# SEBASTIAN MARINO

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## Research Interests

Planet formation and the architecture and dynamics of planetary systems. How do comets and planets form? Where do cometary belts form? What is the composition of *exocomets*? Can they deliver volatiles to terrestrial planets? My research tackles these questions through the use of interferometric observations and their comparison with radiative transfer models, together with numerical simulations.

## Career

**Research fellow, Institute of Astronomy, Cambridge, UK** (planned) *Oct 2020 - Sep 2023*
**Postdoctoral researcher, Max Planck Institute for Astronomy, Heidelberg, Germany** *Nov 2018 - Sep 2020*
**PhD in Astronomy, University of Cambridge, UK** *Oct 2015 - Oct 2018*
PhD thesis: *Exocometary discs at large radii and their inward transport via planet scattering*
**MS in Astronomy with highest honours, Universidad de Chile, Chile. GPA 100%** *Mar 2014 - July 2015*
MS thesis: *Dust traps and warps in transitional protoplanetary discs*
**BS in Astronomy with highest honours, Universidad de Chile, Chile. GPA 90%** *Mar 2010 - Dec 2013*

## Scholarships & Awards

**2019** **Junior Research fellowship by Jesus College, University of Cambridge** (1 position/400 applicants).
**2018** **Shortlisted for Elsevier early career award**, top young researcher in physical sciences in the UK.
**2017** **NASA Hubble/Sagan fellowship** ($85k/yr), declined to take position at MPIA, Heidelberg.
**2016** **Murdin Prize**, best student publication of the year at Institute of Astronomy.
**2015** **Cambridge Trust Scholarship**, 3-year Ph.D. full funding.
**2014** **Chilean CONICYT scholarship**, 2-year M.S. full funding. I obtained the highest score in the country.
**2013** **Top student in Astronomy.** Ranked first of my class over 4 years of undergraduate studies.
**2010-2013** **Outstanding student**, in top 5% of 5,000 students at the faculty of physical and mathematical sciences.

## Key achievements

- First warped/misaligned protoplanetary disc (Marino et al. 2015, > 120 citations).
- First detection of exocometary gas around a Solar-type star, (Marino et al. 2016, > 60 citations).
- First to postulate that spiral density waves could be triggered by shadows (Montesinos et al. 2016, > 40 citations).
- First detection of CO outgassed from scattered exocomets (Marino et al. 2017, > 40 citations).
- First population synthesis model of exocometary gas (Marino et al. 2020).

## Key Research Skills

- Reduction of interferometric sub-mm and radio data (e.g. Marino et al. 2015b).
- Continuum and spectral analysis of sub-millimetre data (e.g. Marino et al. 2016).
- Matched filter to boost signal-to-noise ratio of noisy interferometric data. (e.g. Marino et al. 2016, 2017a)
- Image reconstruction from optical interferometric data (e.g. Lacour et al. 2016, Perez et al. 2020).
- 3D Radiative transfer of discs at multiple frequencies (e.g. Marino et al. 2015a, 2015b).
- MCMC methods to fit radiative transfer disc models to observations (e.g. Marino et al. 2016).
- Simulations of interferometric data/visibilities (e.g. Marino et al. 2018a).
- N-body simulations of planet-disc interactions (e.g. Marino et al. 2018a, 2018b).
- Collisional evolution of debris discs (e.g. Marino et al. 2017b).
- 1D viscous evolution and photodissociation of exocometary gaseous discs (Marino et al. 2020).

