

# Will Barnes

RESEARCH TERM FACULTY

Department of Physics, American University, Washington, D.C., USA

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## Education

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### Rice University

PH.D. PHYSICS

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

Houston, TX

2016 – 2019

### Rice University

M.S. PHYSICS

Houston, TX

2013 – 2016

### Baylor University

B.S. ASTROPHYSICS

- 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

Waco, TX

2009 – 2013

## Experience

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### Research Term Faculty

DEPARTMENT OF PHYSICS, AMERICAN UNIVERSITY

Washington, D.C.

February 2022 – present

### NRC Postdoctoral Research Associate

SPACE SCIENCE DIVISION, U.S. NAVAL RESEARCH LABORATORY

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

Washington, D.C.

January 2020 – January 2022

### Visiting Postdoctoral Scholar

W. W. HANSEN EXPERIMENTAL PHYSICS LABORATORY, STANFORD UNIVERSITY

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

Stanford, CA

July – December 2019

### Postdoctoral Research Scientist

LOCKHEED MARTIN SOLAR AND ASTROPHYSICS LABORATORY, BAY AREA ENVIRONMENTAL RESEARCH INSTITUTE

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

Palo Alto, CA

May – December 2019

### Research Computing Intern

CENTER FOR RESEARCH COMPUTING, RICE UNIVERSITY

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.

Houston, TX

October 2018 – May 2019

### Graduate Research Assistant

DEPARTMENT OF PHYSICS AND ASTRONOMY, RICE UNIVERSITY

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

Houston, TX

May 2014 – May 2019

## Research Fellowships Awarded

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### NRC Research Associateship Postdoctoral Fellowship

NAVAL RESEARCH LABORATORY, NATIONAL ACADEMIES OF SCIENCES

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

Washington, D.C.

January 2020 – present

### NASA Postdoctoral Program Fellowship (declined)

NASA GODDARD SPACE FLIGHT CENTER, USRA

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

Washington, D.C.

### NSF REU Research Fellowship

BAYLOR UNIVERSITY, CASPER

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

Waco, TX

June – August 2012

### Summer Undergraduate Research Fellowship

BAYLOR UNIVERSITY, DEPT. OF PHYSICS

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

Waco, TX

June – August 2011

## Papers

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

### REFEREED PUBLICATIONS

- 2021 **Static and dynamic solar coronal loops with cross-sectional area variations**, P. J. Cargill, S. J. Bradshaw, J. A. Klimchuk, [W. T. Barnes](#), *MNRAS*, doi: [10.1093/mnras/stab3163](#)
- 2021 **Understanding Heating in Active Region Cores through Machine Learning II. Classifying Observations**, [W. T. Barnes](#), S. J. Bradshaw, N. M. Viall, *ApJ*, doi: [10.3847/1538-4357/ac1514](#)
- 2021 **Forecasting the Remaining Duration of an Ongoing Solar Flare**, J. W. Reep, [W. T. Barnes](#), *SpWea*, doi: [10.1029/2021SW002754](#)
- 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

- 2022 **aiapy: A SunPy affiliated package for analyzing data from the Atmospheric Imaging Assembly**, [W. T. Barnes](#), M. C. M. Cheung, *SunPy Blog*, url: [sunpy.org](#)
- 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

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**Reviewer for:** The Astrophysical Journal, The Journal of Open Source Software

### Python in Astronomy Conference 2020

MEMBER OF SCIENTIFIC ORGANIZING COMMITTEE

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

20 – 24 April 2020

## SHINE Workshop

DISCUSSION SESSION CO-ORGANIZER AND CO-CHAIR (WITH S. BRADSHAW AND N. VIALI)

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

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### CONFERENCE TALKS

#### Third Meeting of the Parker Solar Probe Scholars

JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY

*Virtual*  
9 – 10 November 2021

Predicting Nanoflare Heating Frequency in Active Region 11158 through Loop Hydrodynamics, Forward Modeling, and Machine Learning

#### Machine Learning in Heliophysics

CENTRUM WISKUNDE AND INFORMATICA

*Amsterdam, The Netherlands*

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

UNIVERSITY OF ST ANDREWS

*St Andrews, UK*

11 – 14 June 2019

Constraining the Frequency of Energy Deposition through Quantitative Comparisons of Models and Observations (invited)

