Will Barnes

NRC Postdoctoral Research Associate

Space Science Division, U.S. Naval Research Laboratory, Washington, D.C., USA

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Education

Rice University — *Houston, TX*

Ph.D. Physics — *2016 – 2019*

- Thesis: Diagnosing the Frequency of Energy Deposition in the Magnetically-Closed Solar Corona
- Advisor: Dr. Stephen Bradshaw

Rice University — *Houston, TX*

M.S. Physics — *2013 – 2016*

Baylor University — *Waco, TX*

B.S. Astrophysics — *2009 – 2013*

- Thesis: Astrophysical Applications of Dusty Plasma Physics, Advisor: Dr. Lorin Matthews
- University Honors Program, Magna Cum Laude, Phi Beta Kappa, Dean's List
- Minors: Mathematics, Great Texts of the Western Tradition

Experience

NRC Postdoctoral Research Associate — *Washington, D.C.*

U.S. Naval Research Laboratory — *January 2020 – present*

Investigating observable signatures of impulsive heating and thermal non-equilibrium in EUV and X-ray observations of the solar corona

Visiting Postdoctoral Scholar — *Stanford, CA*

W. W. Hansen Experimental Physics Laboratory, Stanford University — *July – December 2019*

Explored applications of HPC/cloud computing to analysis of HMI data

Postdoctoral Research Scientist — *Palo Alto, CA*

Lockheed Martin Solar and Astrophysics Laboratory, Bay Area Environmental Research Institute — *May – December 2019*

Developed workflows for analyzing AIA imaging data using HPC/cloud infrastructure in collaboration with Stanford U. and NASA Ames

Research Computing Intern — *Houston, TX*

Center for Research Computing, Rice University — *October 2018 – May 2019*

Developed web application for scheduled data transfers with Globus. Refactored high performance computing documentation in reStructuredText and Sphinx with interactive examples. Explored research applications for cloud computing.

Graduate Research Assistant — *Houston, TX*

Department of Physics and Astronomy, Rice University — *May 2014 – May 2019*

Investigated observable signatures of nanoflare heating frequency using hydrodynamic simulations of coronal loops, forward modeling, and machine learning

Research Fellowships Awarded

NRC Research Associateship Postdoctoral Fellowship — *Washington, D.C.*

Naval Research Laboratory, National Academies of Sciences — *January 2020 – present*

Awarded 1-year NRC postdoctoral fellowship to study observational signatures of thermal non-equilibrium in coronal loops

NASA Postdoctoral Program Fellowship (declined) — *Washington, D.C.*

NASA Goddard Space Flight Center, USRA

Awarded competitive NPP Fellowship to study physics of coronal heating; declined in favor of NRC postdoctoral fellowship

NSF REU Research Fellowship — *Waco, TX*

Baylor University, CASPER — *June – August 2012*

Received NSF REU fellowship to study dust grain charging and growth in protoplanetary disks.

Summer Undergraduate Research Fellowship — *Waco, TX*

Baylor University, Dept. of Physics — *June – August 2011*

Awarded summer research funding to investigate plasma physics of charged dust grains in Saturn's F Ring.

Papers

A current publication list is also available from Orcid (ID: 0000-0001-9642-6089).

Refereed Publications

2020 **Understanding Heating in Active Region Cores through Machine Learning II. Classifying Observations**, W. T. Barnes, S. J. Bradshaw, N. M. Viall, *in prep*

2020 **aiapy: A Python Package for Analyzing Solar EUV Image Data from AIA**, Will T. Barnes, Mark C. M. Cheung, Monica G. Bobra, Paul F. Boerner, Georgios Chintzoglou, Drew Leonard, Stuart J. Mumford, Nicholas Padmanabhan, Albert Y. Shih, Nina Shirman, David Stansby, Paul J. Wright, *JOSS*, *doi: 10.21105/joss.02801*

2020 **Nanoflare Diagnostics from Magnetohydrodynamic Heating Profiles**, K. J. Knizhnik, W. T. Barnes, J. W. Reep, V. M. Uritsky, *ApJ*, *doi: 10.3847/1538-4357/aba959*

2020 **SunPy: A Python Package for Solar Physics**, Stuart J. Mumford, Nabil Freij, Steven Christe, Jack Ireland, Florian Mayer, V. Keith Hughitt, Albert Y. Shih, Daniel F. Ryan, Simon Liedtke, David Pérez-Suárez, et al. (including Will Barnes), *JOSS*, *doi: 10.21105/joss.01832*

