Mario Damiano

Ph.D. in Astrophysics

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Professional Interests

- Characterization of exoplanetary atmospheres.
- Spectroscopic data interpretation from observations gathered via space- and ground-based facilities.
- Implementation of inverse information extraction techniques via Bayesian statistics.
- Automation of data evaluation processes leveraging Machine Learning (ML) algorithms.
- Development and deployment of ML solutions for technical and scientific interpretation of data patterns and model predictions.

Professional experience

Oct 2022 - Today **Research Scientist & Data Scientist**, National Aeronautics and Space Administration (NASA) – Jet Propulsion Laboratory (JPL) – California Institute of Technology, CA, US.

- Developed and continuously expanding upon the capabilities of ExoRel$^{\Re}$ to interpret exoplanetary and emission spectroscopic data by leveraging Bayesian statistics. These are specific upgrades aimed at helping the development of the Habitable World Observatory (HWO).Open source, available on GitHub.
- Augmenting the capabilities of EXOSIMS, a sophisticated open source end-to-end mission simulation and yield model analysis tool used to simulate telescope performances, through realistic physical models and machine learning tools to further the development of HWO.
- Developing and deploying machine learning solutions in support of data analysis and interpretation of scientific projects.
- Developed a novel pipeline, ExoTR, to interpret exoplanetary transmission spectroscopic data by using Bayesian statistics. Open source, available on GitHub.
- Awarded multiple STScI grants for Hubble Space Telescope (HST) and James Webb Space Telescope (JWST) observations. Providing independent data analysis for the executed observations.

Nov '18 - Oct '22 **Postdoctoral Research Fellow**, National Aeronautics and Space Administration (NASA) – Jet Propulsion Laboratory (JPL) – California Institute of Technology, CA, US.

Education

2019

Ph.D. in Astrophysics, *University College London (UCL), London, England, UK*,
Field of Study: Astrophysics, Exoplanets, Machine Learning,
Advisors: Prof. Giovanna Tinetti, Dr. Giuseppina Micela, and Dr. Ingo Waldmann
Thesis title: *Data analysis of space and ground observations of exoplanetary atmosphere using Machine Learning algorithms.*

2015 **MSc Physics (Astrophysics)**, *University of Palermo (UNIPA), Palermo, Italy.*,
Advisors: Prof. Giovanni Peres and Dr. Giuseppina Micela
Thesis title: *Exoplanetary atmosphere: high-resolution spectrum with instruments iLocater and HIRES.*

2013 **BSc Physics Science**, *University of Palermo (UNIPA), Palermo, Italy.*,
Advisors: Prof. Giovanni Peres and Dr. Giuseppina Micela
Thesis title: *Exoplanets and stellar activity in the IR-band.*

Professional service

2025-present Member of NASA Study Analysis Group (SAG26) on exoplanet reflectance spectroscopy for the Habitable Worlds Observatory.

2024-present Member of NASA Study Analysis Group (SAG24) on exploring the complementary science value of Starshade observations.

2024-present Steering committee member of the "Atmospheric Characterization" and "Artificial Intelligence and Machine Learning" working groups for the development of the Habitable World Observatory.

2024-2026 External reviewer for James Webb Space Telescope Time Allocation Committee during Cycle 4 and 5.

2022-present Student advising as mentor and co-mentor for the internship program at JPL.

2021-present Peer reviewer for Nature Astronomy (NatAstron), Astronomy and Astrophysics (A&A), and IOP Publishing (AJ, ApJ, and PSJ).

Technical Skills

- Extensive knowledge of the Python language, including packages used for data analysis (i.e. NumPy, SciPy, PyAstronomy, Pandas, mcee, PyMultinest, dynesty), data visualization (i.e. Matplotlib), multi-process parallelization through MPI (i.e. mpi4py) and ML libraries (i.e. Scikit-learn, Tensorflow, Keras);
- Knowledge of the C language (simple scripting for physics calculations);
- Knowledge of the Matlab language (data visualization and statistics);
- Daily usage of high-performance computing resources (knowledge of bash scripting, PBS and SLURM commands) for intensive multi-processes calculation. This includes usage of both CPU and GPU computation.
- Extensive knowledge of text editing tools (i.e. LaTeX, Microsoft Office, Apple Keynote, Overleaf);

Competitively awarded proposals and observing time

2024 Co-I of the selected Astrophysics Decadal Survey Precursor Science proposal (ADSPS): *"Retiring the risk of misidentifying planet types from reflected light spectra"*

