

# Charles J. Law – Curriculum Vitae

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## EDUCATION

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Ph.D., Astronomy and Astrophysics, Harvard University, Cambridge, MA 2018 – Present  
Thesis: Chemical Complexity at High Spatial Resolution during Star and Planet Formation  
Advisor: Prof. Karin I. Öberg

B.A., Physics and Astrophysics, Harvard University, Cambridge, MA 2013 – 2017  
Thesis: [Carbon Chain Molecules Toward Embedded Low-Mass Protostars](#)  
Advisor: Prof. Karin I. Öberg

## AWARDS

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ALMA Ambassador	2022
NSF Graduate Research Fellowship	2019
Smithsonian Astrophysical Observatory Research Fellowship	2017
Leo Goldberg Prize in Astronomy (Harvard University)	2017
Thomas Temple Hoopes Prize (Harvard University)	2017
Phi Beta Kappa (Harvard University)	2017
Frederick Tarantino Memorial Scholarship Award (USRA)	2016
PRISE Undergraduate Research Fellowship (Harvard University)	2016
Detur Book Prize (Harvard University)	2014
John Harvard Scholar (Harvard University)	2014

## PUBLICATIONS

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Author of 36 publications (refereed or under review), including **10 as first author** and 3 as second/third author with major contributions. See a full listing at the end of CV and [ADS](#) library for more details.  
[h-index = 14; 500 total citations (as of Aug 12, 2022)]

## SELECTED TALKS

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I have given **39 talks**, including 8 invited and 10 public talks. See a full listing at the end of CV.

### Invited

Lunch Talk, University of Virginia/NRAO	Nov 2021
Astrochemistry Discussions	Nov 2021
Leiden Astrochemistry Seminar	Oct 2021
Origins Seminar, University of Arizona	May 2021

### Contributed

From Clouds to Planets II, Berlin, Germany [ <i>expected</i> ]	Oct 2022
Exoplanets IV, AAS Topical Conference Series, Las Vegas	May 2022
AstroCheminar, American Chemical Society	Jan 2022
Chemical processes in Solar-type star forming regions, Turin, Italy	Sept 2021
Space Telescope, 2021 Spring Symposium	Apr 2021
Science with the SMA: Present and Future, Taipei, Taiwan	Oct 2019

### Public

Atwood Museum (July 2022), Cape Cod Museum of Natural History (Nov 2021, July 2022),  
Cape Cod Astronomical Society (Jan 2021), Gloucester Area Astronomy Club (Sept 2018, May 2020)

## TELESCOPE OBSERVING & PROPOSALS

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PI of **10 programs** and Co-I on an additional 42 programs for access to observing facilities.

### PI

1. Linking Ice and Complex Molecule Inventories in MYSOs	<b>ALMA</b> , A, 5.4 hrs, Cycle 9
2. Witnessing Giant Planet Formation in the Act	<b>ALMA</b> , B, 6.0 hrs, Cycle 9
3. Search for a Surviving Stellar Companion of Nearby SNRs E0102/N132D	<b>Magellan</b> , 2.5 nights, 2022
4. Connecting Scaling Laws between Exoplanets and Young Disks	<b>SMA</b> , B-Tracks, 2020B+21A
5. Jet-like, IR-bright Ejecta in O-rich LMC Supernova Remnant N132D	<b>Magellan</b> , 3 nights, 2021B
6. Jet-like, IR-bright Ejecta in O-rich LMC Supernova Remnant N132D	<b>Magellan</b> , 4 nights, 2020B
7. Ionized Accretion Flows around 0.1 pc Scale Clusters with O-Type Stars	<b>ALMA</b> , C, 14.8 hrs, Cycle 7
8. Jet-like, IR-bright Ejecta in O-rich LMC Supernova Remnant N132D	<b>Magellan</b> , 3 nights, 2019B
9. Formation of O Stars by Accretion of Ionized Gas	<b>VLA</b> , A, 11 hrs, 2019A
10. Ionized Accretion Flows around 0.1 pc Scale Clusters with O-Type Stars	<b>SMA</b> , B-Trakcs, 2018B+19A

