

John Armstrong, FRAS

MSci | Postgraduate Researcher

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Research Interests: My research interests are in the field of solar flares and machine learning. More specifically, I look at applications of deep learning to chromospheric flare observations and how these techniques can give us novel insights into the physics of the flaring chromosphere. I have worked with data from SST/CRISP, Hinode/SOT, SDO/AIA and Hinode/EIS as well as simulation data from the 1D radiation hydrodynamics code RADYN.

Education

National Centre for Atmospheric Research Advanced Study Program **Estes Park, CO**
Colloquium on Solar Spectropolarimetry 2018
Funding awarded for flights, accommodation and per diem expenses by NCAR. Intensive two week colloquium covering theoretical and observational solar spectropolarimetry and spectropolarimetric data analysis using inversion codes.

University of Glasgow **Scotland**
PhD Solar Physics, Supervisor: Prof. Lyndsay Fletcher 2017–
Title: Applications of deep learning to solar observations
Funding by STFC Data-Intensive Science Centre for Doctoral Training

University of Glasgow **Scotland**
MSci (1st Class Honours) Astronomy and Mathematics 2012–2017
Masters project: Neutron Polarisation in Space Physics, Supervisor: Dr. Alexander MacKinnon
Bachelor's projects: Magnetic Reconnection, Supervisor: Dr. David MacTaggart

Experience

University of Glasgow **Scotland**
PhD Researcher, Title: Data-science applications to solar observations 2017–

- Supervisor: Prof. Lyndsay Fletcher
- Developed a deep CNN for solar object detection.
- Re-purposed a cGAN for the correction of seeing in flare observations.
- Application of an INN for the inversion of solar flare chromosphere data.

University of Glasgow **Scotland**
Masters Project, Title: Neutron Polarisation in Space Physics Oct 2016–Apr 2017

- Supervisor: Dr. Alexander MacKinnon
- Employed the FLUKA multi-particle transport code to simulate galactic cosmic ray impacts throughout the Earth's atmosphere obtaining a distribution of neutron production with height.
- Used previously developed neutron polarisation model to calculate the oscillation in neutron polarisation as a neutron travels through the geomagnetic field.

University of Glasgow

Scotland

Research Intern, Topic: Modelling neutron polarization through magnetic fields Summer 2016

- Supervisor: Dr. Alexander MacKinnon, funding by Astronomy & Astrophysics Group, University of Glasgow.
- Developed a code in FORTRAN 90 which models how the polarization vector of a neutron changes as it traverses a magnetic field.

University of Glasgow

Scotland

Bachelor's Project, Topic: Magnetic Reconnection

Oct 2015 – Feb 2016

- Supervisor: Dr. David MacTaggart
- I looked at various 2D and 3D reconnection models and derived analytical expressions for the reconnection rate whilst studying what kind of models would be applicable to fusion and solar plasmas.

Publications

- "Slic: Solar image classification using convolutional neural networks", **J. A. Armstrong** and L. Fletcher, (2019, in prep.)
- "RADYNVERSION: Learning to Invert a Solar Flare Atmosphere with Invertible Neural Networks", C. M. J. Osborne, **J. A. Armstrong** and L. Fletcher, *The Astrophysical Journal*, (2019, accepted)

Awards

Jul 2016: Astronomy & Astrophysics Group

Funding for summer research project. Total funding £1200

Oct 2017: STFC Data-Intensive Science Centre for Doctoral Training

Research studentship: CDT scholarship which awarded full tuition and maintenance for 4-year PhD study. Total value ~£88000.

Sep–Oct 2018: National Centre for Atmospheric Research (NCAR)

Funding for flights, accommodation and per diem for the ASP Colloquium on Solar Spectropolarimetry. Total value ~£2000.

Technical skills

Programming Languages: Python (advanced), L^AT_EX (advanced), Markdown (intermediate), FORTRAN 90 (intermediate), MATLAB (intermediate), C++ (beginner)

Operating Systems: Mac OSX, Linux, Windows

Teaching

Jan 2019–March 2019: Astronomy 345HM Lab Demonstrator

Helped run the lab for the determination galactic structure from a survey of 21cm neutral hydrogen emission. Also helped out with solar limb darkening lab and taking the calibration of the small radio telescope at the observatory.

Jan 2018–Mar 2018, Sep 2018–Dec 2018: Astronomy 1 Tutor

Demonstrator at class tutorials, helped students with problems based on instrumentation, stellar physics and cosmology. Graded assignments and produced feedback.

Mar 2018, Feb 2019: Machine Learning Workshop

Prepared lectures and tutorials on supervised and unsupervised machine learning to be taught to fellow PhD students.

Jul 2018: Physics Pre-university Summer School (PPUSS)

Helped teach the astrophysics module of the summer school. This involved lessons, labs and exercises on exoplanets, cosmology and heliophysics.

Sep 2018: Work Experience Week

Helped groups of high school students produce poster presentations on work they had been doing throughout the week.

Nov 2018: STFC UK-wide CDT Welcome Event, Edinburgh

I produced and delivered a 1.5 hour tutorial on classical unsupervised machine learning for fellow PhD students.

2013–2017: Private Tutor

Tutored in physics and mathematics from high school to university level.

Memberships

2017–Present: Fellow of the Royal Astronomical Society

References

Prof. Lyndsay Fletcher: Professor of Astrophysics, University of Glasgow, Lyndsay.Fletcher@gla.ac.uk

Dr. Alexander MacKinnon: Senior Lecturer, Centre for Open Studies, University of Glasgow, Alexander.Mackinnon@gla.ac.uk

Dr. Morag Casey: Senior Lecturer, University of Glasgow, Morag.Casey@gla.ac.uk