

ANNA LORRAINE ROSEN, PH.D.

anna.rosen@cfa.harvard.edu \diamond www.anna-rosen.com

Institute for Theory and Computation, Center for Astrophysics | Harvard & Smithsonian, Cambridge MA 02138

EDUCATION

Ph.D., Astronomy & Astrophysics, University of California, Santa Cruz 2017
Advisors: Mark Krumholz, Enrico Ramirez-Ruiz
M.S., Astronomy & Astrophysics, University of California, Santa Cruz 2012
B.A., Physics & Astrophysics, University of California, Berkeley 2009
Cumulative GPA: 3.81/4.0 , Major GPA: 3.82/4.0, Honors: Fall 2007-2009, General Distinction
Community College Transfer Student, Los Angeles Pierce College (LAPC) 2007
Cumulative GPA: 3.95/4.0 , Major GPA: 4.0/4.0
Dean's Honors: 2003-2007, President's Honor: 2004-2007

AWARDS AND RESEARCH POSITIONS

Institute for Theory and Computation (ITC) Post-doctoral Fellowship, Harvard University 2020-2022
NASA Einstein Post-doctoral Fellowship, Harvard University 2017-2020
NASA Hubble Post-doctoral Fellowship (declined) 2017
Rodger Doxsey Dissertation Prize (American Astronomical Society) 2017
ARCS (Achievement Rewards for College Scientists) Foundation Fellowship 2016
American Association of University Women (AAUW) American Dissertation Year Fellowship 2016
Excellence in Mentoring Award (UC Santa Cruz Astronomy & Astrophysics Department) 2015
American Astronomical Society International Travel Grant 2014, 2016, 2017
National Science Foundation Graduate Research Fellowship Program 2011
Daniel Edward Wark Memorial Scholarship (UC Berkeley Astrophysics Department) 2009
NASA Motivating Undergraduates in Science and Technology Scholarship 2007
Alexander Frolich Award for excellence of achievement in Physics (LAPC) 2007
NASA JPL Undergraduate Scholars Award for excellence of achievement in Physics 2007
Thomas McCutcheon Award for excellence of achievement in Mathematics (LAPC) 2006

SUCCESSFUL PROPOSALS

Total of grants obtained as Principal Investigator: \$174,825

1. Co-I, Chandra Observation, Cycle 21 (awarded 100 ks) 2019
Title: *A Superstar Cluster is Born: Probing the X-ray Emission of H72.97-69.39 in LMC-N79*
2. PI, Chandra Theory, Cycle 16 2014
Title: *To Leak or Not to Leak: Where are the Missing X-ray Photons from Massive Star Clusters?*
3. PI, Hubble Archival, Cycle 21 2013
Title: *Simulating the Birth of Massive Star Clusters: Is Destruction Inevitable?*

TECHNICAL SKILLS

Computer Languages	C++, Fortran, IDL, Python, R, MPI
Simulation Codes	ORION2, GIZMO
Analysis Codes	<i>yt</i> , RADMC-3D, GLUE

ADVISING EXPERIENCE

Graduate Students:

Grace Olivier (grad student at OSU), <i>Evolution of Stellar Feedback in H II Regions and X-ray Emission from the Massive Binary WR 20a</i>	2020-present*
Michael Foley (grad student at Harvard), <i>Bubbles around Intermediate and High-mass Stars due to Wind Feedback</i>	2018-2019*
Hope Chen (grad student at Harvard), <i>Effects of an Embedded B-Star Wind in Ophiuchus</i>	2018-2019

Undergraduate Students:

Mikayla Wilson (physics & astronomy undergrad at TCU), Banneker Intern at Harvard <i>Tracing the Evolution of Molecular Outflows in Massive Star Formation</i>	2020
Monica Gallegos-Garcia (now astro grad at Northwestern), Banneker Intern at Harvard <i>Winds in Star Clusters Drive Kolmogorov Turbulence</i>	2018-2020*
Courtney Bishop (physics undergrad at College of William & Mary), SAO NSF REU program <i>Comparing Molecular Line Tracers in Outflows Generated by Massive Star Formation</i>	2018
Evan Carter (physics undergrad at UCSC, then astro masters student at Wesleyan), <i>Synthetic Observations of Low-Mass Star Formation: Implications for Current SED-Fitting Methods</i>	2014-2016

