

# Laura K. Nuttall

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Nationality British

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## Employment

- April 2015 – Present **Postdoctoral Research Associate, Syracuse University, Syracuse, USA.**  
**Brief synopsis of research:** My research is mainly focussed within the Compact Binary Coalescence (CBC) and Detector Characterisation groups of the LIGO Scientific Collaboration. I was the CBC data quality lead during the first observing run; work I led resulted in the unambiguous identification of the first two gravitational-wave detections. I was the main editor for the paper describing the second detection of gravitational waves from the merger of two black holes - GW151226. I am also data quality co-chair within the Detector Characterisation group. I have visited the LIGO-Hanford observatory under the LIGO Visitors Program. I am a member at large for the LIGO Scientific Collaboration Fellows Committee, a member of the LIGO Rapid Response Team and a member of the review team for the LIGO Open Science Center.
- August 2013 – March 2015 **Postdoctoral Research Associate, University of Wisconsin-Milwaukee, Milwaukee, USA.**  
**Brief synopsis of research:** My work at UWM was focussed within the Detector Characterisation group of the LIGO Scientific Collaboration, specifically I was the subsystem lead for the input mode cleaner and co-chair of the alignment sensing and control subsystem and instrumentation group within the Detector Characterisation group. In addition I was, and still am, the LIGO data quality shift coordinator.

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## Education

- 2009 – 2013 **Ph.D, Cardiff University, Cardiff, UK.**  
**Dissertation Topic:** ‘*Electromagnetic Follow Up of Gravitational Wave Candidates*’  
**Supervisor:** Prof. Patrick Sutton  
**Brief synopsis of research:** During my Ph.D I developed and led the analysis of optical images taken by the ROTSE-III telescope system in response to gravitational-wave candidates. In addition I was an active member of the Detector Characterisation groups for both the GEO and LIGO detectors and a visiting student researcher at both the LIGO-Hanford (March - May 2010) and LIGO-Livingston (June - July 2011) observatories.
- 2005 – 2009 **M.Phys., Physics with Astrophysics and Cosmology, 1st Class Honours, Lancaster University, Lancaster, UK.**  
**Masters Project:** The theory of gravitational waves, entitled ‘*Gravitational Waves*’  
**Supervisor:** Dr David Burton

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## Experience

### Teaching Experience

- October 2009 – 2013 **Postgraduate Demonstrator, Cardiff University.**  
Throughout my Ph.D I was a lab demonstrator to first year physics BSc and MPhys students. Duties included guiding students through experiments and marking lab reports.
- November 2012 **Guest Lecturer, University of Glamorgan.**  
Presented a lecture on gravitational waves to third year undergraduate students.
- December 2011/2012 **Lecturer, LEARN, Cardiff University.**  
Ran two four-hour adult education workshops on gravitational waves.

### Computing Experience

Programming Languages: Python, Matlab, IDL, Bash  
Operating Systems: Linux, Mac OSX, Windows

## Other Experience

- 2014 – 2016 **Editor.**  
LIGO Magazine  
LIGO Scientific Collaboration Beginner's Guide
- 2016 – present **Representative.**  
LVC Allies - anti-harassment initiative for the LIGO Scientific Collaboration
- 2012 – 2016 **Member of the Local Organising Committee.**  
Conference for Undergraduate Women in Physics 2016 - Syracuse  
23rd Midwest Relativity Meeting 2013  
Speaking of Science 2012  
Amaldi 9 NRDA 2011

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## Honours, Awards and Scholarships

- 2016 Kavli Fellow
- 2016 Special Breakthrough Prize in Fundamental Physics - LIGO Scientific Collaboration
- 2016 Gruber Cosmology Prize - LIGO Scientific Collaboration
- 2012 Bessie Jones Postgraduate Bursary: Most Outstanding Postgraduate Research Student 2011-2012 - Cardiff University
- 2012 IOP Research Student Conference Fund from the Gravitational Physics Group
- 2011 LIGO Scientific Collaboration Poster Prize at the LIGO Scientific Collaboration and Virgo Collaboration Meeting
- 2010 E4 Computer Engineering SpA Award for the best scientific contribution of a young student at GWDAAW 14
- 2009 The Princess Alexandra Medal - Lancaster University
- 2009 Pendle College Outstanding Academic Achievement Award - Lancaster University
- 2006 - 2009 Physics Prize (received every year of study) - Lancaster University
- 2006 Pilkington Award (excellent performance at Part 1 of MPhys) - Lancaster University
- 2005 Eliahou Dangoor Scholarship - Lancaster University

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## Publications

Publications (including LIGO Scientific Collaboration papers) to which I have made a significant contribution.