## Selected conference contributions & seminars

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| Jan 2021 | Severo Ochoa Advanced School, online | invited lecture |
| Sep 2020 | International Max Planck Research Schools summer school, online | invited talk |
| July 2020 | Exoplanets III conference, online | plenary talk |
| July 2020 | European Astronomical Society Annual Meeting 2020, online | talk |
| Mar 2020 | Colloquim at Max Planck Institute for Astronomy, Heidelberg, Germany | Colloquim |
| Sep 2019 | "Current and future trends in debris disc science II" workshop, Budapest, Hungary | talk |
| Jul 2019 | "Great barriers in planet formation" conference, Palm Cove, Australia | talk |
| Jun 2019 | "Planetary Dynamics" conference, Heidelberg, Germany | talk |
| Mar 2018 | "Diversis mundi: The Solar System in an Exoplanetary context" conference, ESO, Chile | talk |
| Feb 2018 | "Water during planet formation and evolution" workshop, Zurich, Switzerland | talk |
| Feb 2018 | "The Origin and Evolution of Comets" Royal Astronomical Society meeting, London, UK | talk |
| Jan 2018 | Colloquium at Astrophysics department, University of Exeter, UK | Colloquium |
| Sept 2017 | "Planet Formation and Evolution" conference, Jena, Germany | talk |
| May 2017 | Colloquium at Institute of Astronomy, Cambridge, UK | Colloquium |
| Jan 2017 | Colloquium at Department of Astronomy, Universidad de Chile | Colloquium |
| Oct 2016 | "From discs to planets" workshop, Konkoly Observatory, Budapest, Hungary | talk |
| Nov 2016 | Colloquium at Institute of Astronomy, Cambridge, UK | Colloquium |
| May 2016 | "Resolving planet formation in the era of ALMA and extreme AO" conference, ESO, Chile | talk |

**Selected telescope observing proposals (26h of ALMA time as PI, equivalent to US$360k)**

PI on "Unveiling the planetary architecture around the Solar analogue HD107146", ALMA cycle 7, 2019 (12h, B grade).
PI on "Debris discs around UCDs, what lies beyond TRAPPIST-1h?", ALMA cycle 5, 2017 (8h, A grade).
PI on "Double-ring debris discs at 10s of au: probing how far out planets can form", ALMA cycle 4, 2016 (6h, B grade).
PI on "Spatial characterisation of Eta Corvis exozodi", LBTI 2020A (10h).
PI on "Spectroscopic study of newly discovered extreme debris systems", MPG/ESO/FEROS 2020A (16h).
Co-I on "How early on does planetesimal formation take place?", ALMA cycle 6, 2018, (40h, B grade, PI: M. Wyatt).
Co-I on "The frontier of rocky planet formation", ALMA cycle 5, 2017, (30h, B grade, PI: G. Kennedy).
Co-I on "Probing warm dust inside the double-ringed debris disk HD 107146", VLT/SPHERE, 2017 (2h, PI: S. Perez)
Co-I on "The continuum asymmetry of MWC758: dust trap or companion?", VLA, 2016 (PI: S. Casassus).

**Mentoring**

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| 2020 | Supervision of summer intern Elle Miller, Max Planck Institute for Astronomy. |
| 2018-present | Helping with supervision of PhD student Josh Lovell, University of Cambridge. |
| 2016-2017 | Supervisor, Statistical Physics, University of Cambridge. |
| 2015 | Supervisor, Research Workshop, Universidad de Chile. |
| 2014 | Supervisor, Introduction to Cosmology, Universidad de Chile. |
| 2014 | Supervisor, Stellar Astrophysics, Universidad de Chile. |
| 2013 | Supervisor, Electromagnetism, Universidad de Chile. |

**Public Outreach**

2020 "How Did the TRAPPIST-1 Planets Get Their Water?" by Matt Williams at Universe Today
2019 "Comet-Blasted Star May Be a Rerun of the Solar Systems Birth" by Nola Taylor at Scientific American.
2017 "Scientists investigate debris disc in a nearby planetary system" by Tomasz Nowakowski at physics.org
2016 Press release "First evidence of icy comets orbiting a sun-like star", coverage by Astronomy magazine, Daily Mail, LA times, IFL science, etc.
2015 Press release "Shadows cast by a warp in a planet forming system", coverage by phys.org, ESO, space.com, pourlascience.fr, etc.
2016 Managing outreach activity "Galaxy Under Construction" for 500 people at Institute of Astronomy, Cambridge.
2016 Assisting public observing nights at the Institute of Astronomy, Cambridge.
2014-2015 Astronomy talks to general public in the National Astronomical Observatory of Chile.
2014-2015 Art and astronomy exposition at the Contemporary Art Museum in Santiago, Chile.
2013 Staff at the touristic observatory OAA, giving talks and managing telescopes