High School Students:

Shreya Karri <i>Census of Stellar Feedback in the Milky Way</i>	2019
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* Denotes students whose project or contribution led to or will soon lead to a refereed publication

SERVICE EXPERIENCE

NASA JWST Cycle 1 Panelist	2021
Member, Harvard Astronomy Diversity, Equity, and Inclusion (DEI) Committee	2021-Present
Member, CfA Inclusion, Diversity, and Equity in Astronomy (CfA-IDEA) Committee	2020-2021
Referee for A&A, ApJ, MNRAS, & RAA	
CfA Galaxies & Cosmology Seminar Organizer	2019-2021
NASA Theory Astrophysics Program Panelist	2019
NASA Earth and Space Science Fellowship (NESSF) Reviewer	2019
Organizer, Equity & Inclusion Journal Club, Harvard-Smithsonian CfA	2018-2019
Proposal Reviewer for the Czech Science Foundation	2018
ITC Post-doctoral Fellowship Committee Member, Harvard-Smithsonian CfA	1 year
SOC/LOC Member for Harvard-Heidelberg Star Formation meeting, Harvard-Smithsonian CfA	2017, 2019 (Chair)
Organizer, Diverse Topics in Astronomy Lecture Series, Lamat REU Program, UCSC	2015, 2016
Organizer, Space Telescope Proposal Writing Workshop, UCSC Astronomy & Astrophysics Department	2015
Member of the LAMAT Research Internship Admissions Committee	2014
Undergraduate Student Mentor, UCSC Women in Physics Group	2013-2017
Graduate Student Mentor, UCSC Astronomy & Astrophysics Department	2012-2013, 2016-2017
Astronomy Graduate Student Representative, UCSC Graduate Student Association	2012-2013
Organizer, Applying to the NSF GRFP Workshop, UCSC Astronomy & Astrophysics Department	2012-2016

TEACHING EXPERIENCE

Guest Lecture, UT Austin Computational Astrophysics Course, “Modeling Radiative Feedback in (Massive) Star Formation Simulations	2022
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Co-Instructor, Python Programming Bootcamp, Lamat Program, UCSC	2015
Activity Designer/Facilitator, Institute for Science & Engineering Educators Professional Development Program (PDP), Hartnell College	2011
Teaching Assistant, “Astronomy 2: Overview of the Universe”, UCSC	2010
Grader, “Astronomy C161: Relativistic Astrophysics & Cosmology”, UC Berkeley	2010
Undergraduate Student Instructor, “Astronomy C10: Introduction to Astronomy”, UC Berkeley	2009

PROFESSIONAL DEVELOPMENT

Diversity & Inclusion Certificate Program, UCSC Office for Diversity, Equity, and Inclusion	2017
Institute for Science & Engineering Educators, PDP for Inquiry-based Education, UCSC	2011
Astronomy 300: Instruction Techniques in General Astronomy (course), UC Berkeley	2009

REFEREED PUBLICATIONS (9 1ST-AUTHORED PUBLICATIONS)

