MARC HUERTAS-COMPANY

Faculty Research Scientist - Group Leader

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Brief Summary: As an established expert in galaxy formation and evolution, my focus lies in harnessing the power of large-scale surveys to analyze the statistical structural evolution of galaxies. Renowned as one of the global pioneers in the application of machine learning to astrophysics, I currently lead the ML group at the Instituto de Astrofísica de Canarias in Spain. My work is characterized by an innovative approach to utilizing artificial intelligence to help constraining the physical processes driving galaxy formation.

CURRENT POSITIONS

Group Leader Faculty Research Scientist
Instituto de Astrofísica de Canarias
2018 – Ongoing Spain

Adjunct Professor (No Salary)
University of California Santa Cruz
2020 – Ongoing US

PREVIOUS POSITIONS

Visiting Scholar
Center for Computational Astrophysics
2022-2023 US

Visiting Scholar
University of Pennsylvania
2016-2017 US

Maître de Conférences (Associate Professor)
Université de Paris
2010 – 2018 France

- Currently on leave

ESO Fellow
ESO
2008 – 2010 Chile

EDUCATION

Ph.D. in Astrophysics
Observatoire de Paris, Universidad de Granada
2008

M.Sc. in Astrophysics
Observatoure de Paris
2005

M.Sc. in Image Processing, Telecom. Engineering
Ecole des Mines de Paris, Universidad Politécnica de Madrid
2004

PUBLICATIONS/TALKS

- 140+ refereed papers.
  - 9000+ citations (NASA ADS)
  - 37 papers first (17) or second (20) author w/ students and postdocs
  - 4 first author papers with more than 100 citations
  - most cited first author paper: 220 citations, H-index=50, i-100=21 (more citation metrics)
- 20+ invited talks at International conferences both in ML and Astrophysics.

SUPERVISION

Experienced mentor of ECRs over the past decade.

8 Graduate students (main supervisor)
3 on-going

5 Postdoctoral Fellows
1 on-going

10+ M.Sc. students

TEACHING

Experienced lecturer at undergraduate and graduate levels. Machine Learning and Physics.

Associate Professor of Physics (192 hrs per year)
Université de Paris
2010-2019

Yearly 50 hrs course on machine learning for astrophysics
Paris Graduate School
2018-2022

Regular invited lecturer at international machine learning schools for ECRs

IAA School (2025), Vatican School of Astronomy (2023), Saas-Fee (2021), Euclid School (2018-2024), SOMACHINE (2021), Bid4Best ITN (2020), IAC Winter School (2018), Key participant in KITP 2023 program

SELECTED RESPONSIBILITIES

Leading research groups locally and in international collaborations.

Lead and founder of Machine Learning for Astrophysics Group at the IAC (15+ people)

Spain

2018-Ongoing

Deputy Lead Euclid Galaxy Evolution Science Working Group

Euclid Consortium

2024-Ongoing

Member of Euclid Publication Groups

Euclid Consortium

2024-Ongoing

Lead Euclid Galaxy Morphology Work Package

Euclid Consortium

2013-2024

Member of Euclid Diversity Committee

Euclid Consortium

2020-2023

Member of the “Women and Astronomy” Commission

Spanish Astronomical Society

2023-Ongoing

Appointed Member of the “Commission Scientifique Astronomie Astrophysique

NationWide Committee, France

2019-2024

SELECTED FUNDING

More than $0.5 million as PI in EU, Spain, France and US

Co-I in European Doctoral Network EDUCADO

P.I. Knapen

2024-Ongoing

Spanish Research Agency Project - BASALT

P.I. Huertas-Company

2022-Ongoing

Canary Island Government Project - ASTRONOMALY

P.I. Huertas-Company

2021-2023

Spanish Research Agency Project - ASTRODEEP

P.I. Huertas-Company

2018-2022

Google Research Award

P.I. Primack/Huertas-Company

2015-2017

RECENT SCIENTIFIC EVENTS

Regular organizer of scientific events. ML and Astronomy.

Chair of Euclid Galaxy Evolution meeting

Spain

2025

Chair of IAC Winter School

Spain

2024

SOC of Special Session at EAS meeting

Italy

2024

Co-chair of ML session at ICML

US-Europe

2022-2023

SOC of International Vatican Summer School

Italy

2023

ONGOING COLLABORATIONS

Member of key projects focused on observations, ML and simulations.

