Dr. Casey J. Law

Contact Information

Research Scientist
Cahill Center for Astronomy and Astrophysics,
Owens Valley Radio Observatory,
California Institute of Technology
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Research Interests

Astrophysical transients, fast radio bursts, radio interferometry, surveys, algorithms and computing, data science, Python

Education

Northwestern University, Evanston, IL

Ph.D., Astrophysics, 2007

- Thesis: *Surveys of the Galactic Center and the Nature of the Galactic Center Lobe*
- Research Topics: Multiwavelength observational astronomy and Galactic astrophysics
- Adviser: Farhad Yusef-Zadeh

Boston University, Boston, MA

M.A., Astronomy, 2000

- Research Topics: Radio spectroscopy, optical photometry
- Advisers: James Jackson, Ken Janes, Tereasa Brainerd

University of Hawai'i, Manoa, Honolulu, HI

B.S. with distinction, Physics, 1998

- Research Topic: Observations of globular clusters
- Advisor: James Heasley under a Hawai'i Space Grant Fellowship

Employment

Research Scientist July 2019 to present
Cahill Center for Astronomy and Astrophysics & Owens Valley Radio Observatory, Caltech

- Supervisor: Gregg Hallinan
- Software and Algorithms Lab lead and Data subsystem lead for DSA-2000 project

Assistant Project Astronomer December 2011 to June 2019
Postdoctoral Fellow January 2009 to November 2011
Radio Astronomy Lab, UC Berkeley

- Supervisor: Geoff Bower and Carl Heiles
- PI of *realfast* instrument at the Very Large Array

Postdoctoral Fellow July 2006 to December 2008
Department of Astronomy, University of Amsterdam

- Supervisor: Ralph Wijers
- Commissioning of the Low Frequency Array (LOFAR)

Astrophysicist September 2000 to June 2002

Harvard-Smithsonian Center for Astrophysics

- Support astronomer for the *Chandra* X-ray Observatory

Select Publications

1. "Deep Synoptic Array Science: First FRB and Host Galaxy Catalog", Law et al., 2023, AAS Journals, submitted
2. "Magnetic field reversal in the turbulent environment around a repeating fast radio burst", Anna-Thomas, R. et al, 2023, Science, 380, 599
3. "Deep Synoptic Array Science: A Massive Elliptical Host Among Two Galaxy-cluster Fast Radio Bursts", Sharma, K. et al, 2023, ApJ, 950, 175
4. "Deep Synoptic Array Science: Two Fast Radio Burst Sources in Massive Galaxy Clusters", Connor, L. et al, 2023, ApJ, 949, 26
5. "Deep Synoptic Array Science: Discovery of the Host Galaxy of FRB 20220912A", Ravi, V. et al, 2023, ApJ, 949, 3
6. "Deep Synoptic Array science: a 50 Mpc fast radio burst constrains the mass of the Milky Way circumgalactic medium", Ravi, V. et al, 2023, AAS Journals, submitted
7. "Characterizing the Fast Radio Burst Host Galaxy Population and its Connection to Transients in the Local and Extragalactic Universe", Bhandari, S. et al, 2022, AJ, 163, 69
8. "Late-time Evolution and Modeling of the Off-axis Gamma-Ray Burst Candidate FIRST J141918.9+394036", Mooley, K. P. et al, 2022, ApJ, 924, 16
9. "FIRST J153350.8+272729: The Radio Afterglow of a Decades-old Tidal Disruption Event", Ravi, V. et al, 2022, ApJ, 925, 220
10. "On the Fast Radio Burst and Persistent Radio Source Populations", Law, C. J., Connor, L., & Aggarwal, K., 2022, ApJ, 927, 55
11. "A repeating fast radio burst associated with a persistent radio source", Niu, C.-H. et al, 2022, Nature, 606, 873
12. "The host galaxy and persistent radio counterpart of FRB 20201124A", Ravi V. et al, 2022, MNRAS, 513, 982
13. "A repeating fast radio burst source in a globular cluster", Kirsten, F. et al, 2022, Nature, 602, 585
14. "Robust Assessment of Clustering Methods for Fast Radio Transient Candidates", Aggarwal, K, et al, 2021, 914, 53
15. "A Distant Fast Radio Burst Associated with Its Host Galaxy by the Very Large Array", Law, C. J. et al. 2020, ApJ, 899, 161

16. “A Data-driven Technique Using Millisecond Transients to Measure the Milky Way Halo” Platts, E. et al. 2020, ApJ, 859, 49

17. “The Karl G. Jansky Very Large Array Sky Survey (VLASS). Science Case and Survey Design” Lacy, M. et al, 2020, PASP, 132

18. “A repeating fast radio burst source localized to a nearby spiral galaxy” Marcote, B. et al 2020, Nature, 577, 190

19. “A Search for Late-time Radio Emission and Fast Radio Bursts from Superluminous Supernovae” Law, C. J. et al 2019, ApJ, 886, 24

20. “Discovery of the Luminous, Decades-long, Extragalactic Radio Transient FIRST J141918.9+394036”, Law, C. J. et al. 2018, ApJ, 866, L22

21. “Fast Radio Burst 121102 Pulse Detection and Periodicity: A Machine Learning Approach”, Zhang, Y. G. et al 2018, ApJ, 866, 149

22. “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)

23. “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

24. “An extreme magneto-ionic environment associated with the fast radio burst source FRB 121102”, Michilli, D. et al., 2018, Nature, 553, 182