#### 2018 SDO Science Workshop

ROYAL OBSERVATORY BELGIUM, SOLAR-TERRESTRIAL CENTRE OF EXCELLENCE

*Ghent, Belgium*  
29 October – 2 November 2018

Understanding Heating Properties of Active Region Loops through Forward Modeling and Machine Learning

#### Triennial Earth-Sun Summit

AMERICAN GEOPHYSICAL UNION

*Leesburg, VA*

21 – 24 May 2018

Timelag Analysis of Simulated Active Region Cores Heated by Nanoflares

#### Python in Astronomy 2018

CENTER FOR COMPUTATIONAL ASTROPHYSICS, THE FLATIRON INSTITUTE

*New York City, NY*

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

SCI.PY, ENTHOUGHT

*Austin, TX*

10 – 16 July 2017

ChiantiPy: a Python package for Astrophysical Spectroscopy

#### Coronal Loops Workshop VIII

INAF IASF PALERMO

*Palermo, Italy*

27 – 30 June 2017

Constraining Nanoflare Heating Frequency with a Global Active Region Model

#### AAS Solar Physics Division Meeting

AMERICAN ASTRONOMICAL SOCIETY

*Boulder, CO*

31 May – 3 June 2016

Hot Non-flaring Plasmas in Active Region Cores Heated by Single Nanoflares

#### Texas Undergraduate Astronomy Research Symposium

TEXAS A&M UNIVERSITY

*College Station, TX*

14 September 2012

Dust Grain Charging in a Protoplanetary Disk

### SEMINARS

#### Stanford Solar Group Science Meeting

STANFORD UNIVERSITY

*Stanford, CA*

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

LOCKHEED MARTIN SOLAR AND ASTROPHYSICS LABORATORY

*Palo Alto, CA*

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

RICE UNIVERSITY

*Houston, TX*

19 November 2018

Understanding Heating Frequency in Active Region Loops through Forward Modeling and Machine Learning

#### NRL Solar and Heliospheric Physics Branch Seminar

NAVAL RESEARCH LABORATORY

*Washington, D.C.*

11 July 2018

Investigating Heating Frequency in Active Region Cores through Timelag Analysis of Forward Modeled Emission (invited)

#### Space Physics Seminar Series

RICE UNIVERSITY

*Houston, TX*

27 February 2017

A Framework for Forward Modeling Solar Active Regions

## Space Physics Seminar Series

RICE UNIVERSITY

Impacts of Two-fluid Effects on Emission from Impulsively Heated Coronal Loops

Houston, TX

9 November 2015

## WORKSHOPS

### Tutorial Day of the Hinode-14 / IRIS-11 Joint Science Meeting

GEORGE MASON UNIVERSITY

Analyzing Multi-viewpoint Observations with the SunPy Ecosystem

Virtual

29 October 2021

### Workshops at the 238th Meeting of the American Astronomical Society

AMERICAN ASTRONOMICAL SOCIETY

Introduction to SunPy and the Python in Heliophysics Community

Virtual

4 June 2021

### Interrogating Field-Aligned Solar Flare Models (ISSI Team Led by G. Kerr and V. Polito)

INTERNATIONAL SPACE SCIENCE INSTITUTE

Collaborative Development of Python Tools for Field-Aligned Hydrodynamic Simulations

Bern, Switzerland

27 – 31 January 2020

### Heliophysics Community Python Working Group Meeting

LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS

fiasco: a Python Interface to the CHIANTI Atomic Database

Boulder, CO

13 – 15 November 2018

## OUTREACH

### North Houston Astronomy Club Late Summer Gathering

LONE STAR COLLEGE-MONTGOMERY CAMPUS

Why is the Sun So Hot? A Current Perspective on Coronal Heating

Conroe, TX

24 August 2018

## POSTERS

### American Geophysical Union Fall Meeting

AMERICAN GEOPHYSICAL UNION

Observations and Modeling of Long, Cool, and Overdense Loops in Active Region 11575

