

# Will Barnes

POSTDOCTORAL RESEARCH SCIENTIST

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## Education

### 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

### Visiting Postdoctoral Scholar

W. W. HANSEN EXPERIMENTAL PHYSICS LABORATORY, STANFORD UNIVERSITY

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

Stanford, CA

July 2019–present

### Postdoctoral Research Scientist

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

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

Palo Alto, CA

May 2019–present

### 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

Oct. 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

## Papers

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

### REFEREED PUBLICATIONS

- 2019 **Understanding Heating in Active Region Cores through Machine Learning II. Classifying Observations,** [W. T. Barnes](#), S. J. Bradshaw, N. M. Viall, *in prep*
- 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

2018 **Modeling Coronal Loops in 3D with sunpy.coordinates**, W. T. Barnes, *SunPy Blog*, url: [sunpy.org](http://sunpy.org)

## 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.

### 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

Jun. 2012–Aug. 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

Jun. 2011–Aug. 2011

## Professional Service

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### SHINE Workshop

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

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

30 Jul.–3 Aug. 2018

### SPD/AAS Congressional Visit Day

STUDENT REPRESENTATIVE

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

25 May 2018

## Presentations

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### CONFERENCE TALKS

#### Machine Learning in Heliophysics

CENTRUM WISKUNDE AND INFORMATICA

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

Amsterdam, The Netherlands

16–20 Sept. 2019

#### Coronal Loops Workshop IX

UNIVERSITY OF ST ANDREWS

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

St Andrews, UK

11–14 Jun. 2019

#### 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 Nov. 2018

#### 2018 SDO Science Workshop

ROYAL OBSERVATORY BELGIUM, SOLAR-TERRESTRIAL CENTRE OF EXCELLENCE

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

Ghent, Belgium

29 Oct.–2 Nov. 2018

#### Triennial Earth-Sun Summit

AMERICAN GEOPHYSICAL UNION

Timelag Analysis of Simulated Active Region Cores Heated by Nanoflares

Leesburg, VA

21–24 May 2018

#### Python in Astronomy 2018

CENTER FOR COMPUTATIONAL ASTROPHYSICS, THE FLATIRON INSTITUTE

A Complete fiasco - The Difficulties of Dealing with Atomic Data and a Possible Pythonic Solution

New York City, NY

30 Apr.–4 May 2018

#### 16th Python in Science Conference

SCI-PY, ENTHOUGHT

ChiantiPy: a Python package for Astrophysical Spectroscopy

Austin, TX

10–16 Jul. 2017

#### Coronal Loops Workshop VIII

INAF IASF PALERMO

Constraining Nanoflare Heating Frequency with a Global Active Region Model

Palermo, Italy

27–30 Jun. 2017

#### 47th Annual Solar Physics Division Meeting

AMERICAN ASTRONOMICAL SOCIETY

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

Boulder, CO

31 May–3 Jun. 2016

## Texas Undergraduate Astronomy Research Symposium

TEXAS A&M UNIVERSITY

Dust Grain Charging in a Protoplanetary Disk

College Station, TX

14 Sept. 2012

## SEMINARS

### Stanford Solar Group Science Meeting

STANFORD UNIVERSITY

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

Stanford, CA

26 Jun. 2019

### Lockheed Martin Solar and Astrophysics Seminar

LOCKHEED MARTIN SOLAR AND ASTROPHYSICS LABORATORY

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

Palo Alto, CA

20 Jun. 2019

### Space Physics Seminar Series

RICE UNIVERSITY

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

Houston, TX

19 Nov. 2018

### NRL Solar and Heliospheric Physics Branch Seminar

NAVAL RESEARCH LABORATORY

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

Washington, D.C.

11 Jul. 2018

### Space Physics Seminar Series

RICE UNIVERSITY

A Framework for Forward Modeling Solar Active Regions

Houston, TX

27 Feb. 2017

### Space Physics Seminar Series

RICE UNIVERSITY

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

Houston, TX

9 Nov. 2015

## 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 Aug. 2018

## POSTERS

### 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 Jul.–3 Aug. 2018

### Rice Data Science Conference

RICE UNIVERSITY

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

Houston, TX

9–10 Oct. 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 Jul. 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 Jul. 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 Jul. 2015

### Triennial Earth-Sun Summit

AMERICAN ASTRONOMICAL SOCIETY

Nonnegative Matrix Factorization as a Method for Studying Coronal Heating

Indianapolis, IN

26–30 Apr. 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 Mar. 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  
 2015, 2016, 2018 **Studentship Travel Award for SPD Annual Meetings**, 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

<b>Languages</b>	Bash, C, C++, IDL, Mathematica, MATLAB, Python
<b>Scientific Computing</b>	numerical methods, high performance computing (e.g. SLURM, PBS), parallel/distributed data processing
<b>Markup</b>	CSS, HTML, LaTeX, markdown, reStructuredText
<b>DevOps</b>	continuous integration, documentation, testing, version control

### OPEN SOURCE CONTRIBUTIONS

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

#### fiasco

MAINTAINER

2017-present

[github.com/wtbarnes/fiasco](https://github.com/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

CONTRIBUTOR

2016-present

[github.com/sunpy/sunpy](https://github.com/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. Specifically, I have worked to implement the widely-used AIA temperature response functions in SunPy.

#### ChiantiPy

CONTRIBUTOR

2016–2017

[github.com/chianti-atomic/ChiantiPy](https://github.com/chianti-atomic/ChiantiPy)

ChiantiPy is a Python interface to CHIANTI atomic database. My main contributions to ChiantiPy have been improving the documentation and packaging infrastructure and adding a test suite.

## Teaching and Mentoring

### STUDENTS MENTORED

#### Lily Han

UNDERGRADUATE

Rice University

Oct. 2017–Apr. 2018

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

#### Brandon Wang

HIGH SCHOOL INTERN

Clements High School

Apr. 2017–May 2018

Advisor for STEM research course.

#### Tessa Wilkinson

UNDERGRADUATE

Google Summer of Code

May 2016–Aug. 2016

Mentor for project to implement AIA response functions in SunPy

### TEACHING EXPERIENCE

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

GUEST LECTURER

Rice University

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

GUEST LECTURER

Rice University

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**

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 (Junior Membership)
- Phi Beta Kappa
- Sigma Pi Sigma