Emma L. Alexander

MPhys (Hons), PhD, FRAS, AFHEA | Research Associate in Radio Astronomy

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Profile

Astrophysicist working within radio astronomy and polarimetry, with a current research focus on radio galaxies and machine learning. Member of the POSSUM, QUOCKA, 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

Research Associate — October 2021 - present

- Working on the polarisation properties of well-resolved radio galaxies in the POSSUM (Polarisation Sky Survey of the Universe's Magnetism) Pilot Surveys.
- Previously: machine learning for radio astronomy: building machine learning datasets from the ASKAP telescope EMU survey Zooniverse data, using specialist data selection, extraction and formatting (6 months).

PhD student; Supervisors: Dr. Patrick Leahy & Prof. Anna Scaife — September 2017 - September 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 — September 2016 - June 2017

- Project title: Magnetic Structures in the Spiral Galaxy NGC 628. Calibration and imaging of C, L, and X-band data from the Karl G. Jansky Very Large Array (JVLA) in CASA, and subsequent analysis of Faraday rotation maps with Python scripts.

Summer student; Supervisor: Dr. Justin Bray — June 2016 - July 2016

- Project title: Radio pulses from the star CU Virginis. 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 2015 - August 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 2017 - September 2017

- Project title: 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).

Publications

Refereed

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, p. 4737–4750 (2019).

In review & in prep.

6. G. Segal, [4 others], **E. L. Alexander** et al., **Identifying anomalous sources in the EMU Pilot Survey data using a complexity-based approach.**. Submitted to MNRAS (2022). `https://arxiv.org/abs/2206.14677`
5. M. M. Boyce, [21 others], **E. L. Alexander** et al., **Hydra II: Characterisation of Aegean, Caesar, ProFound, PyBDSF, and Selavy source finders.** Submitted to PASA (2022).
4. M. M. Boyce, [21 others], **E. L. Alexander** et al., **Hydra I: An extensible multi-source-finder comparison and cataloguing tool.** Submitted to PASA (2022).
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.** Submitted to MNRAS (2022). `https://arxiv.org/abs/2205.01413`
2. 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 (2022).
1. M. Bowles, H. Tang, E. Vardoulaki, **E. L. Alexander** et al., **Radio Galaxy Zoo EMU: Towards a Semantically Meaningful Morphology Taxonomy**. To be submitted to MNRAS (2022).

Education

University of Manchester — Manchester, UK

PhD in Astrophysics — 2017 – 2022

- Project: *Magnetic Fields around Radio Galaxies* (see research experience).

MPhys in Physics with Astrophysics (First Class Honours) — 2013 – 2017

- Masters Project: *Magnetic Structures in the Spiral Galaxy NGC 628* (see research experience).

Huntington School — York, UK

A-Levels and GCSEs — 2006-2013

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

Observing & Sucessful Proposals

PI: Australia Telescope Compact Array, 2019APRS, **A polarised look at extended DRAGNs in Ophiuchus** (C3315, 40 hours).
Co-I: Australia Telescope Compact Array, 2018APRS/2018OCTS/2019APRS/2020APRS, **The QUOCKA Survey** (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

Presentations

Invited

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
A Tour through the Radio Universe, York Astronomical Society (remote).	2020
A Tour through the Radio Universe, Derby & District Astronomical Society.	2019
Cosmic Magnetism, York Astronomical Society.	2018

Contributed

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
Magnetic fields around Ophiuchus radio galaxies with POSSUM, Poster, 'New Science enabled by New Technologies in the SKA Era' conference.	2019
Radio Astronomy & Astrophysical Magnetism, Multiple occasions.	2018 – 2020
Recombination line science with SKA precursor technology., Astrolunch, ASTRON, Dwingeloo, Netherlands.	2017

Teaching & Supervising

Associate Fellow of the Higher Education Academy (AFHEA),	2020 – pres
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

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

Selected Media & Outreach

Television

***Breakfast*, BBC One**, Multiple live apperances (in-studio and remote) to discuss astronomy news. Topics included ‘Oumuamua, New Horizons, Chang’e 4, and the Perseid meteor shower. 2018 – 2020
***Newsround*, CBBC**, Pre-recorded segment on astronomy. `https://www.bbc.co.uk/newsround/49911516` 2019
BBC News & BBC World News, Multiple remote live apperance; topics included lunar eclipse and New Horizons probe. 2019

Radio & podcasting

The Jodcast, Producing, presenting, interviewing, and audio editing of a popular astronomy podcast. 2017 - 2020.
BBC Radio 5 Live, Monthly (Jan – Sept 2018) discussion of recent astrophysical news and the night sky. One-off features on a range of topics, including: Jupiter opposition, Jodrell Bank UNESCO award, and Betelgeuse dimming. 2018 – 2020
BBC World Service OS, Explaining the physics of the “broom challenge”. 2020
BBC Radio 5 Live, Discussion panel: this year & next in space. 2018

Press Releases & articles

The Conversation, “A 4G network on the Moon is bad news for radio astronomy” 2020
ASTRON press release, “Star formation may be halted by cold ionised hydrogen” 2019

Consulting

CBBC Newsround, Various articles and features including `https://www.bbc.co.uk/newsround/59559445` 2020 – 2021
Netflix: *Night on Earth*, Consultant for astronomy content (episode: *Moonlit Plains*). 2019 – 2020
BBC News, Feature on how Wi-Fi works. 2019

Online talks & workshops

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

Events

Bluedot Festival, Jodrell Bank Observatory, Cheshire, UK. Science explanations and talk introductions. 2016 - 2019
ScienceX, Trafford Centre, Manchester, UK. Science busking. 2018
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

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

References

Available on request