

Matthew E. Orr | Curriculum Vitae

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Education

California Institute of Technology	Pasadena, CA
<i>Ph.D. Physics, Thesis Advisor: Dr. Philip F. Hopkins</i>	<i>June 2019</i>
Dissertation Title: "Spatially Resolved Star Formation in Cosmological Zoom-in Simulations: Understanding the Role of Feedback in Scaling Relations" (Defended May 28, 2019).	
<i>M.S. Physics</i>	<i>June 2017</i>
University of Southern California	Los Angeles, CA
<i>B.S. Physics, Minor in Astronomy, Magna Cum Laude</i>	<i>May 2014</i>
La Cañada High School	La Cañada Flintridge, CA

Experience

Research.....	
Rutgers University, Burkhart Group/Flatiron Institute-CCA, Galaxies Group	Rutgers, CCA
<i>Joint Rutgers-Flatiron Postdoctoral Theory Associate</i>	<i>September 2020 – Present</i>
Joint theory postdoctoral appointment between Rutgers University Physics & Astronomy department and the Flatiron Institute Center for Computational Astrophysics. Focus on the connections between star formation and feedback, and galaxy formation and evolution, using a combination of cosmological zoom-in simulations (the FIRE-2 suite) and analytic work. Primarily accomplished under the advisement of, and in collaboration with. Dr. Blakesley Burkhart, at both institutions.	
TAPIR, Hopkins Group (FIRE Collaboration)	Caltech
<i>Postdoctoral Scholar in Theoretical Astrophysics</i>	<i>July 2019 – July 2020</i>
<i>National Science Foundation Graduate Research Fellow</i>	<i>September 2014 – June 2019</i>
<i>Rose Hills Graduate Research Fellow</i>	<i>September 2014 – August 2015</i>
Theoretical astrophysics research, combining analytic work with simulations, under the advisement of Dr. Philip F. Hopkins. Work focuses on investigating physical origins for spatially resolved star formation and galaxy evolution relations with the Feedback in Realistic Environments (FIRE) simulations, and producing synthetic observations of cosmological simulations to understand the origins of today's stellar populations, and the challenges and opportunities facing the next generation of high-resolution galaxy studies. Resulted in a number of first and N-th author publications.	
NASA Jet Propulsion Laboratory – California Institute of Technology	JPL
<i>JPL Science Affiliate – Astronomy, Physics and Space Technology</i>	<i>April 2018 – July 2020</i>
<i>JPL SURF Student & Year-round Intern</i>	<i>May 2013 – July 2014</i>
Developed a chemistry and radiative transfer pipeline for synthetic observations of the FIRE simulations, making use of the CHIMES chemistry & RADMC3D radiative transfer codes. Efforts focused on investigating the CO, C, and C ⁺ emission from the FIRE spiral galaxy sample. As well, interned as an undergraduate, learning computational methods to model observations from a photodissociative region in the Taurus molecular cloud taken with Herschel and the Five College Radio Astronomy Observatory, using chemical network & radiative transfer codes, with Drs. Paul Goldsmith and Jorge Pineda. Resulted in an ApJ publication.	
U.S. Air Force Research Labs Collaborative High Altitude Flow Facility	USC, AFRL
<i>Research Assistant (Civilian Contractor)</i>	<i>December 2010 – May 2013</i>
Research with Edwards AFB Advanced Concepts Division (Propulsion Directorate) with Drs. Markus Young, David Sharpe and Matthew Gilpin, involving the design and fabrication of a bimodal latent-heat energy storage, solar-thermal power and propulsion system for small satellites, using molten Boron and Silicon. Built a facility-class 1.8 meter solar furnace for on-sun testing, calculated freezing surface contours in constrained geometries in molten Silicon and heat transfer analysis for thermal shielding efficiencies. Resulted in several internal AFRL technical reports (Distribution C).	

Rhodes Helioseismology Group*Research Assistant and Telescope Operator*

Operated the Mt. Wilson 60' Solar Telescope, analyzing of Solar sub-surface flows, under Dr. Edward Rhodes. Photographed and developed large-format images of Solar active-regions for Mt. Wilson Observatory historical sunspot archive.

USC, Mt. Wilson Observatory*May 2012 – May 2013***Science Outreach & Miscellaneous****On-Set Rocketry Consultant for Television and Film***Science Consultant on CBS' Strange Angel, Seasons 1 & 2*

On-set consultant for the rocketry-related aspects of CBS' Strange Angel, based on the book of the same name by George Pendle. Helped to ensure the most realistic depiction of early rocketry and its contemporary physics, including background items, early test setups, and actors' interactions with rockets and the science behind them. Two seasons, six episodes.