- B. P. Abbott et al., '*Effects of Data Quality Vetoes on a Search for Compact Binary Coalescences in Advanced LIGO's First Observing Run*', 2016, In Preparation
- B. P. Abbott et al., '*Upper Limits on the Rates of Binary Neutron Star and Black-Hole Neutron-Star Mergers from Advanced LIGOs First Observing Run*', 2016, Ap. J., 832, 2, L21
- B. P. Abbott et al., '*Binary Black Hole Mergers in the First Advanced LIGO Observing Run*', 2016, Phys. Rev. X., 6, 041015
- B. P. Abbott et al., '*GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence*', 2016, Phys. Rev. Lett., 116, 241103
- B. P. Abbott et al., '*GW150914: First Results from the Search for Binary Black Hole Coalescence with Advanced LIGO*', 2016, Phys. Rev. D, 93, 122003
- B. P. Abbott et al., '*Characterization of Transient Noise in Advanced LIGO relevant to Gravitational Wave Signal GW150914*', 2016, Class. Quantum Grav., 33, 134001
- D. V. Martynov et al., '*Sensitivity of the Advanced LIGO Detectors at the Beginning of Gravitational Wave Astronomy*', 2016, Phys. Rev. D, 93, 112004

- B. P. Abbott et al., ‘*Observation of Gravitational Waves from a Binary Black Hole Merger*’, 2016, Phys. Rev. Lett., 116, 061102
- K. L. Dooley et al., ‘*GEO 600 and the GEO-HF Upgrade Program: Successes and Challenges*’, 2016, Class. Quantum Grav., 33, 075009
- L. K. Nuttall et al., ‘*Improving the Data Quality of Advanced LIGO Based on Early Engineering Run Results*’, 2015, Class. Quantum Grav., 32, 245005
- T. Adams et al., ‘*Cost-Benefit Analysis for Commissioning Decisions in GEO 600*’, 2015, Class. Quantum Grav., 32, 135014
- J. Aasi et al., ‘*Characterization of the LIGO Detectors during their Sixth Science Run*’, 2015, Class. Quantum Grav., 32, 105012
- D. Tshilumba, L. K. Nuttall, T. MacDonald, R. Mittleman, B. Lantz, F. Matichard, C. Collette, ‘*Vibration Analysis and Control of the LIGO Observatories Large Chamber and Support Piers*’, 2014, Proceedings of ISMA2014 including USD2014
- J. Aasi et al., ‘*First Searches for Optical Counterparts to Gravitational-wave Candidate Events*’, 2014, ApJS, 211, 7
- L. K. Nuttall et al., ‘*Large-Scale Image Processing with the ROTSE Pipeline*’, 2013, ApJS, 209, 24
- L. K. Nuttall for the LIGO Scientific Collaboration and Virgo Collaboration, W. Zheng, C. Akerlof, ‘*The Analysis of ROTSE Images of Potential Counterparts to Gravitational Wave Events*’, 2012, J. Phys.: Conf. Ser. 363 012033
- J. Abadie et al., ‘*Implications For The Origin Of GRB 051103 From LIGO Observations*’, 2012, Ap. J., 755, 2
- J. Abadie et al., ‘*Implementation and Testing of the First Prompt Search for Gravitational Wave Transients with Electromagnetic Counterparts*’, 2011, A&A, 539, A124
- L. K. Nuttall & P. J. Sutton, ‘*Identifying the Host Galaxy of Gravitational Signals*’, 2010, Phys. Rev. D, 82, 102002

#### Other Publications

As an active member of the LIGO Scientific Collaboration the following publications are those for which I hold authorship rights.