2024 25.0 primary JWST hours awarded in Cycle 3. Co-I of GO-05177: *"Detailed Atmospheric Characterization of a Unique Low-Temperature Exo-Saturn"*

2024 17.0 primary JWST hours awarded in Cycle 3. Co-I of GO-04711: *"Efficient and Detailed Characterization of a Temperate Water World Candidate"*

2023 13.1 primary JWST hours awarded in Cycle 2. PI of GO-03942: *"Probing the volcanic outgassing activity of a warm sub-Earth planet"*

2021 14.4 primary JWST hours awarded in Cycle 1. PI of GO-02334: *"Exploring the nature of a temperate exoplanet in the Fulton gap"*

2021 67.9 primary JWST hours awarded in Cycle 1. Co-I of GO-02372: *"Deep Characterization of the Atmosphere of a Temperate Sub-Neptune"*

2021 15.4 primary JWST hours awarded in Cycle 1. Co-I of GO-01952: *"Determining the Atmospheric Composition of the Super-Earth 55 Cancri e"*

2020 8 primary HST orbits awarded in Cycle 28. Co-I of GO-16448: *"Confirming a tentative detection of an atmosphere around a potentially rocky planet"*

Awards

- JPL Voyager Award for individual achievement (two in 2024, one in 2025);
- "Tessera Preziosa del mosaico di Palermo", recognition for outstanding citizens of Palermo, Italy, 2018;

Peer-reviewed publications

27 refereed publications, 11 first-author papers, h-index = 21 (using Google Scholar)
For more info see: `https://mdamiano.github.io/publications/`

First author peer-reviewed manuscripts

11. *Effects of planetary mass uncertainties on the interpretation of the reflectance spectra of Earth-like exoplanets*
Damiano, M., Burr, Z., Hu, R., Burt, J., Kataria, T.,
AJ, 169, 97, Feb 2025 - DOI: 10.3847/1538-3881/ada610

10. *Starshade Exoplanet Data Challenge: What We Learned*
Damiano, M., Shaklan, S., Hu, R., Dunne, B., Tanner, A., Nida, A., Carson J. C., Hildebrandt, S. R., Lisman, D.,
JATIS, Vol. 10, Issue 4, 048001, Oct 2024 - DOI : 10.1117/1.JATIS.10.4.048001

9. *LHS 1140 b is a potentially habitable water world*
Damiano, M., Bello-Arufe, A., Yang, J., Hu, R.,
ApJL, 968, L22, June 2024 - DOI : 10.3847/2041-8213/ad5204

8. *Reflected spectroscopy of small exoplanets III: probing the UV band to measure biosignature gasses*
Damiano, M., Hu, R., Mennesson, B.,
AJ, 166, 157, Sep 2023 - DOI: 10.3847/1538-3881/acefd3

7. *A transmission spectrum of the sub-Earth planet L98-59 b in 1.1-1.7 μm*
Damiano, M., Hu, R., Barclay, T., Zieba, S., Kreidberg, L., Brande, J., Colon, K. D., Covone, G., Crossfield, I., Domagal-Goldman, S. D., Fauchez, T. J., Fiscale, S., Gallo, F., Gilbert, E., Hedges, C. L., Kite, E. S., Kopparapu, R. K., Kostov, V. B., Morley, C., Mullally, S. E., Pidhorodetska, D., Schlieder, J. E., Quintana, E. V.,
AJ, 164, 225, Oct 2022 - DOI: 10.3847/1538-3881/ac9472

6. *Reflected spectroscopy of small exoplanets II: characterization of terrestrial exoplanets*
   Damiano, M. & Hu, R.,
   AJ, 163, 299, May 2022 - DOI: 10.3847/1538-3881/ac6b97

5. *Reflected spectroscopy of small exoplanets I: determining the atmospheric composition of sub-Neptune planets*
   Damiano, M. & Hu, R.,
   AJ, 162, 200, Oct 2021 - DOI: 10.3847/1538-3881/ac224d

4. *Multi-orbital-phase and multi-band characterization of exoplanetary atmospheres with reflected light spectra*
   Damiano, M., Hu, R., Hildebrandt, S. R.,
   AJ, 160, 206, Nov 2020 - DOI: 10.3847/1538-3881/abb76a

3. *ExoReL$^{\Re}$: A Bayesian Inverse Retrieval Framework For Exoplanetary Reflected Light Spectra*
   Damiano, M. & Hu, R.,
   AJ, 159, 175, Mar 2020 - DOI: 10.3847/1538-3881/ab79a5

