

# Charles J. Law – Curriculum Vitae

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## EDUCATION

Ph.D., Astronomy and Astrophysics (Harvard University, Cambridge, MA)	2018 – Present
<b>Thesis:</b> Zooming in on the Chemistry of Star and Planet Formation	Advisor: Prof. Karin Öberg
M.A., Astronomy and Astrophysics (Harvard University, Cambridge, MA)	2021
B.A., Physics and Astrophysics (Harvard University, Cambridge, MA)	2013 – 2017
<b>Thesis:</b> <a href="#">Carbon Chain Molecules Toward Embedded Low-Mass Protostars</a>	Advisor: Prof. Karin Öberg

## AWARDS

AAS Rodger Doxsey Travel Prize (241 <sup>st</sup> AAS meeting)	2023
ALMA Ambassador	2022
AAS Chambliss Prize Honorable Mention (235 <sup>th</sup> AAS meeting)	2020
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
USRA Frederick Tarantino Memorial Scholarship Award	2016
PRISE Undergraduate Research Fellowship (Harvard University)	2016
Detur Book Prize (Harvard University)	2014
John Harvard Scholar (Harvard University)	2014

## PUBLICATIONS

Author of **40 publications** (refereed or under review), including 10 as first author and 4 as second/third author with major contributions. See a full listing at the end of CV and [ADS](#) library for more details. [611 citations; h-index = 16 (Dec 2, 2022)]

## TALKS

I have given **48 talks**, including 8 invited and 11 public talks. See a full listing at the end of CV.

## TELESCOPE OBSERVING & PROPOSALS

PI of **10 programs** and Co-I on an additional 44 programs for access to observing facilities.

### PI:

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

**Co-I:** ALMA (376 hrs), ACA (64 hrs), SMA (256 hrs), VLA (17 hrs), NOEMA (56 hrs), VLBA (72 hrs), GBT (14 hrs), IRAM 30m (50 hrs), JWST (21 hrs), Chandra (190 ks), HST (3 orbits), VLT (12 hrs), Shane (10 nights), Gemini (5 hrs), WIYN (1.5 nights), MMT (0.5 nights)

**Observing:** SMA (15 nights; 2016 – 2018); Magellan (7.5 nights; 2019, 2021, 2022); MMT (1 night; 2016)

**Funding:** ALMA Ambassador (\$10,000), NRAO/SOS, VLA 2019A (\$33,601; Q. Zhang), ALMA/SOS, ALMA Cycle 4 (\$9,000; Q. Zhang)

## MAJOR COLLABORATIONS

<b>X-ray Mega-Flares in the Orion Nebula Cluster</b> <i>PI: Konstantin V. Getman</i> Multi-telescope (Chandra, VLBA, ALMA, HET) campaign to study flares in ~1000 PMS stars in the ONC	2022 – Present
<b>N132D Chandra Legacy Team</b> <i>PI: Paul P. Plucinsky</i> Chandra Cycle 20 Large Program legacy observations of SNR N132D at unprecedented depth	2019 – Present
<b>Molecules with ALMA at Planet-forming Scales (MAPS)</b> <i>PI: Karin I. Öberg; co-PIs: Yuri Aikawa, Edwin A. Bergin, Viviana V. Guzmán, Catherine Walsh</i> ALMA Cycle 6 Large Program to study the chemistry of five protoplanetary disks at 10-20 au scales [MAPS team <a href="#">webpage</a> and selected press <a href="#">coverage</a> ]	2018 – Present

## TEACHING

### 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 (Undergraduate, 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
Unveiling the Cosmos (Beacon Hill Seminars)	Spring, Fall 2021

### 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

## OUTREACH

Subject Matter Expert, NASA Community College Network	2022 – Present
Subject Matter Expert, NASA JWST Community Events	2021 – Present
Volunteer, CfA Public Observatory Night	2017 – Present
Guest, Down to Earth with Terry Virts, Podcast	Feb 2022
Contributing Author, <a href="#">Astrobites</a>	2018 – 2020
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

