

Dr Joseph Callingham

PERSONAL DETAILS

Nationality: Australian

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EDUCATION

THE UNIVERSITY OF SYDNEY

December 2013 - January 2017 PHD IN ASTROPHYSICS

Title: *The Extragalactic Sky at Low Radio Frequencies: A Study of Peaked-Spectrum Sources*

Supervisors: Prof. Bryan Ganesler and Prof. Ron Ekers

2009 - 2012 BACHELOR OF SCIENCE (ADVANCED) - FIRST CLASS HONOURS (PHYSICS)

Majors: Physics, Applied Mathematics. **Minors:** Ancient Greek History, Political Science.

EMPLOYMENT

January 2023 - present	Head of the SKA Science Group, ASTRON
January 2023 - present	Adjunct Assistant Professor, Leiden University
January 2020 - December 2022	NWO Veni Fellow, Leiden University
January 2017 - December 2019	de Bruyn Fellow, ASTRON

REFEREED PAPERS

I am first author of **eleven papers** published in *Nature Astronomy*, *The Astrophysical Journal*, *Astronomy and Astrophysics*, and *Monthly Notices of the Royal Astronomical Society*. I am also co-author of an additional 85 papers published in a range of peer-reviewed journals, 42 of which I have contributed to significantly. I have published two first-author papers in *Nature Astronomy*. My **h-index is 26**, with a total of 2,942 citations. **Four of my papers have over 100 citations each.** Bibliographic information for my highest impact work and total publication record can be found at the end of this CV.

SUCCESSFUL TELESCOPE PROPOSALS

I have been the principal and co-investigator on successful proposals for a range of telescopes spanning the electromagnetic spectrum. With respect to co-investigated proposals, I have been part of 35 proposals that have been awarded a total time of 800+ hours. I list the telescopes and time awarded below for proposals for which I was PI:

Radio: LOFAR (454 hrs) • ALMA (1 hr) • ATCA (106 hrs) • VLA (40 hrs) • EVN (30 hrs) • VLBA (22 hrs) • LBA (10 hrs) • GMRT (50 hrs) • MWA (60 hrs)

Optical/IR: VLT (20 hrs - on VISIR, SINFONI, NACO, GRAVITY, and XSHOOTER) • TNG (5 hrs - on Harps-N) • Magellan Telescopes (4 hrs) • AAT (6 hrs) • Keck (6 hrs)

X-ray: Swift X-ray Telescope (2 hrs) • XMM-Newton (5 hrs)

SKILLS

LOW RADIO FREQUENCY INTERFEROMETRY AND ALL-SKY SURVEYS

I am an **integral member** of the teams producing the high-impact LOFAR and Murchison Widefield Array all-sky surveys. This has provided me with **extensive experience in radio observations** and developing data reduction software for new telescopes. Producing the all-sky survey also means I have acquired detailed knowledge about radio astronomy instrumentation, and how best to extract science from widefield surveys. My recent long-term legacy LOFAR proposal observing star-planet interactions was recently awarded over 300 hours.

SKILLS (CONTINUED)

STATISTICS AND BIG DATA

Experience in **Bayesian statistics** and **Markov Chain Monte Carlo (MCMC)** methods, with a specialty in model inference. These skills allow me to robustly leverage the most information out of large data sets, which is key for scientifically exploiting the science from the new generation of astronomical instruments.

COMMUNICATION

Proficient **public speaker** and **debater**. I have presented complex scientific results to the general public and professional audiences.

TEAMWORK AND LEADERSHIP

Successfully worked in, and led, **large international consortia** to achieve complex research goals. I have had many **leadership roles** within academia allowing me to be highly adaptable in team environments.

PROGRAMMING

Comprehensive experience in a diverse range of programming languages, with an **ability to quickly adapt** to a new language most suited to a task. I have extensive experience with Python, MySQL, Shell, CSS, and Matlab. I also have practice utilising supercomputers to **process large data sets**.

MULTI-WAVELENGTH EXPERIENCE AND DIVERSE SCIENCE INTERESTS

I am first author of a range of papers in Galactic and extragalactic astrophysics that cover the electromagnetic spectrum. Such diverse publications demonstrates that I have the necessary skills to quickly learn a new area and make a significant contribution. I have also been PI for numerous optical, IR, radio, and X-ray instruments.

