

# Emma L. Alexander

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EmmaAlexander



emmaalexander.github.io

## Profile

Astrophysicist with research interests in radio astronomy, polarimetry, and machine learning, with a focus on radio galaxies, citizen science, and classification. Member of the POSSUM, QUOCCA, and EMU collaborations. Experience in observing (e.g. ATCA), data reduction (e.g. CASA), and data analysis (e.g. Python), working with Square Kilometre Array pathfinder telescopes. Communicating science, particularly astronomy, through a variety of outreach (presentations, demonstrations) and media (television, podcasting, and radio).

## Experience

### HM Revenue & Customs

SALFORD, UK

AD HOC STATISTICAL OFFICER

JAN 2024 - PRES.

Providing statistical insights to inform tax policy using a variety of software including SQL and R.

### University of Manchester

MANCHESTER, UK

POSTDOCTORAL RESEARCH ASSOCIATE

APRIL 2022 - DEC 2023

- Stellar classification with Machine Learning (PI: Prof. Albert Zijlstra). Application of various Machine Learning techniques to solve complex astronomical problems. Examples include use of Gradient-Boosted Decision Tree method XGBoost to solve multi-class stellar categorisation problem. Key communication point between team of astronomers and AI experts at external industry partner (Know Center, Austria).
- Analysing the polarisation properties of well-resolved radio galaxies in the POSSUM (Polarisation Sky Survey of the Universe's Magnetism) Pilot Surveys (PI: Dr. Paddy Leahy).

RESEARCH ASSOCIATE IN MACHINE LEARNING FOR RADIO ASTRONOMY

OCT 2021 - MARCH 2022

- Machine learning for radio astronomy: building datasets for machine learning and citizen science from the ASKAP telescope, using specialist data selection, extraction and formatting (supervisor: Prof. Anna Scaife).

PHD STUDENT; SUPERVISORS: DR. PATRICK LEAHY & PROF. ANNA SCAIFE

SEPT 2017 - SEPT 2021

- Member of the POSSUM collaboration, focusing on magnetic fields around well-resolved radio galaxies.
- Analysis of large polarisation data cubes from the Australian Square Kilometre Array Pathfinder telescope (ASKAP) via extensive use of programming languages (e.g. Python) and astronomical software (e.g. CASA) in both Linux and MacOSX environments.
- Observing with the Australia Telescope Compact Array (ATCA): proposal writing (as PI & Co-I), observation planning and supervising, reduction and analysis of data in Miriad.

MASTERS STUDENT; SUPERVISORS: PROF. ANNA SCAIFE, DR. DAVID MULCAHY, DR. JUSTIN BRAY

SEPT 2016 - JUNE 2017

- Calibration and imaging of C, L, and X-band JVLA data in CASA.
- Analysis of Faraday rotation maps with Python scripts.

SUMMER STUDENT; SUPERVISOR: DR. JUSTIN BRAY

JUNE - JULY 2016

- Reduction and analysis of ATCA data of the magnetically chemically peculiar star CU Virginis in Miriad.
- Imaging of radio pulses from the star in CASA, and spectrographic analysis of the results via Python.

SUMMER STUDENT; SUPERVISOR: DR. PATRICK LEAHY

JUNE - AUG 2015

- Solar sidelobe analysis for the C-Band All Sky Survey (C-BASS). Improved existing models of sidelobes and solar variability using IDL, Python and MATLAB.

### Netherlands Institute for Radio Astronomy (ASTRON)

DWINGELOO, NETHERLANDS

SUMMER STUDENT; SUPERVISOR: DR. JESS BRODERICK

JUNE - SEPT 2017

- 'Recombination line science with SKA precursor technology - a search towards the Galactic Centre with the Engineering Development Array (EDA)'. Normalisation and stacking of uncalibrated data from an exploratory scan by the EDA, to obtain detections of carbon and hydrogen Radio Recombination Lines (RRLs).
- Resulted in lowest frequency detection to date of hydrogen RRLs (see publications list: Oonk, Alexander et al.)

## Education

### University of Manchester

MANCHESTER, UK

PHD IN ASTRONOMY & ASTROPHYSICS

2022

MPHYS IN PHYSICS WITH ASTROPHYSICS (FIRST CLASS HONOURS)

2017

### Huntington School

YORK, UK

- A-Levels: Physics (A\*); Chemistry (A\*); Biology (A\*); Mathematics (A\*); Further Mathematics (A); General Studies (A).
- GCSEs: 13 A\* - A, including English and Mathematics.