2. *A Principal Component Analysis-based Method to Analyze High-resolution Spectroscopic Data of Exoplanets*
   Damiano, M., Micela, G., Tinetti, G.,
   ApJ, 878, 153, June 2019 - DOI: 10.3847/1538-4357/ab22b2

1. *Near-IR transmission spectrum of HAT-P-32 b using HST/WFC3.*
   Damiano, M., Morello, G., Tsiaras, A., Zingales, T., Tinetti, G.,
   AJ, 154, 39, Jul 2017 - DOI: 10.3847/1538-3881/aa738b

Co-Author

16. *Volcanic Satellites Tidally Venting Na, K, SO_2 in Optical & Infrared Light*,
    Oza, A V., Gebek, A., Westram, M. M., Tokadjian, A., Piro, A. L., Hu, R., Unni, A., Chari, R., Bello-Arufe, A., Schmidt, C. A., Louca, A. J., Miguel, Y., Estrela, R., Yang, J., **Damiano, M.**, Hasegawa, Y., Welbanks, L., Powell, D., Garg, R., Gupta, P., Yung, Y. L., Lopes, R. M. C.,
    MNRAS, Sep 2025 - DOI: 10.1093/mnras/staf1526

15. *The transmission spectrum of the potentially rocky planet L 98-59 c*,
    Barclay, T., Sheppard, K. B., Latouf, N., Mandell, A. M., Quintana, E. V., Gilbert, E. A., Liuzzi, G., Villanueva, G. L., Arney, G., Brande, J., Colón, K. D., Covone, G., Crossfield, I. J. M., **Damiano, M.**, Domagal-Goldman, S. D., Fauchez, T. J., Fiscale, S., Gallo, F., Hedges, C. L., Hu, R., Kite, E. S., Koll, D., Kopparapu, R. K., Kostov, V. B., Kreidberg, L., Lopez, E. D., Mang, J., Morley, C. V., Mullally, F., Mullally, S. E., Pidhorodetska, D., Schlieder, J. E., Vega, L. D., Youngblood, A., Zieba, S.,
    AJ, 169, 241, Apr 2025 - DOI: 10.3847/1538-3881/ada5f6

14. *Evidence for a Volcanic Atmosphere on the Sub-Earth L 98-59 b*,
    Bello-Arufe, A., **Damiano, M.**, Bennett, K.A., Hu, R., Welbanks, L., MacDonald R.J., Seligman, D.Z., Sing, D.K., Tokadjian, A., Oza, A.V., Yang, J.,
    ApJL, 980, L26, Feb 2025 - DOI: 10.3847/2041-8213/adaf22

13. *The Detectability of $CH_4/CO_2/CO$ and N_2O Biosignatures through Reflection Spectroscopy of Terrestrial Exoplanets*,
Tokadjian, A., Hu, R., **Damiano, M.**,
AJ, 168, 292, Dec 2024 - DOI: 10.3847/1538-3881/ad88eb

12. *A Benchmark JWST Near-Infrared Spectrum for the Exoplanet WASP-39b*,
The JWST Transiting Exoplanet Community Early Release Science Team, 80 co-authors,
Nature, Jul 2024 - DOI: 10.1038/s41550-024-02292-x

11. *A secondary atmosphere on the rocky exoplanet 55 Cancri e*,
Hu, R., Bello-Arufe, A., Zhang, M., Paragas, K., Zilinskas, M., van Buchem, C., Bess, M., Patel, J., Ito, Y., **Damiano, M.**, Scheucher, M., Oza, A.V., Knutson, H.A., Miguel, Y., Dragomir, D., Brandeker, A., Demory, B.O.,
Nature, May 2024 - DOI: 10.1038/s41586-024-07432-x

10. *Early Release Science of the Exoplanet WASP-39b with JWST NIRSpec G395H*,
The JWST Transiting Exoplanet Community Early Release Science Team, 92 co-authors,
Nature, Jan 2023 - DOI: 10.1038/s41586-022-05591-3

9. *Early Release Science of the exoplanet WASP-39b with JWST NIRCam*,
The JWST Transiting Exoplanet Community Early Release Science Team, 99 co-authors,
Nature, Jan 2023 - DOI: 10.1038/s41586-022-05590-4

8. *Identification of carbon dioxide in an exoplanet atmosphere*,
The JWST Transiting Exoplanet Community Early Release Science Team, 131 co-authors,
Nature, Sept 2022 - DOI: 10.1038/s41586-022-05269-w