25. “The Nonhomogeneous Poisson Process for Fast Radio Burst Rates”, Lawrence, E. 2017, AJ, 154, 117

26. “A direct localization of a fast radio burst and its host”, Chatterjee, S. et al 2017, Nature, 541, 58

27. “The Repeating Fast Radio Burst FRB 121102 as Seen on Milliarcsecond Angular Scales”, Marcote, B. et al 2017, ApJ, 834, 8

28. “The Host Galaxy and Redshift of the Repeating Fast Radio Burst FRB 121102”, Tendulkar, S. et al, 2017, ApJ, 834, 7

29. “realfast: Real-time, Commensal Fast Transient Surveys with the Very Large Array”, Law, C.J. et al 2018, ApJS, 236, 8

30. “A Multi-telescope Campaign on FRB 121102: Implications for the FRB Population”, Law, C.J. et al, 2017, ApJ, 850, 76

31. “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

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

33. “The LOFAR Transients Pipeline”, Swinbank, J. D. et al, 2015, A&C 11, 25

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

35. “LOFAR: The LOw-Frequency ARray”, van Haarlem, M. et al 2013, A&A, 556, 2

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

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

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

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

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

41. “Observing pulsars and fast transients with LOFAR”, Stappers, B. W. et al 2011, A&A, 530, 80

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

43. “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

44. “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

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

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

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

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

Professional Honors and Service

Reviewer for ISF, SARAO (MeerKAT), NCRA, FAST, NRAO, NASA and NSF, 2013 – present

Referee for the AAS Journals, MNRAS, Astronomy & Computing, PASP, and New Astronomy, 2006 – present

Chair, Natural Resources and Environmental Commission, City of South Pasadena, 2020 – present

Chair, LOC, "Scientific Frontiers and Synergies for the DSA-2000 Radio Camera", 2023

SOC member, IAU Symposium 369, "The Dawn of Cosmology & Multi-Messenger Studies with Fast Radio Bursts", 2022

Co-organizer, 3rd URSI Atlantic Radio Science meeting, Session on Techniques of Time-Domain Astrophysics, 2022

Mentor and Judge, Student Faculty Programs, Caltech, 2020 – present

Judge, AAS Chambliss poster competition, 2020 – present

Member, NRAO Users Committee, 2019 – 2022

Member, VLA Sky Survey Survey Science Group, 2014 – 2022

Editor, Astronomy and Computing, 2018 – 2019

Visitor, Dunlap Institute for Astronomy and Astrophysics, 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 – 2019

Member, Berkeley Institute for Data Science, 2014 – 2019

Jansky Very Large Array Resident Observer, 2012

Chair (LOC) and member (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

Teaching and Outreach

Caltech, Pasadena, CA

Student Advising **2019 – 2021**

- Caltech programs: Summer Undergraduate Research Fellowship, Freshman Summer Research Institute, and the Summer Research Consortium
- Graduate students: **Kshitij Aggarwal** (co-advisor and thesis committee; West Virginia Univ.), **Wael Farah** (thesis examiner; Swinburne Univ.), **Emma Platts** (Kavli project co-mentor; Univ. of Cape Town)
- Undergraduates **Carlos Ayala**, **Tyrone McNichols**, **Jerome (Johnny) Seebeck**, **Evan Portnoi**, **Rey Squillace**, **Ethan Alderete**
  Co-advisors: Gregg Hallinan, Vikram Ravi

Lecturing and Volunteering **2019 – 2022**

- Palomar Greenways Lecture Series, 2023
- OVRO Astronomy Lecture Series – Lecturer, 2022
- Arroyo Vista Elementary, South Pasadena – Science Night co-organizer, 2021-2022

UC Berkeley, Berkeley, CA

Student Advising **2009 – 2019**

- Graduate students: **Peter Williams**, **Chat Hull**, and **James McBride**
  Co-advisors: Carl Heiles and Geoff Bower
- Undergraduates: **Luis Chinchilla-Garcia** (UC LEADS prgram), **Bridget Andersen**, **Sabrina Berger**, **Sanyum Channa**, **Andrew Halle**, **Jun Tan**, **Yawen Sun**, **Kyle Blanchard**, and **Phillip Sells**
- Breakthrough Listen intern program

Lecturing and Volunteering **2009 – 2019**

- Prison University Project – Five years as lead math tutor for college-level curriculum in San Quentin State Prison
- Science@Cal – Six years as co-organizer of monthly lecture series and participation in annual "Cal Day" events
- Open Oakland – Participated in projects related to air quality, open software, and civic hacking
- UCB Astronomy 290 – Two guest lectures in graduate course on department research
- Franklin Elementary, Oakland, California – Two visits to present astronomy concepts to 3rd graders
- Mount Diablo Astronomical Society – Guest lecture on radio transients
- Splunk Inc. – Guest lecture on radio transients at Splunk Science Society lecture series
- Cal-Bridge – Co-organized workshop for Python in Astronomy for CSU-UC bridge program

University of Amsterdam, Amsterdam, The Netherlands

Student Advising **2006 – 2007**

- **Thijs Coenen**
  Co-adviser: Ralph Wijers.

Northwestern University, Evanston, IL

Teaching Assistant **2004**

- Taught weekly physics discussion session with roughly 100 students

Observatory Host **2003 – 2006**

- Led monthly open night tours at Dearborn Observatory

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**

- Developed and led 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.

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