Dr. Brett Christopher Addison

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Education:

2010 – 2015	University of New South Wales	Ph.D. Astrophysics "Spin-orbit Alignments of Exoplanets" *Ph.D. conferred on 15 April 2015*
2005 – 2009	Florida Institute of Technology	B.Sc. Astronomy/Astrophysics and Mathematical Sciences Dual major (graduated w/ Magna Cum Laude)

Personal Statement:

I am an Adjunct Postdoctoral Research Associate in the Centre for Astrophysics and Supercomputing at Swinburne University of Technology focused on measuring the fundamental constant α using high-resolution spectra of giant stars. I am working with Prof. Michael Murphy on measuring variations in α (governs the strength of the electromagnetic force) throughout the Milky Way. I am also an Adjunct Research Fellow at the University of Southern Queensland working with the exoplanet group on the detection and characterisation of exoplanets. Specifically, I am using the MINERVA-Australis telescope array located at the Mt. Kent Observatory as well as space-based telescopes such as NASA's Transiting Exoplanet Survey Satellite (*TESS*) to study exoplanets. I am also interested in the formation and migration histories of planets, characterisation of exoplanetary atmospheres, and how these atmospheres are shaped and evolve due to the magnetic activity and XUV environment of the host star.

Skills & Abilities:

- Significant programming and data analysis skills using Python, modern Fortran, IDL, and experience in R and Matlab.
- Experience with Nested Sampling and Markov Chain Monte Carlo Bayesian modelling techniques in Python.
- Developed analysis tools in Python and Fortran for data collected from MINERVA-Australis and other telescopes around the world as well as tools to fit and model transit light curves and radial velocities.
- Extensive use of data visualisation packages and tools in Python (e.g., Matplotlib and Bokeh).
- Experience running data analysis code using High-Performance Computing (HPC) resources.
- Active observer on MINERVA-Australis, Stellar Observations Network Group (SONG) telescope, & the Anglo-Australian Telescope, acquiring data to confirm transiting planet candidates, measure their masses, and spin-orbit alignments.
- Experience writing Python scripts and using APIs to query/extract stellar properties from catalogues and databases.
- Excellent communications skills through presentation of research findings at international and domestic conferences, publication of results in top quartile (Q1) peer-review journals, and strong collaborations with international partners and stakeholders (such as at MIT, Harvard, NASA, George Mason University, UC Riverside, etc.).

Research Experience:

11/2022 – 12/2023 **Swinburne University of Technology (Postdoctoral Research Associate)**
Supervisor: Prof. Michael Murphy **Location:** Hawthorn, Vic Australia (remotely)

12/2023 – current **Adjunct Postdoctoral Research Associate**

- *Working on measuring the fine structure constant α using high-resolution spectra of red clump stars collected from HARPS, ESPRESSO, and Keck Planet Finder (KPF) spectrographs.*
- *Using red clump stars observed at great distances towards our galactic centre to test non-standard models of physics and theories of α-variation in regions with higher dark matter densities.*
- *Analyzing the spectra of giant stars to look for spectral features that predict evolutionary state using a differential equivalent width method.*
- *Demonstrated that nearby (~150pc) red clump stars can be used to measure α using archival HARPS spectra.*
- *Awarded 4.1hr on VLT/ESPRESSO in 2023B to transfer α measurement models from HARPS to ESPRESSO.*

08/2018 – 07/2022 **University of Southern Queensland (Research Fellow in Astrophysics)**
Supervisor: Prof. Rob Wittenmyer **Location:** Toowoomba, QLD Australia
07/2022 – current **Adjunct Research Fellow**

- *Led the radial velocity follow-up and confirmation of TESS transiting exoplanet candidates using the MINERVA-Australis Telescope array and SONG telescopes.*
- *Characterised and measured the bulk properties of exoplanets from the analysis of data collected from telescopes around the world and in space.*
- *Made the exciting discovery of an ultra-hot Jupiter called TOI-1431b (Addison et al. 2021). Measured the planet's mass, radius, and day/nightside temperatures (second hottest nightside temperature ever measured). Discovery gained significant media coverage, including in the ABC, 7News, CNET, and Brisbane Times.*
- *Published planet discovery and mass measurement of TOI-257b (Addison et al. 2021).*
- *Measured the Spin-orbit alignment of one of the youngest planets, AU Mic b (Addison et al. 2021).*
- *Published the Minerva-Australis commissioning paper (Addison et al. 2019).*
- *Contributed to the discovery of an additional **47** TESS exoplanets and co-author on **24** planet discovery papers.*
- *Taught several astronomy/astrophysics courses as examiner and tutor.*

07/2021 – current ***University of Southern Queensland (Astrophysics lecturer/tutor)***

