Dr. Casey J. Law

Contact Information

Staff Scientist
Department of Astronomy and Owens Valley Radio Observatory
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Research Interests

Astrophysical transients, fast radio bursts, radio interferometry, distributed computing, surveys, intergalactic and interstellar media, data science, Python, polarimetry

Education

Northwestern University, Evanston, IL

Ph.D., Astrophysics, 2007

- Thesis Title: *Surveys of the Galactic Center and the Nature of the Galactic Center Lobe*
- Research Topics: Galactic outflows, radio, X-ray, and infrared observations of the Galactic center
- Adviser: Farhad Yusef-Zadeh

Boston University, Boston, MA

M.A., Astronomy, 2000

- Research Topics: Galactic molecular gas survey, optical photometry of stellar clusters, gravitational lensing
- Advisers: James Jackson, Ken Janes, Tereasa Brainerd

University of Hawai'i, Manoa, Honolulu, HI

B.S. with distinction, Physics, 1998

- Hawai'i Space Grant Fellowship with James Heasley of the Institute for Astronomy
- Research Topic: Optical photometry of globular clusters with the UH 2.2m and CFHT

Employment

Staff Scientst July 2019 to present

Owens Valley Radio Observatory, Caltech

- Supervisor: Gregg Hallinan
- Leader of Calibration, Imaging, and Software Lab
- Radio transients
- Commissioning of the Long-Wavelength Array Owens Valley and Deep Synoptic Array 110

Assistant Project Astronomer December 2011 to Jun 2019

Postdoctoral Fellow January 2009 to November 2011

Radio Astronomy Lab, UC Berkeley

- Supervisor: Geoff Bower and Carl Heiles
- Leader of *realfast* fast transient search project at the Very Large Array

- Radio transients and polarimetry
- Commissioning of the Allen Telescope Array, Karoo Array Telescope, Jansky Very Large Array

Postdoctoral Fellow July 2006 to December 2008
Department of Astronomy, University of Amsterdam
- Supervisor: Ralph Wijers
- Low frequency radio transients
- Commissioning of the Low Frequency Array (LOFAR)

Astrophysicist September 2000 to June 2002
Harvard-Smithsonian Center for Astrophysics
- Data analyst and support astronomer for the *Chandra* X-ray Observatory
- Tested, documented, and developed code for the CIAO software package
- 10% of time dedicated to independent research

Teaching and Outreach

UC Berkeley, Berkeley, CA

Lecturer, Astronomy 290 **2016 – 2018**
- Two guest lectures in graduate course on department research

Visitor, Franklin Elementary, Oakland, California **2016 – 2017**
- Two visits to present astronomy concepts to 3rd graders

Visitor, Mount Diablo Astronomical Society **2017**
- Guest lecture on radio transients

Visitor, Splunk Inc. **2017**
- Guest lecture on radio transients at Splunk Science Society lecture series

Tutor, Cal Bridge **2017**
- Co-organized workshop for Python in Astronomy for CSU-UC bridge program

Volunteer, Berkeley Inst. for Data Science, Open Oakland **2015 – present**
- Participated in projects related to air quality, open software, and civic hacking

Tutor and Coordinator, Prison University Project **2010 – 2014**
- Led tutoring of introductory math for college-level curriculum in San Quentin State Prison.

Co-organizer, Science@Cal **2009 – 2014**
- Helped organize and advertise monthly lecture series.
- Demonstrated principles of radio astronomy at annual "Cal Day" event.

Student Advising **2009 – present**

- UC LEADS Undergraduate **Luis Chinchilla-Garcia** visited UC Berkeley from UCLA to study clustering algorithms for fast radio transient classification. Summer 2016.
- Doctoral students **Peter Williams**, **Chat Hull**, and **James McBride** Mr. Williams, Mr. Hull, and Mr. McBride used data from the Allen Telescope Array to study radio transients and the polarimetric properties of galaxies. Co-adviser: Carl Heiles and Geoff Bower, 2008 – 2012.
- Undergraduates **Sabrina Berger** (Summer Undergraduate Research Fellow), **Sanyum Channa**, **Andrew Halle**, **Jun Tan**, **Yawen Sun**, **Kyle Blanchard**, and **Phillip Sells**
  Students have worked with realfast data analysis, FRB science, the NERSC supercomputer, AWS cloud computing, and radio interferometric search software. 2012 – present.
- Breakthrough Listen Interns
  Lectured and supervised individual projects. 2016 – present.