**Professional service**

Referee, The Astrophysical Journal
Referee, The Astronomical Journal
Referee, Publications of the Astronomical Society of the Pacific
Reviewer, Stephen Hawking Fellowship
Telescope Time Allocation Committee Member, MPIA

**Organised conferences**

LOC for “Binary Stars” conference, Cambridge, UK, 2016
LOC for “Current and future trends in debris disc science II” workshop, Budapest, Hungary, 2019
LOC for “Planetary Dynamics” conference, Heidelberg, Germany, 2019

## IT Skills & Languages

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| **Computer Languages** | Python, JAVA, C, MATLAB, LaTeX, Linux, HTML |
| **Analysis and modelling software** | CASA, RADMC3D, MIRA, SQUEEZE, MERCURY, Rebound |
| **Tools** | jupyter notebooks, Emacs, github |

Spanish, native language
English, fluent (speaking, reading, writing) TOEFL iBT 106

**List of publications (35 refereed articles, > 870 citations, H-index:17), link to publications**

**First author publications (> 340 citations):**

1. **Marino, S.**; Pérez, S.; Casassus, S., *"Shadows Cast by a Warp in the HD 142527 Protoplanetary Disc"*, ApJL, Volume 798, Issue 2, article id. L44 (2015) 125 citations.
2. **Marino, S.**; Matrà, L.; Stark, C.; Wyatt, M. C.; Casassus, S.; Kennedy, G.; Rodriguez, D.; Zuckerman, B.; Pérez, S.; Dent, W. R. F.; Kuchner, M.; Hughes, A. M.; Schneider, G.; Steele, A.; Roberge, A.; Donaldson, J.; Nesvold, E., *"Exocometary gas in the HD 181327 debris ring"*, MNRAS, Volume 460, Issue 3, p.2933-2944 (2016) 68 citations.
3. **Marino, S.**; Wyatt, M. C.; Panic, O.; Matrà, L.; Kennedy, G. M.; Bonsor, A.; Kral, Q.; Dent, W. R. F.; Duchene, G.; Wilner, D.; Lisse, C. M.; Lestrade, J.-F.; Matthews, B., *"ALMA observations of the η Corvi debris disc: inward scattering of CO-rich exocomets by a chain of 3-30 $M_{\oplus}$"*, MNRAS, Volume 465, Issue 3, p.2595-2615 (2017) 46 citations.
4. **Marino, S.**; Casassus, S.; Pérez, S.; Lyra, W.; Roman, P. E.; Avenhaus, H.; Wright, C. M.; Maddison, S. T., *"Compact Dust Concentration in the MWC 758 Protoplanetary Disc"*, ApJ, Volume 813, Issue 1, article id. 76, (2015) 36 citations.
5. **Marino, S.**.; Carpenter, J.; Wyatt, M. C.; Booth, M.; Casassus, S.; Faramaz, V.; Guzman, V.; Hughes, A. M.; Isella, A.; Kennedy, G. M.; Matrà, L.; Ricci, L.; Corder, S., *"A gap in the planetesimal disc around HD 107146 and asymmetric warm dust emission revealed by ALMA"*, MNRAS, Volume 479, Issue 4, p.5423-5439 (2018) 20 citations
6. **Marino, S.**; Wyatt, M. C.; Kennedy, G. M.; Holland, W.; Matrà, L.; Shannon, A.; Ivison, R. J., *"ALMA observations of the multiplanet system 61 Vir: what lies outside super-Earth systems?"*, MNRAS, Volume 469, Issue 3, p.3518-3531 (2017) 17 citations.
7. **Marino, S.**; Bonsor, A.; Wyatt, M. C.; Kral, Q., *"Scattering of exocomets by a planet chain: exozodi levels and the delivery of cometary material to inner planets"*, MNRAS, Volume 479, Issue 2, p.1651-1671 (2018) 11 citations
8. **Marino, S.**; Yelverton, B.; Booth, M.; Faramaz, V.; Kennedy, G. M.; Matrà, L.; Wyatt, M. C., *"A gap in HD 92945's broad planetesimal disc revealed by ALMA"*, MNRAS, Volume 484, Issue 1, p.1257-1269 (2019) 8 citation
9. **Marino, S.**; González-Gaitán, S.; Förster, F.; Folatelli, G.; Hamuy, M.; Hsiao, E., *"Searching for Light Echoes Due to Circumstellar Matter in SNe Ia Spectra"*, ApJ, Volume 806, Issue 1, article id. 134, (2015) 5 citations.
10. **Marino, S.**; Flock, M.; Henning, Th.; Kral, Q.; Matrà, L.; Wyatt, M. C., *"Population synthesis of exocometary gas around A stars"*, MNRAS, 492, 4409 (2020) 3 citations
11. **Marino, S.**; Wyatt, M. C.; Kennedy, G. M.; Kama, M.; Matrá, L.; Triaud, A. H. M. J.; Henning, Th., *"Searching for a dust cometary belt around Trappist-1 with ALMA"*, MNRAS, 492, 6067 (2020) 2 citation
12. **Marino, S.**; Zurlo, A.; Faramaz, V.; Milli, J.;, Henning, Th.; Kennedy, G. M.; Matrà, L.; Pérez, S.; Delorme, P.; Cieza, L. A.; Hughes, A. M.; *"Insights into the planetary dynamics of HD 206893 with ALMA"*, submitted to MNRAS.