Paramount Studios*January – June 2018, 2019***Caltech Astro Outreach***Graduate Student Volunteer, Speaker*

Volunteer for Astronomy department outreach events throughout the academic year and summer. Involvement includes being a telescope operator for stargazing nights, Q & A panelist and one-time lecturer for the public lecture series, and general volunteer for Astronomy on Tap events at a local beer hall.

Caltech*June 2016 – July 2020***USC Rocket Propulsion Laboratory***Lab Lead*

Coordinated lab work, as lab lead. Projects included: Silver Spur 3, Traveler Static Fire, Del Grande Mk. II, Avionics Test Vehicles I & II, Traveler Mk. I – all minimum-diameter, composite-case flight vehicles and static ground tests, with solid rocket motors ranging in size from O-4000 to R-18,000. All led up to the Traveler Mk. I, the lab's single-stage ballistic space-shot attempt (Mach 6, max. altitude 491,000 feet). Work included carbon fiber, fiberglass, Kevlar, and cork composites layups (wet & prepreg), machining, fabrication, assembly and integration of the lab's solid rocket motors.

USC*August 2010 – December 2012***Institute Leadership & Service****Cahill Astronomy Galaxies arXiv Discussion***Co-Organizer/Discussion Lead***Caltech Graduate Title IX Advisory Board***Graduate Student Member***Caltech Board of Trustees Student Experience Committee***Graduate Student Representative***Caltech Graduate Student Council***Physics Option Representative**Publications & Strategic Communications Chair***Graduate Dean's Advisory Council***Chairman***Caltech***August 2018 – March 2020***Caltech***September 2017 – June 2019***Caltech***July 2016 – April 2019***Caltech***June 2016 – June 2019**June 2016 – May 2018***Caltech***January 2016 – June 2019***Recent Publications & Presentations****First Author Publications**

1. **Orr, M.**, Hatchfield, H., Battersby, C., et al. (2021). Fiery Cores: Bursty and Smooth Star Formation Distributions across Galaxy Centers in Cosmological Zoom-in Simulations, *ApJ* 908, L31.
2. **Orr, M.**, Hayward, C. C., Medling, A. M., et al. (2020). Swirls of FIRE: Spatially Resolved Gas Velocity Dispersions and Star Formation Rates in FIRE-2 Disk Environments, *MNRAS* 496, 1620.
3. **Orr, M.**, Hayward, C. C., & Hopkins, P. F. (2019). A Simple Non-equilibrium Feedback Model for Galaxy-Scale Star Formation: Delayed Feedback and SFR Scatter, *MNRAS* 486, 4724.
4. **Orr, M.**, Hayward, C. C., Hopkins, P. F., et al. (2018). What FIREs Up Star Formation: the Emergence of the Kennicutt-Schmidt Law from Feedback, *MNRAS* 478, 3653.
5. **Orr, M.**, Hayward, C. C., Nelson, E. J., et al. (2017). Stacked Star Formation Rate Profiles of Bursty Galaxies Exhibit "Coherent" Star Formation, *ApJ* 849, L2.
6. **Orr, M.**, Pineda, J., & Goldsmith, P. (2014). Photon-Dominated Region Modeling of the [C I], [C II], and CO line emission from a boundary in the Taurus Molecular Cloud. *ApJ*, 795, 26.

Contributing Author Publications.....

