

Dr. Ricardo Chávez Murillo

Observational Extragalactic Astronomy and Cosmology | Multiwavelength surveys and distance indicators | Reproducible inference pipelines

ORCID: [0000-0003-3031-8784](https://orcid.org/0000-0003-3031-8784)

Email: ricardo.chavez.murillo@gmail.com

Web: <https://www.inaoep.mx/~ricardoc>

RESEARCH PROFILE

Interests: I use nebular physics and emission-line diagnostics, combined with rigorous inference, to turn star-forming galaxies into precision tools for galaxy evolution and cosmology. My research focuses on **star formation and feedback in compact, intensely star-forming galaxies**, the **galaxy-AGN connection**, and **distance indicators** grounded in nebular physics. I combine **multiwavelength observations** (UV, optical, NIR, MIR, mm) with **selection-aware, uncertainty-quantified inference** to connect heterogeneous datasets to robust constraints on stellar mass growth, dust, chemical enrichment, ionised-gas conditions, and black-hole activity across cosmic time.

- I develop **end-to-end, uncertainty-aware pipelines** and **Bayesian/hierarchical** frameworks that propagate uncertainties from object-level measurements to **population-level trends**, with explicit treatment of nuisance parameters, selection effects, and systematics.
- My work links **data, physical models, and validation**, using forward modelling and synthetic tests to ensure results remain stable under realistic uncertainties, blending, and complex selection functions common in modern surveys.
- I combine **multiwavelength constraints** (including IR and mm) to break degeneracies between age, metallicity, and dust, and to identify and characterise **AGN** via joint line diagnostics and SED modelling.
- I design pipelines and student projects that ingest **survey-mode data streams** (e.g. **LSST** and **SDSS-V**) and connect them to targeted follow-up, enabling rapid, publishable science and robust population studies.
- I contribute department-level infrastructure through **shared software, reproducibility standards, and methods training modules** (probabilistic inference, Python/Git, validation with mocks), with clear pathways for **joint supervision and collaboration** with Data Science and AI groups at UdeC.
- At UdeC, I would build a student-driven programme that exploits **Chile-based observing access** and survey data to address: (i) how feedback and gas conditions regulate bursty star formation, (ii) how AGN activity emerges and couples to host galaxies, and (iii) how physically grounded emission-line scaling relations can strengthen distance-indicator work, all with rigorous uncertainty budgets and open, reusable software.

SELECTED ACHIEVEMENTS

- **Research output:** 30 publications; 1239 citations; h-index 15 (ADS*), spanning observational galaxy evolution and cosmology, with emphasis on **rigorous uncertainty budgets** and reproducible analysis.
- **Inference and pipelines:** Developed and maintain **reproducible, end-to-end Python workflows** (Git-versioned, HPC-ready) for measurement, cross-matching, validation with mocks, and **population inference**, designed to scale from student projects to survey-sized catalogues.
- **Systematics expertise:** Demonstrated track record in identifying, quantifying, and marginalising over **observational and modelling systematics**, supporting robust results in multi-instrument analyses, emission-line measurements, and sample selection.
- **Leadership and collaboration:** Scientific lead of the WEAVE project group in Mexico (2020–present), coordinating multi-institution efforts and shared analysis workflows in deadline-driven, survey-style environments, experience that translates naturally to UdeC’s collaborative culture and large-programme participation.
- **Teaching and mentoring:** Supervision of 1 PhD and 1 MSc (ongoing); 2 MSc completed; mentoring of 1 postdoctoral researcher; strong commitment to inclusive mentoring and to training students in modern data analysis, reproducibility, and scientific communication, in Spanish and English.
- **Funding and project delivery:** PI on a competitive national grant (CONAHCYT Frontier Science), with experience defining fundable work plans, managing deliverables, and integrating student training with publication-ready outputs.
- **Observing to papers:** Proven track record converting telescope time and heterogeneous survey data into refereed publications and student-led projects, with emphasis on transparent reduction, quality control, and systematics-aware measurement.