**Second author publications:**

13. Casassus, S.; **Marino, S.**; Pérez, S.; Roman, P.; Dunhill, A.; Armitage, P. J.; Cuadra, J.; Wootten, A.; van der Plas, G.; Cieza, L.; Moral, Victor; Christiaens, V.; Montesinos, Matías, *"Accretion Kinematics through the Warped Transition Disc in HD142527 from Resolved CO(6-5) Observations"*, ApJ, Volume 811, Issue 2, article id. 92, (2015) 72 citations.
14. Matrà, L.; **Marino, S.**; Kennedy, G. M.; Wyatt, M. C.; Öberg, K. I.; Wilner, D. J., *"An Empirical Planetesimal Belt Radius-Stellar Luminosity Relation"*, ApJ, Volume 859, Issue 1, article id. 72 (2018) 27 citations
15. Kral, Q.; **Marino, S.**; Wyatt, M. C.; Kama, M.; Matrà, L., *"Imaging [CI] around HD 131835: reinterpreting young debris discs with protoplanetary disc levels of CO gas as shielded secondary discs"*, MNRAS, 489, 3670 (2019) 22 citations
16. Kennedy, G. M.; **Marino, S.**; Matrà, L.; Panic, O.; Wilner, D.; Wyatt, M. C.; Yelverton, B., *"ALMA observations of the narrow HR 4796A debris ring"*, MNRAS, Volume 475, Issue 4, p.4924-4938 (2018) 18 citations
17. Casassus, S.; **Marino, S.**; Lyra, W.; Baruteau, C.; Vidal, M.; Wootten, A.; Pérez, S.; Alarcon, F.; Barraza, M.; Cárcamo, M.; Dong, R.; Sierra, A.; Zhu, Z.; Ricci, L.; Christiaens, V.; Cieza, L., *"Cm-wavelength observations of MWC 758: resolved dust trapping in a vortex"*, MNRAS, Volume 483, Issue 3, p.3278-3287 (2019) 6 citations
18. Pérez, S.; **Marino, S.**; Casassus, S.; Baruteau, C.; Zurlo, A.; Flores, C.; Chauvin, G., *"Upper limits on protolunar disc masses using ALMA observations of directly imaged exoplanets"*, MNRAS, Volume 488, Issue 1, p.1005-1011 (2019) 4 citations

**Remaining co-author publications:**

19. Casassus, S.; Wright, C. M.; **Marino, S.**; Maddison, S. T.; Wootten, A.; Roman, P.; Pérez, S.; Pinilla, P.; Wyatt, M.; Moral, V.; Ménard, F.; Christiaens, V.; Cieza, L.; van der Plas, G., *"A Compact Concentration of Large Grains in the HD 142527 Protoplanetary Dust Trap"*, ApJ, Volume 812, Issue 2, article id. 126, (2015) 63 citations.