2020 **The SunPy Project: Open Source Development and Status of the Version 1.0 Core Package**, The SunPy Community, Will T. Barnes, Monica G. Bobra, Steven D. Christe, Nabil Freij, Laura A. Hayes, Jack Ireland, Stuart Mumford, David Pérez-Suárez, Daniel F. Ryan, Albert Y. Shih, et al., *ApJ*, *doi: 10.3847/1538-4357/ab4f7a*

2019 **Solar Active Region Heating Diagnostics from High Temperature Emission using the Marshall Grazing Incidence X-ray Spectrometer (MaGIXS)**, P. S. Athiray, Amy R. Winebarger, Will T. Barnes, Stephen J. Bradshaw, Sabrina Savage, Harry P. Warren, Ken Kobayashi, Patrick Champey, Leon Golub, Lindsay Glesener, *ApJ*, *doi: 10.3847/1538-4357/ab3eb4*

2019 **Understanding Heating in Active Region Cores through Machine Learning I. Numerical Modeling and Predicted Observables**, W. T. Barnes, S. J. Bradshaw, N. M. Viall, *ApJ*, *doi: 10.3847/1538-4357/ab290c*

2016 **Inference of Heating Properties from Hot Non-flaring Plasmas in Active Region Cores II. Nanoflare Trains**, W. T. Barnes, P. J. Cargill, S. J. Bradshaw, *ApJ*, *doi: 10.3847/1538-4357/833/2/217*

2016 **Inference of Heating Properties from Hot Non-flaring Plasmas in Active Region Cores I. Single Nanoflares**, W. T. Barnes, P. J. Cargill, S. J. Bradshaw, *ApJ*, *doi: 10.3847/0004-637X/829/1/31*

Conference Proceedings

2017 **ChiantiPy: A Python Package for Astrophysical Spectroscopy**, W. T. Barnes, K. P. Dere, *16th SciPy Conference*, *doi: 10.25080/shinma-7f4c6e7-011*

2013 **Dust Grain Growth in a Protoplanetary Disk: Effects of Location on Charge and Size**, W. T. Barnes, L. S. Matthews, T. W. Hyde, *44th LPSC*, *bibcode: 2013LPI....44.1897B*

Other Non-refereed Publications

2020 **The Ongoing Development and Support of Atomic Physics in Solar and Heliospheric Science**, Y. J. Rivera, W. T. Barnes, A. Higginson, E. Landi, J. C. Raymond, J. W. Reep, *Heliophysics 2050 White Paper*, *doi: 10.5281/zenodo.4033424*

2020 **Science Platforms for Heliophysics Data Analysis**, M. G. Bobra, W. T. Barnes, M. C. M. Cheung, L. A. Hayes, J. Ireland, M. Janvier, M. S. F. Kirk, J. P. Mason, S. J. Mumford, P. J. Wright, *Heliophysics 2050 White Paper*, *doi: 10.5281/zenodo.4025217*

2020 **Toward A Sustainable Software Development Model for Heliophysics**, W. T. Barnes, J. Juno, J. W. Reep, J. Ireland, P. J. Wright, S. A. Spitzer, B. L. Alterman, D. Stansby, E. Lichko, *Heliophysics 2050 White Paper*

2018 **Modeling Coronal Loops in 3D with sunpy.coordinates**, W. T. Barnes, *SunPy Blog*, *url: sunpy.org*

Professional Service

Reviewer for: The Astrophysical Journal

Python in Astronomy Conference 2020

Member of Scientific Organizing Committee — *20 – 24 April 2020*

Organize webpage, communicate meeting announcements to community, and assist in choosing program of speakers

SHINE Workshop

Discussion session co-organizer and co-chair (with S. Bradshaw and N. Viall) — *30 July – 3 August 2018*

Topic: Signatures of Time-dependent Heating in Active Regions and the Slow Solar Wind

SPD/AAS Congressional Visit Day

Student Representative — *25 June 2018*

Visited senators and representatives to lobby for increase in NASA heliophysics budget

Presentations

Conference Talks

Machine Learning in Heliophysics

Amsterdam, The Netherlands

Centrum Wiskunde and Informatica — *16 – 20 September 2019*

Seeing the Trees through a Random Forest: Details of Active Region Heating Revealed through Forward Modeling and Classification

Coronal Loops Workshop IX — *St Andrews, UK*
University of St Andrews — *11 – 14 June 2019*
Constraining the Frequency of Energy Deposition through Quantitative Comparisons of Models and Observations (invited)

