Sophia Vaughan

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Research Interests

- The characterisation of exoplanet atmospheres at high spectral resolution.
- Biosignatures, technosignatures and the search for extraterrestrial life.

Research Experience

2024-	**Max Planck Institute for Astronomy Postdoc, Supervisor: Prof. Laura Kreidberg** High spectral resolution characterisation of exoplanets in reflected light.
2020-2024	**University of Oxford Astrophysics DPhil, Supervisor: Prof. Jayne Birkby** Developed high spectral resolution techniques for characterising exoplanets in reflected light.
2019-2020	**University of Oxford Master's Project, Supervisor: Prof. Suzanne Aigrain** Worked on using Gaussian Processes to model stellar spectra and measure stellar radial velocities.
2019	**Joint Institute of VLBI - ERIC (JIVE), Supervisor: Prof. Huib Jan van Langevelde** Studied inverse phase referencing of MASERs using CASA (Common Astronomy Software Applications).
2018	**University of Oxford Astrophysics Summer Project, Supervisor: Dr Helen Spiers** Worked with the Zooniverse team on public outreach projects.

Education

2020-2024	**DPhil Astrophysics** **University of Oxford, St John's College** Thesis: *Reflected light from exoplanet atmospheres: towards rocky worlds* Supervisors: Prof Jayne Birkby and Prof Raymond Pierrehumbert
2016-2020	**Master of Physics, 1st Class Honours, 8th highest score in the cohort** **University of Oxford, St John's College** Masters Project: *Detection of Transiting Exoplanets with the TESS Space Mission* Supervisor: Prof Suzanne Aigrain

Conferences

Two HoRSEs	Berlin, Germany	Contributed Talk	Jul 2024
Exoplanets V	Leiden, Netherlands	Poster	Jun 2024
Extreme Solar Systems V	Christchurch, NZ	Poster	Mar 2024
Exoplanets Atmospheres to Architectures	Washington, US	Contributed Talk	Sep 2023
Exoplanets by the Lake	Munich, Germany	Contributed Talk	Aug 2023
Science with the Habitable Worlds Observatory and Beyond	Baltimore, US	Contributed Talk	Jul 2023
National Astronomy Meeting	Cardiff, UK	Contributed Talk	Jul 2023
Optimal Exoplanet Imagers	Leiden, Netherlands	Invited Workshop	Feb 2023
UKEXOM	Edinburgh, Scotland	Highlight Talk	Sept 2022
National Astronomy Meeting	Warwick, UK	Contributed Talk	Jul 2022
Rocky Worlds II	Oxford, UK	Contributed Talk	Jul 2022
Spirit of Lyot	Leiden, Netherlands	Poster	Jul 2022
Exoplanets IV	Las Vegas, US	Poster	May 2022
Spatially Resolved Spectroscopy with Extremely Large Telescopes	Oxford, UK	Poster	Sep 2021
EAS Annual Meeting	Online	Poster	Jul 2021
STScI Spring Symposium	Online	Poster	Apr 2021
Habitable Worlds	Online	Poster	Feb 2021

Telescope Observations

VLT(16.4m)/ESPRESSO	PI	2023B	2.5 nights	VM/dVM	*Mirror in the Desert: a high resolution reflection spectrum of the unusual ultra hot Neptune LTT-9779 b*
VLT(8.2m)/CRIRES+	Co-I	2023B	6.6 hours		*A Desert Island: Probing the Origins of the Desert with Atmospheric Transmission of a Hot Neptune*
VLT(8.2m)/ESPRESSO	Co-I	2022B	30 hours		*Through the Looking Glass: a high resolution ESPRESSO survey of exoplanet reflection spectra*
VLT(8.2m)/CRIRES+	Co-I	2022A	8 hours	dVM	*Revealing an atmosphere shrouded in mystery with high-resolution spectroscopy*

Data Analysis Experience

VLT(8.2m)/ESPRESSO	Data	Experience in analysing high-resolution spectroscopy observations of exoplanets in reflected light and of the unique challenges this poses.
VLT(16.4m)/ESPRESSO	Data	Developed analysis of high-resolution spectroscopy observations of exoplanets in reflected light with the 4UT mode and the differences between this and single UT mode.
VLT(8.2m)/CRIRES+	Simulation	Created simulated high-resolution spectroscopy observations of exoplanets (transit and emission) and analysed them to verify the observational requirements for observing proposals.
VLT(8.2m)/ESPRESSO	Simulation	Developed a high-resolution simulation of ESPRESSO observations of exoplanets (reflection) and analysed them to verify the observational requirements for observing proposals.
ELT(39m)/HARMONI	Simulation	Experience in simulating spatially resolved observations of exoplanets (reflection) and analysing them using the 'molecule mapping' method to determine science cases for the present instrument design.

Contributions to Academia

Major International Collaborations and Consortia

HARMONI consortium	2023-

Organisation of Scientific Meetings

SOC of breakout session at UK National Astronomy Meeting	Jul 2022

Teaching Experience

Waynflete Studies Programme tutor, Magdalen College School, Oxford UK	2023
Atmospheric Physics Marker, Department of Physics, University of Oxford, UK	2022-2024
Astrophysics TA, Department of Physics, University of Oxford, UK	2022
Mentor to Masters Student, Department of Physics, University of Oxford, UK	2021-2022

Grants, Honours and Awards

Gibbs Prize, Department of Physics, University of Oxford, UK	2019	£200
Gibbs Prize, Department of Physics, University of Oxford, UK	2018	£150
Casberd Scholarship, St. John's College, University of Oxford, UK	2017-2020	£300/yr

Press Releases and Outreach

Press	Commentary: Sophia Vaughan on searching for an exo-rainbow	Commentary	Jul 2023
Outreach	*Into the cosmos*, Oxford, UK	Volunteer	Jan 2023
Outreach	*Passport to the Solar System*, Oxford, UK	Volunteer	Jun 2021

Languages

Computing: Python, LaTeX and bash. Basic knowledge of: AIPS and Matlab
Spoken: English (native)

Publications

First Author:

[1] Sophia R. Vaughan, Birkby Jayne L., Thatte Niranjan, Carlotti Alexis, Houllé Mathis, Pereira-Santaella Miguel, Vigan Arthur, and Clarke Fraser. Behind the mask: can HARMONI/ELT detect biosignatures in the reflected light of Proxima b? *accepted to* MNRAS.