## PROFESSIONAL ACTIVITIES

Referee, A&A, A&A Letters, ApJ, ApJS	2018 – Present
Co-Organizer, CfA Star Formation Journal Club	2022 – Present
Member, CfA APS-IDEA, Accessibility Subcommittee	2021 – Present
Peer Mentor, Harvard Astronomy Department	2021 – Present
AAS Astronomy Ambassador	2019 – Present
Organizer, ALMA Data Reduction Workshop, CfA	Fall 2022
AAS Chambliss Competition Poster Judge	Summer 2022
Reviewer, ALMA Archival Student Observing Support awards	Spring 2022
Co-Organizer, Graduate School Visitation Days	Spring 2020
Co-Organizer, Student-Faculty Lunch Series	Spring 2020

## MENTORING

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

Sarai Rankin (Morgan State, REU Undergraduate)	Summer 2022 – Present
SMA survey of protoplanetary disks in the Cepheus OBb3 star-forming region	
Arielle Frommer (Harvard, Undergraduate)	Summer 2022 – Present
Spatially-resolved nitrile chemistry in a sample of massive young stellar objects	
Sage Crystian (Harvard, Undergraduate)	Summer 2021
Mapping the vertical structure of protoplanetary disks with CO line emission	
Prabidhik KC (Harvard, Undergraduate)	Spring 2020 – Spring 2022
SMA survey of complex chemistry in ultra-compact HII regions	
Devin Sullivan (Harvard, 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](#).

[611 citations, h-index = 16 (as of Dec 2, 2022); mentees 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.†, 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  
3D 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. *ApJ*, in press  
Cold 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. S., **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*, *subm.*  
HST Proper Motion Measurements of Supernova Remnant N132D: Center of Expansion and Age
2. Pegues, J., et al. (incl. **Law, C. J.**), 2022. *ApJ*, *subm.*  
An SMA Survey of Chemistry in Disks around Herbig AeBe Stars
3. Calahan, J. K., et al. (incl. **Law, C. J.**), 2022. *Nature Astronomy*, in press  
UV-driven Chemistry as a Signpost of Late-stage Planet Formation
4. Galván-Madrid, R., et al. (incl. **Law, C. J.**), 2022. *ApJL*, in press  
Clustered Formation of Massive Stars within an Ionized Rotating Disk
5. Anderson, A. R., et al. (incl. **Law, C. J.**), 2022. *ApJ*, **938**, 55  
Protostellar and Protoplanetary Disk Masses in the Serpens-Aquila Region

6. 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
7. 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
8. 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
9. Öberg, K. I., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 1](#)  
MAPS I. Program Overview and Highlights
10. 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
11. 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
12. Alarcón, F., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 8](#)  
MAPS VIII. CO Gap in AS 209 – Gas Depletion or Chemical Processing?
13. 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>
14. Cataldi, G., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 10](#)  
MAPS X. Studying Deuteration at High Angular Resolution toward Protoplanetary Disks
15. Bergner, J. B., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 11](#)  
MAPS XI. CN and HCN as Tracers of Photochemistry in Disks
16. 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
17. Aikawa, Y., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 13](#)  
MAPS XIII. HCO<sup>+</sup> and Disk Ionization Structure
18. Sierra, A., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 14](#)  
MAPS XIV. Revealing Disk Substructures in Multiwavelength Continuum Emission
19. Bosman, A. D., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 15](#)  
MAPS XV. Tracing Protoplanetary Disk Structure within 20 au
20. Booth, A. S., 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
21. Calahan, J. K., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 17](#)  
MAPS XVII. Determining the 2D Thermal Structure of the HD 163296 Disk
22. 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
23. 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
24. Schwarz, K. R., et al. (incl. **Law, C. J.**), 2021. [ApJS, 257, 20](#)  
MAPS XX. The Massive Disk Around GM Aurigae
25. 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
26. 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