- M. Walker et al., ‘*Effects of Transients in LIGO Suspensions on Searches for Gravitational Waves*’, 2017, arXiv:1702.04701
- D. V. Martynov et al., ‘*Quantum Correlation Measurements in Interferometric Gravitational Wave Detectors*’, 2017, arXiv:1702.03329
- B. P. Abbott et al., ‘*First Search for Gravitational Waves from Known Pulsars with Advanced LIGO*’, 2017, arXiv:1701.07709
- B. P. Abbott et al., ‘*Directional Limits on Persistent Gravitational Waves from Advanced LIGO’s First Observing Run*’, 2016, arXiv:1612.02030
- B. P. Abbott et al., ‘*Upper Limits on the Stochastic Gravitational-wave Background from Advanced LIGO’s First Observing Run*’, 2016, arXiv:1612.02029
- B. P. Abbott et al., ‘*Search for Gravitational Waves Associated with Gamma-Ray Bursts During the First Advanced LIGO Observing Run and Implications for the Origin of GRB150906B*’, 2016, arXiv:1611.07947
- B. P. Abbott et al., ‘*Effects of Waveform Model Systematics on the Interpretation of GW150914*’, 2016, arXiv:1611.07531
- B. P. Abbott et al., ‘*Exploring the Sensitivity of Next Generation Gravitational Wave Detectors*’, 2016, arXiv:1607.08697
- B. P. Abbott et al., ‘*Search for Continuous Gravitational Waves from Neutron Stars in Globular Cluster NGC 6544*’, 2016, arXiv:1607.02216

- B. P. Abbott et al., ‘*Calibration of the Advanced LIGO Detectors for the Discovery of the Binary Black-Hole Merger GW150914*’, 2016, arXiv:1602.03845
- B. P. Abbott et al., ‘*All-sky Search for Short Gravitational-wave Bursts in the First Advanced LIGO Run*’, 2017, Phys. Rev. D, 95, 042003
- B. P. Abbott et al., ‘*Results of the Deepest All-Sky Survey for Continuous Gravitational Waves on LIGO S6 Data Running on the Einstein@Home Volunteer Distributed Computing Project*’, 2016, Phys. Rev. D, 94, 102002
- B. P. Abbott et al., ‘*A First Targeted Search for Gravitational-Wave Bursts from Core-Collapse Supernovae in Data of First-Generation Laser Interferometer Detectors*’, 2016, Phys. Rev. D, 94, 102001
- B. P. Abbott et al., ‘*The Rate of Binary Black Hole Mergers Inferred from Advanced LIGO Observations Surrounding GW150914*’, 2016, ApJL, 833, 1
- B. P. Abbott et al., ‘*Supplement: The Rate of Binary Black Hole Mergers Inferred from Advanced LIGO Observations Surrounding GW150914*’, 2016, ApJS, 227, 2
- B. P. Abbott et al., ‘*The Basic Physics of the Binary Black Hole Merger GW150914*’, 2016, Annalen Phys.
- B. P. Abbott et al., ‘*An Improved Analysis of GW150914 using a Fully Spin-Precessing Waveform Model*’, 2016, Phys. Rev. X., 6, 041014
- B. P. Abbott et al., ‘*Directly Comparing GW150914 with Numerical Solutions of Einstein’s Equations for Binary Black Hole Coalescence*’, 2016, Phys. Rev. D., 94, 064035
- B. P. Abbott et al., ‘*Comprehensive All-sky Search for Periodic Gravitational Waves in the Sixth Science Run LIGO Data*’, 2016, Phys. Rev. D., 94, 042002
- B. P. Abbott et al., ‘*Localization and Broadband Follow-Up of the Gravitational-Wave Transient GW150914*’, 2016, ApJ., 826, 1
- B. P. Abbott et al., ‘*Properties of the Binary Black Hole Merger GW150914*’, 2016, Phys. Rev. Lett., 116, 241102
- B. P. Abbott et al., ‘*High-Energy Neutrino Follow-Up Search of Gravitational Wave Event GW150914 with ANTARES and IceCube*’, 2016, Phys. Rev. D., 93, 122010
- B. P. Abbott et al., ‘*Search for Transient Gravitational Waves in Coincidence with Short Duration Radio Transients during 2007-2013*’, 2016, Phys. Rev. D., 93, 122008
- B. P. Abbott et al., ‘*Observing Gravitational-Wave Transient GW150914 with Minimal Assumptions*’, 2016, Phys. Rev. D., 93, 122004
- B. P. Abbott et al., ‘*Tests of General Relativity with GW150914*’, 2016, Phys. Rev. Lett., 116, 221101
- B. P. Abbott et al., ‘*GW150914: The Advanced LIGO Detectors in the Era of First Discoveries*’, 2016, Phys. Rev. Lett., 116, 131103
- B. P. Abbott et al., ‘*GW150914: Implications for the Stochastic Gravitational Wave Background from Binary Black Holes*’, 2016, Phys. Rev. Lett., 116, 131102
- B. P. Abbott et al., ‘*Astrophysical Implications of the Binary Black Hole Merger GW150914*’, 2016, ApJL, 818, 2
- J. Aasi et al., ‘*First Low Frequency All-Sky Search for Continuous Gravitational Wave Signals*’, 2016, Phys. Rev. D., 93, 042007
- J. Aasi et al., ‘*Search of the Orion Spur for Continuous Gravitational Waves using a Loosely Coherent Algorithm on Data from LIGO Interferometers*’, 2016, Phys. Rev. D., 93, 042006
- B. P. Abbott et al., ‘*An All-Sky Search for Long-Duration Gravitational Wave Transients with LIGO*’, 2016, Phys. Rev. D., 93, 042005