### Co-I

**ALMA** (375.9 hrs), **ACA** (63.6 hrs), **SMA** (208 hrs), **VLA** (16.5 hrs), **NOEMA** (56 hrs), **GBT** (13.75 hrs), **VLBA** (72 hrs), **IRAM 30m** (49.7 hrs), **JWST** (20.6 hrs), **Chandra** (190 ks), **HST** (3 orbits), **VLT** (12 hrs), **Lick/Shane 3m** (10 nights), **Gemini** (5 hrs), **WIYN** (1.5 nights), **Lick/Shane 3m** (10 nights), **MMT** (0.5 nights)

### Observing Experience:

**SMA**, 15 nights (2016 – 2018); **Magellan**, 4.5 nights (2019, 2021); **MMT**, 1 night (2016)

### Funding:

ALMA Ambassador, Research Grant (**\$10,000**)

Harvard Data Science Initiative Research Fund, Regularized Maximum Likelihood Imaging: A New Method for Detecting Planets (**\$9,700**; Collaborator, PI: R. Teague)

NRAO Student Observing Support, VLA 2019A, 2019 (**\$33,601**; Advisor: Q. Zhang)

ALMA Student Observing Support, ALMA Cycle 4, 2016 (**\$9,000**; Advisor: Q. Zhang)

## MAJOR COLLABORATIONS

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Molecules with ALMA at Planet-forming Scales (MAPS) 2018 – Present

*PI: Karin I. Öberg; co-PIs: Yuri Aikawa, Edwin A. Bergin, Viviana V. Guzmán, Catherine Walsh*

ALMA Cycle 6 Large Program to study the chemistry of five protoplanetary disks at 10-20 au scales

N132D Chandra Legacy Team

2019 – Present

*PI: Paul P. Plucinsky*

Chandra Cycle 20 Large Program legacy observations of N132D at unprecedented depth

## TEACHING

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### Teaching Fellow

Interstellar Medium and Star Formation (Graduate, Harvard University)	Spring 2021
Stellar and Planetary Astronomy (Undergraduate, Harvard University)	Spring 2020
Introduction to Scientific Programming in Python (Harvard Pre-College Program)	Summer 2019, 2020
Physics I (Lab): Mechanics, Elasticity, Fluids, and Diffusion (Harvard University)	Fall 2017

### Instructor

Introduction to Scientific Programming in Python (Harvard Pre-College Program)	Summer 2021, 2022
Scientific Computing with SciPy, Python Workshop (SAO Latino Initiative Program)	Summer 2021, 2022

### Pedagogy Training and Teaching Awards

Science Education Undergraduate Mentoring Workshop Series (Harvard University)	Spring 2022
Derek Bok Teaching Certificate (Harvard University)	2021
Derek Bok Certificate of Excellence and Distinction in Teaching (Harvard University)	Spring 2021

### SELECTED OUTREACH

Course Coordinator, Beacon Hill Seminar, <a href="#">Unveiling the Cosmos</a>	Spring, Fall 2021
Guest, Down to Earth with Terry Virts, Podcast	Feb 2022
Contributing Author, <a href="#">Astrobites</a>	Jan 2019 – Present
AAS Astronomy Ambassador	Jan 2019 – Present
Volunteer, CfA Public Observatory Night	Fall 2017 – Present
Astronomy Advisor, Harvard Undergraduate Science Olympiad	2018 – 2020
Presenter, Flipped Science Fair, John F. Kennedy School	June 2018, May 2019
Speaker, <a href="#">Science Research Mentoring Program</a> , Cambridge Rindge and Latin School	Mar 2018
Seminar Leader, Harvard Summit for Young Leaders in China	Aug 2017

### PROFESSIONAL ACTIVITIES

Referee, A&A, A&A Letters, ApJ, ApJS	2018 – Present
AAS Chambliss Competition Poster Judge	Summer 2022
Subject Matter Expert, NASA Community College Network	2022 – Present
Subject Matter Expert, NASA JWST Community Events	2021 – Present
Member, CfA APS-IDEA, Accessibility Subcommittee	2021 – Present
Peer Mentor, Harvard Astronomy Department	2021 – Present
Co-Organizer, Grad School Visitation Days	Spring 2020
Co-Organizer, Student-Faculty Lunch Series	Spring 2020