2006-2013

## Publications

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### REFEREED

7. M. M. Boyce, [21 others], **E. L. Alexander** et al., **Hydra II: Characterisation of Aegean, Caesar, ProFound, PyBDSF, and Selavy source finders**. PASA 1-28 (2023).
6. M. M. Boyce, [21 others], **E. L. Alexander** et al., **Hydra I: An extensible multi-source-finder comparison and cataloguing tool**. PASA 1-27 (2023).
5. M. Bowles, H. Tang, E. Vardoulaki, **E. L. Alexander** et al., **Radio Galaxy Zoo EMU: Towards a Semantic Radio Galaxy Morphology Taxonomy**. MNRAS 522, 2, 2584–2600 (2023).
4. G. Segal, [4 others], **E. L. Alexander** et al., **Identifying anomalous sources in the EMU Pilot Survey data using a complexity-based approach**. MNRAS 521, 1, 1429–1447 (2023).
3. M. Cárcamo, A. M. M. Scaife, **E. L. Alexander** and J. P. Leahy, **CS-ROMER: A novel compressed sensing framework for Faraday depth reconstruction**. MNRAS 518, 2, 1955–1974. (2023).
2. T. D. Joseph, M. D. Filipović, E. J. Crawford, I. Bojičić, **E. L. Alexander** et al., **The ASKAP-EMU Early Science Project: Radio Continuum Survey of the Small Magellanic Cloud**. MNRAS 490, 1, 1202–1219 (2019).
1. J. B. R. Oonk, **E. L. Alexander**, J. Broderick, M. Sokolowski, and R. Wayth, **Spectroscopy with the Engineering Development Array: cold H+ at 63 MHz towards the Galactic center**. MNRAS 487, 4, 4737–4750 (2019).

### CONFERENCE PAPERS

1. M. Bowles, H. Tang, E. Vardoulaki, **E. L. Alexander** et al., **A New Task: Deriving Semantic Class Targets for the Physical Sciences**. Accepted at Fifth Workshop on Machine Learning and the Physical Sciences (NeurIPS 2022). <https://arxiv.org/abs/2210.14760>

### IN REVIEW & IN PREP.

6. I. McDonald et al. (inc. **E. L. Alexander**), **PySSED: an automated method of collating and fitting stellar spectral energy distributions**. Submitted to RASTI Oct 2023.
5. S. E. Cody et al. (inc. **E. L. Alexander**), **Machine learning based stellar classification with highly sparse photometry data**. Submitted to Open Research Europe Dec 2023.
4. B. M. Gaensler et al. (inc. **E. L. Alexander**), **The Polarisation Sky Survey of the Universe's Magnetism (POSSUM). I. Science Goals and Survey Description**, to be submitted to PASA.
3. L. Rudnick et al. (inc. **E. L. Alexander**), **Pseudo-3D Structures in Polarized Radio Sources**. in prep.
2. **E. L. Alexander** et al., **Polarised DRAGNs in the POSSUM Pilot Survey I: Observations and data**. in prep.
1. **E. L. Alexander** et al., **Polarised DRAGNs in the POSSUM Pilot Survey II: Statistics and Structural Analysis**. in prep.

## Observing & Successful Proposals

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**PI: A polarised look at extended DRAGNs in Ophiuchus**, Australia Telescope Compact Array, 2019APRS (C3315, 40 hours).

**Co-I: The QUOCKA Survey** Australia Telescope Compact Array, 2018APRS/2018OCTS/2019APRS/2020APRS, (PI: G. Heald, C3244, 830 hours total). Personal observing contribution: 10 sessions totalling 65 hours, on-site & remote.

**Co-I: e-MERLIN ToO Request, Supernova SN 2013ej** (PI: H. Rampadarath, 13 hours, 2017).

## Awards & Funding

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<b>Fellow of the Royal Astronomical Society (FRAS)</b> , London, UK	2016 – pres.
<b>Winton Poster Prize (Postdoc)</b> , National Astronomy Meeting	2023
<b>COVID funding extension (6 months)</b> , University of Manchester	2021
<b>George Rigg Studentship (3.5 years)</b> , Jodrell Bank Centre for Astrophysics	2017 – 2021
<b>President's Doctoral Scholarship (3 years)</b> , University of Manchester	2017 – 2020
<b>Summer Studentship funding (10 weeks)</b> , SKA Organisation & ASTRON	2017
<b>Summer Studentship funding (6 weeks)</b> , University of Manchester	2016
<b>Undergraduate achievement award</b> , University of Manchester	2013

