

# Dr. Rachael E. Ainsworth

RESEARCH ASSOCIATE IN LONG BASELINE RADIO INTERFEROMETRY | JBCA-ICE OPEN SCIENCE CHAMPION

Jodrell Bank Centre for Astrophysics, School of Physics and Astronomy, The University of Manchester

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## Profile

Astrophysics PhD with 8+ years of experience solving complex data challenges in Astronomy. First to successfully model properties of young stars at metre wavelengths using terabytes of data from next-generation radio telescopes. Skilled in data collection, cleaning, analysis, visualisation, statistics and communicating insights to both technical and non-technical audiences. Passionate about promoting openness, diversity and inclusion in science and technology. Organiser of the women in data meetup group Her+Data MCR and frequent attendee at other local data science and tech events (Open Data MCR, Solidarity MCR, MancML, JBCA Machine Learning Hacknights, She Says MCR, Tech Events NW).

## Experience

### Jodrell Bank Centre for Astrophysics (JBCA), University of Manchester

Manchester, UK

RESEARCH ASSOCIATE

June 2017 - present

- Leading a project to reduce and analyse e-MERLIN data on the Cloud through integration of the CASA pipeline with Project Jupyter.
- Member of the H2020 RadioNET RINGS project working to develop an algorithm for calibrating dispersive delay corrections in long baseline interferometry, for low frequency radio telescopes such as LOFAR.
- Interferometry Centre for Excellence (ICE) Open Science Champion to advocate, train colleagues, give presentations and organise events relating to Open Science in Astronomy.
- Disseminating research insights through invited seminars (3), talks at international conferences (3), interviews and public outreach.

### Dublin Institute for Advanced Studies (DIAS)

Dublin, Ireland

POSTDOCTORAL RESEARCH FELLOW

October 2014 - October 2016

- Impact: Our team was the first to successfully detect and model the properties of a young star with the International Low-Frequency Array (LOFAR) Telescope using the facilities at the Irish Centre for High End Computing (ICHEC).
- I pioneered the collection, cleaning, analysis/statistical modelling and visualisation of radio data for young stars at previously unexplored wavelengths.
- Part of a worldwide collaboration to develop novel processing and analytical techniques for terabytes of data from LOFAR.
- Member of the Communications Working Group to re-define the public communication strategy of DIAS through restructure of the website and social media developments.

PH.D. STUDENT; SUPERVISORS: PROF. TOM RAY (DIAS), DR. ANNA SCAIFE (JBCA)

November 2010 - September 2014

- Led three projects performing systematic modelling of multi-wavelength, multi-scale datasets of protostellar jets from AMI, e-MERLIN & GMRT to disentangle competing radiation processes and investigate the jet launching mechanism.
- Involved in the commissioning of e-MERLIN, which included the reduction and analysis of legacy data (Thermal Jets, PEBBLEs) intermediate to the original MERLIN and the fully upgraded e-MERLIN.
- Published the first investigations of YSOs at metre wavelengths and pioneered to characterise this very long wavelength emission through follow-up observing campaigns on the GMRT and LOFAR.

### University of Tennessee (UT)

Knoxville, TN, USA

SUMMER RESEARCH FELLOW; SUPERVISOR: DR. MICHAEL GUIDRY (UT)

May 2009 - August 2009

- Studied the explosion mechanism of Type Ia Supernovae through computational simulations using the FLASH code on the supercomputing facilities at Oak Ridge National Laboratory.

UNDERGRADUATE STUDENT RESEARCHER; SUPERVISOR: DR. MICHAEL GUIDRY (UT)

June 2008 - August 2008

- Studied the interactions between colliding galaxies using computational simulations developed by the UT Astrophysics Group.

### NASA Jet Propulsion Laboratory / California Institute of Technology (JPL/Caltech)

Pasadena, CA, USA

UNDERGRADUATE STUDENT RESEARCH PROGRAM INTERN; SUPERVISOR: DR. RAGHVENDRA SAHAI (JPL/CALTECH)

September 2008 - December 2008

- Developed and applied a procedure for the reduction and calibration of near-infrared echelle spectroscopic data for (a) a sample of pre-planetary nebulae to look for the signatures of high-velocity outflows that shape the resulting planetary nebula, and (b) stellar interlopers: young stars with winds speeding through and interacting with dense interstellar clouds.