University of Amsterdam, Amsterdam, The Netherlands

Student Advising **2006 – 2007**

- **Thijs Coenen**
  Master's student at the University of Amsterdam building a machine learning algorithm for the automatic classification of radio transients detected by LOFAR. Primary adviser: Ralph Wijers. 2005.

Northwestern University, Evanston, IL

Teaching Assistant **2004**

- Taught weekly physics discussion session with roughly 100 students.

Observatory Host **2003 – 2006**

- Led open night tours of the historic Dearborn Observatory once per month.

Boston University, Boston, MA

Teaching Assistant **1999 – 2000**

- Taught four astronomy lab sections per semester (including night labs).

University of Hawaii at Manoa, Honolulu, HI

Co-organizer, Hawai'i Physics Olympics **1996 – 1998**

- Helped organize annual, state-wide event for high school students.
- Designed events to test understanding of physical concepts.

Co-organizer, Physics Tutoring **1996 – 1998**

- Created and participated in volunteer physics tutoring service for undergraduates.

Grants

Collaborator: Canadian Initiative for Radio Astronomy Data Analysis (CIRADA), Canada Foundation for Innovation, 2017

PI: Real-time, commensal transient detection at the VLA (*realfast* project), NSF, Advanced Technology and Instrumentation grant, awarded 2016.

Senior staff: Anomaly detection with fast imaging radio interferometers. University of California Office of the President grant, awarded 2012.

Co-I: A Coherent Transient Detection System for SKA Pathfinders. University of Western Australia Collaboration grant, awarded 2012.

PI: Meeting of LOFAR and the Transient Radio Sky. NWO and NOVA (NL) collaboration support grants, awarded 2008.

PI: Development of a spatio-spectral analysis technique for X-ray data. *Chandra* archival research grant, awarded 2003.

Professional Honors and Service

Editor, Astronomy and Computing, 2018 – present

Visitor, Dunlap Institute, University of Toronto, July 2018

External Review Committee, CHIME FRB project, 2017 – 2018

Organizer, Radio Astronomy Lab Hack day, 2017

Organizer, Berkeley Astronomy arxiv coffee, 2017 – present

Member, VLA Sky Survey Science Survey Group, 2016 – present

Member, Berkeley Institute for Data Science, 2014 – present

Co-Chair of Technical Working Group for VLA Sky Survey Project, 2014 – 2016

Reviewer for NRAO Science Review Panel and NASA Postdoctoral Program, 2013 – 2015

Member of the SKA Transients Science Working Group, 2013 – present

Developed and contributed to public astronomy software repositories: https://github.com/caseyjlaw, 2012 – present

Referee for the Astrophysical Journal, Astronomical Journal, MNRAS, PASP, and New Astronomy, 2006 – present

Jansky Very Large Array Resident Observer, 2012

Chair of LOC and member of SOC for "LOFAR and the Transient Radio Sky", 2008

Huang Fellowship at Northwestern University, 2002 – 2003

Two Presidential Fellowships (Research and Teaching) at Boston University, 1998 – 2000

Four merit-based tuition waivers from the Department of Physics at the University of Hawai'i, 1995 – 1998