1. “A Massive Star is Born: How Feedback from Stellar Winds, Radiation Pressure, and Collimated Outflows Limits Accretion onto Massive Stars”
Rosen, A.L.; submitted to *The Astrophysical Journal*, [NASA ADS](#)
2. “The dynamics and outcome of star formation with jets, radiation, winds, and supernovae in concert”
Grudić, M.Y., Guszejnov, D., Offner, S.S.R., **Rosen, A.L.**, Raju, A.N., Faucher-Giguère, C., Hopkins, P.F.; 2022, *Monthly Notices of the Royal Astronomical Society*, 512, 216, [NASA ADS](#)
3. “Cluster assembly and the origin of mass segregation in the STARFORGE simulations”
Guszejnov, D., Markey, C., Offner, S.S.R., Grudić, M.Y, Faucher-Giguère, C., **Rosen, A.L.**, Hopkins, P.F., submitted to *Monthly Notices of the Royal Astronomical Society*, [NASA ADS](#)
4. “Less wrong: a more realistic initial condition for simulations of turbulent molecular clouds”
Lane, H.B., Grudić, M.Y, Guszejnov, D., Offner, S.S.R., Faucher-Giguère, C., **Rosen, A.L.**; 2022, *Monthly Notices of the Royal Astronomical Society*, 510, 4767, [NASA ADS](#)
5. “ORION2: A magnetohydrodynamics code for star formation”
Li, P.S., Cunningham, A.J., Gaches, B.L., Klein, R.I., Krumholz, M.R., Lee, A.T, McKee, C.F., Offner, S.S.R., **Rosen, A.L.**, Skinner, M.A., *Journal of Open Source Software*, [JOSS](#)
6. “The Effects of Magnetic Fields and Outflow Feedback on the Shape and Evolution of the Density PDF in Turbulent Star-Forming Clouds”
Appel, S.M., Burkhart, B., Semenov, V.A., Federrath, C., **Rosen, A.L.**; 2022, *The Astrophysical Journal*, 927, 75, [NASA ADS](#)
7. “Blowing Bubbles around Intermediate-Mass Stars: Feedback from Main-sequence Winds is not Enough”
Rosen, A.L., Offner, S.S.R., Foley, M.M., Lopez, L.A., submitted to *The Astrophysical Journal*, [NASA ADS](#)
8. “Dust in the Wind with Resonant Drag Instabilities: I. The Dynamics of Dust-Driven Outflows in GMCs and H II Regions”
Hopkins, P.F., **Rosen, A.L.**, Squire, J., Panopoulou, G.V., Soliman, N.H., Seligman, D., Steinwandel, U.P., submitted to *Monthly Notices of the Royal Astronomical Society*, [NASA ADS](#)
9. “Observations of the Ag(3x1) Phase on Ge(111)”
Mullet, C.H., **Rosen, A.L.**, Chiang, S., 2021, *Journal of Vacuum Science & Technology A*, 39, Issue 5, [NASA ADS](#)
10. “Evolution of Stellar Feedback in H II Regions”
Olivier, G.M., Lopez, L.A., **Rosen, A. L.**, Nayak, O., Reiter, M., Krumholz, M. R., Bolatto, A.D., *Astrophysical Journal*, 2021, 908, 68, [NASA ADS](#)
11. “Continuity of Accretion from Clumps to Class 0 High-Mass Protostars”
Avison, A., Fuller, G.A., N. Peretto, N., Duarte-Cabral, A., **Rosen, A.L.**, Traficante, A., Pineda, J.E., Güsten, R., & Cunningham, N., 2021, *Astronomy & Astrophysics*, 645, A142, [NASA ADS](#)