APPOINTMENTS HELD

- 2019 - 2025 *SECIHTI Research Fellow*, Instituto de Radioastronomía y Astrofísica (IRyA), Universidad Nacional Autónoma de México (UNAM), México.
- Research leadership in survey-scale inference for galaxy evolution and cosmic evolution; delivery of validated, reproducible pipelines with uncertainty budgets.
 - Supervision and mentoring across career stages; coordination of collaborative analysis workflows (shared code-bases, documentation, review practices).
- 2018 - 2019 *Postdoctoral Fellow*, Instituto de Radioastronomía y Astrofísica (IRyA), Universidad Nacional Autónoma de México (UNAM), México.
- 2016 - 2018 *Postdoctoral Fellow*, Cavendish Lab. & Kavli Institute for Cosmology, University of Cambridge, UK.
- 2014 - 2016 *Support Astronomer*, Gran Telescopio Milimétrico (GTM), México.

EDUCATION

- 2010 - 2014 PhD in Astrophysics, Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE), México (October 13th, 2014).
- 2008 - 2010 MSc in Astrophysics, Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE), México (July 9th, 2010).
- 2003 - 2008 BEng in Mechatronics, Tecnológico Nacional de México (TecNM), México (April 11th, 2008).

LEADERSHIP, SERVICE, AND ACADEMIC CITIZENSHIP

- 2020 - 2025 Organiser of the Extragalactic Group Meetings at IRyA, UNAM
- 2020 - 2022 Member of the Internal Gender Equity Commission at IRyA, UNAM
- 2017 SOC, LOC, co-chair at the 2017 KICC Workshop: *Emission Line Galaxies with MOS: from cosmic noon to the reionization era*.
- 2017 Member of the joint postdoc committee for the Astrophysics Group (Cavendish Lab.) and Institute of Astronomy.
- 2017 Member of the postdoc committee for Clare Hall.
- 2013 SOC chair at the 2nd Mexican Astronomy Students Meeting.
- 2012 - 2013 President of the INAOE Students' Association.
- 2012 - 2013 Organiser of the Star Formation and Star Clusters Journal Club at INAOE.
- 2011 - 2013 Students Representative at INAOE's Astrophysics Department academic senate.

GRANTS AND RESEARCH PROJECTS

- 2023 - now Member of the international collaboration "ESTALLIDOS: Multi-faced study of star-formation in the Universe (Estallidos 8)".
- 2023 - now Member of the CosmoVerse COST ACTION "Addressing observational tensions in cosmology with systematics and fundamental physics".
- 2022-2023 PI, CONAHCYT Frontier Science Grant, "Exploring the Hubble constant tension".
- 2020 - now A WEAVE survey of star-forming regions in the local Universe (feedback/kinematics/metallicity).
- 2020 - now Scientific leader of the WEAVE project group in México.

HONOURS & AWARDS

- 2020 - now Sistema Nacional de Investigadores (National System of Researchers, SNII), Level 1.
- 2017 Best Doctoral Thesis Award for the years 2013-2014 from the National Astronomy Conference, Mexico.
- 2012 Excellent Graduate Students Prize, Puebla State Government, Mexico.
- 2011 MSc thesis Honourable Mention from the National Astronomy Conference, Mexico.

SELECTED SOFTWARE AND OPEN RESOURCES

GitHub link: [GitHub: blackdragonae](#)

- **HIIGS** (github.com/blackdragonae/hiigs): Open-source research code for reproducible emission-line galaxy analysis and inference pipelines.
- **h0wsh2023** (github.com/blackdragonae/h0wsh2023): Didactic repository for teaching and hands-on exploration of Hubble-constant inference concepts and workflows.
- **ArXivPulse** (github.com/blackdragonae/ArXivPulse): Open literature-monitoring tool that incorporates AI-assisted interest classification/ranking to sort new arXiv papers by user-defined research priorities.

