University of Vienna (online), two hours weekly.

Research stays

09/09/24 – 09/13/24 — **Visiting researcher** at Universitat Jaume I.

05/02/24 – 05/10/24 — **Visiting graduate student** at Virginia Tech.

09/02/23 – 12/02/23 — **Visiting graduate student** at Virginia Tech.

Grants

08/10/25 – 08/09/27 — **Presidential Postdoctoral** travel grant for training and professional development-related expenses, $10.000.

05/26/25 – 05/30/25 — **Fields Institute travel grant** to participate in the workshop "Applications of Commutative Algebra", Toronto, Canada. CAD$1,000.

07/01/24 – 07/05/24 — **UVa travel grant** for conferences, funded by the University of Valladolid for the VT-Swiss Coding Theory & Cryptography Summer School, Riva San Vitale, Switzerland. 600€.

07/17/23 – 07/21/23 — **UVa travel grant** for conferences, funded by the University of Valladolid for the conference (ACA'2023), Instytut Informatyki Technicznej, Varsovia. 600€.

09/02/23 – 12/02/23 — **FPU Mobility Grant**, National grant EST23/00777 funded by the Spanish Ministry of Universities for a research stay at Virginia Tech. 5,658.67€.

12/01/21 – 11/30/25 — **FPU Contract**, National pre-doctoral contract funded by the Spanish Ministry of Universities. 85,952.40€.

12/10/20 – 09/31/21 — **Departmental Collaboration Research Scholarship**, IMUVA (Mathematics Research Institute), University of Valladolid, funded by University of Valladolid's Consejo Social. 1,000€.

10/23/19 – 06/22/20 — **Departmental Collaboration Research Scholarship**, Department of Algebra, Mathematical Analysis, Geometry and Topology, University of Valladolid, funded by the Spanish Ministry of Education. 1,000€.

Prizes and awards

2021 **Special prize for M.Sc. students.** IMUVa (Mathematics Research Institute of the University of Valladolid), University of Valladolid. 2000€.

Professional memberships

- Spanish thematic networks: EACA (computational algebra), MATSI (information theory), MDA (discrete mathematics), RGAS (algebraic geometry and singularity theory).

Referee for

Journals
- Communications in Algebra; Computational and Applied Mathematics; Designs, Codes and Cryptography; Finite Fields and Their Applications; IEEE Transactions on Information Theory; Journal of Algebra and its Applications.

Conferences
- Discrete Mathematics Days.

Other
- MathSciNet, Zentralblatt MATH.

Skills

Languages
- **Spanish,** native speaker.
  English, advanced professional proficiency. Certificate in Advanced English (CAE) by Cambridge, with a grade indicating C2 proficiency.

Programming
- C, LaTeX, Macaulay2, Magma, Maple, Mathematica, Matlab, Python, SageMath, Singular.