Clara Sousa-Silva

· Quantum Astrochemist ·

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Education

PhD in Astrophysics - Quantum Chemistry
London, UK

University College London - ExoMol group
May 2011- Sept 2015

- Thesis: "Modelling Phosphine Spectra for the Atmospheric Characterization of Cool Stars and Exoplanets". Advisor: J Tennyson.

Integrated MPhys - Masters of Physics and Astronomy with Honours
Edinburgh, Scotland

University of Edinburgh
2005-2010

- Thesis: "Influence of a Star's Evolution on its Planetary System". Advisor: Ken Rice. Grade: A equivalent.

Experience

Research Scientist - 51 Pegasi b Fellow
Cambridge, USA

Massachusetts Institute of Technology (until Sep 2020) and Harvard (after Sep 2020)
Aug 2019 –

- Using computational chemistry to understand potential alien biospheres. Projects include expanding the RASCALL (Rapid Approximate Spectral Calculations for ALL) database to obtain spectra for thousands of molecules associated with exoplanet atmospheres.
- Combining observational data and theoretical spectroscopy to characterize exoplanets and potential alien biospheres.
- Updating the PH_3 linelist for integration into HITEMP, GEISA, and ExoMol databases, and application to high-resolution spectroscopy.

Director of the Science Research Mentoring Program
Cambridge, USA

Harvard-Smithsonian Center for Astrophysics & MIT
June 2019 –

- Organizing and managing teams of junior scientists and high school students collaborating on publishable astrophysics research.
- Developing and delivering monthly advisory meetings and lectures to the students, as well as an end of year symposium.

Postdoctoral Associate
Cambridge, USA

Massachusetts Institute of Technology
Sept 2016 - July 2019

- Joint post-doc at the Kavli Institute and the department of Earth, Atmospheric and Planetary Sciences.
- Primary research foci are the assessment of phosphine as a biosignature gas and the development of the RASCALL database.

Head of Education for the Twinkle Space Mission
London, UK

University College London
Jan 2015 - Sep 2016

- Creator of EduTwinkle, the educational and outreach program of the Twinkle Space Mission.
- Founder of ORBYTS (Original Research by Young Twinkle Students), where students perform original research alongside scientists.

Researcher in Schools (RIS) - Goldman Sachs Fellow
London, UK

Brilliant Club/Goldman Sachs/King's College London/Highams Park School
Sep 2014 - Jul 2016

- For two years, I taught 19 groups of middle- and high-school students in Geology, Chemistry, Physics and Astronomy as a member of the first RIS cohort, which trains scientists to teach alongside their research (Qualified Teacher Status awarded June 2016).
- Led outreach and action research projects for 6-18 yr olds, with focus on widening STEM participation by under-represented groups.

Research Intern
Ljubljana, Slovenia

Chemistry Department of the Institut Josef Stefan
Sep 2010 - Jan 2011

- Duties included liaising with instrument companies, organizing meetings/presentations, researching/purchasing equipment.
- Set-up experiment for the study of crystal structures, and developed a computational program for spectrometer calibration.

Relevant Awards and Observing Time

51 Pegasi b Felllowship Grant Award
EAPS, MIT

Heising-Simons Foundation
2019

- This award provides exceptional junior scientists with the opportunity to conduct research in astronomy. *Grant Award: $375,000.*

Sagan Fellowship (Declined)
CfA, Harvard

NASA Hubble Fellowship Program (NHFP)
2019

- The NHFP program supports outstanding postdoctoral scientists to pursue independent research.

MIT Physics Research Fellows Grant
MIT

Physics Department, MIT; Heising-Simons Foundation
2018

- Award granted for the project proposal "Creating a Rosetta Stone for the Interpretation of Exoplanet Biospheres".

Observing Proposals

- **ALMA (2018.A.00023.S):** Confirming phosphine's J = 1-0 transition in the atmosphere of Venus (PI: **J Greaves**; DDT).
- **IRTF (2020B043 and 2021A078):** Confirmation and Mapping of Phosphine on Venus (PI: **C Sousa-Silva**; both observations planned with TEXES, the first cancelled due to COVID]).