SELECTED ACADEMIC GRANTS AND AWARDS

2021	Astronomical Society of Australia's (ASA's) Lousie Webster Prize - for outstanding research by an early-career scientist post-PhD (€1,700)
2020	Lorentz Centre Workshop (€28,000)
2019	NWO Veni Grant (€250,000)
2018	Visiting CSIRO Fellow (€3,000)
2017	The University of Sydney Graduate Merit Award (€12,500)
2017	Curtin University Visiting Scholarship (€3,000)
2016	Australian Delegate for the 66th Lindau Nobel Laureate Meeting and best poster (€5,000)
2014 - 2017	Office of the Chief Executive (OCE) CSIRO Postgraduate Scholarship (€13,000)
2013 - 2017	Australian Postgraduate Award (APA) (€56,000)
2012	Australian Gemini Undergraduate Summer Studentship (€5,000)
2009 - 2013	The University of Sydney Undergraduate Scholarship of Merit (€12,500)

INVITED LONG INTERNATIONAL RESEARCH VISITS

Such research visits were for > 3 weeks.

2019	CSIRO visitor, Sydney, Australia
2017	Curtin University visitor, Perth, Australia

INVITED COLLOQUIA TALKS

Such invitations involved a 3 to 5 day visit to the host institute (exluding March 2020 to March 2022).

December 2022	Department of Astronomy, Armagh Observatory & Planetarium, Armagh, UK
April 2022	Department of Astronomy, Yale University, Yale, USA
March 2022	School of Physical Sciences, Open Univeristy, Milton Keynes, UK
October 2021	Centre for Astrophysics Research, University of Hertfordshire, Herftforshire, UK
May 2021	Thüringer Landessternwarte (TLS), Friedrich Schiller University Jena, Germany
January 2021	Institute for Astrophysical Research, Boston University, Boston, USA
December 2020	Curtin Institute of Radio Astronomy, Curtin University, Perth, Australia
June 2020	School of Physics, Trinity College Dublin, The University of Dublin, Ireland
February 2020	Department of Physics and Astronomy, University of Leicester, Leicester, UK
December 2019	Dunlap Institute for Astronomy and Astrophysics, University of Toronto, Toronto, Canada

INVITED COLLOQUIA TALKS (CONTINUED)

November 2019	Center for Computational Astrophysics, Flatiron Institute, New York, USA
October 2019	Center for Cosmology and Particle Physics, New York University, New York, USA
June 2019	Botswana International University of Science and Technology, Palapye, Botswana
November 2018	Torun Centre for Astronomy, Nicolaus Copernicus University, Torun, Poland
November 2018	Jodrell Bank Centre for Astrophysics, University of Manchester, Manchester, UK
June 2018	School of Physics, University of Nairobi, Nairobi, Kenya
May 2018	Sydney Institute for Radio Astronomy, University of Sydney, Sydney, Australia
May 2018	CSIRO Astronomy and Space Science (CASS), Sydney, Australia
November 2017	Kapteyn Institute, University of Groningen, Groningen, The Netherlands
June 2017	Joint physics and astronomy colloquium, The University of Bologna, Bologna, Italy
May 2017	SPI-MAX Seminar, Department of Physics, The University of Oxford, Oxford, UK
May 2017	ISOLDE Seminar, CERN, Geneva, Switzerland
August 2016	SKA-Office and University of Cape Town, Cape Town, South Africa
February 2016	National Radio Astronomy Observatory (NRAO), Socorro, USA

INVITED CONFERENCE TALKS

I have given over 45 conference talks to a variety of audiences, including general scientists at the AAS, ASA, and EAS, and specialised optical and radio astronomical communities. Below I list my invited talks and the conferences they were presented at:

September 2022	<i>To Boldly Go: Science in the SKA-Era</i> VLA Sky Survey in the Multiwavelength Spotlight, Socorro, USA
April 2022	<i>Radio exoplanets and Stars: First Detections</i> Exoplanets 4, Las Vegas, USA
February 2022	<i>Alfvén Engines in Space: Stellar Systems at Low-Frequencies</i> VLBI in the SKA Era, Manchester, UK
July 2021	<i>Riding the serpent's tail: The Discovery of Apep</i> , Louise Webster Prize Talk Annual Meeting of the Astronomical Society of Australia (ASA), Melbourne, Australia
February 2021	<i>Radio exoplanets: Discoveries</i> , SKA Cradle of Life (CoL), Manchester, UK
October 2020	<i>Radio exoplanets and stars</i> , GLOW, Munich, Germany
November 2019	<i>Stellar systems at milliarcsecond resolution</i> , NL-VLBI, Zwolle, The Netherlands
August 2019	<i>Radio stars and exoplanets</i> , AAS Extreme Solar Systems IV, Reykjavik, Iceland
June 2019	<i>A Twist in the Tail: Anisotropic Mass Loss in New Wolf-Rayet Binary System</i> , EWASS, Lyon, France
December 2018	<i>LOFAR2 and LOFAR Update: International baselines under control</i> , Science at Low Frequencies V, Nagoya, Japan
June 2017	<i>Dying young and Frustrated? A low radio frequency view of young radio galaxies</i> , The Broad Impact of Low Frequency Observing, Bologna, Italy

ORGANISED SCIENTIFIC MEETINGS

Meetings where I was chair of the Science Organising Committee (SOC) and/or Local Organising Committee (LOC) are shown in bold.

July 2022	Life Around a Radio Star, Lorentz Centre, Leiden, The Netherlands, SOC/LOC
December 2021	Science at Low Frequencies VIII, Leiden, The Netherlands, SOC/LOC
May 2021	6th workshop on CSS and GPS radio sources, Torun, Poland, SOC
December 2020	Science at Low Frequencies VII, Amsterdam, The Netherlands, SOC/LOC
June 2018	HI absorption in galaxies, Dwingeloo, The Netherlands, SOC
April 2018	AGN and the next generation of radio telescopes, EWASS, Liverpool, UK, SOC
March 2018	LOFAR International Baseline Survey Workshop, Lorentz Centre, Leiden, The Netherlands, SOC
March 2018	Life Cycle of Radio AGN, Dwingeloo, The Netherlands, LOC
April 2018	ASTRON Hackathon, Dwingeloo, The Netherlands, Chair SOC/LOC

ACADEMIC GOVERNANCE SERVICE

I am also a regular referee for *Nature Astronomy*, *ApJ*, *MNRAS*, *A&A*, and *PASA*.

- 2022 - present MWA TAC Member
- 2021 - present Grant evaluator for Research Council of Canada
- 2021 - 2022 Organiser of Leiden observatory's colloquia
- 2020 - present MeerKAT TAC contributor
- 2020 - 2022 Co-founder of the Leiden Equity, Diversity, and Inclusion Journal club
- 2020 - 2022 Member of the Leiden Observatory COVID-19 Social Support committee
- 2020 - present Member of the Leiden Observatory diversity committee (Chair for 2020)
- 2019 - 2022 ATNF TAC reader
- 2018 - present Board Member for the QUOCKA Survey
- 2013 - 2016 Councilor of the Sydney University Postgraduate Representative Association (PhD student Union)

SELECTED TEACHING EXPERIENCE

While my first fellowship at a research-only institute did not require me to teach, I saw it as a valuable contribution to the community and a way to extend my skill set. As such, the teaching experience I have accumulated is relatively diverse. I thoroughly enjoy teaching and look forward to this being a bigger component of my work in the future.