## Education

### University of Dublin, Trinity College

Dublin, Ireland

PH.D. IN ASTROPHYSICS

2017

- Thesis: *Morphology and Time Evolution of Thermal Jets Associated with Low Mass Young Stars*
- Submitted: August 2014 – Viva voce: September 2016 – Awarded: April 2017

### University of Tennessee

Knoxville, TN, USA

B.SC. IN PHYSICS, MINOR IN STUDIO ART (PHOTOGRAPHY)

2010

- Overall GPA: 3.61/4.0, Honours: *cum laude*
- Activities, Awards and Societies: 2010 UT Chancellor's Honours Award for Extraordinary Professional Promise, Phi Eta Sigma Freshman Honours Fraternity, The Society of Physics Students, Central Program Council, Film Committee, The Campus Literary and Art Magazine: The Phoenix

## Volunteer Work

### HER+Data MCR

Manchester, UK

ORGANISER

July 2017 - present

- Established the Manchester chapter of HER+Data, a meetup group to bring together women who work with and love data - to support one another, inspire each other, share experiences and talk data (<https://meetup.com/HER-Data-MCR>).
- Organising cross-city events and meetups: event planning and promotion, coordinating with sponsors, venues and speakers, and working with and managing a team of co-organisers.
- Identifying new partners to work with, creating opportunities for collaboration and support, and connecting tech companies, industry stakeholders and academic institutions with our 350+ members to cultivate a community that actively supports women in STEM.
- Responsible for content creation and management of social media (@herplusdatamcr).

### Mozilla Foundation

Manchester, UK

MENTOR AND COHORT HOST

February - May 2018

- Invited to act as Mentor and Cohort A Host during Round 5 of Mozilla's Open Leadership Training.
- Reviewed and rated Round 5 Project Lead applications.
- Met with my assigned Project Lead every two weeks to provide support and guidance as they went through the training and learned how to work openly on their projects.
- Hosted Full Cohort meetings (60 - 90min, 35 participants) every two weeks, which involved emceeing/moderating each of the calls for Cohort A, and providing support/setting the tone for a cohort to bond together as a group during the program.
- Gained valuable coaching skills and connections across the Mozilla and open source community.
- Hosted a local site and participated in the Global Sprint (May 10-11, 2018, <http://bit.ly/MozSprintMCR>).

OPEN PROJECT LEAD

September - December 2017

- Selected for Round 4 of Mozilla's Open Leadership program where I received training and developed skills in open leadership, project management, building communities, open communications and running awesome events. ("Open" refers to working collaboratively, making outputs freely accessible for others to use in order to maximise impact, and promoting inclusion, equity and diversity.)
- Founded *Resources for Open Science in Astronomy* (<https://github.com/rainsworth/ROSA>), an ongoing program to enable a more collaborative and open culture in academia (<https://bit.ly/ROSAinterview>).
- Designed and hosted a 1 hour session at Mozilla Festival 2017 to engage 20 participants in a discussion on how to best advocate Open Science to researchers (<https://bit.ly/MozFestRecap>).
- Strong communicator to a range of stakeholders and audiences (researchers, advocates, policy makers, general public) through interviews, blog posts, social media, podcasts, online project demonstrations and fostering our cohort's Twitter community: #RebelFoxes.

