

Clara Sousa-Silva

QUANTUM ASTROCHEMIST · SCIENCE COMMUNICATOR

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Experience

Research Scientist - 51 Pegasi b Fellow

Cambridge, USA

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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 PH₃ linelist for integration into HITEMP, GEISA and ExoMol databases, and application to high-resolution spectroscopy.

Co-Director of the Science Research Mentoring Program

Cambridge, USA

HARVARD-SMITHSONIAN CENTER FOR ASTROPHYSICS - MIT

June 2019 –

- Organizing and managing an outreach program where high school students do a year-long independent research project under the guidance of astrophysicists.
- 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.

Education

PhD in Astrophysics - Quantum Chemistry

London, UK

UNIVERSITY COLLEGE LONDON - EXOMOL GROUP

2011-2015

- 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". Grade: A.

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.
- 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.

Talks and Panels (recent sample)

Astrophysics Institute Seminar - CAUP	<i>Porto, Portugal</i>
SPEAKER (INVITED)	<i>March 2020</i>
Astrobiology and Planetary Exploration - University College London	<i>London, UK</i>
SPEAKER (INVITED)	<i>February 2020</i>
Planetary Seminar - Cornell University	<i>Ithaca, USA</i>
SPEAKER (INVITED)	<i>November 2019</i>
Geosciences Seminar - University of Chicago	<i>Chicago, USA</i>
SPEAKER (INVITED)	<i>October 2019</i>
AbSciCon 2019	<i>Seattle, USA</i>
SPEAKER (CONTRIBUTED)	<i>June 2019</i>
ExoComets Meeting	<i>Leiden, Netherlands</i>
SPEAKER (INVITED)	<i>May 2019</i>
UK Exoplanets Meeting	<i>London, UK</i>
SPEAKER (INVITED)	<i>April 2019</i>
MIT Haystack Colloquium	<i>Westford, USA</i>
COLLOQUIUM SPEAKER (INVITED)	<i>Jan. 2019</i>
Life Beyond Earth - Museum of Science	<i>Boston, USA</i>
PANELIST (INVITED)	<i>Nov. 2018</i>
Big History - University of Amsterdam	<i>Amsterdam, Netherlands</i>
SPECIAL GUEST LECTURER (INVITED)	<i>Oct. 2018</i>
Anton Pannekoek Institute Seminar - University of Amsterdam	<i>Netherlands</i>
SPEAKER (INVITED)	<i>Oct. 2018</i>
High Resolution Spectroscopy For Exoplanet Atmospheres	<i>Nice, France</i>
HORSE CONFERENCE SPEAKER (INVITED)	<i>Oct. 2018</i>
Spectroscopy of Exoplanets	<i>Cumberland Lodge, Windsor, UK</i>
CONFERENCE (INVITED)	<i>Jul. 2018</i>
Breakthrough Discuss	<i>Stanford University, USA</i>
PANELIST (INVITED)	<i>April 2018</i>

Working Groups, Committees, and Proposals (sample)

2018-Now	NASA NUP - PI: N Lewis/N Batalha , A Community Tool for Computing, Visualizing, and Manipulating Molecular & Atomic Opacities	<i>Molecular Opacities Expert</i>
2019-Now	TESS Team , Target of Interest (TOI) vetter for planetary candidates from the TESS mission, using both the SPOC and the QLP pipelines.	<i>TOI Vetter</i>
2018-Now	ARIEL Working Group for Molecular Spectroscopy , Working group focused on spectroscopic parameters to support the science of the ARIEL space mission.	<i>Leader</i>
2016-Now	WiXII (Women in Course 12) Board , Organization dedicated to fostering a welcoming, supportive community for everyone in EAPS (MIT).	<i>Cabinet Member</i>
2017-Now	Diversity Council , Advisory group for the implementation and improvement of diversity strategies at MIT.	<i>Postdoctoral Representative</i>
2018-Now	Proposal Panels , Reviewer in multiple panels, including the GWIS National Fellowship Program, NASA FDL 2019 Challenges, and the Heising-Simons MIT Physics Research Grants.	<i>Proposal reviewer</i>
2017-2019	Countless 2020 AMO and Astronomy Decadal Survey White Papers , e.g., arXiv:1811.06157 , arXiv:1903.04686 , and arXiv:1903.04664	<i>Theoretical Spectra Expert</i>
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)	<i>Molecular Opacities Expert</i>
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	<i>Molecular Opacities Expert</i>