Euclid Consortium

COSMOS-Web

Rubin - LSST

JWST-CEERS

UniverseTBD

MulitModalUniverse

CAMELS

TNG

PUBLICATIONS

Highlighted Papers

- Angeloudi, E. [Eirini], Falcón-Barroso, J., **Huertas-Company, M.** [Marc], Boecker, A., Sarmiento, R., Eisert, L., & Pillepich, A. (2024). Constraints on the in situ and ex situ stellar masses in nearby galaxies obtained with artificial intelligence. *Nature Astronomy*, *8*(10), 1310–1320. doi:10.1038/s41550-024-02327-3. arXiv: 2407.00166 [astro-ph.GA]
- **Huertas-Company, M.** [M.], Gravet, R., Cabrera-Vives, G., Pérez-González, P. G., Kartaltepe, J. S., Barro, G., ... Mcintosh, D. H. (2015). A Catalog of Visual-like Morphologies in the 5 CANDELS Fields Using Deep Learning., *221*(1), 8. doi:10.1088/0067-0049/221/1/8. arXiv: 1509.05429 [astro-ph.GA]
- **Huertas-Company, M.** [M.], Aguerri, J. A. L., Bernardi, M., Mei, S., & Sánchez Almeida, J. (2011). Revisiting the Hubble sequence in the SDSS DR7 spectroscopic sample: a publicly available Bayesian automated classification., *525*, A157. doi:10.1051/0004-6361/201015735. arXiv: 1010.3018 [astro-ph.CO]

These 3 highlighted papers are representative of groups of papers summarizing my career trajectory.
Group 1 (2008-2014): Generalizing Machine Learning for the study of galaxy morphology. First open source ML codes for galaxy morphology (galSVM) and first ML-based catalogs.
Group 2 (2014-2018): Pioneering deep learning applications in astronomy. First works using deep learning (CNNs) in astronomy. They also illustrate the importance of open access catalogs to trigger science and the commitment of my group to always release data products.
Group 3 (2018-2024): Pushing the boundaries of AI to understand the physics of galaxy formation. My group has progressively moved to more advanced applications of AI (e.g., SBI, anomaly detection, self-supervised) to link simulations and observations.

First Author

- **Huertas-Company, M.** [M.], Iyer, K. G. [K. G.], Angeloudi, E. [E.], Bagley, M. B., Finkelstein, S. L. [S. L.], Kartaltepe, J., ... Yung, L. Y. A. (2024). Galaxy morphology from z $\sim$ 6 through the lens of JWST., *685*, A48. doi:10.1051/0004-6361/202346800. arXiv: 2305.02478 [astro-ph.GA]
- **Huertas-Company, M.** [M.], & Lanusse, F. (2023). The Dawes Review 10: The impact of deep learning for the analysis of galaxy surveys., *40*, e001. doi:10.1017/pasa.2022.55. arXiv: 2210.01813 [astro-ph.IM]
- **Huertas-Company, M.** [Marc], Sarmiento, R., & Knapen, J. H. (2023). A brief review of contrastive learning applied to astrophysics. *RAS Techniques and Instruments*, *2*(1), 441–452. doi:10.1093/rasti/rzad028. arXiv: 2306.05528 [astro-ph.IM]
- **Huertas-Company, M.** [Marc], Guo, Y., Ginzburg, O., Lee, C. T., Mandelker, N., Metter, M., ... Zhang, H. (2020). Stellar masses of giant clumps in CANDELS and simulated galaxies using machine learning., *499*(1), 814–835. doi:10.1093/mnras/staa2777. arXiv: 2006.14636 [astro-ph.GA]
- **Huertas-Company, M.** [Marc], Rodriguez-Gomez, V., Nelson, D., Pillepich, A., Bottrell, C., Bernardi, M., ... Vogelsberger, M. (2019). The Hubble Sequence at z $\sim$ 0 in the IllustrisTNG simulation with deep learning., *489*(2), 1859–1879. doi:10.1093/mnras/stz2191. arXiv: 1903.07625 [astro-ph.GA]
- **Huertas-Company, M.** [M.], Primack, J. R., Dekel, A., Koo, D. C., Lapiner, S., Ceverino, D., ... Tuccillo, D. (2018). Deep Learning Identifies High-z Galaxies in a Central Blue Nugget Phase in a Characteristic Mass Range., *858*(2), 114. doi:10.3847/1538-4357/aabfed. arXiv: 1804.07307 [astro-ph.GA]
- **Huertas-Company, M.** [M.], Bernardi, M., Pérez-González, P. G., Ashby, M. L. N., Barro, G., Conselice, C., ... Shankar, F. (2016). Mass assembly and morphological transformations since z $\sim$ 3 from CANDELS., *462*(4), 4495–4516. doi:10.1093/mnras/stw1866. arXiv: 1606.04952 [astro-ph.GA]
- **Huertas-Company, M.** [M.], Gravet, R., Cabrera-Vives, G., Pérez-González, P. G., Kartaltepe, J. S., Barro, G., ... Mcintosh, D. H. (2015). A Catalog of Visual-like Morphologies in the 5 CANDELS Fields Using Deep Learning., *221*(1), 8. doi:10.1088/0067-0049/221/1/8. arXiv: 1509.05429 [astro-ph.GA]
- **Huertas-Company, M.** [M.], Pérez-González, P. G. [P. G.], Mei, S., Shankar, F., Bernardi, M., Daddi, E., ... Gravet, R. (2015). The Morphologies of Massive Galaxies from z ~3—Witnessing the Two Channels of Bulge Growth., *809*(1), 95. doi:10.1088/0004-637X/809/1/95. arXiv: 1506.03084 [astro-ph.GA]
- **Huertas-Company, M.** [M.], Mei, S. [S.], Shankar, F., Delaye, L., Raichoor, A., Covone, G., ... Povic, M. (2013). The evolution of the mass-size relation for early-type galaxies from z $\sim$ 1 to the present: dependence on environment, mass range and detailed morphology., *428*(2), 1715–1742. doi:10.1093/mnras/sts150. arXiv: 1207.5793 [astro-ph.CO]
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- **Huertas-Company, M.** [M.], Aguerri, J. A. L., Bernardi, M., Mei, S., & Sánchez Almeida, J. (2011). Revisiting the Hubble sequence in the SDSS DR7 spectroscopic sample: a publicly available Bayesian automated classification., *525*, A157. doi:10.1051/0004-6361/201015735. arXiv: 1010.3018 [astro-ph.CO]

