




Emma L. Alexander

MPhys (Hons), PhD, FRAS, AFHEA | POSTDOCTORAL RESEARCH ASSOCIATE

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Profile

Astrophysicist working within radio astronomy, polarimetry, and Machine Learning, with a focus on radio galaxies, citizen science, and stellar 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).

Research Experience

University of Manchester

MANCHESTER, UK

POSTDOCTORAL RESEARCH ASSOCIATE

APRIL 2023 - JUNE 2023

- Stellar classification with Machine Learning (supervisor: 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).

POSTDOCTORAL RESEARCH ASSOCIATE

APRIL 2022 - MARCH 2023

- Working on the polarisation properties of well-resolved radio galaxies in the POSSUM (Polarisation Sky Survey of the Universe's Magnetism) Pilot Surveys (supervisor: 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

2017 - 2022

MPhys IN PHYSICS WITH ASTROPHYSICS (FIRST CLASS HONOURS)

2013 - 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.

Publications

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 PREP.

3. **E. L. Alexander** et al., **Polarised DRAGNs in the POSSUM Pilot Survey I: Observations and data**. To be submitted to MNRAS (2023).
2. **E. L. Alexander** et al., **Polarised DRAGNs in the POSSUM Pilot Survey II: Statistics and Structural Analysis**. MNRAS (2023).
1. B. M. Gaensler, [others], **E. L. Alexander** et al., **The Polarisation Sky Survey of the Universe's Magnetism (POSSUM). I. Science Goals and Survey Description** To be submitted to PASA (2023).

Observing & Successful Proposals

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

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

Teaching & Supervising

Associate Fellow of the Higher Education Academy (AFHEA) ,	2020 – pres.
Academic Tutor, 2nd Year Undergraduates , University of Manchester, UK	2022 – pres.
Presentation: Intro to Linux , JBCA Autumn Computing Sessions	2022
Demonstrator, 2nd Year Undergraduate Laboratory , University of Manchester, UK	2018 – 2021
Examination Invigilator , University of Manchester, UK	2018
Demonstrator, 1st Year Undergraduate Laboratory , University of Manchester, UK	2017
Peer Assisted Study Sessions (PASS) Leader & Peer Mentor , University of Manchester, UK	2014 – 2016

Presentations

INVITED

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

CONTRIBUTED

Mapping extended Faraday Rotation structure across radio galaxy lobes with ASKAP POSSUM , SPARCS XI conference, remote.	2022
Rotation Measure maps of Radio Galaxies with ASKAP , SPARCS X conference, remote.	2021
Magnetic fields around radio galaxies with POSSUM , Jodrell Bank Centre for Astrophysics, internal seminar.	2021
Magnetic fields around radio galaxies with POSSUM , 'A precursor view of the SKA Sky' conference, remote.	2021
Radio Astronomy & Astrophysical Magnetism , PhD discussion sessions and work experience weeks.	2018 – 2020
Recombination line science with SKA precursor technology , Astrolunch, ASTRON, Dwingeloo, Netherlands.	2017

POSTERS

Magnetic fields around radio galaxies with ASKAP POSSUM , 'New Eyes on the Universe' conference (remote).	2023
Magnetic fields around Ophiuchus radio galaxies with POSSUM , 'New Science enabled by New Technologies in the SKA Era' conference.	2019

Public Engagement & Outreach

ONLINE TALKS AND WORKSHOPS

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

EVENTS

Bluedot Festival , Jodrell Bank Observatory, Cheshire, UK. Science explanations and talk introductions.	2016 - 2022
ScienceX , Trafford Centre, Manchester, UK. Science busking.	2018
Astrotram (part of City of Science Festival) , Manchester, UK. Science busking.	2016
Platform for Investigation , Museum of Science and Industry (MOSI), Manchester, UK	2016
British Science Festival Fringe , Bradford, West Yorkshire, UK. Science busking.	2015
Physics in the Field volunteer for the Institute of Physics , Various locations	2014-2015
Stargazing Live event: public astronomy demonstrations , York, UK.	2011 - 2013

SCHOOLS

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

MISC.

TikTok staff training , Workshop on the science of the New Crescent Moon.	31/03/23
Astrotweeps , Running of science communication Twitter account for 1 week.	2018

Media

TELEVISION

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

RADIO & PODCASTING

The Jodcast , 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
BBC World Service OS , Explaining the physics of the “broom challenge”.	2020
BBC Radio 5 Live , One-off features on a range of topics, including: New Horizons probe, Jupiter opposition, Jodrell Bank UNESCO award, Betelgeuse dimming.	2018 – 2020
BBC Radio Coventry & Warwickshire , 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
BBC Radio 5 Live , Discussion panel: this year & next in space.	2018
BBC Radio 5 Live , Monthly (Jan – Sept) discussion of recent astrophysical news and the night sky on <i>Up All Night</i> .	2018

CONSULTING

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

Service

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

References

Available on request