12. “Winds in Star Clusters Drive Kolmogorov Turbulence”
Gallegos-Garcia, M., Burkhart, B., **Rosen, A.L.**, Naiman, J.P., Ramirez-Ruiz, E., 2020, *Astrophysical Journal Letters*, 899, 30, [NASA ADS](#)
13. “The Role of Outflows, Radiation Pressure, and Magnetic Fields in Massive Star Formation”
Rosen, A. L., Krumholz, M. R., 2020, *Astronomical Journal*, 160, 78, [NASA ADS](#)
14. “Zooming in on Individual Star Formation: Low- and High-mass Stars”
Rosen, A.L., Offner, S.S.R., Sadavoy, S.I., Bhandare, A., Vázquez-Semadeni, Ginsburg, A., 2020, *Space Science Reviews*, 216, 62, [NASA ADS](#)
15. “Formation and Evolution of Disks Around Young Stellar Objects”
Zhao, B, Tomida, K, Hennebelle, P., Tobin, J.J., Maury, A., Hirota, T., Sánchez-Monge, Á., Kuiper, R., **Rosen, A.**, Bhandare, A., Padovani, M., Lee, Y., 2020, *Space Science Reviews*, 216, 43, [NASA ADS](#)
16. “Circumbinary Disks: Accretion and Torque as a Function of Mass Ratio and Disk”
Duffell, P.C., D’Orazio, D., Derdzinski, A., Haiman, Z., MacFayden, A., **Rosen, A.L.**, & Zrake, J., 2020, *Astrophysical Journal*, 901, 25, [NASA ADS](#)
17. “Massive Star Formation via the Collapse of Subvirial and Virialized Turbulent Massive Cores”
Rosen, A.L., Li, P.S., Zhang, Q., Burkhart, B., 2019, *Astrophysical Journal*, 887, 108, [NASA ADS](#)
18. “unyt: Handle, manipulate, and convert data with units in Python”
Goldbaum, N.J., ZuHone, J.A., Turk, M.J., Kowalik, K., & **Rosen, A.L.**, 2018, *Journal of Open Source Software*, 3, 28, 809; [NASA ADS](#)
19. “Hybrid Adaptive Ray-Moment Method (HARM²): A Highly Parallel Method for Radiation Hydrodynamics on Adaptive Grids”
Rosen, A. L., Krumholz, M. R., Oishi, J.S., Lee, A.T., & Klein, R.I., 2017, *Journal of Computational Physics*, 330, 924; [NASA ADS](#)
20. “An Unstable Truth: How Massive Stars get their Mass”
Rosen, A. L., Krumholz, M. R., McKee, C.F., & Klein, R.I., 2016, *Monthly Notices of the Royal Astronomical Society*, 463, 2553; [NASA ADS](#)
21. “Gone with the Wind: Where is the Missing Stellar Wind Energy from Massive Star Clusters?”
Rosen, A. L., Lopez, L.A., Krumholz, M. R., & Ramirez-Ruiz, E.; 2014, *Monthly Notices of the Royal Astronomical Society*, 442, 2701; [NASA ADS](#)
22. “What Sets the Initial Rotation Rates of Massive Stars?”
Rosen, A. L., Krumholz, M. R., & Ramirez-Ruiz, E.; 2012, *Astrophysical Journal*, 748, 97; [NASA ADS](#)

SCIENTIFIC PRESENTATIONS

Given **36** invited talks and **32** contributed talks to date, including

1. Invited Seminar, CITA; Toronto, Canada 2022
2. Invited Colloquium, Durham University; Durham, UK 2022
3. Talk, Ringberg Virtual Seminar Series 2021
4. Invited Talk, Purdue University; Astrophysics Seminar; West Lafayette, IN 2021
5. Invited Colloquium, Carnegie Observatories; Pasadena, CA 2021
6. Invited NSF REU Colloquium, Center for Astrophysics | Harvard & Smithsonian Cambridge, MA 2021
7. Invited Talk, University of Wisconsin, Madison; Astronomy Lunch Talk; Madison, WI 2021
8. Invited Talk, Los Alamos National Laboratory; Los Alamos, NM 2021
9. Invited Colloquium, Caltech Astronomy Colloquium; Pasadena, CA 2021
10. Invited Colloquium, Royal Observatory of Edinburgh; Edinburgh, Scotland 2021
11. Invited Talk, JILA Astrophysics Friday Seminar; University of Colorado, Boulder, Boulder, CO 2021
12. Invited Colloquium, Rice University Physics & Astronomy Department; Houston, TX 2021