TEACHING AND MENTORING

- Active supervision experience across career stages: currently supervising 1 PhD student and 1 MSc thesis; previously supervised 2 MSc students to completion and mentored 1 postdoctoral researcher.
- Training emphasis: probabilistic inference, reproducible computational workflows (Python/Git), and survey-scale data analysis practices suitable for team-based research.
- Core areas taught: radiative processes, stellar astrophysics, extragalactic astronomy, cosmology, computational methods.
- Courses taught:

2025/02	Panchromatic Synthetic Observations, IRyA, UNAM.
2025/02	Advanced Cosmology, IRyA, UNAM.
2024/08	Extragalactic Astronomy and Cosmology, IRyA, UNAM.
2023/02	Stellar Astrophysics, IRyA, UNAM.
2022/08	Radiative Processes in Astrophysics, IRyA, UNAM.
2022/08	Advanced Cosmology, IRyA, UNAM.
2022/04	Electromagnetism propaedeutics, IRyA, UNAM.
2022/02	Extragalactic Astronomy and Cosmology, IRyA, UNAM.
2021/08	Radiative Processes in Astrophysics, IRyA, UNAM.
2021/02	Stellar Astrophysics, IRyA, UNAM.
2020/08	Extragalactic Astronomy and Cosmology, IRyA, UNAM.
2019/08	Radiative Processes in Astrophysics, IRyA, UNAM.
2016/08	1A Physics supervisions, Selwyn College, University of Cambridge.

PUBLICATIONS

30 Publications with 1239 citations; h-index: 15*.

Google Scholar link: [Google Scholar statistics](#)

ADS link: [NASA/ADS statistics](#)

Authorship: My name in **bold**; [†] denotes corresponding author.

Key Publications

2025	Chávez R. , Terlevich R., Terlevich E., González-Morán A.L., Fernández-Arenas D., Bresolin F., Plionis M., et al., <i>Mapping the Hubble flow from $z \sim 0$ to $z \sim 7.5$ with H II Galaxies</i> , MNRAS, 538, 1264 [12 citations]
2025	Chávez R. , González-Lópezlira R.A. & Bruzual G., <i>The Youngest Star Clusters in the Large Magellanic Cloud</i> , MNRAS, 538, 2989 [3 citations]
2021	González-Morán A.L., Chávez R. [†] , Terlevich E., Terlevich R., Fernández-Arenas D., Bresolin F., Plionis M., et al., <i>Independent cosmological constraints from high-z H II galaxies: new results from VLT-KMOS data</i> , MNRAS, 505, 1441 [59 citations]
2019	González-Morán A.L., Chávez R. [†] , Terlevich R., Terlevich E., Bresolin F., Fernández-Arenas D., Plionis M., Basilakos S., Melnick J., Telles E., <i>Independent Cosmological Constraints from high-z H II Galaxies</i> , MNRAS, 487, 4669 [62 citations]
2018	Fernández-Arenas D., Terlevich E., Terlevich R., Melnick J., Chávez R. , Bresolin F., Telles E., Plionis M., Basilakos S., <i>An independent determination of the local Hubble constant</i> , MNRAS, 474, 1250 [93 citations]

Journal Articles

2025	Di Valentino E., Said J.L., Riess A., et al., <i>The CosmoVerse White Paper: Addressing observational tensions in cosmology with systematics and fundamental physics</i> , Physics of the Dark Universe, 49, 101965. [342 citations]
2023	Fernández-Arenas D., Carrasco E., Terlevich R., Terlevich E., Amorín R., Bresolin F., Chávez R. , et al., <i>Spatially resolved properties of the ionized gas in the H II galaxy J084220+115000</i> , MNRAS, 519, 4221 [6 citations]