Relevant Awards

51 Pegasi b Fellowship Grant Award

EAPS, MIT

HEISING-SIMONS FOUNDATION

2019

- The 51 Pegasi b Fellowship provides exceptional postdoctoral scientists with the opportunity to conduct theoretical, observational, and experimental research in planetary 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 which contributes to NASA Astrophysics. Sagan fellows are selected to answer the question: "Are We Alone?"

MIT Physics Research Fellows Grant

MIT

PHYSICS DEPARTMENT, MIT

2018

- Award granted for the project proposal entitled "Creating a Rosetta Stone for the Interpretation of Exoplanet Biospheres". Sponsors: Heising-Simons Foundation.

Publications

- 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:10.1089/ast.2018.1954 *Astrobiology*
- 2019 **C Sousa-Silva**, *When We Finally Find Aliens, They Might Smell Terrible* *Scientific American*
- 2019 **C Sousa-Silva, JJ Petkowski and S Seager**, *Molecular Simulations for the Spectroscopic Detection of Atmospheric Gases*; doi:10.1039/C8CP07057A *PCCP*
- 2019 **W Bains, JJ Petkowski, C Sousa-Silva and S Seager**, *Trivalent Phosphorus and Phosphines as Components of Biochemistry in Anoxic Environments*; doi:10.1089/ast.2018.1958 *Astrobiology*
- 2019 **W Bains, JJ Petkowski, C Sousa-Silva and S Seager**, *Thermodynamic ecology of biological phosphine production*, 658: 521-536; doi:10.1016/j.scitotenv.2018.12.086 *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 C₂H₂*, 204: 42-55; doi:10.1016/j.jqsrt.2017.08.018 *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)*, 53.1: 015020 *Physics Education*
- 2017 **L K McKemmish, et al., and C Sousa-Silva***, *MARVEL Analysis of the Measured High-resolution Rovibronic Spectra of 48Ti16O*, 228.2: 15 *ApJ Sup*
- 2016 **C Sousa-Silva, J Tennyson and S N Yurchenko**, *Communication: Tunnelling Splitting in the Phosphine Molecule*, 145, 091102; doi: 10.1063/1.4962259 *J Chem Phys*
- 2016 **J Tennyson, S Yurchenko, et al., including C Sousa-Silva**, *The ExoMol database: molecular line lists for exoplanet and other hot atmospheres*, 327, 73-94 *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*, 446.3: 2337-2347; doi:10.1093/mnras/stu2246 *MNRAS*
- 2014 **C Sousa-Silva, N Hesketh, S N Yurchenko and J Tennyson**, *High Temperature Partition Functions and Thermodynamic Data for Phosphine and Ammonia*, 142: 66-74; doi:10.1016/j.jqsrt.2014.03.012 *JQSRT*
- 2013 **C Sousa-Silva, S N Yurchenko and J Tennyson**, *A Computed Room Temperature Line List for Phosphine*, 288: 28-37; doi: 10.1016/j.jms.2013.04.002 *JMS*
- 2013 **C Sousa-Silva, G Veryasov, E Goresnik, M Ponikvar and A Jesih**, *Crystal Structure and Vibrational Spectra of Hydrazinium (+1) Fluorocadmate*, 144.10: 1455-1459 *MfCCM*

* Indicates a supervisory role

h-index: 8, total citations: 430, Total articles published in peer-reviewed journals since 2013: 13 (+ 4 articles in review). First-author articles: 8.