13. Invited Colloquium, University of Chicago Astronomy & Astrophysics Department; Chicago, IL *2021*
14. Invited Talk, Tuesday Lunch Seminar, UCLA Astronomy Department; Los Angeles, CA *2020*
15. Invited Review Talk, Radiation Hydrodynamics: Implementation and Application; Royal Astronomical Society; London, UK *2019*
16. Talk, NASA Hubble Symposium; Washington, DC *2019*
17. Invited Talk, Astronomy Seminar, Rutgers University Physics & Astronomy Department; Piscataway, NJ *2019*
18. Talk, Crete III Through Dark Lanes to New Stars: Celebrating the Career of Prof. Charlie Lada; Crete, Greece *2019*
19. Talk, Zooming in on Star Formation; Nafplio, Greece *2019*
20. Invited Review Talk, International Space Science Institute, Star Formation Workshop; Bern, Switzerland *2019*
21. Talk, UT Austin Astronomy Department, ISM & Planets Seminar; Austin, TX *2018*
22. Invited Talk, Gas Fueling of Galaxy Structures Across Cosmic Time, Astro 3D Workshop; Barossa Valley, South Australia *2018*
23. Invited Colloquium, University of Florida Astronomy Department; Gainesville, FL *2018*
24. Talk, NASA Einstein Symposium, Harvard-Smithsonian CfA; Cambridge, MA *2018*
25. Invited Review Talk, Stars Birth & Death: GMT Community Science Meeting; Honolulu, HI *2018*
26. Talk, The Wonders of Star Formation; Edinburgh, UK *2018*
27. Talk, Tracing the Flow: Galactic Environments and the Formation of Massive Stars; Lake Windermere, UK *2018*
28. Talk, Olympian Symposium 2018: Gas and stars from milli- to mega- parsecs; Paralia Katerini, Greece *2018*
29. Talk, SESTAS at MPA, Max Planck Institute for Astronomy (MPA), Garching, Germany *2018*
30. Talk, Star and Planet Formation Seminar; European Southern Observatory (ESO), Garching, Germany *2018*
31. Talk, Early Phase of Star Formation; Ringberg, Germany *2018*
32. Talk, ITC Luncheon, Harvard-Smithsonian CfA; Cambridge, MA *2018*
33. Invited Talk, Astrophysical Shocks Meeting, AIP Potsdam; Potsdam, Germany *2018*
34. Invited Talk, High Energy Seminar, Harvard-Smithsonian CfA; Cambridge, MA *2017*
35. Talk, NASA Einstein Symposium, Harvard-Smithsonian CfA; Cambridge, MA *2017*
36. Invited Talk, ITC Luncheon, Harvard-Smithsonian CfA; Cambridge, MA *2017*
37. Invited Talk, Astronomy Seminar, University of Massachusetts Lowell; Lowell, MA *2017*
38. Invited Talk, Astronomy Seminar, University of Connecticut; Storrs, CT *2017*
39. Invited Colloquium, Department of Astronomy, University of Massachusetts Amherst; Amherst, MA *2017*
40. Talk, Multi-Scale Star Formation; Morelia, Michoacan, Mexico *2017*
41. Dissertation Talk, 229th AAS Meeting; Grapevine, TX *2017*
42. Talk, Tuesday Seminar, University of Chicago; Chicago, IL *2016*
43. Talk, CITA Seminar, Canadian Institute for Computational Astrophysics; Toronto, Canada *2016*
44. Talk, Galaxy Journal Club, Space Telescope Science Institute; Baltimore, MD *2016*
45. Talk, Thunch Seminar, Princeton; Princeton, NJ *2016*
46. Invited Talk, Galaxies & Cosmology Seminar, Harvard-Smithsonian CfA; Cambridge, MA *2016*
47. Talk, MIT Astrophysics Brown Bag Lunch Series, MIT Kavli Institute; Cambridge, MA *2016*
48. Invited Talk, CCAPP Seminar, Ohio State University; Columbus, OH *2016*
49. Talk, Columbia Astronomy Seminar, Columbia; Manhattan, NY *2016*
50. Talk, Galaxy Lunch Seminar, Yale; New Haven, CT *2016*
51. Invited Talk, TAPIR Seminar, Caltech; Pasadena, CA *2016*

