




# Emma L. Alexander

MPHYS FRAS AFHEA | RESEARCH ASSOCIATE IN MACHINE LEARNING FOR 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).

## Overview of Research Experience

### University of Manchester

MANCHESTER, UK

RESEARCH ASSOCIATE IN MACHINE LEARNING FOR RADIO ASTRONOMY

OCTOBER 2021 - PRESENT

- Building machine learning datasets from the ASKAP telescope EMU survey Zooniverse data.
- Specialist data selection, extraction and formatting, as well as re-processing of ASKAP data products as required.
- Working with the wider ML group to examine the use of these training data with cutting edge machine learning models for next generation survey classification.

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

SEPTEMBER 2017 - PRESENT

- Member of the POSSUM collaboration (Polarisation Sky Survey of the Universe's Magnetism), 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.
- Contributions to POSSUM data challenges, for example relating to source-finding.

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).
- Lowest frequency detection published to date of hydrogen RRLs (see publications list: Oonk, Alexander et al.).

## 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)

### PRESS RELEASES AND ARTICLES

2. "A 4G network on the Moon is bad news for radio astronomy", The Conversation, 23 Oct 2020. <https://theconversation.com/a-4g-network-on-the-moon-is-bad-news-for-radio-astronomy-148652>
1. "Star formation may be halted by cold ionised hydrogen", ASTRON press release, 9 July 2019. <https://www.astron.nl/news-and-events/news/star-formation-may-be-halted-cold-ionised-hydrogen>

## Education

### University of Manchester

PHD IN ASTROPHYSICS

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

MPHYS IN PHYSICS WITH ASTROPHYSICS (FIRST CLASS HONOURS)

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

### Huntington School

A-LEVELS AND GCSES

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

MANCHESTER, UK

2017 – EARLY 2022 (EXPECTED)

2013 – 2017

YORK, UK

2006-2013

## Observing & Successful Proposals

**Co-I: Australia Telescope Compact Array 2020APRS (PI: G. Heald, C3244, 52 hours)**, The QUOCCA Survey.

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

**Co-I: Australia Telescope Compact Array 2019APRS (PI: G. Heald, C3244, 78 hours)**, The QUOCCA Survey. Personal contribution: 3 sessions totalling 20 hours, remote.

**Co-I: Australia Telescope Compact Array 2018OCTS (PI: G. Heald, C3244, 338 hours)**, The QUOCCA Survey. Personal contribution: 2 sessions totalling 12.5 hours, remote.

**Co-I: Australia Telescope Compact Array 2018APRS (PI: G. Heald, C3244, 362 hours)**, The QUOCCA Survey: Pilot observations. Personal contribution: 5 sessions totalling 32 hours, on-site.

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

## 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

<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, Secretary</b> , University of Manchester, UK	2016 – 2017
<b>Astronomy Society Committee, Chair</b> , University of Manchester, UK	2015 – 2016
<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
<b>Astronomy Society Committee, Science Officer</b> , University of Manchester, UK	2014 – 2015

## Selected Media & Outreach

### TELEVISION

<b>Breakfast, BBC One</b> , Multiple live appearances (in-studio and remote) to discuss astronomy news. Topics included ‘Oumuamua, New Horizons, Chang’e 4, and the Perseid meteor shower.	2018 – 2020
<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>	2019
<b>BBC News &amp; BBC World News</b> , Multiple remote live appearance; topics included lunar eclipse and New Horizons probe.	2019

### RADIO & PODCASTING

<b>The Jodcast</b> , Producing, presenting, interviewing, and audio editing of a popular astronomy podcast.	2017 - pres.
<b>BBC Radio 5 Live</b> , 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
<b>BBC World Service OS</b> , Explaining the physics of the “broom challenge”.	2020
<b>BBC Radio 5 Live</b> , Discussion panel: this year & next in space.	2018

### CONSULTING

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

### ONLINE TALKS & 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

### EVENTS

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

## References

<b>Dr. Patrick Leahy</b> , Jodrell Bank Centre for Astrophysics, University of Manchester, Manchester, UK	✉ <a href="mailto:j.p.leahy@manchester.ac.uk">j.p.leahy@manchester.ac.uk</a>
<b>Prof. Anna Scaife</b> , Jodrell Bank Centre for Astrophysics, University of Manchester, Manchester, UK	✉ <a href="mailto:anna.scaife@manchester.ac.uk">anna.scaife@manchester.ac.uk</a>
<b>Dr. Jess Broderick</b> , ICRAR, Curtin University, Western Australia	✉ <a href="mailto:jess.broderick@icrar.org">jess.broderick@icrar.org</a>