1. Dissertation Talk, 241 <sup>st</sup> American Astronomical Society (Seattle, WA) <i>[expected]</i>	Jan 2023
2. Seminar, Carnegie Earth & Planets Laboratory (virtual)	Dec 2022
3. ITC Luncheon Talk, CfA (Cambridge, MA)	Oct 2022
4. Seminar, University of Milan (Milan, Italy)	Oct 2022
5. Contributed, From Clouds to Planets II (Berlin, Germany)	Oct 2022
6. Leiden Astrochemistry Seminar (Leiden, The Netherlands)	Sept 2022
7. Planet and Star Formation Coffee, MPIA (Heidelberg, Germany)	Sept 2022
8. SPF Group Meeting, ESO (Garching, Germany)	Sept 2022
9. Contributed, Planet and Binary Formation in GI Discs (Leicester, UK)	Sept 2022
10. <i>Public Talk</i> , Tellus Science Museum (virtual)	Aug 2022
11. Contributed, Northeast Star and Planet Formation Meeting, Wesleyan University (Middletown, CT)	July 2022
12. <i>Public Talk</i> , Cape Cod Museum of Natural History (Brewster, MA)	July 2022
13. <i>Public Talk</i> , Atwood Museum, Cape Cod (Chatham, MA)	July 2022
14. Contributed, 240 <sup>th</sup> American Astronomical Society (virtual)	June 2022
15. Contributed, VICO-CICO-CASSUM Spring Workshop, University of Virginia (Charlottesville, VA)	May 2022
16. Contributed, Exoplanets IV, AAS Topical Conference Series (Las Vegas, NV)	May 2022
17. Contributed, MAYA: Meeting of ALMA Young Astronomers (virtual)	Mar 2022
18. Contributed, AstroCheminar, American Chemical Society (virtual)	Jan 2022
19. <i>Public Talk</i> , Cape Cod Astronomical Society (virtual)	Jan 2022
20. <b>Invited</b> , Lunch Talk, University of Virginia/NRAO (virtual)	Nov 2021
21. <i>Public Talk</i> , Cape Cod Museum of Natural History (virtual)	Nov 2021
22. <b>Invited</b> , Astrochemistry Discussions (virtual)	Nov 2021
23. <b>Invited</b> , Leiden Astrochemistry Seminar (virtual)	Oct 2021
24. <i>Public Talk</i> , Beacon Hill Seminar (virtual)	Oct 2021
25. Seminar, Exoplanet Pizza Lunch, CfA (virtual)	Sept 2021
26. Contributed, Chemical Processes in Solar-type Star-forming Regions (Turin, Italy)	Sept 2021
27. <b>Invited</b> , SSP Coffee Talk, CfA (virtual)	July 2021
28. Contributed, Emerging Researchers in Exoplanet Science (virtual)	May 2021
29. <b>Invited</b> , Origins Seminar, University of Arizona (virtual)	May 2021
30. Contributed, Space Telescope, 2021 Spring Symposium (virtual)	Apr 2021
31. Contributed, Five Years after HL Tau: A New Era in Planet Formation (virtual)	Dec 2020
32. Contributed, Harvard-Heidelberg Star Formation Workshop (virtual)	Dec 2020
33. Contributed, Astrochemical Frontiers (virtual)	June 2020
34. <i>Public Talk</i> , North Shore Amateur Astronomy Club (virtual)	June 2020
35. <i>Public Talk</i> , Gloucester Area Astronomy Club (virtual)	May 2020
36. <i>Public Talk</i> , Beacon Hill Seminar (Boston, MA)	Mar 2020
37. Seminar, SMA Science Seminar, CfA (Cambridge, MA)	Feb 2020
38. Contributed, New England Star Formation Meeting, University of Connecticut (Storrs, CT)	Jan 2020
39. Contributed, 235 <sup>th</sup> American Astronomical Society (Honolulu, HI)	Jan 2020
40. <i>Public Talk</i> , Union County College/AAI (Cranford, NJ)	Dec 2019
41. Contributed, Science with the SMA: Present and Future (Taipei, Taiwan)	Oct 2019
42. Contributed, 74 <sup>th</sup> International Symposium on Molecular Spectroscopy (Champaign-Urbana, IL)	June 2019
43. Contributed, Supernova Remnants II: An Odyssey in Space after Stellar Death (Chania, Greece)	June 2019
44. Seminar, Exoplanet Pizza Lunch, CfA (Cambridge, MA)	May 2019
45. <b>Invited</b> , ALMA Community Day, MIT (Cambridge, MA)	Apr 2019
46. <b>Invited</b> , ALMA Community Day, CfA (Cambridge, MA)	Apr 2019
47. Seminar, High Energy Phenomena Seminar, CfA (Cambridge, MA)	Feb 2019
48. <b>Invited</b> , SMA Advisory Committee Meeting, CfA (Cambridge, MA)	July 2018
49. <i>Public Talk</i> , Gloucester Area Astronomy Club (Gloucester, MA)	Sept 2018