- 2020 - present Lecturer and developer, Bachelors course on Space Science, Leiden
- 2019 Senior Lecturer, Development in Africa with Radio Astronomy (DARA) School, Botswana
- 2018 Senior Lecturer, DARA Radio Interferometry School, Kenya
- 2017 Lecturer on galaxies for ASTRON summer students, ASTRON, The Netherlands
- 2016 Lecturer for Special Relativity, CAASTRO in the Classroom, Sydney, Australia
- 2013 - 2016 Tutor for Immediate Experimental Laboratory, University of Sydney, Australia
- 2013 - 2016 Tutor for Senior Computational Physics, University of Sydney, Australia
- 2013 - 2016 Tutor for Introductory Astronomy, University of Sydney, Australia

FORMALLY SUPERVISED STUDENTS

My first fellowship at a government research institute meant that being able to formally supervising students was more difficult than for a researcher based at a university since there is no student body. However, I successfully established fruitful connections with both Leiden University and the University of Amsterdam that allowed me to supervise students in that time. I have also supervised several students through the ASTRON summer research program, which involves supervising Masters-level students for 12 weeks on a project. I detail the students and projects I have formally supervised below.

- 2022 - present T. Wing (University of Groningen), PhD Student (Co-supervised with Dr H. Vedantham)
- 2022 - present S. Bloot (University of Groningen), PhD Student (Co-supervised with Dr H. Vedantham)
- 2022 - present F. Ballieux (Leiden University), Masters Student
- 2022 - present E. Benitez Walz (Leiden Student), Masters Student
- 2018 - 2022 K. Ross (University of Curtin), PhD Student (Co-supervised with Dr N. Hurley-Walker)
- 2021 - 2022 M. Slob (Leiden University), Masters Student, Paper submitted
- 2021 - 2022 E. van Dijk (Leiden University), Masters Student
- 2021 - 2022 R. Keers (Leiden University), Masters Student
- 2020 - 2021 S. Bloot (Leiden University), Masters Student, resulted in publication Bloot & Callingham et al. (2021)
- 2020 - 2021 V. van Rooijen (Leiden University), Masters Student
- 2020 - 2021 P. Jol (Leiden University), Masters Student
- 2019 - 2020 K. Verken (Leiden University), Masters Student, resulted in publication Callingham et al. (2020)
- 2019 - 2020 S. Toet (Leiden University), Masters Student, resulted in publication Toet et al. (2020)
- 2019 I. Davis (University of Mexico), ASTRON Summer Student, resulted in publication Davis et al. (2021)
- 2018 - 2019 M. Keim (Leiden University), Masters Student, resulted in publication Keim & Callingham (2019)
- 2018 A. Tuson (University of Manchester), ASTRON Summer Student
- 2017 - 2018 C. Bozon (University of Amsterdam), Bachelor Student
- 2017 M. Rose (Harvard University), ASTRON Summer Student

SELECTED PROFESSIONAL ASSOCIATIONS

- 2020 - Present Junior Member of the International Astronomical Union (IAU)
- 2019 - Present Member of the American Astronomical Society (AAS)
- 2017 - Present Member of the Koninklijke Nederlandse Astronomenclub (KNA)
- 2017 - Present Member of the European Astronomical Society (EAS)
- 2017 - Present Member of the LOFAR Key Science Program consortium
- 2017 - Present Member of the Square Kilometre Array (SKA) consortium
- 2014 - Present Founding member of the GLEAM (the all-sky MWA survey) team
- 2013 - Present Member of the Murchison Widefield Array (MWA) consortium
- 2013 - 2017 Member of the ARC Centre of Excellence for All-sky Astrophysics (CAASTRO)
- 2012 - Present Member of the Astronomical Society of Australia (ASA)

OUTREACH ACTIVITIES

- 2022 Talk, Astronomy on Tap speaker, Leiden, The Netherlands
- 2021 Presenter, Killers of the Cosmos, The Discovery Channel, audience reach of over 150 million people
- 2020 Youtube, The Hunt for exo-auroras, 6 800 views
- 2020 Talk, Astronomy on Tap speaker, New York, USA
- 2019 Talk, Astronomy on Tap speaker, Groningen, The Netherlands
- 2018 Youtube, ESOCast Light: Cosmic Serpent, 66 800 views
- 2018 Youtube, New star is potentially a ticking time bomb | SciShow, 151 000 views
- 2018 Volunteer, ASTRON Open Day volunteer, The Netherlands
- 2018 Radio Interview, Live interview with the BBC World Service, audience reach of over 350 million people
- 2018 Radio Interview, Australian Broadcasting Corporation, audience reach of over 1.5 million people
- 2018 Article, Nature News and Views, Discovery of Apep
- 2017 Volunteer, Blaauw Observatory Open Night, Groningen, The Netherlands
- 2017 Talk, Science in Sci-Fi films, Vera, Groningen, The Netherlands
- 2017 Talk, Field Trips Talks: Surfing through Spacetime, Groningen, The Netherlands
- 2016 Volunteer, Resident astronomer at Uluru (Ayers Rock), Northern Territory, Australia
- 2016 Volunteer, Guide at Sydney Observatory, Sydney, Australia