## Teaching & Supervising

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<b>Associate Fellow of the Higher Education Academy (AFHEA)</b> ,	2020 – pres.
<b>Supervisor, MPhys student research project</b> , 'Predicting the visibility of the New Crescent Moon with Machine Learning', University of Manchester, UK	2023
<b>Academic Tutor, 2nd Year Undergraduates</b> , University of Manchester, UK	2022 – 2023
<b>Presentation: Intro to Linux</b> , JBCA Autumn Computing Sessions	2022
<b>Demonstrator, 2nd Year Undergraduate Laboratory</b> , University of Manchester, UK	2018 – 2021
<b>Examination Invigilator</b> , University of Manchester, UK	2018
<b>Demonstrator, 1st Year Undergraduate Laboratory</b> , University of Manchester, UK	2017
<b>Peer Assisted Study Sessions (PASS) Leader &amp; Peer Mentor</b> , University of Manchester, UK	2014 – 2016

## Presentations

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### INVITED

<b>Magnetic fields around radio galaxies with POSSUM</b> , SKA Magnetism SWG meeting (remote).	2022
<b>Magnetic fields around radio galaxies with POSSUM</b> , Curtin University colloquium (remote).	2021
<b>Radio Astronomy &amp; Astrophysical Magnetism</b> , North American Foundation Awards for Postgraduate Study at the University of Manchester (NAFUM) board meeting (remote).	2020

### CONTRIBUTED

<b>The New Crescent Moon and its role in the Islamic calendar.</b> , National Astronomy Meeting (Cardiff, UK)	2023
<b>Mapping extended Faraday Rotation structure across radio galaxy lobes with ASKAP POSSUM</b> , SPARCS XI conference, remote.	2022
<b>Rotation Measure maps of Radio Galaxies with ASKAP</b> , SPARCS X conference, remote.	2021
<b>Magnetic fields around radio galaxies with POSSUM</b> , Jodrell Bank Centre for Astrophysics, internal seminar.	2021
<b>Magnetic fields around radio galaxies with POSSUM</b> , 'A precursor view of the SKA Sky' conference, remote.	2021
<b>Radio Astronomy &amp; Astrophysical Magnetism</b> , PhD discussion sessions and work experience weeks.	2018 – 2020
<b>Recombination line science with SKA precursor technology.</b> , Astrolunch, ASTRON, Dwingeloo, Netherlands.	2017

### POSTERS

<b>Magnetic fields around radio galaxies with ASKAP POSSUM</b> , National Astronomy Meeting (Cardiff, UK)	2023
<b>Magnetic fields around radio galaxies with ASKAP POSSUM</b> , 'New Eyes on the Universe' conference (remote).	2023
<b>Magnetic fields around Ophiuchus radio galaxies with POSSUM</b> , 'New Science enabled by New Technologies in the SKA Era' conference.	2019

## Public Engagement & Outreach

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### ONLINE TALKS AND WORKSHOPS

<b>Everything Astronomy: An overview of the science &amp; what it can do for you</b> , Young Professionals Society webinar	2020
<b>UK Moonsighting Live</b> , New Crescent Society Facebook Live video, host & astronomy features	2020
<b>The Science of the New Crescent Moon</b> , New Crescent Society online workshop	2020
<b>UK Moonsighting</b> , Three Meem Foundation online workshop	2020

### EVENTS

<b>Portayal of the Scientist in Doctor Who (panellist)</b> , Bluedot festival.	2023
<b>Bluedot Festival</b> , Jodrell Bank Observatory, Cheshire, UK. Science explanations and talk introductions.	2016 - 2023
<b>ScienceX</b> , Trafford Centre, Manchester, UK. Science busking.	2018
<b>Astrotram (part of City of Science Festival)</b> , Manchester, UK. Science busking.	2016
<b>Platform for Investigation</b> , Museum of Science and Industry (MOSI), Manchester, UK	2016
<b>British Science Festival Fringe</b> , Bradford, West Yorkshire, UK. Science busking.	2015
<b>Physics in the Field volunteer for the Institute of Physics</b> , Various locations	2014-2015
<b>Stargazing Live event: public astronomy demonstrations</b> , York, UK.	2011 - 2013

### SCHOOLS

<b>Multilingual Manchester</b> , Project to provide non-English outreach to local EAL (English as Additional Language) students	2022
<b>INFUSE</b> , University of Manchester, UK. Physics workshops for Year 10 and Year 12.	2018 - 2019
<b>Workshop: Journey through the Solar System</b> , Chapel Street Primary School, Manchester, UK	2019
<b>ISOLDE Lego Mindstorms Workshops</b> , University of Manchester, Manchester, UK.	2015