J. Aasi et al., ‘*Prospects for Observing and Localizing Gravitational-Wave Transients with Advanced LIGO and Advanced Virgo*’, 2016, Living Rev. Relativity, 19, 1

J. Aasi et al., ‘*Searches for Continuous Gravitational Waves from Nine Young Supernova Remnants*’, 2015, Ap.J., 813, 1

J. Aasi et al., ‘*Advanced LIGO*’, 2015, Class. Quantum Grav., 32, 074001

J. Aasi et al., ‘*A Directed Search for Gravitational Waves from Scorpius X-1 with Initial LIGO*’, 2015, Phys. Rev. D., 91, 062008

J. Aasi et al., ‘*Narrow-Band Search of Continuous Gravitational-Wave Signals from Crab and Vela Pulsars in Virgo VSR4 Data*’, 2015, Phys. Rev. D., 91, 022004

J. Aasi et al., ‘*Searching for Stochastic Gravitational Waves using Data from the Two Co-located LIGO Hanford Detectors*’, 2015, Phys. Rev. D., 91, 022003

M. G. Aartsen et al., ‘*Multimessenger Search for Sources of Gravitational Waves and High-Energy Neutrinos: Results for Initial LIGO-Virgo and IceCube*’, 2014, Phys. Rev. D., 90, 102002

J. Aasi et al., ‘*Improved Upper Limits on the Stochastic Gravitational-Wave Background from 2009-2010 LIGO and Virgo Data*’, 2014, Phys. Rev. Lett., 113, 231101

J. Aasi et al., ‘*First All-Sky Search for Continuous Gravitational Waves from Unknown Sources in Binary Systems*’, 2014, Phys. Rev. D., 90, 062010

J. Aasi et al., ‘*Methods and Results of a Search for Gravitational Waves Associated with Gamma-Ray Bursts using the GEO600, LIGO, and Virgo Detectors*’, 2014, Phys. Rev. D, 89, 122004

J. Aasi et al., ‘*Search for Gravitational Radiation from Intermediate Mass Black Hole Binaries in Data from the Second LIGO-Virgo Joint Science Run*’, 2014, Phys. Rev. D., 89, 122003

J. Aasi et al., ‘*Search for Gravitational Waves Associated with Gamma-Ray Bursts Detected by the Interplanetary Network*’, 2014, Phys. Rev. Lett., 113, 011102

J. Aasi et al., ‘*Search for Gravitational Wave Ringdowns from Perturbed Intermediate Mass Black Holes in LIGO-Virgo Data from 2005-2010*’, 2014, Phys. Rev. D., 89, 102006

J. Aasi et al., ‘*Implementation of an F-statistic All-Sky Search for Continuous Gravitational Waves in Virgo VSR1 Data*’, 2014, 31, Phys. Rev. D., 165014

J. Aasi et al., ‘*The NINJA-2 Project: Detecting and Characterizing Gravitational Waveforms Modelled using Numerical Binary Black Hole Simulations*’, 2014, Class. Quantum. Grav., 31, 115004

J. Aasi et al., ‘*Application of a Hough Search for Continuous Gravitational Waves on Data from the 5th LIGO Science Run*’, 2014, Class. Quantum. Grav., 31, 085014