Virtual

13 – 17 December 2021

### Heliophysics 2050 Workshop

LUNAR AND PLANETARY INSTITUTE

The Ongoing Development and Support of Atomic Physics in Solar and Heliospheric Science

Virtual

3 – 7 May 2021

### American Geophysical Union Fall Meeting

AMERICAN GEOPHYSICAL UNION

Understanding Heating Properties in Hot and Warm Active Region Loops through Hydrodynamics and Forward Modeling

Virtual

1 – 17 December 2020

### American Geophysical Union Fall Meeting

AMERICAN GEOPHYSICAL UNION

The Sun at Scale: Interactive Analysis of High Resolution EUV Imaging Data on HPC Platforms with Dask

San Francisco, CA

9 – 13 December 2019

### Solar Heliospheric and Interplanetary Environment (SHINE) Workshop

NATIONAL SCIENCE FOUNDATION

Using Synthetic and Observed Timelags to Constrain Nanoflare Heating Frequency in Active Region Cores

Cocoa Beach, FL

30 July – 3 August 2018

### Rice Data Science Conference

RICE UNIVERSITY

Timelag Analysis of Global Hydrodynamic Simulations of Active Regions in the Solar Corona

Houston, TX

9 – 10 October 2017

### Solar Heliospheric and Interplanetary Environment (SHINE) Workshop

NATIONAL SCIENCE FOUNDATION

Modeling Observable Signatures of Nanoflare Heating Frequency in Active Region Cores

Saint-Sauveur, Quebec, CA

24 – 28 July 2017

### Solar Heliospheric and Interplanetary Environment (SHINE) Workshop

NATIONAL SCIENCE FOUNDATION

Understanding the Impact of Nanoflare Heating Frequency on the Observed Emission Measure Distribution

Santa Fe, NM

11 – 15 July 2016

### Coronal Loops Workshop VII

UNIVERSITY OF CAMBRIDGE

Effects of Ion Heating on Emission Measure of Coronal Loops in Active Region Cores

Cambridge, UK

21 – 23 July 2015

### Triennial Earth-Sun Summit

AMERICAN ASTRONOMICAL SOCIETY

Nonnegative Matrix Factorization as a Method for Studying Coronal Heating

Indianapolis, IN

26 – 30 April 2015

### 44th Annual Lunar and Planetary Science Conference

LUNAR AND PLANETARY SCIENCE INSTITUTE

Dust Grain Growth in a Protoplanetary Disk: Effects of Location on Charge and Size

The Woodlands, TX

18 – 22 March 2013

## Honors and Awards

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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 **Chuoque 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

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### 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

MAINTAINER

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.

*2019 – present*

 [LMSAL\\_HUB/aia\\_hub/aiapy](#)

#### fiasco

MAINTAINER

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.

*2017 – present*

 [wtbarnes/fiasco](#)

#### SunPy

CONTRIBUTOR

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.

*2016 – present*

 [sunpy/sunpy](#)

## Teaching and Mentoring

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### STUDENTS MENTORED

#### Lily Han

UNDERGRADUATE

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

*Rice University*

*October 2017 – April 2018*

#### Brandon Wang

HIGH SCHOOL INTERN

Advisor for STEM research course.

*Clements High School*

*April 2017 – May 2018*

#### Tessa Wilkinson

UNDERGRADUATE

Mentor for project to implement AIA response functions in SunPy

*Google Summer of Code*

*May – August 2016*

### TEACHING EXPERIENCE

#### PHYS 480/580: Introduction to Plasma Physics

GUEST LECTURER

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.

*Rice University*

*Fall 2018*

#### ASTR 201: Stars, Galaxies, and the Universe

GUEST LECTURER

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.

*Rice University*

*Spring 2017*

## **PHYS 102: Electricity and Magnetism**

LAB TEACHING ASSISTANT

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

*Rice University*

*Spring 2014, Spring 2015*

## **PHYS 101: Mechanics**

LAB TEACHING ASSISTANT

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

*Rice University*

*Fall 2014, Fall 2015*

## **Memberships**

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- American Astronomical Society, Solar Physics Division
- Phi Beta Kappa
- Sigma Pi Sigma