### MENTORING

I have served as a primary science advisor for four students and co-advisor for one student:

Sarai Rankin (Morgan State University, REU Undergraduate)	Summer 2022 – Present
SMA survey of protoplanetary disks in the Cepheus OBb3 star-forming region	
Arielle Frommer (Harvard University, Undergraduate)	Summer 2022 – Present
Spatially-resolved nitrile chemistry in a sample of massive young stellar objects	
Sage Crystian (Harvard University, Undergraduate)	Summer 2021
Mapping the vertical structure of protoplanetary disks with CO line emission	
Prabidhik KC (Harvard University, Undergraduate)	Spring 2020 – Spring 2022
SMA survey of complex chemistry in ultra-compact HII regions	
Devin Sullivan (Harvard University, Undergraduate / co-advised with K. Öberg)	Fall 2019
<a href="#">Junior Thesis</a> on the distribution of HCN gas in protoplanetary disks	

## PUBLICATIONS

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A full listing of my publications can be found on [ADS](#).

[Mentees are marked with †]

### First Author

1. **Law, C. J.**, Teague, R., Öberg, K. I., et al. 2022. ApJ, subm.  
Mapping Protoplanetary Disk Vertical Structure with CO Isotopologue Line Emission
2. **Law, C. J.**, Crystian, S.<sup>†</sup>, Teague, R., et al., 2022. ApJ, 932, 114  
[CO Line Emission Surfaces and Vertical Structure in Mid-Inclination Protoplanetary Disks](#)
3. **Law, C. J.**, Loomis, R. A., Teague, R., et al., 2021. ApJS, 257, 3  
[MAPS III. Characteristics of Radial Chemical Substructures](#)
4. **Law, C. J.**, Teague, R., Loomis, R. A., et al., 2021. ApJS, 257, 4  
[MAPS IV. Emission Surfaces and Vertical Distribution of Molecules](#)
5. **Law, C. J.**, Zhang, Q., Öberg, K. I., et al., 2021. ApJ, 909, 214  
[Subarcsecond Imaging of the Complex Organic Chemistry in Massive Star-Forming Region G10.6-0.4](#)
6. **Law, C. J.**, Milisavljevic, D., Patnaude, D. J., et al., 2020. ApJ, 894, 73  
[Three-dimensional Kinematic Reconstruction of the Optically-Emitting, High-Velocity, Oxygen-Rich Ejecta of Supernova Remnant N132D](#)
7. **Law, C. J.**, Zhang, Q., Ricci, L., et al., 2018. ApJ, 865, 17  
[Submillimeter Array Observations of Extended CO \( \$J = 2 - 1\$ \) Emission in Interacting Galaxy NGC 3627](#)
8. **Law, C. J.**, Öberg, K. I., Bergner, J. B., et al., 2018. ApJ, 863, 88  
[Carbon Chain Molecules Toward Embedded Low-Mass Protostars](#)
9. **Law, C. J.**, Ricci, L., Andrews, S. M., et al., 2017. AJ, 154, 255  
[An SMA Continuum Survey of Circumstellar Disks in the Serpens Star-Forming Region,](#)
10. **Law, C. J.**, Milisavljevic, D., Crabtree, K. N., et al. 2017. MNRAS, 470, 3  
[TRES Survey of Variable Diffuse Interstellar Bands](#)

### Second or Third Author

1. Muñoz-Romero, C. E., Öberg, K. I., **Law, C. J.**, et al., 2022. in prep.  
Midplane Deuterium Fractionation in the Nearest Planet-Forming Disk
2. Teague, R., **Law, C. J.**, Huang, J., et al., 2021. JOSS, 6, 67  
[disksurf: Extracting the 3D Structure of Protoplanetary Disks](#)
3. Zhang, K., Booth, A., **Law, C. J.**, et al., 2021. ApJS, 257, 5  
[MAPS V. CO Gas Distributions](#)
4. Guzmán, V. V., Bergner, J. B., **Law, C. J.**, et al., 2021. ApJS, 257, 6  
[MAPS VI. Distribution of the Small Organics HCN, C<sub>2</sub>H, and H<sub>2</sub>CO](#)

