Mario Llerena

PhD in Astronomy

INAF - Osservatorio Astronomico di Roma
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Current position

Postdoctoral researcher since September 15, 2023 in the Extragalactic research group at INAF Osservatorio Astronomico di Roma OAR (Italy), under the INAF Large Grant 2022 "Extragalactic Surveys with JWST" (PI L. Pentericci), and the Large Grant RF 2023 F.O. 1.05.23.01.11 "The MOONS Extragalactic Survey".

Career and Education

2023-Present **Postdoc researcher,** INAF OAR, Rome, Italy. Advisor: Dr. Laura Pentericci. **Date**: September 2023. **Summary**: I study the physical properties of high-redshift galaxies using JWST observations, with a particular focus on their ionizing properties.

2019-2023 **PhD in Astronomy,** Universidad de La Serena (ULS), La Serena, Chile. Advisor: Dr. Ricardo Amorín. **Date**: July 2023. *Dissertation Topic*: "Early phases of galaxy formation: Clues through star-forming galaxies at Cosmic Noon" (available here). **Summary**: I studied the properties of emission-line galaxies at $z \sim 2-4$ using deep rest-frame UV and optical spectroscopy. My research focused on understanding the connection between their intense emission lines and physical properties such as chemical abundances and the kinematics of ionized gas. This analysis was motivated by the analogy between these galaxies and the early systems that reionized the Universe.

2011-2016 **Degree of Physicist** *CUM LAUDE (27/30)*, Escuela Politécnica Nacional (EPN), Quito, Ecuador (Licenciatura en Física - 248 credits - 5-years program equivalent to MSc.) Advisor: Dr. Ericson López. *Dissertation Topic*: "Anisotropic cosmological model with an axisymmetric Bianchi I metric in spherical coordinates with non-vanishing cosmological constant".

Publication highlights

48 publications (H-index = 26) on peer reviewed journals, of which 5 publications as first author. 2188 citations, of which 175 citations as first author (source ADS M. Llerena).

Research Internships

2022 INAF-OAR, Italy. Short one-month internship. **Summary of activities:** PhD research focused on the kinematics of ionized gas in galaxies using the NIRVANDELS survey and other deep near-infrared observations. Performed spectral energy distribution (SED) fitting and modeling of physical properties using BEAGLE. **Advisor:** Dr. Laura Pentericci

2022 Instituto de Astrofísica de Andalucía, Spain. Short one-week research visit. **Summary of activities:** PhD research focused on determining chemical abundances in galaxies using UV emission lines combined with photoionization modeling. **Advisor:** Dr. Enrique Pérez-Montero

Co-supervising Experience and Public Outreach

2024-Present Currently working with PhD student Flor Arevalo Gonzalez (INAF OAR and Università di Roma Sapienza) in the selection and analysis of CIII]λ1909Å emitters from various JWST surveys at $z \sim 5-7$. Results from this work are published in A&A: Arevalo-Gonzalez, F., Tripodi, R., **Llerena, M.** et al.(2026), A&A, 709, id.A46, 15 pp.

2022-2023 I worked with MSc student Ana León Contreras (Universidad de La Serena) on the ionized gas kinematics and outflow properties in a sample of Lyman-Break Analogs (LBAs) at $z \sim 0.1-0.3$. Results from this work are published in A&A: León Contreras A., Amorín R., **Llerena M.** et al.(2026), A&A, 707, id.A13, 15 pp..

2015-2019 **Research Assistant**, Quito Astronomical Observatory (OAQ), Ecuador. **Summary of activities:** I participated in research projects in Astronomy using mainly public data archive. I had experience in analysis of X-ray and radio observations. Additionally, I led the organization of outreach activities such as public talks and public night observations.

2015 **Teaching Assistant**, EPN Science Department. **Summary of activities:** I had experience with supporting the exercise classes of the Course: *Tensor Calculus* in the Physics career. I also gave support at public outreach activities.

2013 **Teaching Assistant**, EPN Science Department. **Summary of activities:** I had experience supporting the Courses: *Linear Algebra* and *Newtonian Mechanics*.