## Teaching & Supervising

**Academic Supervisor for Summer Student Placement**, University of Manchester, UK

2018

**Mentor for Mozilla Open Leadership training Round 5**, Mozilla Foundation

2018

**4IR CDT GitHub Workshop**, University of Manchester, UK

2018

**Supervisor for Transition Year Students (15-17 yo)**, Dublin Institute for Advanced Studies, Dublin, Ireland

2015 - 2017

**Exam invigilator**, University of Dublin, Trinity College, Dublin, Ireland

2013 - 2014

**Physics Lab Demonstrating for Junior Freshman Engineering**, University of Dublin, Trinity College, Dublin, Ireland

2012 - 2013

# Publications

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## REFEREED

9. S. J. D. Purser, **R. E. Ainsworth**, T. P. Ray, D. A. Green, A. M. Taylor and A. M. M. Scaife, “Constraining the nature of DG Tau A’s thermal and non-thermal radio emission”, *Monthly Notices of the Royal Astronomical Society*, in press, 2018.
8. C. P. Coughlan, **R. E. Ainsworth**, J. Eislöffel, M. Höft, A. Drabent, A. M. M. Scaife, T. P. Ray, et al., “A LOFAR Detection of the Low Mass Young Star T Tau at 149 MHz”, *Astrophysical Journal*, 834, 206–213, 2017.
7. **R. E. Ainsworth**, C. P. Coughlan, D. A. Green, A. M. M. Scaife and T. P. Ray, “A GMRT survey of regions towards the Taurus molecular cloud at 323 and 608 MHz”, *Monthly Notices of the Royal Astronomical Society*, 462, 2904–2917, 2016.
6. **R. E. Ainsworth**, A. M. M. Scaife, D. A. Green, C. P. Coughlan and T. P. Ray, “GMRT detections of low mass young stars at 323 and 608 MHz”, *Monthly Notices of the Royal Astronomical Society*, 459, 1248–1258, 2016.
5. **R. E. Ainsworth**, A. M. M. Scaife, T. P. Ray, A. M. Taylor, D. A. Green and J. V. Buckle, “Tentative evidence for relativistic electrons generated by the jet of the young Sun-like star DG Tau,” *Astrophysical Journal*, 792, L18–L22, 2014.
4. **R. E. Ainsworth**, T. P. Ray, A. M. M. Scaife, J. S. Greaves and R. J. Beswick, “Sub–arcsecond high sensitivity measurements of the DG Tau jet with e–MERLIN,” *Monthly Notices of the Royal Astronomical Society*, 436, L64–L68, 2013.
3. **R. E. Ainsworth**, A. M. M. Scaife, T. P. Ray, et al., “AMI radio continuum observations of young stellar objects with known outflows,” *Monthly Notices of the Royal Astronomical Society*, 423, 1089–1108, 2012.
2. A. M. M. Scaife, J. Hatchell, **R. E. Ainsworth**, et al., “AMI–LA radio continuum observations of Spitzer c2d small clouds and cores: Serpens region,” *Monthly Notices of the Royal Astronomical Society*, 420, 1019–1033, 2012.
1. A. M. M. Scaife, J. V. Buckle, **R. E. Ainsworth**, et al., “Radio continuum observations of Class I protostellar disks in Taurus: constraining the greybody tail at centimetre wavelengths,” *Monthly Notices of the Royal Astronomical Society*, 420, 3334–3343, 2012.

## UNREFEREED

2. **R. E. Ainsworth**, A. M. M. Scaife, T. P. Ray, D. A. Green and J. V. Buckle, “The Lowest Frequency Observations of YSOs with the GMRT”, Protostars and Planets VI, Heidelberg, July 15–20, 2013. Poster #1H019.
1. R. Sahai, M. Claussen, M. Morris and **R. E. Ainsworth**, “Ballistic Stellar Interlopers producing Bow-Shocks in the Interstellar Medium”, American Astronomical Society Meeting #213, *Bulletin of the American Astronomical Society*, 41, 465, 2009.

## PRESS RELEASES

1. R. Sahai, M. Morris, M. Claussen and **R. E. Ainsworth**, “Hubble Finds Stars That ‘Go Ballistic’ ”, NASA Jet Propulsion Laboratory, 7 January 2009. <https://www.jpl.nasa.gov/news/news.php?release=2009-002>