Hawai'i Space Grant Fellowship, 1997

Refereed Publications

1. "Serendipitous Fast Transient Science with the ngVLA", Law, C. J. et al. 2018, "Science with a Next-Generation VLA", ed. E. J. Murphy (ASP, San Francisco, CA)
2. "Highest Frequency Detection of FRB 121102 at 4-8 GHz Using the Breakthrough Listen Digital Backend at the Green Bank Telescope", Gajjar, V. et al. 2018, ApJ, 863, 2
3. "A Search for Molecular Gas in the Host Galaxy of FRB 121102", Bower, G. C. et al. 2018, AJ, 155, 227
4. "LOFAR 150-MHz observations of SS 433 and W 50", Broderick, J. W. et al. 2018, MNRAS, 475, 5360
5. "RFI flagging implications for short-duration transients", Cendes, Y. et al. 2018, A&C, 23, 103
6. "An extreme magneto-ionic environment associated with the fast radio burst source FRB 121102", Michilli, D. et al. 2018, Nature, 553, 182
7. "Simultaneous X-Ray, Gamma-Ray, and Radio Observations of the Repeating Fast Radio Burst FRB 121102", Scholz, P. et al 2017, ApJ, 846, 80
8. "The Nonhomogeneous Poisson Process for Fast Radio Burst Rates", Lawrence, E. 2017, AJ, 154, 117
9. "Simultaneous Monitoring of X-Ray and Radio Variability in Sagittarius A*", Capellupo, D. M et al 2017, ApJ, 845, 35
10. "FRB 121102 Is Coincident with a Star-forming Region in Its Host Galaxy", Bassa, C. et al 2017, ApJ, 843, 8
11. "A direct localization of a fast radio burst and its host", Chatterjee, S. et al 2017, Nature, 541, 58
12. "The Repeating Fast Radio Burst FRB 121102 as Seen on Milliarcsecond Angular Scales", Marcote, B. et al 2017, ApJ, 834, 8
13. "The Host Galaxy and Redshift of the Repeating Fast Radio Burst FRB 121102", Tendulkar, S. et al, 2017, ApJ, 834, 7
14. "realfast: Real-time, Commensal Fast Transient Surveys with the Very Large Array", Law, C.J. et al 2018, ApJS, 236, 8
15. "A Multi-telescope Campaign on FRB 121102: Implications for the FRB Population", Law, C.J. et al 2017, ApJ, 850, 76

16. "New methods to constrain the radio transient rate: results from a survey of four fields with LOFAR", Carbone, D. et al 2016, MNRAS, 459, 3161

17. "Low-radio-frequency eclipses of the redback pulsar J2215+5135 observed in the image plane with LOFAR", Broderick, J. W. et al 2016, MNRAS, 459, 2681

18. "LOFAR MSSS: detection of a low-frequency radio transient in 400 h of monitoring of the North Celestial Pole", Stewart et al 2016, MNRAS, 46, 2321

19. "The LOFAR Multifrequency Snapshot Sky Survey (MSSS). I. Survey description and first results", Heald et al 2016, A&A, 582, 123

20. "A Millisecond Interferometric Search for Fast Radio Bursts with the Very Large Array", Law, C. J. et al 2015, ApJ, 807, 16

21. "The LOFAR Transients Pipeline", Swinbank, J. D. et al, 2015, A&C 11, 25

22. "Pulsar polarisation below 200 MHz: Average profiles and propagation effects", Noutsos, A. et al 2015, A&A, 576, 41

23. "ALMA and VLA measurements of frequency-dependent time lags in Sagittarius A*: evidence for a relativistic outflow" Brinkerink, C. et al 2015, A&A 576, 41

24. "The LOFAR pilot surveys for pulsars and fast radio transients", Coenen, T. et al 2014, A&A, 570, 60

25. "The Intrinsic Two-dimensional Size of Sagittarius A*", Bower, G. C et al 2014, ApJ, 790, 1

26. "LOFAR: The LOw-Frequency ARray", van Haarlem, M. et al 2013, A&A, 556, 2

27. "The RRAT Trap: Interferometric Localization of Radio Pulses from J0628+0909", Law, C. J. et al 2012, ApJ, 760, 124

28. "All Transients, All the Time: Real-time Radio Transient Detection with Interferometric Closure Quantities", Law, C. J. et al 2012, ApJ, 749, 143

29. "Millisecond Imaging of Radio Transients with the Pocket Correlator", Law, C. J. et al 2011, ApJ, 742, 12