52. Talk, Thursday Theory Seminar, Carnegie Observatories; Pasadena, CA 2016
53. Talk, Star Formation in Different Environments; Quy Nhon, Vietnam 2016
54. Invited Talk, Cosmology Seminar, KIPAC/Stanford, Palo Alto, Ca 2016
55. Invited Talk, Cosmocub, UCSC; Santa Cruz, CA 2016
56. Talk, From Stars to Massive Stars; Gainesville, Florida 2016
57. Invited Talk, Computational Astrophysics Meeting; ANU RSAA, Canberra, Australia 2016
58. Talk, XXIXth IAU General Assembly, IAUS 316: Formation, Evolution, and
Destruction of Massive Star Clusters; Honolulu, Hawaii 2015
59. Talk, Soul of High Mass Star Formation; Puerto Varas, Chile 2015
60. Invited Talk, Star & Planet Formation Day; Gainesville, Florida 2015
61. Invited Talk, Florida ASTROWIN Workshop: Star Formation Feedback; Gainesville, Florida 2015
62. Invited Talk, Formation of Massive Star Clusters Workshop; Prague, Czech Republic 2014
63. Invited Talk, Chemical Evolution Workshop; DARK Copenhagen, Denmark 2014
64. Talk, Summer FLASH, UCSC, Santa Cruz, CA 2014
65. Talk, Olympian Symposium on Star Formation; Paralia Katerinis, Mount Olympus, Greece 2014
66. Invited Talk, Geophysical & Astrophysical Fluid Dynamics Seminar; UCSC, Santa Cruz, CA 2012
67. Talk, XXVIIIth IAU General Assembly Meeting, JD 2: Very Massive Stars in the
Local Universe; Beijing, China 2012
68. Talk, Friday Lunch Astrophysics Seminar Hour (FLASH); UCSC, Santa Cruz, CA 2012
69. Poster, Four Decades of Research on Massive Stars: A Scientific Meeting in
Honour of Anthony F.J. Moffatt; Montreal, Canada 2011
70. Poster, 215th AAS Meeting; Washington, DC 2010

PUBLIC OUTREACH

- Speaker, “How to Make Massive Stars on a (super)Computer,” Western Nevada College/NCCN 2022
Science Matter Expert, NASA Community College Network (NCCN) 2021-Present
- Panelist, Astronomy Career Panel, Girls Inc., Lynn, MA 2021
- Panelist, “Meet a Scientist” Panel for Women’s History Month, Marin Community College 2021
- Panelist, “Writing an Effective Proposal” presented to Harvard Graduate Students 2020
- Interviewee, “How to Make Stars on a (super)Computer,”
Astrochats Interview hosted by MicroObservatory, [Link to YouTube video](#) 2020
- Speaker, “How to Make Massive Stars on a (super)Computer,”
Astronomy on Tap Boston Event 2020
- Presenter, “Visualizing Numerical Simulations with *yt*”
Center for Astrophysics | Harvard & Smithsonian *Demofest* 2019
- Speaker, “How to Make Stars on a (super)Computer,”
Women in Science and Engineering (WiSE) Science on Tap Event 2017
- Speaker, “An Unstable Truth: How Massive Stars get their Mass,”
AAUW Monterey Peninsula Chapter Meeting 2017
- Speaker, “How to Write an Effective Abstract,” Lamat REU Program, UCSC 2016
- Organizer and Panelist, “Astronomy Grad Student and Post-doc Panel,”
Lamat REU Program, UCSC 2016
- Speaker, “Then and Now: From North Hills Prep to a Ph.D. in Astrophysics,”
North Hills Prep School 2016
- Astronomy Outreach Activity, Expanding Your Horizons Workshop for Young Girls,
Hartnell College 2015
- Speaker, “How to Make Stars on a (super)Computer,”
UCSC, Monterey Astronomy Club, Scotts Valley High School 2015
- Speaker, “Computational Astrophysics”, Stanford Pre-collegiate Summer Courses, Stanford 2015
- Speaker, “Star Formation and Stellar Feedback”, Lamat Research Experience 2015, 2016

for Undergraduates (REU) Program, UCSC	
Speaker, "Reading Scientific Literature," Lamat REU Program, UCSC	<i>2015</i>
Graduate Student Panelist, Advancement Via Individual Determination (AVID) Program, Soquel High School	<i>2015</i>
Women in Science & Engineering (WiSE) Astronomy Education Outreach Presentation, Seaside High School	<i>2014</i>
Panelist, STEM Diversity Professional Development Workshop Series, UCSC	<i>2014</i>
Author, www.astrobites.org , Link to my articles	<i>2011-2013</i>
WiSE Education Outreach Presentation, Santa Cruz High School	<i>2011</i>
Panelist, Girls Scouts "Girls Go Tech" Event, NASA Ames, Moffatt Field, CA	<i>2011</i>