- *Instructed courses in astronomy/astrophysics as course examiner/assistant examiner and tutor where I conducted weekly tutorials and designing assessments tailored to foster critical thinking and data analysis skills.*
- *Taught a course in data science (Principles of/Introduction to Data Science & Visualization) as a tutor, delivering comprehensive instruction on foundational data science concepts and Python-based visualization techniques during twice-weekly two-hour tutorials.*
- *Consistently earned high marks, with student survey ratings consistently exceeding 4 out of 5, reflecting my commitment to delivering engaging and effective instruction in both astronomy and data science courses.*

12/2015 – 06/2018 **Mississippi State University (Postdoctoral Researcher)**
Supervisor: Prof. Angelle Tanner **Location:** Starkville, MS USA

- *Worked on developing the Starchive Stellar and Planetary Database.*
- *Measured spin-orbit alignments of hot Jupiters and multi-planet systems via the Rossiter-McLaughlin effect.*
- *Significantly contributed to the measurement of the spin-orbit alignment of Kepler-9 multi-planet system (one of only a few multi-planet systems with such measurements) with Keck RV observations (Wang, Addison, et al 2018).*
- *Published results on the nearly polar orbits of WASP-100b & WASP-109b and spin-orbit alignment of WASP-72b (Addison et al. 2018).*
- *Published results on the spin-orbit alignment of WASP-103b, WASP-87b, & WASP-66b (Addison et al. 2016).*

07/2010 – 04/2015 **University of New South Wales Exoplanetary Science Group (Ph.D. work)**
Supervisor: Prof. Chris Tinney **Location:** Sydney, NSW Australia

- *Measured exoplanet spin-orbit alignments via the Rossiter-McLaughlin effect.*
- *Developed ExOSAM analysis tool (written in Fortran and IDL) to model transit light curves, radial velocities, and Rossiter-McLaughlin effect of exoplanet host stars.*
- *Published results on the spin-orbit alignment of HATS-3b in ApJ (Addison et al. 2014).*
- *Published results on the polar orbit of WASP-79b in ApJ Letters (Addison et al. 2013).*
- *Worked in the team (led in Australia by Daniel Bayliss & Chris Tinney) following-up HATSouth transiting planet candidates with radial velocity measurements using CYCLOPS2 + UCLES on the AAT. Led the effort to measure the spin-orbit alignments of extrasolar planets.*

Publications Statistics:

56 published peer reviewed papers — **9** as first author. Author on a total of **56** journal papers, **4** refereed conference proceedings, and **15** other conference presentations. H-index of **24** (ADS)/**26** (Google Scholar). ADS Library of my papers.

HDR Supervision:

06/2021 – current — Co-supervisor of PhD student Tony Wells at UniSQ.
Supervising student on measuring orbital obliquities of exoplanets and eclipsing binary stars to understand their formation and migration histories.

02/2020 – current — Co-supervisor of PhD student John Gianforte at UniSQ.
Supervising student on measuring transit timing variations to discover new exoplanets and understand planet demographics, formation, and evolution.

02/2022 – 12/2022 — Principal supervisor of Jarrod Slater Master's degree Research Project (MSC8001/8002) at UniSQ.
Supervised student project on searching for long-period exoplanets using MINERVA-Australis. ***Completed Master's degree****.*

02/2022 – 12/2022 — Principal supervisor of Rebecca Barrett Master's degree Research Project (MSC8001/8002) at UniSQ.
Supervised student project on searching for narrow-band transmission from transiting exoplanets observed by TESS using Parkes radio data. ***Completed Master's degree****.*

02/2020 – 12/2020 — Principal supervisor of Tony Wells Master's degree Research Project (MSC8001/8002) at UniSQ.
Successfully supervised student project on characterising exoplanets with MINERVA-Australis. ***Completed Master's degree****.*

Recent Teaching Experience and Course Development:

09/2024 – 12/2024 — Course tutor and marker for PHY1107 Astronomy 2 at UniSQ.
Ran the course tutorial sessions and marked assignments and exams.

09/2024 – 12/2024 — Course marker for PHY6002 Stellar Astrophysics at UniSQ.
Marked assignments and exams for the course.

07/2022 – 10/2022 — Course examiner, tutor, and marker for PHY8003 Galactic Astronomy and Cosmology at UniSQ.
Ran the course tutorial sessions and developed and marked assignments and exams.

07/2022 – 10/2022 — Course examiner, tutor, and marker for PHY8004 Stellar Astronomy at UniSQ.
Ran the course tutorial sessions and developed and marked assignments and exams.

07/2022 – 10/2022 — Course examiner, tutor, and marker for PHY3307 Galactic & Extragalactic Astronomy at UniSQ.
Ran the course tutorial sessions and developed and marked assignments and exams.

07/2022 – 10/2022 — Course tutor for CSC3501/8001 Principles of/Introduction to Data Science & Visualisation at UniSQ.
Ran the course workshop sessions.