J. Aasi et al., ‘*Constraints on Cosmic (Super)Strings from the LIGO-Virgo Gravitational-Wave Detectors*’, 2014, Phys. Rev. Lett., 112, 131101

J. Aasi et al., ‘*Gravitational-Waves from Known Pulsars: Results from the Initial Detector Era*’, 2014, ApJ, 785, 119

J. Aasi et al., ‘*Search for Long-Lived Gravitational-Wave Transients Coincident with Long Gamma-Ray Bursts*’, 2013, Phys. Rev. D., 88, 122004

J. Aasi et al., ‘*A Directed Search for Continuous Gravitational Waves from the Galactic Center*’, 2013, Phys. Rev. D., 88, 102022

J. Aasi et al., ‘*Parameter Estimation for Compact Binary Coalescence Signals with the First Generation Gravitational Wave Detector Network*’, 2013, Phys. Rev. D., 88, 062001

- J. Aasi et al., ‘*Enhanced Sensitivity of the LIGO Gravitational Wave Detector by using Squeezed States of Light*’, 2013, Nature Photonics, 7, 613
- J. Aasi et al., ‘*Search for Gravitational Waves from Binary Black Hole Inspiral, Merger and Ringdown in LIGO-Virgo Data from 2009-2010*’, 2013, Phys. Rev. D., 87, 022002
- J. Aasi et al., ‘*Einstein@Home All-Sky Search for Periodic Gravitational Waves in LIGO S5 Data*’, 2013, Phys. Rev. D., 87, 042001
- S. Adrian-Martinez, ‘*A First Search for Coincident Gravitational Waves and High Energy Neutrinos using LIGO, Virgo and ANTARES Data from 2007*’, 2013, JCAP, 1306, 008
- J. Abadie et al., ‘*Search for Gravitational Waves Associated with Gamma-Ray Bursts during LIGO Science Run 6 and Virgo Science Runs 2 and 3*’, 2012, ApJ, 760, 12
- P.A. Evans et al., ‘*Swift Follow-Up Observations of Candidate Gravitational-Wave Transient Events*’, 2012, ApJS, 203, 28
- J. Abadie et al., ‘*All-Sky Search for Gravitational-Wave Bursts in the Second Joint LIGO-Virgo Run*’, 2012, Phys. Rev. D., 85, 122007
- J. Abadie et al., ‘*Upper Limits on a Stochastic Gravitational-Wave Background using LIGO and Virgo Interferometers at 600-1000 Hz*’, 2012, Phys. Rev. D, 85,102004
- J. Abadie et al., ‘*Search for Gravitational Waves from Intermediate Mass Binary Black Holes*’, 2012, Phys. Rev. D, 85, 102004
- J. Abadie et al., ‘*Search for Gravitational Waves from Low Mass Compact Binary Coalescence in LIGO’s Sixth Science Run and Virgo’s Science Runs 2 and 3*’, 2012, Phys. Rev. D, 85, 082002
- J. Abadie et al., ‘*All-sky Search for Periodic Gravitational Waves in the Full S5 LIGO Data*’, 2012, Phys. Rev. D, 85, 022001
- J. Aasi et al., ‘*The Characterization of Virgo Data and its Impact on Gravitational-Wave Searches*’, 2012, CQG, 29, 155002
- J. Abadie et al. ‘*First Low-Latency LIGO+Virgo Search for Binary Inspirals and their Electromagnetic Counterparts*’, 2012, A&A, 541, A155

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## Presentations

- Colloquium ‘*The Astrophysics we can do with LIGO - Exploring the Apparent Black Hole Mass Gap and Hunting for Electromagnetic Counterparts*’  
 March 2017 Perimeter Institute for Theoretical Physics, Canada
- Colloquium ‘*Observing Gravitational Waves with Advanced LIGO and Hunting for Counterparts*’  
 March 2017 University of Guelph, Canada
- Invited Poster ‘*Detecting Gravitational Waves from the Merger of Black Holes with LIGO*’  
 February 2017 Israeli-American Kavli Frontiers of Science Symposium, Irvine CA, USA
- Invited Talk ‘*Observing Gravitational Waves with Advanced LIGO and Hunting for Counterparts*’  
 February 2017 JINA-CEE Frontiers in Nuclear Astrophysics, Michigan State University, USA
- Invited Talk ‘*Observing Gravitational Waves with Advanced LIGO*’  
 October 2016 Compact Stars and Gravitational Waves, Kyoto University, Japan
- Colloquium ‘*Gravitational Waves: The Birth of a New Era of Astronomy*’  
 October 2016 Perimeter Institute for Theoretical Physics, Canada
- Colloquium ‘*Gravitational Waves: The Birth of a New Era of Astronomy*’  
 September 2016 Lancaster University, UK