[2] Sophia R. Vaughan, Timothy D. Gebhard, Kimberly Bott, Sarah L. Casewell, Nicolas B. Cowan, David S. Doelman, Matthew Kenworthy, Johan Mazoyer, Maxwell A. Millar-Blanchaer, Victor J. H. Trees, Daphne M. Stam, Olivier Absil, Lisa Altinier, Pierre Baudoz, Ruslan Belikov, Alexis Bidot, Jayne L. Birkby, Markus J. Bonse, Bernhard Brandl, Alexis Carlotti, Elodie Choquet, Dirk van Dam, Niyati Desai, Kevin Fogarty, J. Fowler, Kyle van Gorkom, Yann Gutierrez, Olivier Guyon, Sebastiaan Y. Haffert, Olivier Herscovici-Schiller, Adrien Hours, Roser Juanola-Parramon, Evangelia Kleisioti, Lorenzo König, Maaike van Kooten, Mariya Krasteva, Iva Laginja, Rico Landman, Lucie Leboulleux, David Mouillet, Mamadou N'Diaye, Emiel H. Por, Laurent Pueyo, and Frans Snik. Chasing rainbows and ocean glints: Inner working angle constraints for the Habitable Worlds Observatory. MNRAS, 524(4):5477–5485, October 2023.

Co-author:

[3] Luke T. Parker, Jayne L. Birkby, Rico Landman, Joost P. Wardenier, Mitchell E. Young, Sophia R. Vaughan, Lennart van Sluijs, Matteo Brogi, Vivien Parmentier, and Michael R. Line. Into the red: an M-band study of the chemistry and rotation of β Pictoris b at high spectral resolution. MNRAS, 531(2):2356–2378, June 2024.

[4] J. Fowler, Sebastiaan Y. Haffert, Maaike A. M. van Kooten, Rico Landman, Alexis Bidot, Adrien Hours, Mamadou N'Diaye, Olivier Absil, Lisa Altinier, Pierre Baudoz, Ruslan Belikov, Markus Johannes Bonse, Kimberly Bott, Bernhard Brandl, Alexis Carlotti, Sarah L. Casewell, Elodie Choquet, Nicolas B. Cowan, Niyati Desai, David Doelman, Kevin Fogarty, Timothy D. Gebhard, Yann Gutierrez, Olivier Guyon, Olivier Herscovici-Schiller, Roser Juanola-Parramon, Matthew Kenworthy, Elina Kleisioti, Lorenzo Konig, Mariya Krasteva, Iva Laginja, Lucie Leboulleux, Johan Mazoyer, Maxwell A. Millar-Blanchaer, David Mouillet, Emiel Por, Laurent Pueyo, Frans Snik, Dirk van Dam, Kyle van Gorkom, and **Vaughan, Sophia R.** Visible extreme adaptive optics on extremely large telescopes: Towards detecting oxygen in Proxima Centauri b and analogs. *arXiv e-prints*, page arXiv:2309.00725, September 2023.

[5] Niyati Desai, Lorenzo König, Emiel Por, Roser Juanola-Parramon, Ruslan Belikov, Iva Laginja, Olivier Guyon, Laurent Pueyo, Kevin Fogarty, Olivier Absil, Lisa Altinier, Pierre Baudoz, Alexis Bidot, Markus Johannes Bonse, Kimberly Bott, Bernhard Brandl, Alexis Carlotti, Sarah L. Casewell, Elodie Choquet, Nicolas B. Cowan, David Doelman, J. Fowler, Timothy D. Gebhard, Yann Gutierrez, Sebastiaan Y. Haffert, Olivier Herscovici-Schiller, Adrien Hours, Matthew Kenworthy, Elina Kleisioti, Mariya Krasteva, Rico Landman, Lucie Leboulleux, Johan Mazoyer, Maxwell A. Millar-Blanchaer, David Mouillet, Mamadou NDiaye, Frans Snik, Dirk van Dam, Kyle van Gorkom, Maaike van Kooten, and **Vaughan, Sophia R.** Integrated photonic-based coronagraphic systems for future space telescopes. *arXiv e-prints*, page arXiv:2309.04925, September 2023.

[6] N. L. Eisner, O. Barragán, C. Lintott, S. Aigrain, B. Nicholson, T. S. Boyajian, S. Howell, C. Johnston, B. Lakeland, G. Miller, A. McMaster, H. Parviainen, E. J. Safron, M. E. Schwamb, L. Trouille, **Vaughan, S.**, N. Zicher, C. Allen, S. Allen, M. Bouslog, C. Johnson, M. N. Simon, Z. Wolfenbarger, E. M. L. Baeten, D. M. Bundy, and T. Hoffman. Planet Hunters TESS II: findings from the first two years of TESS. MNRAS, 501(4):4669–4690, March 2021.