- **Huertas-Company, M.** [M.], Aguerri, J. A. L., Tresse, L., Bolzonella, M., Koekemoer, A. M., & Maier, C. (2010). Evolution of blue E/S0 galaxies from z ~1: merger remnants or disk-rebuilding galaxies?, *515*, A3. doi:10.1051/0004-6361/200913188. arXiv: 1002.3076 [astro-ph.CO]
- **Huertas-Company, M.** [M.], Foex, G., Soucail, G., & Pelló, R. (2009). The role of environment in the morphological transformation of galaxies in 9 rich intermediate redshift clusters., *505*(1), 83–96. doi:10.1051/0004-6361/200912621. arXiv: 0907.3905 [astro-ph.CO]
- **Huertas-Company, M.** [M.], Tasca, L., Rouan, D., Pelat, D., Kneib, J. P., Le Fèvre, O., ... Willott, C. (2009). A robust morphological classification of high-redshift galaxies using support vector machines on seeing limited images. II. Quantifying morphological k-correction in the COSMOS field at 1 < z < 2: Ks band vs. I band., *497*(3), 743–753. doi:10.1051/0004-6361/200811255. arXiv: 0811.1045 [astro-ph]
- **Huertas-Company, M.** [M.], Rouan, D., Tasca, L., Soucail, G., & Le Fèvre, O. (2008). A robust morphological classification of high-redshift galaxies using support vector machines on seeing limited images. I. Method description., *478*(3), 971–980. doi:10.1051/0004-6361:20078625. arXiv: 0709.1359 [astro-ph]