- 2022 Mehrabi A., Basilakos S., Tsiapi P., Plionis M., Terlevich R., Terlevich E., Gonzalez Moran A. L., **Chávez R.**, Bresolin F., Fernandez Arenas D., Telles E., *Using our newest VLT-KMOS H II galaxies and other cosmic tracers to test the Lambda cold dark matter tension*, MNRAS, 509, 224 [22 citations]
- 2021 Tsiapi P., Basilakos S., Plionis M., Terlevich R., Terlevich E., Gonzalez Moran A. L., Chavez R., et al., *Cosmological constraints using the newest VLT-KMOS H II galaxies and the full Planck CMB spectrum*, MNRAS, 506, 5039 [8 citations]
- 2021 Montaña A., Zavala J. A., Aretxaga I., Hughes D. H., Ivison R. J., Pope A., Sánchez-Argüelles D., et al., *Early science with the Large Millimeter Telescope: a 1.1 mm AzTEC survey of red-Herschel dusty star-forming galaxies*, MNRAS, 505, 5260 [13 citations]
- 2020 Bresolin F., Rizzi L., Ho I.-T., Terlevich R., Terlevich E., Telles E., **Chávez R.**, Basilakos S., Plionis M., *Internal kinematics of giant H II regions in M101 with the Keck Cosmic Web Imager*, MNRAS, 495, 4347 [15 citations]
- 2020 Hogarth L., Amorín R., Vílchez J. M., Hägele G. F., Cardaci M., Pérez-Montero E., Firpo V., Jaskot A., **Chávez R.**, *Chemodynamics of green pea galaxies - I. Outflows and turbulence driving the escape of ionizing photons and chemical enrichment*, MNRAS, 494, 3541 [46 citations]
- 2018 Terlevich E., Fernández-Arenas D., Terlevich R., Gieles M., **Chávez R.**, González-Morán A.L., *From Giant H II regions and H II galaxies to globular clusters and compact dwarf ellipticals*, MNRAS, 481, 268 [8 citations]
- 2017 Melnick J., Telles E., Bordalo V., **Chávez R.**, Fernández-Arenas D., Terlevich E., Terlevich R., Bresolin F., Plionis M., Basilakos S., *The $L - \sigma$ relation for H II galaxies in green*, A&A, 599, 76 [18 citations]
- 2016 **Chávez R.**, Plionis M., Basilakos S., Terlevich R., Terlevich E., Melnick J., Bresolin F., González-Morán A. L., *Constraining the Dark Energy Equation of State with H II Galaxies*, MNRAS, 462, 2431 [67 citations]
- 2016 Fernández X., et al., *Highest Redshift Image of Neutral Hydrogen in Emission: A CHILES Detection of a Starbursting Galaxy at $z = 0.376$* , ApJ, 824, L1 [129 citations]
- 2016 Terlevich R., et al., *Direct measurement of lensing amplification in Abell S1063 using a strongly lensed high redshift H II Galaxy*, A&A, 592, L7 [6 citations]
- 2015 Terlevich R., Terlevich E., Melnick J., **Chávez R.**, Plionis M., Bresolin F. & Basilakos S., *On the road to precision cosmology with high-redshift H II galaxies*, MNRAS, 451, 3001 [71 citations]
- 2014 **Chávez R.**, Terlevich R., Terlevich E., Bresolin F., Melnick J., Plionis M. & Basilakos S., *The $L - \sigma$ relation for massive bursts of star formation*, MNRAS, 442, 3565 [103 citations]
- 2013 Koulouridis E., Plionis M., **Chávez R.**, Terlevich E., Terlevich R., Bresolin F. & Basilakos S., *The Environment of H II Galaxies revisited*, A&A, 554, 13 [6 citations]
- 2012 **Chávez R.**, Terlevich E., Terlevich R., Plionis M., Bresolin F., Basilakos S. & Melnick J., *Determining the Hubble constant using giant extragalactic H II regions and H II galaxies*, MNRAS, 425L, 56 [74 citations]
- 2011 Plionis M., Terlevich R., Basilakos S., Bresolin F., Terlevich E., Melnick J. & **Chávez R.**, *A strategy to measure the dark energy equation of state using the H II galaxy Hubble function and X-ray active galactic nuclei clustering: preliminary results*, MNRAS, 416, 2981 [58 citations]

Books and Chapters

- 2024 Fernández-Arenas D. and **Chávez R.**, *Determination of the local Hubble constant using Giant extragalactic H II regions and H II galaxies*, Invited chapter for the edited book Hubble Constant Tension (Eds. E. Di Valentino and D. Brout, Springer Singapore), arXiv:2309.15248
- 2014 **Chávez R.**, *Constraining the Parameter Space of the Dark Energy Equation of State Using Alternative Cosmic Tracers*, PhD Thesis, arXiv:1410.7843 [1 citation]