7. *Unveiling shrouded oceans on temperate sub-Neptunes via transit signatures of solubility equilibria vs. gas thermochemistry*,
Hu, R., **Damiano, M.**, Scheucher, M., Kite, E., Seager, S., Rauer, H.,
ApJL, 921, L8, Oct 2021 - DOI: 10.3847/2041-8213/ac1f92

6. *Starshade Exoplanet Data Challenge*,
Hu, R., Hildebrandt, S. R., **Damiano, M.**, Shaklan, S., Martin, S., Lisman, D.,
JATIS, 7(2), 021216, Mar 2021 - DOI: 10.1117/1.JATIS.7.2.021216

5. *The Transiting Exoplanet Community Early Release Science Program for JWST*,
Bean, J.L., plus 96 co-authors,
PASP 130k4402, Nov 2018 - DOI: 10.1088/1538-3873/aadbf3

4. *A chemical survey of exoplanets with ARIEL*,
Tinetti, G., plus 242 co-authors,
Exp Astron 46, 135, Sep 2018 - DOI: 10.1007/s10686-018-9598-x

3. *A Population Study of Gaseous Exoplanets*,
Tsiaras, A., Waldmann, I.P., Zingales, T., Rocchetto, M., Morello, G., **Damiano, M.**, Karpouzas, K., Tinetti, G., McKemmish, L.K., Tennyson, J., and Yurchenko, S.N.,
AJ, 155, 156, Mar 2018 - DOI: 10.3847/1538-3881/aaaf75

2. *A New Approach to Analyzing HST Spatial Scans: The Transmission Spectrum of HD 209458 b*,
Tsiaras, A., Waldmann, I.P., Rocchetto, M., Varley, R., Morello, G., **Damiano, M.**, Tinetti, G.,
ApJ, 832, 202, Dec 2016 - DOI: 10.3847/0004-637X/832/2/202

1. *Detection of an Atmosphere Around the Super-Earth 55 Cancri e*,
Tsiaras, A., Rocchetto, M., Waldmann, I.P., Venot, O., Varley, R., Morello, G., **Damiano, M.**, Tinetti, G., Barton, E.J., Yurchenko, S.N., Tennyson, J.,
ApJ, 820, 99, Apr 2016 - DOI: 10.3847/0004-637X/820/2/99

Conference Proceedings and White Papers

6. *Direct imaging characterization of cool gaseous planets*,
Min, M., Barstow, J., Mayorga, L.C., Wakeford, H., Wang, J., Hu, R., Biller, B., Caballero, J.A., Carone, L., Casewell, S., Chubb, K.L., **Damiano, M.**, Gandhi, S., Garcia-Munoz, A., Helling, C., Keller, F., Lowson, N., Nasedkin, E., MacDonald, R., Ruffio, J.B., Shkolnik, E., Stark, C.C.,
arXiv, 2512.13766, Dec 2025

5. *Identifying rocky planets and water worlds among sub-Neptune-sized exoplanets with the Habitable Worlds Observatory*,
Hu, R., Min, M., Millar-Blanchaer, M., Lustig-Yaeger, J., Robinson, T., Burt, J., Coustenis, A., **Damiano, M.**, Dong, C., Dressing, C., Fossati, L., Kane, S., Kelkar, S., Lichtenberg, T., Ruffio, J-B., Sur, D., Tokadjian, A., Turbet, M.,
arXiv, 2509.16798, Sep 2025

4. *HWO yield sensitivities in the NIR and NUV*,
Morgan, R., Savransky, D., Turmon, M., **Damiano, M.**, Hu, R., Mennesson, B., Mamajek, E.E., Robinson, T.D., Tokadjian, A.,
SPIE 130925M, Aug 2024 - DOI: 10.1117/12.3020858

3. *Quantifying the impacts of schedulability on science yield of exoplanet imaging missions*,
Savransky, D., Knight, R., Turmon, M., Spohn, C., Morgan, R., **Damiano, M.**, Genszler, G., Kulik, J.,
SPIE, 126801K, Oct 2023 - DOI: 10.1117/12.2677102

2. *Exo-Earth yield of a 6m space telescope in the near-infrared*,
Morgan, R., Savransky, D., **Damiano, M.**, Lisman, D., Mennesson, B., Mamajek, E. E., Robinson, T. D., Turmon, M.,
SPIE, 126801L, Oct 2023 - DOI: 10.1117/12.2677785

1. *Exoplanet Detection from Starshade Images using Convolutional Neural Networks*,
Ahmed, Z., D'Amico, S., Hu, R., **Damiano, M.**,
SPIE, 1268028, Oct 2023 - DOI: 10.1117/12.2676600