Major Contribution

- Angeloudi, E. [Eirini], Falcón-Barroso, J., **Huertas-Company, M.** [Marc], Boecker, A., Sarmiento, R., Eisert, L., & Pillepich, A. (2024). Constraints on the in situ and ex situ stellar masses in nearby galaxies obtained with artificial intelligence. *Nature Astronomy*, *8*(10), 1310–1320. doi:10.1038/s41550-024-02327-3. arXiv: 2407.00166 [astro-ph.GA]
- Angeloudi, E. [Eirini], **Huertas-Company, M.** [Marc], Falcón-Barroso, J., Sarmiento, R., Walo-Martín, D., Pillepich, A., & Vega Ferrero, J. (2024). Simulation-based inference of the 2D ex-situ stellar mass fraction distribution of galaxies using variational autoencoders. *arXiv e-prints*, arXiv:2410.24069. doi:10.48550/arXiv.2410.24069. arXiv: 2410.24069 [astro-ph.GA]
- Avirett-Mackenzie, M. S., Villforth, C., **Huertas-Company, M.**, Wuyts, S., Alexander, D. M., Bonoli, S., ... Shankar, F. (2024). A post-merger enhancement only in star-forming Type 2 Seyfert galaxies: the deep learning view., *528*(4), 6915–6933. doi:10.1093/mnras/stae183. arXiv: 2401.09632 [astro-ph.GA]
- Euclid Collaboration, Aussel, B., Kruk, S., Walmsley, M., **Huertas-Company, M.**, Castellano, M., ... Finelli, F. (2024). Euclid preparation: XLIII. Measuring detailed galaxy morphologies for Euclid with machine learning., *689*, A274. doi:10.1051/0004-6361/202449609. arXiv: 2402.10187 [astro-ph.GA]
- Iglesias-Navarro, P., **Huertas-Company, M.**, Martín-Navarro, I., Knapen, J. H., & Pernet, E. (2024). Deriving the star formation histories of galaxies from spectra with simulation-based inference., *689*, A58. doi:10.1051/0004-6361/202449909. arXiv: 2406.18661 [astro-ph.GA]
- Pandya, V., Zhang, H., **Huertas-Company, M.** [Marc], Iyer, K. G. [Kartheik G.], McGrath, E., Barro, G., ... Yung, L. Y. A. (2024). Galaxies Going Bananas: Inferring the 3D Geometry of High-redshift Galaxies with JWST-CEERS., *963*(1), 54. doi:10.3847/1538-4357/ad1a13. arXiv: 2310.15232 [astro-ph.GA]
- Smith, M. J., Roberts, R. J., Angeloudi, E., & **Huertas-Company, M.** (2024). AstroPT: Scaling Large Observation Models for Astronomy. *arXiv e-prints*, arXiv:2405.14930. doi:10.48550/arXiv.2405.14930. arXiv: 2405.14930 [astro-ph.IM]
- Spagnoletti, A., Boucaud, A., **Huertas-Company, M.**, Kabalan, W., & Biswas, B. (2024). Bayesian Deconvolution of Astronomical Images with Diffusion Models: Quantifying Prior-Driven Features in Reconstructions. *arXiv e-prints*, arXiv:2411.19158. doi:10.48550/arXiv.2411.19158. arXiv: 2411.19158 [astro-ph.IM]
- The Multimodal Universe Collaboration, Audenaert, J., Bowles, M., Boyd, B. M., Chemaly, D., Cherinka, B., ... Wu, J. F. (2024). The Multimodal Universe: Enabling Large-Scale Machine Learning with 100TB of Astronomical Scientific Data. *arXiv e-prints*, arXiv:2412.02527. doi:10.48550/arXiv.2412.02527. arXiv: 2412.02527 [astro-ph.IM]
- Vega-Ferrero, J. [Jesús], **Huertas-Company, M.**, Costantin, L., Pérez-González, P. G., Sarmiento, R., Kartaltepe, J. S., ... Yung, L. Y. A. (2024). On the Nature of Disks at High Redshift Seen by JWST/CEERS with Contrastive Learning and Cosmological Simulations., *961*(1), 51. doi:10.3847/1538-4357/ad05bb. arXiv: 2302.07277 [astro-ph.CO]
- Angeloudi, E. [Eirini], Falcón-Barroso, J., **Huertas-Company, M.**, Sarmiento, R., Pillepich, A., Walo-Martín, D., & Eisert, L. (2023). ERGO-ML: towards a robust machine learning model for inferring the fraction of accreted stars in galaxies from integral-field spectroscopic maps., *523*(4), 5408–5429. doi:10.1093/mnras/stad1669. arXiv: 2306.01056 [astro-ph.GA]
- Costantin, L. [Luca], Pérez-González, P. G. [Pablo G.], Vega-Ferrero, J. [Jesús], **Huertas-Company, M.**, Bisigello, L., Buitrago, F., ... Yung, L. Y. A. (2023). Expectations of the Size Evolution of Massive Galaxies at $3 \leq z \leq 6$ from the TNG50 Simulation: The CEERS/JWST View., *946*(2), 71. doi:10.3847/1538-4357/acb926. arXiv: 2208.00007 [astro-ph.GA]
- Eisert, L., Pillepich, A., Nelson, D., Klessen, R. S., **Huertas-Company, M.**, & Rodriguez-Gomez, V. (2023). ERGO-ML I: inferring the assembly histories of IllustrisTNG galaxies from integral observable properties via invertible neural networks., *519*(2), 2199–2223. doi:10.1093/mnras/stac3295. arXiv: 2202.06967 [astro-ph.GA]
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galaxies., *671*, A102. doi:10.1051/0004-6361/202245042. arXiv: 2209.12907 [astro-ph.GA]