# Presentations

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<b>JBCA Internal Seminar</b> , University of Manchester, Manchester, UK	2018
<b>JBCA Sun, Stars and Galaxies group lunch talk</b> , University of Manchester, Manchester, UK	2018
<b>Cosmic Rays: The salt of the star formation recipe, Contributed talk</b> , Florence, Italy	2018
<b>EWASS 2018, Contributed talk</b> , Liverpool, UK	2018
<b>High Resolution Surveying with International LOFAR, Invited talk</b> , Lorentz Centre, Leiden, Netherlands	2018
<b>Invited Seminar</b> , National University of Ireland Maynooth, Ireland	2018
<b>Invited Seminar</b> , Imperial College London, UK	2017
<b>Radio Stars from kHz to THz Workshop, Contributed talk</b> , MIT Haystack Observatory, MA, USA	2017
<b>Open Research Forum</b> , Contact Theatre, University of Manchester Library, UK	2017
<b>Science Tea talk</b> , Jodrell Bank Observatory, Cheshire, UK	2016
<b>The Accretion/Outflow Connection in YSOs Workshop, Contributed talk</b> , ESA/ESTEC, Noordwijk, Netherlands	2015
<b>Invited Seminar</b> , Thüringer Landessternwarte, Tautenburg, Germany	2015
<b>Lunch talk</b> , Leiden Observatory, Leiden, Netherlands	2014
<b>e–MERLIN Science Meeting, Contributed talk</b> , University of Manchester, Manchester, UK	2014
<b>Postgraduate Seminar Series, Seminar</b> , University of Dublin, Trinity College, Dublin, Ireland	2014
<b>The Metrewavelength Sky Conference, Contributed talk</b> , NCRA–TIFR, Pune, India	2013
<b>Protostars and Planets VI, Poster</b> , Heidelberg, Germany	2013
<b>Radio Stars and Their Lives in the Galaxy Workshop, Contributed talk</b> , MIT Haystack Observatory, MA, USA	2012
<b>Astronomical Science Group of Ireland Spring Meeting, Contributed talk</b> , Birr, Ireland	2012
<b>Seminar</b> , Dublin Institute for Advanced Studies, Dublin, Ireland	2012
<b>National Astronomy Meeting of the Royal Astronomical Society, Poster</b> , University of Manchester, Manchester, UK	2012
<b>Seminar</b> , University of Southampton, Southampton, UK	2011
<b>Young European Radio Astronomers Conference, Contributed talk</b> , University of Manchester, Manchester, UK	2011

## Observing & High-Performance Computing Programmes

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**Co-I: VLA Cycle 2018A (PI: H. Liu, 18A-243, 18 hours)**, Properties of the hot inner disks in accretion outburst young stellar objects at X, Ka and Ku-band, A-config to expand the sample of radio continuum spectra of such hot inner disks.

**Co-I: e-MERLIN (PI: J. Greaves, CY5214, 330 hours)**, Planet-Earth Building Blocks - a Legacy e-MERLIN Survey.

**Co-I: e-MERLIN (PI: J. Greaves, CY4211, 12 hours)**, What planets for DG Tau?: Observations of DG Tau at 21–24 GHz to investigate dust concentration in the circumstellar disk.

**PI: VLA Cycle 2016A (16A-051, 6.5 hours)**, Confirming Cosmic Ray Production in a Protostellar Jet: Observations of DG Tau at C and X-band, C-config to measure the bow shock proper motion.

**PI: LOFAR Cycle 5 (LC5\_004, 8 hours)**, VLBI Investigations of a Protostellar Jet with LOFAR: Low-frequency, high-resolution observations of T Tau.

**Co-I: ICHEC 2016 (PI: C. Coughlan, dsast016b, class: B, 600000 CPU hours on Fionn)**, New Discoveries at Low Frequencies - Searching for Young Stellar Objects and Exoplanets with LOFAR, Irish Centre for High-Performance Computing.

**PI: VLA Cycle 2015A (15A-143, 2 hours)**, Cosmic Rays Generated in the Jet of a Young Sun-like Star?: Observations of DG Tau at S-band, A-config to confirm synchrotron nature of bow shock.

**PI: ICHEC 2015 (dsast014c, class: C, 6000 CPU hours on Fionn)**, Calibrating LOFAR Observations of Young Stellar Objects, Irish Centre for High-Performance Computing.

**PI: VLA Cycle 2014A (14A-439, 14 hours)**, Polarisation Measurements of Protostellar Jets: Observations of 3 YSOs at L and S-band, A-config to detect linearly polarised emission.

**PI: VLA Cycle 2014A (14A-457, 6 hours)**, Radio Continuum Observations of FU Orionis Stars: Observations of 4 FUors at X and Ku-band, A-config to detect individual ejection episodes.

**Co-I: LOFAR Cycle 1 (PI: J. Eislöffel, LC1\_001, 17 hours)**, Low Frequency Observations of Jets from Young Stars in Taurus: To follow up the low frequency GMRT observations at 150 MHz, confirm the emission mechanism at low frequency, and study outflow structure.

**PI: GMRT Cycle 25 (25\_072, 22 hours)**, Low Frequency Radio Emission from the Youngest Low Mass Protostars: To extend the GMRT pathfinder program to Class 0 objects at 325 and 610 MHz.

