Charles D. Kilpatrick

Contact Information

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Research Interests

massive stars, gravitational wave astronomy, supernovae, fast radio bursts

Academic Appointments

SkAI Affiliate, *The SkAI Institute* 2025–present
Research Assistant Professor, *Northwestern University* 2023–present
CIERA Fellow, *Northwestern University* 2021–2023
Postdoctoral Scholar, *Northwestern University* 2020–2021
Advisor: Wen-fai Fong
Postdoctoral Scholar, *University of California, Santa Cruz* 2016–2020
Advisor: Ryan J. Foley

Education

Ph.D., Astronomy, *University of Arizona* 2016
"New Observational Insight on Shock Interactions Toward Supernovae and Supernova Remnants"
Advisor: George H. Rieke
B.Sc., Astrophysics & History (Minor), *California Institute of Technology* 2010

Honors and Awards

CIERA Fellowship 2021–2023
UC Santa Cruz Barbara Walker "Best Paper" Award 2018
Science Breakthrough of the Year (LIGO/Virgo EM follow-up team) 2017
Gruber Cosmology Prize (LIGO collaboration) 2017
AAS Rodger Doxsey Travel Prize 2016
Caltech, graduated with Honors in Astrophysics & History 2010

Leadership & Collaborations

NSF TROVE (PI) *The Multimessenger Treasure TROVE, a Tool for Rapid Object Vetting and Examination* (NSF AST-2432037; Northwestern lead). Real-time vetting and prioritization of candidate electromagnetic counterparts to gravitational-wave and high-energy neutrino events; community software, workshops, and public workspaces in partnership with the University of Arizona.

STEP The Southern Photometric Local Universe Transient Extension Program: transient discovery and follow-up on S-PLUS *griz* imaging, including multi-messenger follow-up of gravitational-wave alerts.

Instrument development Science team member for SCALES, VIPER, and HISPEC at Keck; GIRMOS at Gemini-North; and STAR-X (NASA). Development of the Keck HISPEC data-reduction pipeline (modular DRP architecture, calibration management, and Keck Observatory Archive integration).

Observing Experience

†: independently operated telescope/instrument
≈200 nights on ground-based facilities; additional time as PI/Co-I on *HST* and *JWST* (see below).
Cerro Tololo Observatory, SOAR 4m (Goodman HTS)
Kitt Peak National Observatory, Mayall 4m (KOSMOS, MOSAIC3)
Lick Observatory, Nickel 1m (Direct†), Shane 3m (KAST)
W.M. Keck Observatory 10m (LRIS, DEIMOS, OSIRIS, NIRC2, NIRES)
IRTF 4m (SpeX/MORIS)
Large Binocular Telescope 2×8.4m (MODS1/MODS2)
Las Campanas Observatory, Swope 1m (Direct†)
University of Arizona, Kuiper 1.5m (Mont4K†), Bok 2.3m (PISCES†, B&C spectrograph†)
Arizona Radio Observatory, SMT 10m (ALMA Band 6), Kitt Peak 12m (ALMA Band 3)
Gemini-North (e.g., 'Alopeke high-speed imaging), MMT, Las Cumbres Observatory (network)

Observing Programs & Grants

Programs as PI ($1.73M to date)

JWST/GO-11374 (Cycle 5) — 13.2 hr/**$146,521**
Title: *A JWST/MIRI Search for Elements Beyond the Iron Peak in Cassiopeia A*

NSF-AST-2432037 (2024–2027) — **$694,951**
Title: *The Multimessenger Treasure TROVE, a Tool for Rapid Object Vetting and Examination*

Hubble Space Telescope/GO-18008 (Cycle 33) — 2 orbits (ToO)/**$33,924**
Title: *Using HST to Find Supernova Progenitor Stars in JWST, HST, and Euclid Imaging*

Hubble Space Telescope/GO-17706 (Cycle 32) — 2 orbits/**$50,548**
Title: *Finding Supernova Progenitor Stars in HST and JWST Imaging*

Hubble Space Telescope/GO-17415 (Cycle 31) — 4 orbits/**$39,680**
Title: *SN 2019yvr: A Hydrogen-poor Supernova with Late-Time Circumstellar Interaction and a Progenitor Candidate*

JWST/AR-6241 (Cycle 3) — **$88,940**
Title: *Characterizing Supernova Progenitor Stars in Archival JWST Imaging*

JWST/AR-5441 (Cycle 3) — **$134,648**
Title: *A JWST Sample of Extragalactic Red Supergiants*