2018 SDO Science Workshop — *Ghent, Belgium*
Royal Observatory Belgium, Solar-Terrestrial Centre of Excellence — *29 October – 2 November 2018*
Understanding Heating Properties of Active Region Loops through Forward Modeling and Machine Learning

Triennial Earth-Sun Summit — *Leesburg, VA*
American Geophysical Union — *21 – 24 May 2018*
Timelag Analysis of Simulated Active Region Cores Heated by Nanoflares

Python in Astronomy 2018 — *New York City, NY*
Center for Computational Astrophysics, The Flatiron Institute — *30 April – 4 May 2018*
A Complete fiasco - The Difficulties of Dealing with Atomic Data and a Possible Pythonic Solution

16th Python in Science Conference — *Austin, TX*
SciPy, Enthought — *10 – 16 July 2017*
ChiantiPy: a Python package for Astrophysical Spectroscopy

Coronal Loops Workshop VIII — *Palermo, Italy*
INAF IASF Palermo — *27 – 30 June 2017*
Constraining Nanoflare Heating Frequency with a Global Active Region Model

AAS Solar Physics Division Meeting — *Boulder, CO*
American Astronomical Society — *31 May – 3 June 2016*
Hot Non-flaring Plasmas in Active Region Cores Heated by Single Nanoflares

Texas Undergraduate Astronomy Research Symposium — *College Station, TX*
Texas A&M University — *14 September 2012*
Dust Grain Charging in a Protoplanetary Disk

Seminars

Stanford Solar Group Science Meeting — *Stanford, CA*
Stanford University — *26 June 2019*
Seeing the Trees through a Random Forest: Details of Active Region Heating Revealed through Forward Modeling and Classification

Lockheed Martin Solar and Astrophysics Seminar — *Palo Alto, CA*
Lockheed Martin Solar and Astrophysics Laboratory — *20 June 2019*
Seeing the Trees through a Random Forest: Details of Active Region Heating Revealed through Forward Modeling and Classification

Space Physics Seminar Series — *Houston, TX*
Rice University — *19 November 2018*
Understanding Heating Frequency in Active Region Loops through Forward Modeling and Machine Learning

NRL Solar and Heliospheric Physics Branch Seminar — *Washington, D.C.*
Naval Research Laboratory — *11 July 2018*
Investigating Heating Frequency in Active Region Cores through Timelag Analysis of Forward Modeled Emission (invited)

Space Physics Seminar Series — *Houston, TX*
Rice University — *27 February 2017*
A Framework for Forward Modeling Solar Active Regions

Space Physics Seminar Series — *Houston, TX*
Rice University — *9 November 2015*
Impacts of Two-fluid Effects on Emission from Impulsively Heated Coronal Loops

Workshops

Interrogating Field-Aligned Solar Flare Models (ISSI Team Led by G. Kerr and V. Polito) — *Bern, Switzerland*
International Space Science Institute — *27 – 31 January 2020*
Collaborative Development of Python Tools for Field-Aligned Hydrodynamic Simulations

Heliophysics Community Python Working Group Meeting — *Boulder, CO*
Laboratory for Atmospheric and Space Physics — *13 – 15 November 2018*
fiasco: a Python Interface to the CHIANTI Atomic Database

Outreach

North Houston Astronomy Club Late Summer Gathering — *Conroe, TX*
Lone Star College-Montgomery Campus — *24 August 2018*
Why is the Sun So Hot? A Current Perspective on Coronal Heating

Posters

American Geophysical Union Fall Meeting — *San Francisco, CA*
American Geophysical Union — *9 – 13 December 2019*
The Sun at Scale: Interactive Analysis of High Resolution EUV Imaging Data on HPC Platforms with Dask

Solar Heliospheric and Interplanetary Environment (SHINE) Workshop — *Cocoa Beach, FL*
National Science Foundation — *30 July – 3 August 2018*
Using Synthetic and Observed Timelags to Constrain Nanoflare Heating Frequency in Active Region Cores

Rice Data Science Conference — *Houston, TX*
Rice University — *9 – 10 October 2017*
Timelag Analysis of Global Hydrodynamic Simulations of Active Regions in the Solar Corona

Solar Heliospheric and Interplanetary Environment (SHINE) Workshop — *Saint-Sauveur, Quebec, CA*
National Science Foundation — *24 – 28 July 2017*
Modeling Observable Signatures of Nanoflare Heating Frequency in Active Region Cores

Solar Heliospheric and Interplanetary Environment (SHINE) Workshop — *Santa Fe, NM*
National Science Foundation — *11 – 15 July 2016*
Understanding the Impact of Nanoflare Heating Frequency on the Observed Emission Measure Distribution