### MISC.

<b>TikTok staff training</b> , Workshop on the science of the New Crescent Moon.	2023
<b>Astrotweeps</b> , Running of science communication Twitter account for 1 week.	2018

## Media

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### TELEVISION

<b>Breakfast, BBC One</b> , expert comment on ESA JUICE mission (in studio, live).	13/04/23
<b>Breakfast, BBC One</b> , expert comment on Comet C/2022 E3 (ZTF) (in studio, live).	25/01/23
<b>Breakfast, BBC One</b> , review of 2022 space news (in studio, live).	30/12/22
<b>Breakfast, BBC One</b> , feature on Perseid meteor shower (remote, live).	11/08/20
<b>Newsround, CBBC</b> , pre-recorded segment on astronomy. <a href="https://www.bbc.co.uk/newsround/49911516">https://www.bbc.co.uk/newsround/49911516</a>	Oct 2019
<b>BBC World News</b> , expert comment on lunar eclipse (remote, live).	20/01/19
<b>Breakfast, BBC One</b> , expert comment on Chang'e 4 mission (in studio, live).	12/01/19
<b>Breakfast, BBC One</b> , expert comment on New Horizons mission (in studio, live).	01/01/19
<b>BBC News channel</b> , expert comment on New Horizons mission (remote, live)	01/01/19
<b>Breakfast, BBC One</b> , expert comment on 'Oumuamua (in studio, live)	07/11/18
<b>Stargazing Live, BBC One</b> , Contributed to Episodes 3 & 4 of Series 6.	Jan 2016

### RADIO & PODCASTING

<b>The Jodcast</b> , Producing, presenting, interviewing, and audio editing of a popular astronomy podcast. Notable interviewees include Chris Lintott ( <i>The Sky at Night</i> ) and Katie Mack (@AstroKatie).	2017 – 2020
<b>BBC World Service OS</b> , Explaining the physics of the “broom challenge”.	2020
<b>BBC Radio 5 Live</b> , One-off features on a range of topics, including: New Horizons probe, Jupiter opposition, Jodrell Bank UNESCO award, Betelgeuse dimming.	2018 – 2020
<b>BBC Radio Coventry &amp; Warwickshire</b> , Answering questions: “will human teleportation ever be possible?”; “why don't flames have shadows?”; “why can we see the Moon during the day?” and more for <i>Vicapedias</i> .	2018 – 2019
<b>BBC Radio 5 Live</b> , Discussion panel: this year & next in space.	2018
<b>BBC Radio 5 Live</b> , Monthly (Jan – Sept) discussion of recent astrophysical news and the night sky on <i>Up All Night</i> .	2018

### CONSULTING

<b>CBBC Newsround</b> , Various articles	2020
<b>Netflix: <i>Night on Earth</i></b> , Consultant for astronomy content (episode: <i>Moonlit Plains</i> ).	2019 – 2020
<b>Pulsars</b> , Collaboration on content for radio play.	2019 – 2020
<b>BBC News</b> , Feature on how Wi-Fi works.	2019

## Service

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<b>Laboratory teaching committee</b> , Dept. of Physics & Astronomy, University of Manchester, UK	2020 – 2021
<b>Postgraduate representative</b> , Dept. of Physics & Astronomy, University of Manchester, UK	2018 – 2020
<b>PhD interviews support team</b> , Jodrell Bank Centre for Astrophysics, University of Manchester	2020
<b>Local Organising Committee: Internal Symposium</b> , Jodrell Bank Centre for Astrophysics, University of Manchester	2019
<b>Local Organising Committee: A Centenary of Astrophysical Jets conference</b> , SKAO HQ, Cheshire, UK	2019
<b>Laboratory open day tour guide</b> , University of Manchester, UK	2019
<b>Internal Seminar organiser</b> , Jodrell Bank Centre for Astrophysics, University of Manchester, UK	2017 – 2018
<b>Postgraduate committee</b> , Jodrell Bank Centre for Astrophysics, University of Manchester, UK	2017 – 2018
<b>Astronomy Society Committee</b> , (Science Officer; then Chair; then Secretary), University of Manchester, UK	2014 – 2017
<b>Physics Netball team, Captain</b> , University of Manchester, UK	2015 – 2016
<b>UCAS interview day help</b> , School of Physics & Astronomy, University of Manchester, UK	2015 – 2016

## References

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Available on request