20. Montesinos, M.; Pérez, S.; Casassus, S.; **Marino, S.**; Cuadra, J.; Christiaens, V., *"Spiral Waves Triggered by Shadows in Transition Discs"*, ApJL, Volume 823, Issue 1, article id. L8 (2016) 47 citations.

21. Price, D. J.; Cuello, N.; Pinte, C.; Mentiplay, D.; Casassus, S.; Christiaens, V.; Kennedy, G. M.; Cuadra, J.; Pérez, S.; **Marino, S.**; Armitage, P. J.; Zurlo, A.; Juhasz, A.; Ragusa, E.; Laibe, G.; Lodato, G., *"Circumbinary, not transitional: on the spiral arms, cavity, shadows, fast radial flows, streamers, and horseshoe in the HD 142527 disc"*, MNRAS, Volume 477, Issue 1, p.1270-1284 (2018) 47 citations

22. Lacour, S.; Biller, B.; Cheetham, A.; Greenbaum, A.; Pearce, T.; **Marino, S.**; Tuthill, P.; Pueyo, L.; Mamajek, E. E.; Girard, J. H.; Sivaramakrishnan, A.; Bonnefoy, M.; Baraffe, I.; Chauvin, G.; Olofsson, J.; Juhasz, A.; Benisty, M.; Pott, J.-U.; Sicilia-Aguilar, A.; Henning, T.; Cardwell, A.; Goodsell, S.; Graham, J. R.; Hibon, P.; Ingraham, P.; Konopacky, Q.; Macintosh, B.; Oppenheimer, R.; Perrin, M.; Rantakyr, F.; Sadakuni, N.; Thomas, S., *"An M-dwarf star in the transition disc of Herbig HD 142527. Physical parameters and orbital elements"*, A&A, Volume 590, id.A90, (2016) 46 citations.

23. Pérez, S.; Dunhill, A.; Casassus, S.; Roman, P.; Szulágyi, J.; Flores, C.; **Marino, S.**; Montesinos, M., *"Planet Formation Signposts: Observability of Circumplanetary Discs via Gas Kinematics"*, ApJL, Volume 811, Issue 1, article id. L5, (2015) 40 citations.

24. Casassus, S.; Avenhaus, H.; Pérez, S.; Navarro, V.; Cárcamo, M.; **Marino, S.**; Cieza, L.; Quanz, S. P.; Alarcón, F.; Zurlo, A.; Osses, A.; Rannou, F. R.; Román, P. E.; Barraza, M, *"An inner warp in the DoAr 44 T Tauri transition disc"*, MNRAS, Volume 477, Issue 4, p.5104-5114 (2018) 34 citations

25. Wyatt, M. C.; Bonsor, A.; Jackson, A. P.; **Marino, S.**; Shannon, A., *"How to design a planetary system for different scattering outcomes: giant impact sweet spot, maximizing exocomets, scattered discs"*, MNRAS, Volume 464, Issue 3, p.3385-3407 (2017) 27 citations.

26. Cieza, L. A.; Ruíz-Rodríguez, D.; Pérez, S.; Casassus, S.; Williams, J. P.; Zurlo, A.; Principe, D. A.; Hales, A.; Prieto, J. L.; Tobin, J. J.; Zhu, Z.; **Marino, S.**, *"The ALMA early science view of FUor/EXor objects - V. Continuum disc masses and sizes"*, MNRAS, Volume 474, Issue 4, p.4347-4357 (2018) 27 citations

27. Kral, Q.; Wyatt, M. C.; Triaud, A. H. M. J.; **Marino, S.**; Thébault, P.; Shorttle, O., *"Cometary impactors on the TRAPPIST-1 planets can destroy all planetary atmospheres and rebuild secondary atmospheres on planets f, g, and h"*, MNRAS, Volume 479, Issue 2, p.2649-2672 (2018) 11 citations

28. Pérez, S.; Casassus, S.; Hales, A.; **Marino, S.**; Cheetham, A.; Zurlo, A.; Cieza, L.; Dong, R.; Alarcón, F.; Benítez-Llambay, P.; Fomalont, E., *"Long baseline observations of HD100546 with ALMA: a possible circumplanetary disk detected in dust continuum and gas kinematics"*, ApJL, 889, L24 (2020) 11 citations