Publications

in review	**J Greaves** *et al., including* **C Sousa-Silva**, *On the Robustness of Phosphine Signatures in Venus' Clouds* (arxiv link)	*Matters Arising Nature*
in review	**J Greaves,** *et al., including* **C Sousa-Silva**, *Re-analysis of Phosphine in Venus' Clouds* (arxiv link)	*Matters Arising response*
in review	**W Bains** *et al., including* **C Sousa-Silva**, *Phosphine on Venus Cannot be Explained by Conventional Processes* (arxiv link)	*Astrobiology*
accepted	**J Camilo Zapata** *et al., including* **C Sousa-Silva***, *Computational IR Spectroscopy of 956 P-bearing Molecules*	*Frontiers*
accepted	**N Guerrero** *et al., including* **C Sousa-Silva**, *The TESS Objects of Interest Catalog*	*ApJS*
accepted	**Z Zhan** *et al., including* **C Sousa-Silva**, *Isoprene as a Biosignature Gas*	*Astrobiology*
2020	**F Wunderlich** *et al., including* **C Sousa-Silva**, *Detectability of biosignatures on LHS 1140 b* (DOI link)	*A & A*
2020	**P Strøm** *et al., including* **C Sousa-Silva**, *Exocomets from a Solar System Perspective* (DOI link)	*PASP*
2020	**T Encrenaz** *et al., including* **C Sousa-Silva**, *A stringent upper limit of the PH_3 abundance at the cloud top of Venus* (DOI link)	*A&A letters*
2020	**C Sousa-Silva, S Seager, JJ Petkowski, S Ranjan, Z Zhan, R Hu and W. Bains**, *Phosphine as a Biosignature Gas in Exoplanet Atmospheres* (DOI link)	*Astrobiology*
2020	**J Greaves** *et al., including* **C Sousa-Silva**, *Phosphine Gas in the Cloud Decks of Venus* (DOI link)	*Nature Astronomy*
2020	**S Ranjan** *et al., including* **C Sousa-Silva**, *Photochemistry of CO_2-Rich Anoxic Rocky Planet Atmospheres* (DOI link)	*ApJ*
2020	**V Airapetian** *et al., including* **C Sousa-Silva**, *Impact of space weather on climate and habitability of terrestrial-type exoplanets* (DOI link)	*IJA*
2019	**C Sousa-Silva, JJ Petkowski and S Seager**, *Molecular Simulations for the Spectroscopic Detection of Atmospheric Gases* (DOI link)	*PCCP*
2019	**W Bains, JJ Petkowski, C Sousa-Silva and S Seager**, *Trivalent Phosphorus and Phosphines as Components of Biochemistry in Anoxic Environments* (DOI link)	*Astrobiology*
2019	**W Bains, JJ Petkowski, C Sousa-Silva and S Seager**, *Thermodynamic ecology of biological phosphine production* (DOI link)	*Science of the Total Environment*
2018	**K L Chubb** *et al., and* **C Sousa-Silva***, *MARVEL analysis of the measured high-resolution rovibrational spectra of C_2H_2* (DOI link)	*JQSRT*
2017	**C Sousa-Silva, E J Barton, K L Chubb, M Gorman, L K McKemmish and J Tennyson**, *Original Research By Young Twinkle Students (ORBYTS)* (DOI link)	*Physics Education*
2017	**L K McKemmish** *et al., and* **C Sousa-Silva***, *MARVEL Analysis of the Measured High-resolution Rovibronic Spectra of 48Ti16O* (DOI link)	*ApJ Sup*
2016	**C Sousa-Silva, J Tennyson and S N Yurchenko**, *Communication: Tunnelling Splitting in the Phosphine Molecule* (DOI link)	*J Chem Phys*
2016	**J Tennyson** *et al., including* **C Sousa-Silva**, *The ExoMol database: molecular line lists for exoplanet and other hot atmospheres* (DOI link)	*JMS*
2014	**C Sousa-Silva, A F Al-Refaie, J Tennyson, S N Yurchenko**, *ExoMol line lists - VII: The Rotation-vibration Spectrum of Phosphine up to 1500K* (DOI link)	*MNRAS*
2014	**C Sousa-Silva, N Hesketh, S N Yurchenko and J Tennyson** , *High Temperature Partition Functions and Thermodynamic Data for Phosphine and Ammonia* (DOI link)	*JQSRT*
2013	**C Sousa-Silva, S N Yurchenko and J Tennyson**, *A Computed Room Temperature Line List for Phosphine* (DOI link)	*JMS*
2013	**C Sousa-Silva, G Veryasov, E Goreshnik, M Ponikvar and A Jesih**, *Crystal Structure and Vibrational Spectra of Hydrazinium (+1) Fluorocadmate* (DOI link)	*MfCCM*

***** Indicates a supervisory role

h-index: 13; i10-index: 14; total citations: 747. Total articles published in peer-reviewed journals since 2013: 19 (+ 6 articles accepted/in review). First-author articles: 8.

Talks and Panels (sample)

Institute for Theory and Computation — *Harvard University*
Colloquium Speaker — *February 2021*

Biosignatures VS Technosignatures — *Columbia University*
Debate Colloquium Speaker — *December 2020*

Life in the Universe — *Royal Astronomy Society*
Webinar Panelist — *November 2020*

Grande conférence de l'iREx — *Université de Montréal*
Public Lecture Speaker (virtual) — *November 2020*

Would we know life if we saw it? — *WIRED*
Webinar Speaker — *November 2020*

Life on Venus? Or much ado about nothing? — *SETI*
Webinar Speaker — *November 2020*

Chemistry Seminar (webinar) — *UNSW, Australia*
Speaker (INVITED) — *October 2020*

Astronomy Seminar (webinar) — *AMNH, USA*
Speaker (INVITED) — *September 2020*

"What Makes a Planet Uninhabitable?" — *Chicago, USA*
Speaker (INVITED); Online conference — *September 2020*

"Detecting and Interpreting Agnostic Biosignatures" — *Exoplanets III*
Speaker (CONTRIBUTED); Online conference — *July 2020*