Coronal Loops Workshop VII — *Cambridge, UK*
University of Cambridge — *21 – 23 July 2015*
Effects of Ion Heating on Emission Measure of Coronal Loops in Active Region Cores

Triennial Earth-Sun Summit — *Indianapolis, IN*
American Astronomical Society — *26 – 30 April 2015*
Nonnegative Matrix Factorization as a Method for Studying Coronal Heating

44th Annual Lunar and Planetary Science Conference — *The Woodlands, TX*
Lunar and Planetary Science Institute — *18 – 22 March 2013*
Dust Grain Growth in a Protoplanetary Disk: Effects of Location on Charge and Size

Honors and Awards

Nov 2018 **Metcalf Travel Award to the SDO Workshop**, Solar physics Division of the AAS
Nov 2017 **Scientific Image Contest (Second Place)**, Wiess School of Natural Sciences, Rice University
Jul 2017 **Outstanding Student Poster Award**, SHINE Workshop
May 2016 **William and Elva Gordon Fellowship**, Department of Physics and Astronomy, Rice University
May 2016 **Chuoke Graduate Student Award**, Department of Physics and Astronomy, Rice University
Apr 2015 **Studentship Travel Award for AAS Solar Physics Division Meeting**, Solar Physics Division of the AAS
Apr 2013 **URSA Scholars Week Outstanding Research Poster in Physics**, Baylor University
2009–2013 **President's Gold Scholarship**, Baylor University
2011, 2012 **Gordon K. Teal Scholarship**, Department of Physics, Baylor University
2010, 2011 **Herbert D. Schwetman Scholarship**, Department of Physics, Baylor University

Software and Computing

Skills

Languages Bash, C, C++, IDL, Mathematica, MATLAB, Python
Scientific Computing numerical methods, high performance computing, parallel/distributed data processing
Markup CSS, HTML, LaTeX, markdown, reStructuredText
DevOps continuous integration, documentation, testing, version control

Open Source Contributions

A more complete record of my contributions is available on GitHub and GitLab.

aiapy — *2019 – present*
Maintainer — *LMSAL_HUB/aia_hub/aiapy*
aiapy provides basic analysis and calibration routines for processing data from the Atmospheric Imaging Assembly. I am the primary developer of aiapy in collaboration with others at LMSAL.

fiasco — *2017 – present*
Maintainer — *wtbarnes/fiasco*
fiasco provides a modern Python interface to the CHIANTI atomic database in addition to implementing many atomic physics calculations commonly used in solar physics. I am the creator and primary maintainer of fiasco.

SunPy *2016 – present*

Contributor *sunpy/sunpy*

SunPy is a library for solar data analysis in Python. I am an active member of the SunPy community and have made several contributions to the package. As of December 2019, I am the deputy lead developer for the package and a maintainer for the ‘image‘ and ‘instr‘ subpackages.

Teaching and Mentoring

Students Mentored

Lily Han *Rice University*

Undergraduate *October 2017 – April 2018*

Assisted in advising undergraduate thesis work on force-free field extrapolations and forward modeling

Brandon Wang *Clements High School*

High school intern *April 2017 – May 2018*

Advisor for STEM research course.

Tessa Wilkinson *Google Summer of Code*

Undergraduate *May – August 2016*

Mentor for project to implement AIA response functions in SunPy

Teaching Experience

PHYS 480/580: Introduction to Plasma Physics *Rice University*

Guest Lecturer *Fall 2018*

Gave guest lecture for introductory plasma course for senior undergraduate and graduate students. Topics covered included electrostatic waves, binary collisions, and motion in a uniform magnetic field.

ASTR 201: Stars, Galaxies, and the Universe *Rice University*

Guest Lecturer *Spring 2017*

Gave two guest lectures for non-majors astronomy course of approximately 70 undergraduate students. Topics covered included eclipses, phases of the moon, and the celestial sphere.

PHYS 102: Electricity and Magnetism *Rice University*

Lab Teaching Assistant *Spring 2014, Spring 2015*

Instructed lab sections of 40+ undergraduate students on topics including electrostatic interactions, magnetic induction, and basic circuits.

PHYS 101: Mechanics *Rice University*

Lab Teaching Assistant *Fall 2014, Fall 2015*

Instructed lab sections of 40+ undergraduate students on topics including kinematics, collisions, and simple harmonic motion.

Memberships

- American Astronomical Society, Solar Physics Division (Junior Membership)
- Phi Beta Kappa
- Sigma Pi Sigma