02/2022 – 06/2022 — Course assistant examiner, tutor, and marker for PHY3306 Solar & Stellar Astronomy at UniSQ.
Ran the course tutorial sessions and developed and marked assignments and exams.

02/2022 – 06/2022 — Course tutor and marker for PHY2204 Astronomical Techniques at UniSQ.
Ran the course tutorial sessions and marked assignments and exams.

02/2022 – 06/2022 — Course tutor and marker for SCI8102 Research Skills at UniSQ.
Ran the course tutorials/workshop sessions and marked assignments.

08/2021 – 11/2021 — Course assistant for PHY8003 Galactic Astronomy and Cosmology at UniSQ.
Ran the course tutorial sessions and marked assignments and exams.

08/2021 – 11/2021 — Course assistant for PHY8004 Stellar Astronomy at UniSQ.

Ran the course tutorial sessions and marked assignments and exams.

08/2021 – 11/2021 Course assistant for PHY3307 Galactic and Extragalactic Astronomy at UniSQ.
Ran the course tutorial sessions and marked assignments and exams.

08/2021 – 11/2021 Course assistant for PHY1107 Astronomy 2 at UniSQ.
Marked the assignments and exams.

08/2021 – 11/2021 Course assistant for PHY8102 Research Skills at UniSQ.
Marked the assignments.

Recent Telescope Time Allocation:

1. *Testing fundamental physics with distant red clump stars – Phase 1: Bright local reference stars*
Addison, B. (PI), Murphy, M. (D-PI), Scott, B., Flynn, C., Fan, L., et al.
Awarded 4.1hr on VLT/ESPRESSO 2023B.

2. *Using obliquity to probe the formation and migratory history of brown dwarfs*
Wells, T. (PI), **Addison, B.** (D-PI), & Wittenmyer, R.
Awarded 1.75 nights on 3.6m/HARPS 2023B.

3. *Probing the Origins of Warm and Tropical Jovian and sub-Jovian planets by Measuring their Orbital Obliquities*
Addison, B., Wright, D., Wittenmyer, R., Bergmann, C., Schwab, C., Wang, S., Zhou, G., & Knight, S.
Awarded 2 night on AAT/Veloce 2020B.

4. *Confirming and Characterising the TESS Warm and Tropical Jovian candidates with SONG*
Addison, B., Wittenmyer, R., Wright, D., Clark, J., & Wang, S.
Awarded 77 hours on SONG 2020B. Resulted in two publications on TOI-1431b/MASCARA-5b.

5. *Detecting and characterising newly found Warm and Tropical Jovians with SONG*
Addison, B., Wittenmyer, R., Wright, D., Clark, J., & Wang, S.
Awarded 98 hours on SONG 2020A.

Time Allocation Committees:

1. *Member of the SONG time allocation committee*
April 2020 – April 2021

Recent Public Outreach & Press:

13/01/2023 **7News Toowoomba TV interview on Discovery of TOI-778b**
- *TV interview can be accessed at https://fb.watch/i1ErGiEpvy/?mibextid=VhDh1V.*

28/04/2021 **Live interview on ABC Radio Mornings with Rebecca Levingston on the Discovery of TOI-1431b**
- *Radio interview starts at ~57 minutes at https://www.abc.net.au/radio/brisbane/programs/mornings/mornings/13312764.*

15/03/2021 **Invited Astronomy public outreach talk to the Macarthur Astronomical Society (MAS)**
- *Gave a 1-hour presentation to MAS on 'The Hunt for & Characterization of Alien Worlds Beyond the Solar System'.*

25/06/2020 **7News Toowoomba TV interview on AU Mic b Discovery and Follow-up**
- *TV interview can be accessed at https://www.youtube.com/watch?v=z9-6zltEouw.*

23/01/2020 **ABC Radio Brisbane interview on Discovery of TOI-257b**

22/01/2020 **7News Toowoomba TV interview on Discovery of TOI-257b**
- *Written article and TV interview can be accessed at https://tinyurl.com/rx7nkyq.*

04/03/2018 **Science at the Tavern Astronomy Public Outreach @ Dave's Dark Horse Tavern**

- *Presented astronomical talks to audience of ~ 60 people about the Solar System, Exoplanets, & Life Beyond Earth. The event last approximately 2 hours.*
- *Presentation was interactive that included karaoke, astro trivia, and fun science news. Similar to Astronomy on Tap. https://www.msstate.edu/events/2018/02/science-tavern/*
- *Planned and organized the event.*

Select Journal Publications (full list available on ADS here):

1. *Spinning up a Daze: TESS Uncovers a Hot Jupiter orbiting the Rapid-Rotator TOI-778:*
   Clark, Jake, **Addison, Brett C.**, Okumura, Jack, Vach, Sydney, Heitzmann, Alexis,..., 2023, The Astronomical Journal, 165, 207. 2023AJ....165..207C

