Guillermo Gallego Sánchez

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Summary

I am a mathematician specializing in Complex Algebraic and Differential Geometry, currently working as a Postdoc Researcher at Freie Universität Berlin. My research on Higgs bundles and related topics has been published in leading journals such as Advances in Mathematics, and I have presented my work at international conferences across Europe and America, with research stays at McGill University (Montreal) and the University of Chicago.

Alongside my research, I have developed strong teaching experience that bridges pure mathematics and data science applications. As part of my PhD program, I taught several subjects of the Degree in Mathematics at Universidad Complutense de Madrid, including Computational Geometry, with particular specialization in data science. Additionally, I served as an instructor for a Data Science Bootcamp at NEOLAND Academy in 2019, where I translated complex mathematical concepts into practical, industry-focused training. As part of my formation I also completed the Master's program for high-school teacher's training, with several months of practical experience in the classroom.

Work Experience

Postdoc Researcher May 2024 - present
Freie Universität Berlin

Postdoc Researcher (FPI-UCM: POP) November 2023 - May 2024
Universidad Complutense de Madrid

Predoc Researcher (FPI-UCM) November 2020 - November 2023
Universidad Complutense de Madrid

Instructor July-September 2019
NEOLAND Academy (Madrid)

Education, languages and computer skills

PhD in Mathematics October 2023
Universidad Complutense de Madrid

Master's degrees

1. **Master in High-School Theacher Training**. Universidad Complutense de Madrid. Academic Year 2019-2020.
2. **Master in Advanced Mathematics**. Universidad Complutense de Madrid. Academic Year 2018-2019.

Bachelor's degrees

1. **Degree in Mathematics**. Universidad Complutense de Madrid. 2013-2018.
2. **Degree in Physics**. Universidad Complutense de Madrid. 2013-2018.

Languages

1. **Spanish**. Native speaker.
2. **English**. Fluent. IELTS 7.5 (equivalent to CEFR C1), but my current level is a C2.

3. **German**. A2.
4. **French**. Basic knowledge.

Computer skills

1. I am an expert in **Python**, with familiarity with the Jupyter Notebook and the Anaconda and SageMath distributions. In particular, I have extensively used and taught about many of the Python libraries used for Data Science: numpy, pandas, matplotlib, keras, tensorflow...
2. **Other programming languages**: R, Matlab, C, Basic, bash, Java, Javascript, SQL
3. **Markup languages**: LaTeX, Markdown, HTML
4. I am an advanced user of GNU/Linux and its command line. I maintain my own personal computer and my own server, where I self-host my own website.

Research

Publications in peer-reviewed journals

1. Multiplicative Higgs bundles and involutions. ***Advances in Mathematics***, Volume 451, 109789, ISSN 0001-8708. 2023. (Joint work with O. García-Prada).
2. Higgs bundles twisted by a vector bundle. ***International Journal of Mathematics***. 2021. (Joint work with O. García-Prada and M.S. Narasimhan).

Preprints

1. Multiplicative Hitchin fibrations and Langlands duality. ***ArXiv*** preprint. 2025.

Proceedings

1. Universal spectral covers and the Hitchin map. ***TEMat monográficos***, 2: Proceedings of the 3rd BYMAT Conference. 107-110. 2021.

Research Projects

1. **Costa Rican - German collaboration: Fundamental groups, character varieties and Higgs bundles**. Deutsche Forschungsgemeinschaft (DFG). Code: 524596398. PI: Alexander Schmitt.
2. **Hitchin-Ngô Lab**. Severo Ochoa Laboratory at ICMAT. 2020 - 2024. Coordinator: Oscar García-Prada.
3. **Moduli spaces and gauge theory**. Ministerio de Ciencia e Innovación. 2019 - 2023. PI: Oscar García-Prada. Code: PID2019-109339GB-C31.

Research Stays

1. **McGill University** (Montreal, Canada). Research visit to Jacques Hurtubise. February-March 2024.
2. **The University of Chicago** (Chicago, USA). Research visit to Ngô Bao Châu. November 2022.

Teaching experience

Courses taught

1. **Computational Geometry**. 4th year of the Degree in Mathematics. UCM. 15 hours. Year 2023-2024

2. **Smooth Manifolds**. 4th year of the Degree in Mathematics. UCM. 15 hours. Year 2023-2024
3. **Physics: Mechanics and Waves**. 2nd year of the Degree in Mathematics. UCM. 15 hours. Year 2021-2022
4. **Differential geometry of curves and surfaces**. 3rd year of the Degree in Mathematics. UCM. 30 hours. Year 2021-2022
5. **Calculus**. 1st year of the Degree in Computer Science. UCM. 15 hours. Year 2021-2022
6. **Physics: Mechanics and Waves**. 2nd year of the Degree in Mathematics. UCM. 15 hours. Year 2020-2021
7. **Projective geometry**. 2nd year of the Degree in Mathematics. UCM. 15 hours. Year 2020-2021
8. **Data Science Bootcamp**. NEOLAND Academy. 432 hours. July-September 2019.

Supervised students

1. Román Ahumada Gialanella. **Master's Thesis**. Topic: "The derived category of sheaves". UCM. Year 2023-2024. Cosupervised with Emilio Franco.
2. Juan Martín Fajardo. **Bachelor's Thesis**. Topic: "Čech cohomology". UCM. Year 2023-2024. Cosupervised with Guillermo Sánchez Arellano.
3. Román Ahumada Gialanella. **Bachelor's Thesis**. Topic: "Variational principles in geometry". UCM. Year 2022-2023. Cosupervised with Ángel González Prieto.
4. Tomás Ruiz-Roso Salgado. **Bachelor's Thesis**. Topic: "Gauge theory and algebraic topology". UCM. Year 2021-2022.