T80S 0.8m Robotic Telescope — 80 hr
Title: *The S-PLUS Transient Extension Program (STEP)*

Hubble Space Telescope/GO (Cycle 30) — 92 orbits/**$187,306**
Title: *Snapshot Observations of Type II Supernovae*

Hubble Space Telescope/GO (Cycle 29) — 2 orbits/**$26,421**
Title: *The Progenitor System and Ongoing Circumstellar Interaction of SN 2021qvr*

NuSTAR/GO (Cycle 7) — 20 ks/**$78,309**
Title: *A Search for the First X-ray Counterpart to an Extragalactic FRB*

JWST/GO-1936 (Cycle 1) — 14.8 hr/**$120,977**
Title: *Nebular Spectroscopy of a Kilonova with JWST* [withdrawn]

Hubble Space Telescope/AR (Cycle 28) — **$89,627**
Title: *Using the full power of the HST Archive to Address the Red Supergiant Problem*

Hubble Space Telescope/WFC3 (Cycle 27) — 2 orbits/**$18,999**
Title: *The Progenitor of Supernova 2017ein*

Las Cumbres (17AB–20B) — 138.7 hours
Title: *Constraining Supernova Progenitor Systems with LCOGTN*

Gemini-S., Keck/NIRC2/OSIRIS (17B–20B) — 40 hours
Title: *Identifying the Progenitors of Astrophysical Transients*

Teaching Experience

- TA, "Cosmology" (ASTR 201; ∼90 students), *U. Arizona* — 2013
- TA, "Life in the Universe" (ASTR 202; ∼80 students), *U. Arizona* — 2014
- Instructor, "Gravitational wave seminar" (ASTR 296; 6 students), *UCSC* — Spring 2019

Computing and Analysis Experience

Reduction and analysis of radio, millimeter, infrared, optical, ultraviolet, and X-ray data. Includes data taken with *HST*/WFPC2, ACS, & WFC3, VLA, HHSMT/Band 3 & 6, *Spitzer*/IRS & IRAC, *Swift*/UVOT & XRT, *Chandra*/ACIS, Keck/LRIS, DEIMOS, NIRC2, & OSIRIS, VLT/FORS2, Bok/B&C spectrograph, Kuiper/Mont4K, Nickel/Direct, Swope/Direct.

Programming languages and packages C, Python, Perl, IDL, CASA, CLASS, Miriad, IRAF, ds9.

Software development https://github.com/charliekilpatrick

I develop data-reduction pipelines for optical/infrared time-domain surveys, see: POTPyRI

I develop pipelines for analyzing *HST*, *Chandra*, and *Spitzer* imaging, see: hst123, superchandra, forwardmodel

Student Mentoring

1. Wynn Jacobson-Galán, undergraduate student, University of California, Santa Cruz 2016–2019
Constraining Type Ia Supernova Progenitor Scenarios with Extremely Late-time Photometry of

Supernova SN 2013aa; ApJ, 857, 88 (2018). *Now:* NASA Hubble Fellow, California Institute of Technology.

2. Rodrigo Angulo, undergraduate student, University of California, Santa Cruz 2017–2019
Unburned carbon in the Outer Layers of Type Ia Supernova. Now: Ph.D. student, Johns Hopkins University.
3. Carli Smith, undergraduate student, University of California, Santa Cruz 2019–2020
A Progenitor Candidate for the Type II Supernova 2018gj. Now: graduate student, The Pennsylvania State University.
4. Jason Vazquez, REU student, Northwestern University 2021–2024
The Type II-P Supernova 2019mhm and Constraints on Its Progenitor System; ApJ, 949, 75 (2023). *Now:* Ph.D. student, University of Wisconsin–Milwaukee.
5. Yuxin (Vic) Dong, Ph.D. student, Northwestern University 2021–present
Connecting Fast Radio Bursts to Optical Transients. Now: Ph.D. candidate, Northwestern University; NSF Graduate Research Fellow.
6. Edin Peskovic, REU student, Northwestern University 2022
Determining the Binary Fraction of Type II Supernova Progenitor Systems. Now: Ph.D. student, Illinois Institute of Technology.
7. Mars Bell, REU student, Northwestern University 2023
Type II Supernovae and Their Binary Companion Stars. Now: undergraduate student, Illinois Institute of Technology.
8. Aswin Suresh, Ph.D. student, Northwestern University 2024–present
Red supergiants observed by JWST. Now: Ph.D. student, CIERA, Northwestern University.
9. Phelipe D'Arc, Ph.D. student, Centro Brasileiro de Pesquisas Físicas (CBPF) 2025–present
Simulation-based inference for supernova and kilonova spectra.