Scholarships/Grants awarded

2026 XVIII LARIM – IAU Grant. **Budget**: 350 EUR. Registration fee.

2025 Curiosity Science INAF Grant 'Stellar outflows driving ionizing photon escape in the early Universe' (PI M. Llerena), Italy. **Budget**: 15000 EUR for two years for traveling and publication expenses.

2024 INAF Mini-grant 'Galaxies in the epoch of Reionization and their analogs at lower redshift' (PI M. Llerena), Italy. **Budget**: 16000 EUR for two years for traveling and publication expenses.

2024 IAU Grant for XXXII IAU General Assembly. **Budget**: 1000 EUR. Registration fee and extra expenses.

2022 Adelina Gutierrez SOCHIAS scholarship, Chile: **Budget**: 960 EUR. Funding received for travel and participation in an international school.

2021 ANID Beneficios Complementarios National PhD programs, Chile. **Budget**: 5700 EUR. Awarded 2 years for covering travel expenses and computer equipment, in addition to PhD funding. Independently wrote the research proposal.

2019 ANID Scholarship for National PhD programs, Chile: Awarded 4 years full support. Wrote research proposal independently.

Telescope time allocation

2026 PI: 26 hours of LBT/LUCI-2. Approved program. Wrote research proposal independently.

2026 co-I: One Cycle 5 JWST approved programs: GO 9695

2024 co-I: Three Cycle 4 JWST approved programs: GO 8410, 7201, 7014

2024 PI: 18 hours of LBT/MODS with MOS mode to observe Lyα in a sample of selected extreme emission line galaxies at $z = 3.1-3.7$. Approved program. Wrote research proposal independently.

2023 co-PI: 18 hours of GTC/OSIRIS+ with MOS mode to observe Lyα in a sample of selected extreme emission line galaxies. Approved program with priority grade B. Wrote research proposal independently.

2023 co-I: 16 hours of VLT/ERIS to observe NIR emission line of local metal-poor galaxies. Collaboration in phase 2 observation preparation.

2023 PI: 13 hours of ALMA/Band 8 to observe [CII]λ158μm in a sample of CIII]λ1909Å at $z \sim 3$. Approved program with priority grade B. Wrote research proposal independently.

2022 PI: 16 hours of Magellan/FIRE to observe strong emission-line galaxies at $z \sim 3$. Wrote research proposal independently.

Peer-review

2026 Referee for the evaluation process of the Concurso de Proyectos Fondecyt de Iniciación en Investigación 2027, Chile. Evaluation of research projects for ANID funding.

2026 Member of the Evaluation Committee for the proposal to create the Institute of Astronomy at EPN, Ecuador.

2023-Present Referee for the peer-reviewed astronomical journals MNRAS, A&A, and ApJ.

2023-Present Distributed peer review process for the proposal evaluation at ALMA and LBT telescopes.

Conferences/Schools attended (last four years)

2026 Conference: The Drivers of Galaxy Evolution through Cosmic Time (Florence, Italy). **Talk presented:** Insights into the role of extreme low-mass starbursts in cosmic reionization.

2026 Conference: Charting Cosmic Dawn in Copenhagen (Denmark). **Flash Talk presented:** Insights into the role of extreme low-mass starbursts in cosmic reionization.

2026 Conference: Towards the Full Bloom of First Star, Galaxy, and Black Hole Formation Exploration (Japan). **Flash Talk presented:** Insights into the role of extreme low-mass starbursts in cosmic reionization.

2025 Conference: The Baryon Cycle from Reionization to the Cosmic Noon (Chile). **Talk presented:** Faint UV galaxies as the dominant contributors of ionizing photons during the Epoch of Reionization.

2025 Workshop: HERA2025: "The Physics of Galaxies at the Epoch of Reionization." (Italy). **Talk presented:** The ionizing photon production efficiency of $z \sim 4-10$ galaxies.

2025 Conference: Escape of Lyman radiation from galactic labyrinths (Greece). **Talk presented:** The ionizing photon production efficiency of $z \sim 4-10$ galaxies.

