Paul James Wright

CONTACT INFORMATION

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Publication List: NASA Astrophysics Data System

RESEARCH SUMMARY

Physics PhD candidate with experience in time-series analysis techniques, deep learning, and methods for recovering the the temperature distribution of the solar atmosphere (an ill-posed inverse problem). These techniques were used on a wide range of spectroscopic and narrowband data, including images from remote sensing instruments such as the *Solar Dynamics Observatory* (*SDO*/AIA) which provides ~ 0.7 Tb data per day. Attended and presented at a wide range of conferences (11 oral presentations; 4 invited), including an invited workshop talk on accelerating temperature inversion with neural networks. Extensive experience with technical writing, outreach and public engagement, and passionate about data visualisation.

EDUCATION

University of Glasgow, Glasgow, UK — 2014 – present
Ph.D. Physics — (expected April 2019)

University of Southampton, Southampton, UK — 2010 – 2014
MPhys Astrophysics with a year abroad
Year abroad at Harvard University/Smithsonian Astrophysical Observatory
First-class honours (1:1)

EXPERIENCE & SKILLS

Post-Graduate Research Assistant, University of Glasgow — 2014 – present
SUPA School of Physics and Astronomy

- Initiated observations of the Sun with a telescope not designed for heliophysics (*NuSTAR*). These novel observations are the most sensitive of their kind and have resulted in numerous, highly-collaborative peer-reviewed publications.
- Extracted signatures of heating in the solar atmosphere using techniques including time-lag analysis (cross-correlation); Fourier analysis; wavelet analysis; and local intermittency measure (LIM).
- Studied the temperature distribution of the solar atmosphere through the recovery of an ill-posed inverse problem (the differential emission measure, DEM) using techniques such as Tikhonov regularisation, Markov-chain Monte Carlo, Spline fitting, and Sparse Inversion (by Basis Pursuit).
- The press-release image produced from the *NuSTAR* observations obtained for Wright *et al.* 2017 was published by numerous news outlets and is one of the five iconic images from *NuSTAR*'s first five years in space.

Researcher, NASA Frontier Development Lab — 2018
SETI Institute/NASA Ames Research Center, Mountain View, CA

- A selective 8-week applied Artificial Intelligence accelerator established to tackle knowledge gaps useful to NASA's science and exploration goals, and humanity.
- Implemented Deep Learning algorithms (Convolutional Neural Networks; CNNs) such as U-Net, AlexNet and ResNet to predict disk-integrated Solar Spectral Irradiance (SSI) from from high-resolution images (~ 0.7 Tb/day) which share a common latent space.
- Predicted SSI with median absolute relative uncertainties of $< 1.6\%$ using a CNN augmented with a Multi-Layer Perceptron (MLP), saving \$20 M on a new instrument.
- Used a 1x1 CNN (equivalent to an MLP) to improve the computational speed for differential emission measure inversion (10000-times increase). Further improvement to the resulting temperature distribution was obtained by training a CNN to correct the profile to minimise the residual between observed and synthesized SSI.
- Received the NASA Frontier Development Lab "Contribution to Science" award.

EXPERIENCE & SKILLS (CONT.)

Visiting Researcher, NASA Goddard Space Flight Center (GSFC) 2016
Heliophysics Science Division
- Explored the possibility of incorporating temperature maps (our data product) in to the Helioviewer project, and their usefulness as a scientific tool.

Research Scholar, Center for Astrophysics | Harvard & Smithsonian 2013 – 2014
Solar and Stellar X-ray Group
- Designed and implemented a sophisticated stellar flare detection routine (the most sensitive of its kind) based on Fourier analysis.
- This work had coverage by Science and the Smithsonian Magazine.

BOOK CHAPTERS

[1] **Wright, P. J.**, Cheung, M. C. M., Thomas, R., *et al* 2018 *DeepEM: A Deep Learning Approach to Differential Emission Measure Inversion*. In M. Bobra & J. Mason, eds., *Machine Learning, Statistics, and Data Mining for Heliophysics*, Chapter 4

SELECT AWARDS AND GRANTS TOTAL: £7000

University of Glasgow

NASA Frontier Development Lab, Contribution to Science Award	2018
Solar Physics Division Meeting (AAS/SPD) Student Poster Award	2017
Solar Physics Division Meeting (AAS/SPD) Studentship Award	2017
National Astronomical Observatory of Japan Travel Award	2016
European Space Agency/Cambridge Philosophical Society Travel Award	2015

TEACHING

Coursera Inc.

"Data Scientists Toolbox" Community Mentor 2017 – present
An invited mentor of the first module of the Data Science specialisation offered by Johns Hopkins University.

University of Glasgow

Astronomy 1 Tutorial Demonstrator 2016 - 2017
Astronomy 3/4 (Honours) Laboratory Demonstrator 2015 - 2016
Demonstrated, supervised, and marked a number of final-year research projects.
Physics Pre-University Summer School 2015

OUTREACH & PUBLIC ENGAGEMENT

UK Solar Physics (UKSP) Nuggets, concise, easy-to-read science articles
84. The first *NuSTAR* microflare 2017

Glasgow Science Centre, Demonstrator	2016
British Science Week, Demonstrator	2016
Institute of Physics: *Women and Girls in Science*, Demonstrator	2016
Scottish Television (STV), Guest Presenter	2015
World Wide Telescope, Ambassador	2013 – 2014

PROFESSIONAL DEVELOPMENT

Coursera, Inc. (MOOC Platform)
Using Coursera.org, a massive open online course (MOOC) platform, to take specialisations (a series of related courses plus a final capstone project) offered by accredited universities to further develop skills and understanding in a wide range of topics.

Data Science, Johns Hopkins University 2017 – present
Nine-course (plus capstone) introduction to data science.
Mastering Software Development in R, Johns Hopkins University 2018 – present
Four-course (plus capstone) specialisation providing rigorous training in R.

TECHNICAL SKILLS:	*Computing:* IDL (5+ years), Python (3+ years), PyTorch, R, Bash, LaTeX, PyCharm, git (GitHub, Gitlab), Microsoft Office, Adobe Creative Cloud, Linux/Unix, Mac OSX, Microsoft Windows.
	General: Data Analysis, Data Visualisation, Interdisciplinary Collaboration, Public Speaking, Teaching, Writing (Technical & Lay).