### Other Co-Authored Publications

1. Banovetz, J., et al. (incl. **Law, C. J.**), 2022. ApJ, in prep.  
HST Proper Motion Measurements of Supernova Remnant N132D: Center of Expansion and Age
2. Calahan, J. K., et al. (incl. **Law, C. J.**), 2022. Nature Astronomy, in prep.  
Witnessing a Major Chemical Transition During Planet Formation
3. Pegues, J., et al. (incl. **Law, C. J.**), 2022. ApJ, subm.  
An SMA Survey of Chemistry in Disks around Herbig AeBe Stars
4. Bae, J., et al. (incl. **Law, C. J.**), 2022. ApJL, 934, L20  
[MAPS. A Circumplanetary Disk Candidate in Molecular Line Emission in the AS 209 Disk](#)
5. Anderson, A. R., et al. (incl. **Law, C. J.**), 2022. ApJ, in press  
[Protostellar and Protoplanetary Disk Masses in the Serpens-Aquila Region](#)

6. Sharda, P., et al. (incl. **Law, C. J.**), 2022. MNRAS, 509, 2  
[First extragalactic measurement of the turbulence driving parameter: ALMA observations of the star-forming region N159E in the Large Magellanic Cloud](#)
7. Martín Doménech, R., et al. (incl. **Law, C. J.**), 2021. ApJ, 923, 155  
[Hot corino chemistry in the Class I binary source Ser-emb 11](#)
8. Öberg, K. I., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 1  
[MAPS I. Program Overview and Highlights](#)
9. Czekala, I., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 2  
[MAPS II. CLEAN Strategies for Synthesizing Images of Molecular Line Emission in Protoplanetary Disks](#)
10. Bosman, A. D., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 7  
[MAPS VII. Substellar O/H and C/H and Superstellar C/O in Planet-feeding Gas](#)
11. Alarcón, F., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 8  
[MAPS VIII. CO Gap in AS 209 – Gas Depletion or Chemical Processing?](#)
12. Ilee, J. D., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 9  
[MAPS IX. Distribution and Properties of the Large Organic Molecules HC<sub>3</sub>N, CH<sub>3</sub>CN, and c-C<sub>3</sub>H<sub>2</sub>](#)
13. Cataldi, G., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 10  
[MAPS X. Studying Deuteration at High Angular Resolution toward Protoplanetary Disks](#)
14. Bergner, J. B., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 11  
[MAPS XI. CN and HCN as Tracers of Photochemistry in Disks](#)
15. Le Gal, R., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 12  
[MAPS XII. Inferring the C/O and S/H Ratios in Protoplanetary Disks with Sulfur Molecules](#)
16. Aikawa, Y., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 13  
[MAPS XIII. HCO<sup>+</sup> and Disk Ionization Structure](#)
17. Sierra, A., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 14  
[MAPS XIV. Revealing Disk Substructures in Multiwavelength Continuum Emission](#)
18. Bosman, A. D., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 15  
[MAPS XV. Tracing Protoplanetary Disk Structure within 20 au](#)
19. Booth, A., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 16  
[MAPS XVI. Characterizing the Impact of the Molecular Wind on the Evolution of the HD 163296 System](#)
20. Calahan, J., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 17  
[MAPS XVII. Determining the 2D Thermal Structure of the HD 163296 Disk](#)
21. Teague, R., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 18  
[MAPS XVIII. Kinematic Substructure in the Disks of HD 163296 and MWC 480](#)
22. Huang, J., et al. (incl. **Law, C. J.**), 2021. ApJS, 257, 19  
[MAPS XIX. Spiral Arms, a Tail, and Diffuse Structures Traced by CO around the GM Aur Disk](#)
23. Schwarz, K. (incl. **Law, C. J.**), 2021. ApJS, 257, 20  
[MAPS XX. The Massive Disk Around GM Aurigae](#)
24. Sano, H., et al. (incl. **Law, C. J.**), 2020. ApJ, 902, 53  
[ALMA CO Observations of Gamma-Ray Supernova Remnant N132D in the Large Magellanic Cloud: Possible Evidence for Shocked Molecular Clouds Illuminated by Cosmic-Ray Protons](#)
25. Le Gal, R., et al. (incl. **Law, C. J.**), 2020. ApJ, 898, 131  
[A 3mm chemical exploration of small organics in Class I YSOs](#)