30. "Spectropolarimetry with the Allen Telescope Array: Faraday Rotation toward Bright Polarized Radio Galaxies", Law, C. J. et al 2011, ApJ, 728, 57

31. "A Constraint on the Organization of the Galactic Center Magnetic Field Using Rotation Measures", Law, C. J. et al 2011, ApJ, 731, 36

32. "Observing pulsars and fast transients with LOFAR", Stappers, B. W. et al 2011, A&A, 530, 80

33. "Wild at Heart: The Particle Astrophysics of the Galactic Centre", Crocker, R. M. et al., 2011, MNRAS, 413, 763

34. "The Allen Telescope Array Pi GHz Sky Survey I. Survey Description and Static Catalog Results for the Bootes Field", Bower, G. C. et al., 2010, ApJ, 725, 1792

35. "The Allen Telescope Array Twenty-centimeter Survey – A 690 sq-deg, 12 Epoch Radio Data Set. I. Catalog and Long-duration Transient Statistics", Croft, S. et al. 2010, ApJ, 719, 45

36. "A Multiwavelength View of a Mass Outflow from the Galactic Center", Law, C. J. 2010, ApJ, 708, 474

37. "Green Bank Telescope Multiwavelength Survey of the Galactic Center Region", Law, C. J., et al. 2008, ApJS, 177, 255

38. "X-Ray Observations of Stellar Clusters Near the Galactic Center", Law, C. & Yusef-Zadeh, F. 2004, ApJ, 611, 858

39. "Detection of X-Ray Emission from the Arches Cluster near the Galactic Center", Yusef-Zadeh, F., Law, C., et al. 2002, ApJ, 570, 665

Software

1. "rfpipe: Radio interferometric transient search pipeline", Law, C. J. 2017, ASCL, 1710.002

2. "vysmaw: Fast visibility stream muncher", Pokorny, M. & Law, C. J. 2017, ASCL, 1710.001

3. "rtpipe: Searching radio interferometry data for fast, dispersed transients", Law, C. J. 2017, ASCL, 1706.002

4. "tpipe: Searching radio interferometry data for fast, dispersed transients", Law, C. J. 2016, ASCL, 1603.012

Invited Talks

1. "FRBs in the ngVLA Era", Invited talk at "Astrophysical Frontiers" meeting, Portland, OR, July 2018

2. "Magnetar Unification of FRBs", Invited talk at FRB McGill Workshop, Montreal, QC, June 2017

3. "Practical radio observing issues: interferometry", Invited talk at "Fast Radio Bursts: New Probes of Physics and Cosmology", Aspen, CO, February 2017

4. "realfast: Commensal Fast Transient Surveys with the VLA", Seminar at NRAO, Socorro, NM, April 2016

5. “Real-Time Commensal Fast Transient Searches with the VLA” at "Hotwiring the Transient Universe IV”, Santa Barbara, CA, May 2015

6. “Searching for Fast Radio Transients at 1 Terabyte per hour”, Seminar at NRAO Socorro, NM, March 2015

7. “Searching for Fast Radio Transients at 1 Terabyte per hour”. Invited talk at “Conference on Data Analysis (CODA 2014)” in Santa Fe, NM, March 2014.

8. “VLA Searches for Fast Radio Transients at 1 TB/hour”. Talk at “Hotwiring the Transient Universe III” in Santa Fe, NM, November 2013.

9. “Real-Time Transient Detection with Interferometric Closure Quantities”. Talk at “Interferometric Techniques for Impulsive Signals at Radio Frequencies” at Ohio State University, April 2013.

10. “Real-Time Radio Transient Detection with the VLA”. Seminar for LANL Statistics group, April 2012.

11. “The VLA as a Millisecond Transient Survey Machine ”. Colloquium at NRAO Socorro, March 2012.

12. “Radio Interferometric Searches for Millisecond Transients”. Colloquium at University of Cape Town, October 2011.

13. “Breaking Through the Faraday Fog”. Colloquium at University of Sydney, April 2011.

14. “Probing the Transient Radio Sky”. Colloquium at Southampton University, March 2010.