7. Su, K.-Y., Hopkins, P. F., Bryan, G. L., ... **Orr, M.**, et al. (2021). Which AGN Jets Quench Star Formation in Massive Galaxies?, arXiv 2102.02206. *Accepted to MNRAS*.
8. Gurvich, A. B., Faucher-Giguère, C.-A., Richings, A. J., ... **Orr, M.**, et al. (2020). Pressure balance in the multiphase ISM of cosmologically simulated disc galaxies, MNRAS 498, 3664.
9. Keating, L., Richings, A., Murray, N., ... **Orr, M.**, et al. (2020). Reproducing the CO-to-H₂ conversion factor in cosmological simulations of Milky Way-mass galaxies, MNRAS 499, 837.
10. Benincasa, S. M., Loebman, S. R., ... **Orr, M.**, et al. (2019). Live Fast, Die Young: GMC lifetimes in the FIRE cosmological simulations of Milky Way-mass galaxies, MNRAS 497, 3993.
11. Hani, M. H., Hayward, C. C., **Orr, M.**, et al. (2019). Variations in the slope of the resolved star-forming main sequence: a tool for constraining the mass of star-forming regions, MNRAS 493, L87.
12. Su, K.-Y., Hopkins, P. F., Hayward, C. C., ... **Orr, M.**, et al. (2019). The failure of stellar feedback, magnetic fields, conduction, and morphological quenching in maintaining red galaxies, MNRAS 487, 4393.
13. Su, K.-Y., Hopkins, P., Hayward, C., ... **Orr, M.**, et al. (2018). Cosmic Rays or Turbulence can Suppress Cooling Flows (Where Thermal Heating or Momentum Injection Fail), MNRAS 491, 1190.
14. Su, K.-Y., Hopkins, P., Hayward, C., ... **Orr, M.**, et al. (2018). Discrete effects in stellar feedback: Individual Supernovae, Hypernovae, and IMF Sampling in Dwarf Galaxies, MNRAS 480, 1666.
15. Hopkins, P. F., Wetzel, A., Kereš, D., ... **Orr, M.**, et al. (2018). FIRE-2 simulations: physics versus numerics in galaxy formation, MNRAS 480, 800.
16. Stark, D. V., Bundy, K.A., **Orr, M.**, et al. (2017). SDSS-IV MaNGA: Constraints on the Conditions for Star Formation in Galaxy Discs, MNRAS 474, 2323.

Invited Talks.....

Rutgers University Astro Seminar – Piscataway, NJ	October 2020
AAS 2020 Summer Meeting (ISM-BIG Meeting-in-a-meeting) – "Madison, WI"	June 2020
UConn Galaxies Seminar – Storrs, CT	January 2020
UC Santa Cruz IMPS Seminar – Santa Cruz, CA	February 2019
Ohio State University CCAPP Colloquium – Columbus, OH	October 2018

Contributed Talks.....

CICO-VICO Fall 2020 Workshop – Virtual	December 2020
New England Star Formation Workshop – Storrs, CT	January 2020
AAS 2020 Winter Meeting – Honolulu, HI	January 2020
Galaxy Formation & Evolution in Southern California 2019 – Irvine, CA	August 2019
AAS 2019 Winter Meeting (Dissertation Talk) – Seattle, WA	January 2019
Galaxy Formation & Evolution in Southern California 2018 – Pasadena, CA	August 2018
Santa Cruz Galaxy Workshop – Santa Cruz, CA	August 2018
The Multi-scale Physics of Star Formation and Feedback – Heidelberg, Germany	June 2018
AAS 2018 Summer Meeting – Denver, CO	June 2018
Swinburne-CalTech Science Workshop 3 (SCTW3) – Pasadena, CA	September 2017
Galaxy Formation & Evolution in Southern California 2017 – Pasadena, CA	August 2017
Star Formation in Different Environments 2017 (SFDE17) – Quy Nhon, Binh Dinh, Vietnam	August 2017
The Local Truth: Star-Formation and Feedback in the SOFIA Era – Asilomar, CA	October 2016
Galaxy Formation & Evolution in Southern California 2016 – Pasadena, CA	September 2016
Theoretical Astrophysics in Southern California 2015 (TASC2015) – Fullerton, CA	November 2015

Poster Presentations.....

STScI Multi-Object Spectroscopy Workshop – Virtual	May 2021
Santa Cruz Galaxy Workshop – Santa Cruz, CA	August 2019
Linking the Milky Way and Nearby Galaxies, <i>Winner, Best Science Poster</i> – Helsinki, Finland	June 2019

Public Talks

Rutgers Astronomical Society Public Lecture Series – Virtual	April 2021
Pasadena Astro on Tap (Caltech Astronomy Outreach) – Pasadena, CA	April 2020
GCC Planetarium “A Conversation with the Stars” – Glendale, CA	April 2019
Caltech Astronomy Outreach Lecture Series – Pasadena, CA	February 2018
Palomar Observatory Greenway Lecture Series – Palomar, CA	November 2017

Grant Funding

Co-I (PI: Jorge Pineda): NASA-JPL Strategic Initiative for R&D – \$552,000 FY 2018/9
Bridging the Gap: Observations and Theory of Star Formation Meet on Large and Small Scales

Awards, Fellowships & Scholarships

2019: Caltech Institute Service Award	2019: Caltech Institute Leadership Award
2018: TAPIR Osci Basci Award	2017: Caltech Student Leadership Award
2014: NSF Graduate Research Fellowship	2014: Hertz Fellowship Finalist
2014: Rose Hills Graduate Research Fellowship	2012: Barry M. Goldwater Scholarship

Interests

- Hiking & Biking
- Amateur Rocketry
- Robert Burns
- Distance Running
- Woodworking
- Deep Sky Astrophotography