2. *TOI-1431b/MASCARA-5b: A Highly Irradiated Ultra-Hot Jupiter Orbiting One of the Hottest & Brightest Known Exoplanet Host Stars:*
   Addison, Brett C., Knudstrup, Emil, Wong, Ian, Hebrard, Guillaume, Dorval, Patrick,..., 2021, The Astronomical Journal, 162, 292. 2021AJ....162..292A

3. *The obliquity and atmosphere of the ultra-hot Jupiter TOI-1431b (MASCARA-5b): A misaligned orbit and no signs of atomic or molecular absorptions:*
   Stangret, M., Pallé, E., Casasayas-Barris, N., Oshagh, M., Bello-Arufe, A., Luque, R., Nascimbeni, V., Yan, F., Orell-Miquel, J., Sicilia, D., Malavolta, L., **Addison, B. C.**,..., 2021, Astronomy & Astrophysics, 654, 73. 2021A&A...654A..73S

4. *The Youngest Planet to Have a Spin-Orbit Alignment Measurement AU Mic b:*
   Addison, Brett C., Horner, Jonathan, Wittenmyer, Robert A., Plavchan, Peter,..., 2021, The Astronomical Journal, 162, 137. 2021AJ....162..137A

5. *TOI-257b (HD 19916b): A Warm sub-Saturn Orbiting an Evolved F-type Star:*
   Addison, Brett, Wright, Duncan J., Nicholson, Belinda A., Cale, Bryson, Mocnik, Teo,..., 2021, Monthly Notices of the Royal Astronomical Society, 502, 3704. 2021MNRAS.502.3704A

6. *Minerva-Australis. I. Design, Commissioning, and First Photometric Results:*
   Addison, Brett, Wright, Duncan J., Wittenmyer, Robert A., Horner, Jonathan, Mengel, Matthew W.,..., 2019, Publications of the Astronomical Society of the Pacific, 131, 115003. 2019PASP..131k5003A

7. *Stellar Obliquities & Planetary Alignments (SOPA). I. Spin-Orbit Measurements of Three Transiting Hot Jupiters: WASP-72b, WASP-100b, and WASP-109b*
   Addison, Brett, Wang, S., Johnson, M., Tinney, C., Wright, D., Bayliss, D., 2018, The Astronomical Journal, 156, 197. 2018AJ....156..197A

8. *Spin-Orbit Alignment for Three Transiting Hot Jupiters: WASP-103b, WASP-87b, & WASP-66b*
   Addison, Brett, Tinney, C., Wright, D., Bayliss, D., 2016, Astrophysical Journal, 823, 29. 2016ApJ...823...29A

9. *A Spin-Orbit Alignment for the Hot Jupiter HATS-3b*
   Addison, Brett, Tinney, C., Wright, D., Bayliss, D., 2014, Astrophysical Journal, 792, 112. 2014ApJ...792..112A

10. *A Nearly Polar Orbit for the Extrasolar Hot Jupiter WASP-79b*
    Addison, Brett, Tinney, C., Wright, D., Bayliss, D., Zhou, G., Hartman, J. D., Bakos, G. Á., Schmidt, B. 2013, Astrophysical Journal Letters, 774, 9. 2013ApJ...774L...9A

Recent Conference/Workshop proceedings & Colloquiums/Seminars:

1. *Exoplanet Discovery and Characterisation in the era of TESS and JWST (June 2023)*

Invited colloquium presentation at the University of Melbourne, Parkville, VIC, Australia.

2. *Exoplanet Discovery and Characterisation with the MINERVA-Australis Telescope Array in the era of TESS and JWST (2022)*
Oral presentation at the Astronomical Society of Australia Conference (ASA), Hobart, Australia.

3. *TOI-1431b/MASCARA-5b: An Ultra-hot Jupiter Orbiting One of the Hottest & Brightest Known Exoplanet Host Stars (2021)*
Invited Talk – TESS Science Conference II (virtual presentation).

4. *TOI-1431b/MASCARA-5b: A Highly irradiated hot Jupiter on a nearly polar orbit around one of the hottest known exoplanet host stars (2021)*
Invited Talk – TESS Science Team Meeting #24 (virtual presentation).

5. *Exoplanet Discovery with MINERVA-Australis: The Confirmation of the TESS Transiting Warm sub-Saturn Candidate, TOI-257b (2021)*
Oral presentation at the 43rd COSPAR 2021 Scientific Assembly, virtual conference.

6. *Minerva-Australis Confirms TESS Warm sub-Saturn Candidate TOI-257b & Measures the Orbital Obliquity of AU Mic b (2020)*
Poster presentation at Exoplanets III Conference, virtual conference (Covid-19, formally in Heidelberg, Germany).