KEY SELECTED PAPERS

I list below six publications that I view as my most significant work, with a brief explanation for its choice. My entire publication record can be found in the attached publication list.

1. **Joseph R. Callingham**, H. Vadrnatham, T. Shimwell, and 10 others
A new class of radio emission from stellar systems
Nature Astronomy, 2021, 12, 7 [cited by 15]
This paper presents 19 new detections of stellar systems from LOFAR observations, demonstrating we are now sensitive to a new class of stellar system emission that does not correlate with known coronal or chromospheric activity indicators. The radio emission can be modelled as a breakdown of co-rotation and potential star-planet interactions. This paper is key to demonstrating that radio astronomy is on the cusp of being another avenue for exoplanet detections.
2. **Joseph R. Callingham**, P. Tuthill, B. Pope, and 5 others
Anisotropic winds in a Wolf–Rayet binary identify a potential gamma-ray burst progenitor
Nature Astronomy, 2019, 3, 82-87 [cited by 22]
This paper details the discovery of a stellar system that represents the most likely gamma-ray burst progenitor in our own Milky Way – a result that was unexpected since such systems were only previously thought to be found extragalactically. It was published in Nature Astronomy and garnered significant publicity. The paper demonstrates my ability to make a significant impact in a scientific field that was not part of my PhD with unique ideas.
3. **Joseph R. Callingham**, R. Ekers, B. Gaensler, and 23 others
Extragalactic Peaked-spectrum Radio Sources at Low Frequencies
The Astrophysical Journal, 2017, 836, 174-196 [cited by 92]
This paper represents an important advance in the field of radio galaxy evolution as it increased the number of known “young” radio galaxies by an order of magnitude and revealed several sources that clearly violated the prevailing theoretical understanding of radio galaxy evolution. The clean selection criteria I developed in the paper for identifying these young radio sources has made the paper subject to substantial follow-up studies. The paper also highlights my ability to recover science from large number statistics.
4. **Joseph R. Callingham**, B. Pope, and 13 others
Low-frequency monitoring of flare star binary CR Draconis
Astronomy & Astrophysics, 2021, 648, A13 [cited by 22]
This study represents the conclusive detection of auroral radio emission from a M dwarf system. It is also the first attempt at searching for periodicity in low-frequency radio lightcurves, establishing the key methodology for that search. The manuscript was highlighted by Nature.
5. N. Hurley-Walker, **Joseph R. Callingham**, P. Hancock, and 42 others
GaLactic and Extragalactic All-sky Murchison Widefield Array (GLEAM) survey – A low-frequency extragalactic catalogue
Monthly Notices of the Royal Astronomical Society, 2017, 464, 1146-1167 [cited 401]
This paper represents a significant advance in radio astronomy as it describes the production of the widest fractional bandwidth radio survey produced to date. The survey’s broad impact is highlighted by the fact the paper has over 300 citations in less than 5 years. While second author, I made critical and substantial contributions to production of the survey over 3 years, such as ensuring an accurate flux density calibration, and to the publication of the paper. This paper also highlights my ability to work as part of a team to achieve a long-term and complex objective.
6. H. Vadrnatham, **Joseph R. Callingham**, T. Shimwell, and 8 others
Coherent radio emission from a quiescent red dwarf indicative of star-planet interaction
Nature Astronomy, 2020, 4, 577 [cited by 62]
This paper presents the first detection of a star-planet interaction at low radio-wavelengths. While second author, I initiated the LOFAR project that led to the discovery of the source, and made the discovery directly. This discovery has led to the recognition that radio astronomy is beginning to impact the exoplanetary field.