- Expósito-Márquez, J., Brook, C. B., **Huertas-Company**, **M.**, Di Cintio, A., Macciò, A. V., Grand, R. J. J., … Arjona-Gálvez, E. (2023). A probabilistic deep learning model to distinguish cusps and cores in dwarf galaxies., *519*(3), 4384–4396. doi:10.1093/mnras/stac3799. arXiv: 2209.05965 [astro-ph.GA]
- Sarmiento, R. [Regina], **Huertas-Company**, **M.**, Knapen, J. H., Ibarra-Medel, H., Pillepich, A., Sánchez, S. F., & Boecker, A. (2023). MaNGIA: 10 000 mock galaxies for stellar population analysis., *673*, A23. doi:10.1051/0004-6361/202245509. arXiv: 2211.11790 [astro-ph.GA]
- Costantin, L. [Luca], Pérez-González, P. G., Méndez-Abreu, J., **Huertas-Company**, **M.**, Pampliega, B. A., Balcells, M., … Koekemoer, A. M. (2022). From Naked Spheroids to Disky Galaxies: How Do Massive Disk Galaxies Shape Their Morphology?, *929*(2), 121. doi:10.3847/1538-4357/ac5a57. arXiv: 2202.02332 [astro-ph.GA]
- Domínguez Sánchez, H. [H.], Margalef, B., Bernardi, M., & **Huertas-Company**, **M.** (2022). SDSS-IV DR17: final release of MaNGA PyMorph photometric and deep-learning morphological catalogues., *509*(3), 4024–4036. doi:10.1093/mnras/stab3089. arXiv: 2110.10694 [astro-ph.GA]
- Varma, S., **Huertas-Company**, **M.**, Pillepich, A., Nelson, D., Rodriguez-Gomez, V., Dekel, A., … Primack, J. (2022). The building up of observed stellar scaling relations of massive galaxies and the connection to black hole growth in the TNG50 simulation., *509*(2), 2654–2673. doi:10.1093/mnras/stab3149. arXiv: 2110.11989 [astro-ph.GA]
- Bretonnière, H. [Hubert], Boucaud, A., & **Huertas-Company**, **M.** (2021). Probabilistic segmentation of overlapping galaxies for large cosmological surveys. *arXiv e-prints*, arXiv:2111.15455. doi:10.48550/arXiv.2111.15455. arXiv: 2111.15455 [astro-ph.IM]
- Cheng, T.-Y., **Huertas-Company**, **M.**, Conselice, C. J., Aragón-Salamanca, A., Robertson, B. E., & Ramachandra, N. (2021). Beyond the hubble sequence - exploring galaxy morphology with unsupervised machine learning., *503*(3), 4446–4465. doi:10.1093/mnras/stab734. arXiv: 2009.11932 [astro-ph.GA]
- Ginzburg, O., **Huertas-Company**, **M.**, Dekel, A., Mandelker, N., Snyder, G., Ceverino, D., & Primack, J. (2021). The nature of giant clumps in high-z discs: a deep-learning comparison of simulations and observations., *501*(1), 730–746. doi:10.1093/mnras/staa3778. arXiv: 2011.06616 [astro-ph.GA]
- Koppula, S., Bapst, V., **Huertas-Company**, **M.**, Blackwell, S., Grabska-Barwinska, A., Dieleman, S., … Back, T. (2021). A Deep Learning Approach for Characterizing Major Galaxy Mergers. *arXiv e-prints*, arXiv:2102.05182. doi:10.48550/arXiv.2102.05182. arXiv: 2102.05182 [astro-ph.GA]
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- Zanisi, L. [Lorenzo], **Huertas-Company**, **M.**, Lanusse, F., Bottrell, C., Pillepich, A., Nelson, D., … Primack, J. (2021). A deep learning approach to test the small-scale galaxy morphology and its relationship with star formation activity in hydrodynamical simulations., *501*(3), 4359–4382. doi:10.1093/mnras/staa3864. arXiv: 2007.00039 [astro-ph.GA]
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