Astrophysics Colloquium (webinar) — *Dartmouth College, USA*
Speaker (INVITED) — *May 2020*

Astrophysics Institute Seminar — *CAUP, Portugal*
Speaker (INVITED) — *March 2020*

Astrobiology and Planetary Exploration — *UCL, UK*
Speaker (INVITED) — *February 2020*

Planetary Seminar — *Cornell University, USA*
Speaker (INVITED) — *November 2019*

Geosciences Seminar - University of Chicago — *Chicago, USA*
Speaker (INVITED) — *October 2019*

AbSciCon 2019 — *Seattle, USA*
Speaker (CONTRIBUTED) — *June 2019*

ExoComets Meeting — *Leiden, Netherlands*
Speaker (INVITED) — *May 2019*

UK Exoplanets Meeting — *London, UK*
Speaker (INVITED) — *April 2019*

Proposals, Working Groups, and White Papers (sample)

2018-Now	**NASA NUP - PI: N Lewis/N Batalha**, A Community Tool for Computing, Visualizing, and Manipulating Molecular & Atomic Opacities	*Molecular Opacities Expert*
2019-Now	**TESS Team**, Target of Interest (TOI) vetter for planetary candidates from the TESS mission, using both the SPOC and the QLP pipelines.	*TOI Vetter*
2018-Now	**ARIEL Working Group for Molecular Spectroscopy**, Working group focused on spectroscopic parameters to support the science of the ARIEL space mission.	*Leader*
2018	**Hubble Space Telescope Cycle 27 GO Proposal - PI: L Kreidberg**, The ANTHEM Program: Atmospheres of sub-Neptunes from TESS with HST Exploratory Measurements (submitted)	*Molecular Opacities Expert*
2018	**NASA Exobiology Proposal - PI: S Seager**, A Database Approach to Life's use of Chemical Space for Insight into the Nature and Signatures of Life on Other Worlds	*Molecular Opacities Expert*
2017-2019	**Countless 2020 AMO and Astronomy Decadal Survey White Papers**, e.g., arXiv:1811.06157, arXiv:1903.04686, and arXiv:1903.04664	*Theoretical Spectra Expert*
2017	**SEEC/NExSS White Paper for NAS call on Exoplanet Science Strategy**, Exploring Extreme Space Weather Factors of Exoplanetary Habitability	*Co-author*

Broader Impacts (sample)

2016-Now	**Scientific Outreach:**, Director of the JUnior Research Award (JURA) and the Harvard-MIT Science Research Mentoring (SRMP) programs, where high-school students collaborate in publishable astrophysics research, and are paid a stipend.	*Director*
2016-Now	**Public Outreach:**, NOVA Exoplanet Lab for PBS; "Scientist in Every Florida School" for The University of Florida Thompson Earth Systems Institute; AMAzing Space with NOVA Speaker (Chat Plays GBH); FutureFest panelist (London); WGBH BostonTalks Presenter; "Life Beyond Earth" panelist (Boston Museum of Science); Breakthrough Discuss panelist; countless public appearances to discuss and present my work on phosphine.	*Science Contributor*
2016-Now	**Art Collaborations:**, Space Tapestry (Aleksandra Mir, TATE Liverpool); Multiverse: Octave of Light (David Ibbett, Boston Museum of Science).	*Science Contributor*
2016-2019	**WiXII (Women in Course 12) Board**, Organization dedicated to fostering a welcoming, supportive community for everyone in EAPS (MIT).	*Cabinet Member*
2017-2019	**Diversity Council (MIT)**, Advisory group for the development and implementation of DEI policy.	*Postdoc Rep*
2018-Now	**Proposal Panels**, Reviewer for multiple panels, including HST Cycle 28, the GWIS National Fellowship Program, NASA FDL 2019 Challenges, and the Heising-Simons MIT Physics Research Grants.	*Reviewer*
2018-Now	**Journal Reviews**, Reviewer for the Astrophysical Journal and the Journal of Molecular Spectroscopy.	*Reviewer*
2019	**Scientific American**, *When We Finally Find Aliens, They Might Smell Terrible*	*Op-ed writer*

Competencies

Technical Skills

- Career-long expertise in exoplanets and infrared spectroscopy, including leading the ARIEL working group for molecular opacities.
- Experience working within several space missions associated with exoplanet detection and characterization (e.g., Twinkle and TESS).
- Experience in the analysis of astronomical data from ALMA and TESS observations, and the calibration of industrial spectrometers.
- Native-level fluency in English and Portuguese, with (rusty) conversational Spanish and French.
- Excellent publication record, in spectroscopy, atmospheric chemistry, exoplanet characterization, and science outreach.

Behavioral Skills

- Excellent communication skills from a decade-long background in outreach, education, and the public dissemination of science.
- Extensive collaborative and team-working expertise from liaising with technical teams, artists, schools and the general public.
- Diplomatic and problem-solving skills from mentoring and managing science teams, ranging from school children to junior scientists.
- Management and leadership experience from organizing scientific committees, research projects, conferences, and public events.