## TALKS

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1. Seminar, Carnegie Earth & Planets Laboratory, Washington, D.C. [ <i>expected</i> ]	Dec 2022
2. Contributed, From Clouds to Planets II, Berlin, Germany [ <i>expected</i> ]	Oct 2022
3. Seminar, Planet and Star Formation Coffee, MPIA/Heidelberg, Germany [ <i>expected</i> ]	Sept 2022
4. Contributed, Planet and Binary Formation in GI Discs, Leicester, UK [ <i>expected</i> ]	Sept 2022
5. <i>Public Talk</i> , Tellus Science Museum, Cartersville, GA [ <i>expected</i> ]	Aug 2022
6. Contributed, Northeast Star and Planet Formation Meeting, Wesleyan, MA	July 2022
7. <i>Public Talk</i> , Cape Cod Museum of Natural History	July 2022
8. <i>Public Talk</i> , Atwood Museum, Cape Cod	July 2022
9. Contributed, 240 <sup>th</sup> AAS, Pasadena, CA	June 2022
10. Contributed, VICO-CICO-CASSUM Spring Workshop, University of Virginia	May 2022
11. Contributed, Exoplanets IV, AAS Topical Conference Series, Las Vegas, NV	May 2022
12. Contributed, MAYA: Meeting of ALMA Young Astronomers	Mar 2022
13. Contributed, AstroCheminar, American Chemical Society	Jan 2022
14. <i>Public Talk</i> , Cape Cod Astronomical Society	Jan 2022
15. <b>Invited</b> , Lunch Talk, University of Virginia/NRAO	Nov 2021
16. <i>Public Talk</i> , Cape Cod Museum of Natural History	Nov 2021
17. <b>Invited</b> , Astrochemistry Discussion	Nov 2021
18. <b>Invited</b> , Leiden Astrochemistry Seminar	Oct 2021
19. <i>Public Talk</i> , Beacon Hill Seminar	Oct 2021
20. Seminar, Exoplanet Pizza Lunch, CfA	Sept 2021
21. Contributed, Chemical Processes in Solar-type Star-forming Regions, Turin, Italy	Sept 2021
22. <b>Invited</b> , SSP Coffee Talk, CfA	July 2021
23. Contributed, Emerging Researchers in Exoplanet Science	May 2021
24. <b>Invited</b> , Origins Seminar, University of Arizona	May 2021
25. Contributed, Space Telescope, 2021 Spring Symposium	Apr 2021
26. Contributed, Five Years after HL Tau: A New Era in Planet Formation	Dec 2020
27. Contributed, Harvard-Heidelberg Star Formation Workshop	Dec 2020
28. Contributed, Astrochemical Frontiers	June 2020
29. <i>Public Talk</i> , North Shore Amateur Astronomy Club	June 2020
30. <i>Public Talk</i> , Gloucester Area Astronomy Club	May 2020
31. <i>Public Talk</i> , Beacon Hill Seminar	Mar 2020
32. Seminar, SMA Science Seminar, CfA	Feb 2020
33. Contributed, New England Star Formation Meeting, UConn, CT	Jan 2020
34. Contributed, 235 <sup>th</sup> AAS, Honolulu, HI	Jan 2020
35. <i>Public Talk</i> , Union County College/AAI, NJ	Dec 2019
36. Contributed, Science with the SMA: Present and Future, Taipei, Taiwan	Oct 2019
37. Contributed, ISMS, 74 <sup>th</sup> , Champaign-Urbana, IL	June 2019
38. Contributed, SNRs II, Chania, Crete, Greece	June 2019
39. Seminar, Exoplanet Pizza Lunch, CfA	May 2019
40. <b>Invited</b> , ALMA Community Day, MIT	Apr 2019
41. <b>Invited</b> , ALMA Community Day, CfA	Apr 2019
42. Seminar, High Energy Phenomena Seminar, CfA	Feb 2019
43. <b>Invited</b> , SMA Advisory Committee Meeting, CfA	July 2018
44. <i>Public Talk</i> , Gloucester Area Astronomy Club	Sept 2018