- Invited Talk ‘*Searching for Gravitational Waves from Advanced LIGO’s First Observing Run*’  
 May 2016 JINA-CEE International Symposium on Neutron Stars in the Multi-Messenger Era: Prospects and Challenges, Ohio University, USA
- Talk ‘*Applying Data Quality to Searches for Compact Binary Coalescences in the First Observing Run of Advanced LIGO*’  
 April 2016 APS April Meeting, Salt Lake City, USA
- Colloquium ‘*Gravitational Waves: The Birth of a New Area of Astronomy*’  
 March 2016 Colgate College, USA
- Colloquium ‘*Gravitational Waves: The Birth of a New Area of Astronomy*’  
 February 2016 Massachusetts Institute of Technology, USA
- Invited Talk ‘*Ensuring we will Recognise Gravitational Waves in Advanced LIGO/Virgo*’  
 June 2015 General Relativity & Gravitation: A Centennial Perspective, Pennsylvania State University, USA
- Colloquium ‘*Preparing for Advanced LIGO: Characterising Gravitational Wave Interferometers*’  
 March 2014 Cardiff University, UK
- Talk ‘*First Search for Optical Counterparts to Gravitational-Wave Candidate Events*’  
 October 2013 23rd Midwest Relativity Meeting, University of Wisconsin-Milwaukee, USA
- Talk ‘*Electromagnetic Observations of Gravitational Wave Events*’  
 February 2013 Bristol Exeter Cardiff Student Seminars (BECss), Bristol University, UK
- Poster ‘*Automation of the ROTSE Image Processing Pipeline*’  
 April 2012 New Windows on Transients Across the Universe, Royal Society Discussion Meeting, London, UK
- Talk ‘*Automation of the ROTSE Image Processing Pipeline for Rapid Identification of Electromagnetic Counterparts to Gravitational Wave Triggers*’  
 March 2012 NAM 2012, Manchester, UK
- Talk ‘*A Pipeline for the Identification of Optical Transients in ROTSE Images with Events in Gravitational Wave Data*’  
 July 2011 Amaldi 9 NRDA 2011, Cardiff, UK.
- Talk ‘*Electromagnetic Observations of Gravitational Wave Events*’  
 April 2011 Speaking of Science, Cardiff, UK
- Colloquium ‘*LIGO and the LOOC UP Project*’  
 January 2011 University of Michigan, USA
- Poster ‘*Identifying the Host Galaxy of Gravitational Wave Candidates*’  
 January 2010 GWDAW 14, Rome, Italy

I have actively participated in many LIGO Scientific Collaboration and Virgo Collaboration meetings. I have presented my work to the entire collaboration and compact binary coalescence, burst and detector characterisation working groups at numerous face to face and plenary sessions.

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## Outreach Activities

- Development Team An Astro Safari: interactive hour introducing students to astrophysics (2014-2015)  
 CoffeeShop Astrophysics: informal public lecture series (2014-2015)
- Mentor Adopt-a-Physicist (2013/2014)  
 Discover! Saturday Club for Girls (2012)  
 Researcher in Residence at Christ College Brecon (2010-2012)
- Online Maintainer of the UWM astrophysics group website (2013-2015)  
 Builder/maintainer of CoffeeShop Astrophysics website (2014-2015)  
 Head of social media for the UWM astrophysics group (2013-2015)
- Presenter STEM/GEM days at UW-Waukesha (2014)  
 Black Hole Bash at UWM (2014)

Speaker Conference for Undergraduate Women in Physics - Syracuse (2016)  
Women In Science: Postdoctoral Seminar Program (2014/2015)  
AstroBreak at the UWM Planetarium (2014/2015)  
Monmouth Astronomical Society (2013)  
Sixth Form Conference held at Cardiff University (2010/2011)

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## References

- Academic **Prof. Duncan Brown**, Charles Brightman Professor of Physics.  
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- Academic **Prof. Patrick Brady**, Professor of Physics.  
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