Conference Proceedings

- 2014 **Chávez R.**, Terlevich E., Terlevich R., Plionis M., Melnick J., Bresolin F. & Basilakos S., *The Hubble Constant via H II Galaxies and Giant H II Regions*, in *Massive Young Star Clusters Near and Far: From the Milky Way to Reionization. 2013 Guillermo Haro Conference*, Eds. Y. D. Mayya, D. Rosa González and E. Terlevich. INAOE & AMC, 215
- 2014 Plionis M., Terlevich R., Basilakos S., Terlevich E., **Chávez R.**, Bresolin F. & Melnick J., *Tracing the High- z Hubble Expansion with H II Galaxies*, in *Massive Young Star Clusters Near and Far: From the Milky Way to Reionization. 2013 Guillermo Haro Conference*, Eds. Y. D. Mayya, D. Rosa González and E. Terlevich. INAOE & AMC, 211
- 2014 Terlevich R., **Chávez R.**, Terlevich E., Bresolin F., Melnick J., Plionis M. & Basilakos S., *The $L - \sigma$ Relation for Massive Bursts of Star Formation and its Use for Precision Cosmology*, in *Massive Young Star Clusters Near and Far: From the Milky Way to Reionization. 2013 Guillermo Haro Conference*, Eds. Y. D. Mayya, D. Rosa González and E. Terlevich. INAOE & AMC, 197
- 2011 **Chávez R.**, Terlevich R., Terlevich E., Bresolin F., Melnick J., Plionis M. & Basilakos S., *Constraining the Dark Energy Equation of State Using Alternative Cosmic Tracers*, RMXAC, 40, 9
- 2010 Plionis M., Terlevich R., Basilakos S., Bresolin F., Terlevich E., Melnick J. & **Chávez R.**, *Constraining the Dark Energy Equation of State using Alternative High- z Cosmic Tracers*, AIPC, 1241, 267 [15 citations]
- 2010 Plionis M., Terlevich R., Basilakos S., Bresolin F., Terlevich E., Melnick J. & **Chávez R.**, *The Dark Energy Equation of*

CONFERENCES AND WORKSHOPS

- 2024/10 LXVII Congreso Nacional de Física, Chihuahua, México.
 2024/07 24th Guillermo Haro Workshop: El Futuro de la Astrofísica en México a corto y mediano plazo, Tonantzintla, Puebla, Mexico.
- 2023/10 LXVI Congreso Nacional de Física, Morelia, México.
 2023/05 First CosmoVerse Conference: Anomalies and Tensions in Cosmology, Lisbon, Portugal.
 2022/10 LXV Congreso Nacional de Física, Zacatecas, México.
 2021/06 70th Lindau Nobel Laureate Meeting, online.
 2021/01 237th meeting of the American Astronomical Society, online.
 2020/10 LXIII Congreso Nacional de Física, online.
 2020/06 Assessing Uncertainties in Hubble's Constant Across the Universe, ESO Conference, online.
 2020/02 JWST Master Class México 2020, Cd. México, México.
 2019/12 II Reunion de Extragaláctica en México, Morelia, México.
 2019/07 Guillermo Haro Workshop: The Formation and Evolution of Super Star Clusters: Theory and Observations, Tonantzintla, Puebla, Mexico.
- 2018/10 LXI Congreso Nacional de Física, Puebla, México.
 2018/09 Guillermo Haro 2018 Workshop: Synergy between the GTC and GTM/LMT, Tonantzintla, Puebla, Mexico.
 2017/09 Emission Line Galaxies with MOS: from cosmic noon to the reionization era, KICC Workshop, Cambridge, UK. LOC, SOC, co-Chair.
- 2016/06 66th Lindau Nobel Laureate Meeting, Lindau, Germany.
 2015/12 5th Science with the GTC, Puebla, Mexico.
 2013/12 5th Guillermo Haro Conference. Massive Young Star Clusters Near and Far: From the Milky Way to Re-ionization, Puebla, Mexico.
- 2013/11 XXV Congreso Nacional de Astronomía (National Astronomy Conference), Mexico City, Mexico.
 2013/08 Segunda Reunión de Estudiantes de Astronomía (2nd Mexican Astronomy Students Meeting), Tonantzintla, Puebla, Mexico. SOC, Chair
- 2013/07 Guillermo Haro Workshop in Advanced Astrophysical Research. Galaxy structure and evolution through Integral Field Spectroscopy: the next generation surveys, Tonantzintla, Puebla, Mexico.
- 2012/01 Cosmology on the Beach 2012, Essential Cosmology for the Next Generation, Cancun, Mexico.
 2011/08 COSMO11, International Conference on Particle Physics and Cosmology, Porto, Portugal.
 2010/11 XIII Latin American Regional IAU Meeting, Morelia, Mexico.
 2010/07 Guillermo Haro Workshop in Advanced Astrophysical Research. Compact super star-clusters, birth, evolution and feedback, Tonantzintla, Puebla, Mexico.
- 2009/09 XXIII Congreso Nacional de Astronomía (National Astronomy Conference), Ensenada, Mexico.