**PI: GMRT Cycle 25 (25\_066, 58 hours)**, Blind Survey of the NGC 1333 Star Forming Region at Low Frequencies: To perform a radio census of Class 0–III YSOs at 610 MHz.

## Honours & Awards

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<b>Sponsorship to attend FOSTER Open Science Trainer Bootcamp</b> , FOSTER Open Science	2018
<b>Sponsorship to attend OpenCon</b> , University of Manchester Library, UK	2017
<b>Mozilla Festival Session Facilitator</b> , Mozilla	2017
<b>Mozilla Open Leader</b> , Mozilla	2017
<b>Ph.D. funding (4 years)</b> , Dublin Institute for Advanced Studies	2010
<b>UT Chancellor's Honours Award for Extraordinary Professional Promise</b> , University of Tennessee	2010
<b>Summer Research Fellowship</b> , University of Tennessee	2009
<b>Undergraduate Student Research Program</b> , National Aeronautics and Space Administration	2008
<b>Phi Eta Sigma Freshman Honors Fraternity</b> , University of Tennessee	2006

## Outreach

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<b>Hacktoberfest event co-organiser</b> , Manchester Technology Centre, UK	2018
<b>PyData MCR lightning talk</b> , University of Manchester, UK	2018
<b>Women in Physics Careers Panel</b> , School of Physics & Astronomy, University of Manchester, UK	2017 - 2018
<b>Volunteer for SKA at Bluedot Festival</b> , Jodrell Bank Observatory, Cheshire, UK	2017 - 2018
<b>JBCA Representative for UK Prime Minister Theresa May's visit</b> , Jodrell Bank Observatory, Cheshire, UK	2018
<b>The Jodcast</b> , Jodrell Bank Centre for Astrophysics, University of Manchester, UK	2018
<b>Speaker on Public Open Nights</b> , Dunsink Observatory, Dublin, Ireland	2011 - 2017
<b>Judge, SciFest@School</b> , Santa Sabina Sutton Secondary School, Sutton, Ireland	2017
<b>Interviewed for The DeTECHtives TV show</b> , Raidió Teilifís Éireann (RTÉ), Dublin, Ireland	2017
<b>President of Ireland Michael D. Higgins hosted DIAS on the 75th Anniversary of its foundation</b> , Áras an Uachtaráin, Dublin, Ireland	2015
<b>Volunteer, European Science Open Forum</b> , Dublin Convention Centre, Dublin, Ireland	2012
<b>Photographer, lecture by NASA Astronaut Shane Kimbrough</b> , Dublin City University, Dublin, Ireland	2011
<b>Photographer, "Exploring the Final Frontier: Fifty Years On" lecture with Russian Cosmonaut Mikhail Kornienko</b> , Dublin City University, Dublin, Ireland	2011

## Service

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**Internal Symposium organiser**, Jodrell Bank Centre for Astrophysics, University of Manchester, UK

2018

**Colloquium organiser**, Jodrell Bank Centre for Astrophysics, University of Manchester, UK

2018

**Referee**, The Astrophysical Journal

2017 - pres.

## References

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**Prof. Anna Scaife**, Jodrell Bank Centre for Astrophysics, University of Manchester, Manchester, UK ✉ [anna.scaife@manchester.ac.uk](mailto:anna.scaife@manchester.ac.uk)

**Prof. Tom Ray**, School of Cosmic Physics, Dublin Institute for Advanced Studies, Dublin, Ireland ✉ [tr@cp.dias.ie](mailto:tr@cp.dias.ie)

**Prof. Luke Drury**, School of Cosmic Physics, Dublin Institute for Advanced Studies, Dublin, Ireland ✉ [ld@cp.dias.ie](mailto:ld@cp.dias.ie)

**Dr. David Green**, Cavendish Laboratory, University of Cambridge, Cambridge, UK ✉ [dag@mrao.cam.ac.uk](mailto:dag@mrao.cam.ac.uk)

**Dr. Raghvendra Sahai**, Jet Propulsion Laboratory/Caltech, Pasadena, CA, USA ✉ [raghvendra.sahai@jpl.nasa.gov](mailto:raghvendra.sahai@jpl.nasa.gov)