Charles J. Law – Curriculum Vitae

Center for Astrophysics | Harvard & Smithsonian
60 Garden Street, Cambridge, MA 02138, USA
charles.law@cfa.harvard.edu | claw-astro.github.io
ORCID iD: 0000-0003-1413-1776 | 724-493-0763

EDUCATION

Ph.D., Astronomy and Astrophysics (Harvard University, Cambridge, MA) — 2018 – Present
Thesis: 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
Thesis: Carbon Chain Molecules Toward Embedded Low-Mass Protostars — Advisor: Prof. Karin Öberg

AWARDS

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
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 **39 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.
[594 citations; h-index = 15 (as of Nov 1, 2022)]

TALKS

I have given **47 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 42 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**, B, 2020B+2021A
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**, B, 2018B+2019A

Co-I: **ALMA** (376 hrs), **ACA** (64 hrs), **SMA** (208 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** (6 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

X-ray Mega-Flares in the Orion Nebula Cluster 2022 – Present
PI: Konstantin V. Getman
Multi-telescope (Chandra, VLBA, ALMA, HET) campaign to study flares in ~1000 PMS stars in the ONC

N132D Chandra Legacy Team 2019 – Present
PI: Paul P. Plucinsky
Chandra Cycle 20 Large Program legacy observations of SNR N132D at unprecedented depth

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
[MAPS team webpage and selected press coverage]

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, Astrobites	2018 – 2020
Astronomy Advisor, Harvard Undergraduate Science Olympiad	2018 – 2020
Presenter, Flipped Science Fair, John F. Kennedy School	June 2018, May 2019
Speaker, Science Research Mentoring Program, 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, 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, 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
Junior Thesis on the distribution of HCN gas in protoplanetary disks

PUBLICATIONS

A full listing of my publications can be found on ADS.
[594 citations, h-index = 15 (as of Nov 1, 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. subm.
   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., **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_2H, and H_2CO

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 Marks the Late-stages of Planet Formation
4. Anderson, A. R., et al. (incl. **Law, C. J.**), 2022. ApJ, 938, 55
   Protostellar and Protoplanetary Disk Masses in the Serpens-Aquila Region
5. 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

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_3N, CH_3CN, and c-C_3H_2
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^+ 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

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