29. Baruteau, C.; Barraza, M.; Pérez, S.; Casassus, S.; Dong, R.; Lyra, W.; **Marino, S.**; Christiaens, V.; Zhu, Z.; Carmona, A.; Debras, F.; Alarcón, F., *"Dust traps in the protoplanetary disc MWC 758: two vortices produced by two giant planets?"*, MNRAS, Volume 486, Issue 1, p.304-319 (2019) 10 citations

30. Matrà, L.; Wyatt, M. C.; Wilner, D. J.; Dent, W. R. F.; **Marino, S.**; Kennedy, G. M.; Milli, J., *"Kuiper Belt-Like Hot and Cold Populations of Planetesimal Inclinations in the $\beta$ Pictoris Belt Revealed by ALMA"*, AJ, Volume 157, Issue 4, article id. 135 (2019) 8 citations

31. Read, M. J.; Wyatt, M. C.; **Marino, S.**; Kennedy, G. M., *"Shaping HR8799's outer dust belt with an unseen planet"*, MNRAS, Volume 475, Issue 4, p.4953-4966 (2018) 8 citations

32. Casassus, S.; Pérez, S.; Osses, A.; **Marino, S.**, *"Cooling in the shade of warped transition discs"*, MNRASL, Volume 486, Issue 1, p.L58-L62 (2019) 4 citations

33. Sepulveda, A. G.; Matra, L.; Kennedy, G. M.; del Burgo, C.; Oberg, K. I.; Wilner, D. J.; **Marino, S.**; Booth, M.; Carpenter, J. M.; Davies, C. L.; Dent, W. R. F.; Ertel, S.; Lestrade, J.; Marshall, J. P.; Milli, J.; Wyatt, M. C.; MacGregor, M. A.; Matthews, B. C., *"The REASONS Survey: Resolved Millimeter Observations of a Large Debris Disk Around the Nearby F Star HD 170773"*, ApJ, Volume 881, Issue 1, article id. 84 (2019) 2 citations

34. Pinilla, P.; Pascucci, I.; **Marino, S.**, *"Hints on the origins of particle traps in protoplanetary disks given by the $M_{\rm dust} - M_\star$ relation"*, A&A, 635, A105 (2020) 1 citation

35. Kral Q., Matrà L., Kennedy G., **Marino S.**, Wyatt M., *"Survey of planetesimal belts with ALMA: gas detected around the Sun-like star HD 129590"*, arXiv, arXiv:2005.05841 (2020)

36. Matrà, L.; Dent, W.R.F.; Wilner, D.J.; **Marino, S.**, Wyatt, M.C.; Marshall, J.P.; Su, K.Y.L.; Chavez, M.; Hales, A.; Hughes, A.M.; Greaves, J.S.; and Corder, S.A.; "Dust Populations in the Iconic Vega Planetary System Resolved by ALMA", arXiv, arXiv:2006.16257, (2020)

37. Matrà, L.; Kral, Q.; Su, K.; Brandeker, A.; Dent, W.; Gaspar, A.; Kennedy, G.; **Marino, S.**; Oberg, K.; Roberge, A.; Wilner, D.; Wilson, P.; Wyatt, M.; Cataldi, G.; Higuchi, A.; Hughes, M.; Kiefer, F.; Lecavelier des Etangs, A.; Lyra, W.; Matthews, B.; Moor, A.; Welsh, B.; Zuckerman, B., *"Exocometary Science"*, Astro2020: Decadal Survey on Astronomy and Astrophysics, science white papers, no. 391; Bulletin of the American Astronomical Society, Vol. 51, Issue 3, id. 391 (2019)

MNRAS=Monthly Notices of the Royal Astronomical Society; MNRASL=Monthly Notices of the Royal Astronomical Society Letters; ApJ=The Astrophysical Journal; ApJL=The Astrophysical Journal Letters; A&A=Astronomy & Astrophysics; AJ=The Astronomical Journal.