Participation in Thesis commitees

1. Juan Martín Pérez Bernal. **PhD Thesis**. Topic: "Donaldson-Uhlenbeck type moduli spaces for principal bundles over higher dimensional manifolds". FU Berlin. 29 October 2024.

Talks

Invited talks at international conferences

1. "Multiplicative Higgs bundles". Modern Musings on Monopoles. **Simons Center for Geometry and Physics** (Stony Brook, NY, USA). 24 October 2025.
2. 3-Hour Mini-Course: "Nonabelian Hodge theory and moduli spaces of Higgs bundles". Workshop on Higgs bundles and character varieties. **Universidad de Costa Rica. Sede de Guanacaste.** (Liberia, Costa Rica). 4-8 August 2025.
3. "Multiplicative Higgs bundles and involutions". Workshop on the Hitchin system, Langlands duality and mirror symmetry. **ICMAT** (Madrid, Spain). 27 April 2023.

Invited talks at national conferences

1. "Spectral data and Langlands duality for some multiplicative Higgs bundles". Special activity of the Hitchin-Ngô Lab. **ICMAT** (Madrid, Spain). 24 June 2025.
2. "Langlands duality for generalized Hitchin systems". M^3 Christmas Geometry Workshop. **ICMAT** (Madrid, Spain). 19 December 2024.
3. "Gauge theory and algebraic geometry". Geometry and Topology for the future II. **UCM** (Madrid, Spain). 25 April 2024.

4. "The Hitchin fibration: Analogues and generalizations". VI Congress of Young Researchers of the RSME. **Universidad de León** (Leon, Spain). 6 February 2023.
5. "The Hitchin fibration: Analogues and generalizations". II Joint Meeting RSME-UMA. **Hotel Reina Victoria de Ronda, Málaga** (Ronda, Spain). 12 December 2022.
6. "Multiplicative Higgs bundles". Young Researchers Workshop of the Hitchin-Ngô Lab. **ICMAT** (Madrid, Spain). 4 March 2022.
7. "Higgs bundles twisted by a vector bundle". XIII Young Researchers Workshop in Mathematics. **UCM** (Madrid, Spain). 23 September 2019.

Invited seminar talks

1. "Multiplicative Hitchin fibrations and Langlands duality". Math-Physics Joint Seminar. **University of Pennsylvania** (Philadelphia, PA, USA). 28 October 2025.
2. "Finite group actions and duality for Picard stacks". Algebraic Geometry Seminar. **NCTS** (Taipei, Taiwan). (Online). 7 March 2025.
3. "Analogues and generalizations of Hitchin's moduli space. Multiplicative Higgs bundles". Algebraic Geometry Seminar. **FU Berlin** (Berlin, Germany). 15 October 2024.
4. "Multiplicative Hitchin fibrations and Langlands duality". Geometry and Topology Seminar. **CIRGET, UQAM** (Montreal, Canada). 28 February 2024.
5. "An invitation to the geometric Langlands program". Antonio Giraldo and Sonia Sastre Seminar. **UPM** (Madrid, Spain). 12 May 2022.
6. "Higgs bundles twisted by a vector bundle". Algebra, number theory and algebraic geometry Seminar. **Albert-Ludwigs-Universität Freiburg** (Freiburg im Breisgau, Germany). (Online). 4 February 2022.

Other talks

1. "Monoids, symmetric varieties and multiplicative Hitchin systems". BYMAT 2023. **ICMAT** (Madrid, Spain). 14 November 2023.
2. "Moduli spaces and geometric structures". 7th PhDay Math UCM. **UCM** (Madrid, Spain). 3 June 2023.
3. "Introduction to category theory". Dedekind's Army Seminar. **UCM** (Madrid, Spain). 30 November 2021.
4. "The Hitchin system". 5th PhDay Math UCM. **UCM** (Madrid, Spain). 24 June 2021.
5. "Universal spectral covers and the Hitchin system". BYMAT 3rd Edition. **Online**. 1 December 2020.
6. 3-Hour Mini-Course:"Symplectic geometry in Classical Mechanics". SEMF Summer School. **Universitat de València** (Valencia, Spain). 9-13 July 2018.
7. "Classification of compact surfaces". Dedekind's Army Seminar. **UCM** (Madrid, Spain). 28 February 2018.
8. "Debunking some myths about π". 25th anniversary of the Faculty of Mathematics and π-day. **UCM** (Madrid, Spain). 14 March 2018.
9. "Symplectic geometry". Dedekind's Army Seminar. **UCM** (Madrid, Spain). 22 February 2017.

Collaboration, organization and representation

Collaboration as journal referee

I have reviewed several articles for the International Journal of Mathematics.

Organization

1. Organizer of the research seminar of the Complex Analysis group of the FU Berlin. 2024 - present.
2. Organizer of the seminar "The Hitchin system, Langlands duality and mirror symmetry" at ICMAT. January-April 2023.
3. Coordinator of the Network of PhD Students in Mathematics at UCM. Academic year 2022-2023.
4. Collaborator in the organization of the international conference Moduli spaces and geometric structures at ICMAT. 12-16 September 2022.

Student representation

1. Representative of master's students in the Committee of the Department of Algebra, Geometry and Topology of the Faculty of Mathematics at UCM. 2018-2019.
2. Student representative in the Faculty Committee of the Faculty of Mathematics at UCM. With participation in the Committee of Quality. 2016-2018.
3. Secretary of the Lewis Carroll Association of the Faculty of Mathematics at UCM. 2017-2019.