OBSERVATIONAL EXPERIENCE

- **Core capabilities:** spectroscopic/IFU reduction and analysis (calibration, extraction, kinematics, emission-line measurements), end-to-end QC, and systematics-aware measurement pipelines. Well positioned to exploit Chile-based facilities through student-led proposal, reduction, and publication cycles.
- **Programme design and execution:** PI/co-I experience across multi-facility observing programmes; emphasis on reproducible reduction, validation, and uncertainty budgets suitable for population inference.
- **Selected facilities/instruments:**
 - **Subaru/NAOJ:** HDS echelle (Nov 2012; PI: Fabio Bresolin; observer / reducer).
 - **VLT:** successful X-shooter and KMOS proposals (2013, 2014, 2015, 2022; ~100 h awarded across multiple PI programmes).
 - **GTC/Keck:** participation in proposal preparation; data reduction and analysis (including KCWI, MOSFIRE; MEGARA).
 - **Space data exploitation:** HST/JWST programme data analysis; **JWST/NIRSpec** spectral extraction and emission-line fitting (**JADES**).
 - **GTM/LMT:** 13 service observing runs as Support Astronomer (service mode; multiple programmes).
 - **2m-class (Mexico):** 20 observing runs (2010–2023) at OAGH-Cananea and OAN-SPM; Long Slit Boller & Chivens; echelle Mezcal and CanHiS; PI on multiple proposals.

OUTREACH

- Delivered numerous public lectures in Spanish on cosmology and galaxy evolution, with recordings available online for broad access.
- Authored an outreach article, *“The Tension in the Hubble Constant”*, aimed at the student community at UNAM Morelia.
- Designed and delivered hands-on workshops for an Astrophysics Summer School and a Basic Astronomy Course, focusing on observational concepts and modern data analysis practices.
- During the COVID-19 pandemic, converted two graduate-level courses into publicly accessible online video materials to support remote learning and wider outreach.

MEMBERSHIP OF PROFESSIONAL BODIES

2023 - now International Astronomical Union (IAU), Active Individual Member.
2022 - now Sociedad Mexicana de Física (SMF), Regular Active Member.

LANGUAGES

Spanish Native proficiency
English Professional proficiency (TOEFL ITP: 630 pts)
French Limited working proficiency

COMPUTATIONAL TOOLS

- **Scientific Python:** NumPy/SciPy, Astropy, pandas, matplotlib; reproducible analysis and publication workflows.
- **Machine learning:** scikit-learn; PyTorch/TensorFlow; JAX.
- **Research computing:** HPC batch workflows, MultiNest, automation, performance profiling; scalable data handling.
- **Software engineering:** Git, packaging, documentation; open-source maintenance (e.g. HIIGS).
- **Additional:** C/C++, SQL, Mathematica, MATLAB, IRAF, IDL.

* As reported by the ADS site to this date: [NASA/ADS statistics](#)
Last updated: February 26, 2026