2024 Conference: 40th annual IAP Symposium "Unveiling the physics of early galaxy and black hole formation with JWST" (France). **Talk presented:** The ionizing photon production efficiency of $z \sim 4-10$ galaxies.

2024 Conference: IAU General Assembly Symposium - IAUS391 The first chapters of our cosmic history with JWST (South Africa). **Talk presented:** Physical properties of extreme emission-line galaxies at $z \sim 4-9$ from the JWST CEERS survey.

2024 Conference: Cosmic Dawn at High Latitudes (Sweden). **Talk presented:** Physical properties of extreme emission-line galaxies at $z \sim 4-9$ from the JWST CEERS survey. Slides here

2024 Conference: I2I: Back again to linking Galaxy Physics from ISM to IGM Scales (Italy). **Talk presented:** Physical properties of extreme emission-line galaxies at $z \sim 4-9$ from the JWST CEERS survey.

2023 Conference: 12th Young Researcher Meeting (Italy). **Talk presented:** Physical conditions in the interstellar medium of low-mass star-forming galaxies at $z \sim 3$.

2022 Conference: From galaxies to cosmology with deep spectroscopic surveys (France). **Talk presented:** Ionized gas kinematics in UV emission-line galaxies at $z \sim 3$. Slides here.

2022 School: IAA-CSIC Severo Ochoa Advanced School on Galaxy Evolution (Spain). **Poster presented:** Global properties of CIII]λ1908 emitting star-forming galaxies at $z \sim 3$ in the VANDELS survey. Poster here.

2022 Journal Club: Galaxies and AGN Seminar, STScI/Hopkins (USA, Virtual). **Talk presented:** Nebular properties of star-forming CIII]λ1908 emitters at $z \sim 3$.

2022 Conference: VANDELS collaboration final meeting (Italy, Virtual). **Talk presented:** Ionized gas kinematics in UV emission-line galaxies at $z \sim 3$.

2022 Conference: XIII Estallidos Workshop (Spain, Virtual). **Talk presented:** Nebular properties of star-forming CIII]λ1908 emitters at $z \sim 3$. Slides here.

2022 Conference: XVII SOCHIAS Annual Meeting (Chile, virtual) **Talk presented:** Nebular properties of star-forming CIII]1908 emitters at z$\sim$3

Skills

Languages Spanish (Native), English (Fluent)

Software Python (Programming), BAGPIPES (SED fitting)

Publications as First author

Llerena, M., Pentericci, L., Amorín, R., et al. (2026). "Extreme equivalent-width-selected low-mass starbursts at z = 4 − 9: Insights into their role in cosmic reionization". *A&A* 708, A152, A152. **DOI:** 10.1051/0004-6361/202557897.

Llerena, M., Pentericci, L., Napolitano, L., et al. (2025). "The ionizing photon production efficiency of star-forming galaxies at z ∼ 4–10". *A&A* 698, A302, A302. **DOI:** 10.1051/0004-6361/202453251.

Llerena, M., Amorín, R., Pentericci, L., Arrabal Haro, P., et al. (2024). "Physical properties of extreme emission-line galaxies at z ∼ 4–9 from the JWST CEERS survey". *A&A* 691, A59, A59. **DOI:** 10.1051/0004-6361/202449904.

Llerena, M., Amorín, R., Pentericci, L., Calabrò, A., et al. (2023). "Ionized gas kinematics and chemical abundances of low-mass star-forming galaxies at z ∼ 3". *A&A* 676, A53, A53. **DOI:** 10.1051/0004-6361/202346232.

Llerena, M., Amorín, R., Cullen, F., et al. (2022). "The VANDELS survey: Global properties of CIII]λ1908 Å emitting star-forming galaxies at z ∼ 3". *A&A* 659, A16, A16. **DOI:** 10.1051/0004-6361/202141651.

Academic References

Dr. Laura Pentericci, INAF-OAR, Researcher, laura.pentericci@inaf.it

Dr. Ricardo Amorín, **PhD advisor**, Instituto de Astrofísica de Andalucía (CSIC), amorin@iaa.csic.es

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