Professional Service

- **Referee**: ApJ, MNRAS, A&A (2016–present)
- **TAC / time-allocation review**: *Chandra*, Gemini, GMRT, *HST*, *JWST*, NOIRLab, *NuSTAR*
- **Ad-hoc proposal review**: NSF
- Roman Space Telescope Science User Panelist (2025–present)
- Co-chair, Extragalactic Transient Working Group, La Silla Schmidt Southern Survey (LS4) (2024–present)

Refereed Publications

First Author: 18, Contributing Author: >155

Total h-index ≈ 55, $\approx 17{,}200$ citations

First Author Publications

1. Kilpatrick, C.D., Suresh, A., Davis, K.W., et al. *The Type II SN 2025pht in NGC 1637: A Red Supergiant with Carbon-rich Circumstellar Dust as the First JWST Detection of a Supernova Progenitor Star.* (2025), ApJL, 992, L10
2. Kilpatrick, C.D., Tejos, N., Andersen, B. C., et al. *Limits on Optical Counterparts to the Repeating Fast Radio Burst 20180916B from High-speed Imaging with Gemini-North/'Alopeke.* (2024), ApJ, 964, 121
3. Kilpatrick, C.D., Foley, R.J., Jacobson-Galán, W.V., et al. *SN 2023ixf in Messier 101: A Massive, Variable Red Supergiant as the Progenitor Candidate to a Type II Supernova.* (2023), ApJL, 952, 23
4. Kilpatrick, C.D., Izzo, L., Bentley, R.O., et al. *Type II-P Supernova Progenitor Star Initial Masses and SN 2020jfo: Direct Detection, Light Curve Properties, Nebular Spectroscopy, and Local Environment.* (2023), MNRAS, 524, 2161
5. Kilpatrick, C.D., Coulter, D.A., Foley, R.J., et al. *Updated Photometry of the Yellow Supergiant Progenitor and Late-time Observations of the Type IIb Supernova 2016gkg.* (2022), ApJ, 926, 46
6. Kilpatrick, C.D., Fong, W., Blanchard, P.K., et al. *Deep Hubble Space Telescope Observations of GW170817: Complete Light Curve, Local Environment, and Host Galaxy Substructure.* (2022), ApJ, 926, 49
7. Kilpatrick, C.D., Coulter, D.A., Arcavi, I., et al. *The Gravity Collective: A Search for the Electromagnetic Counterpart to the Neutron Star-Black Hole Merger GW190814.* (2021), ApJ, 923, 258
8. Kilpatrick, C.D., Drout, M.R., Auchettl, K., et al. *A cool and inflated progenitor candidate for*

the Type Ib supernova 2019yvr at 2.6 years before explosion. (2021), MNRAS, 892

9. Kilpatrick, C.D., Burchett, J.N., Jones, D.O., et al. *Deep optical observations contemporaneous with emission from the periodic FRB 180916.J0158+65.* (2021), ApJL, 907, 3
10. Kilpatrick, C.D., Coulter, D.A., Dimitriadis, G., et al. *X-ray Limits on the Progenitor System of the Type Ia Supernova 2017ejb.* (2018), MNRAS, 481, 4123
11. Kilpatrick, C.D. & Foley, R.J. *The Dusty Progenitor Star of the Type II Supernova 2017eaw.* (2018), MNRAS, 481, 2536
12. Kilpatrick, C.D., Takaro, T., Foley, R.J., et al. *A Potential Progenitor for the Type Ic Supernova 2017ein.* (2018), MNRAS, 480, 2072
13. Kilpatrick, C.D., Foley, R.J., Drout, M.R., et al. *Connecting the progenitors, pre-explosion variability, and giant outbursts of luminous blue variables with Gaia16cfr.* (2018), MNRAS, 473, 4805
14. Kilpatrick, C.D., Foley, R.J., Kasen, D., et al. *Electromagnetic Evidence that SSS17a is the Result of a Binary Neutron Star Merger.* (2017), Science, 358, 1583
15. Kilpatrick, C.D., Foley, R.J., Abramson, L.E., et al. *On the Progenitor of the Type IIb Supernova 2016gkg.* (2017), MNRAS, 465, 4650
16. Kilpatrick, C.D., Andrews, J., Smith, N., et al. *An optical and near-infrared study of the Type Ia/IIn Supernova PS15si.* (2016), MNRAS, 463 1088
17. Kilpatrick, C.D., Bieging, J.H., & Rieke, G.H. *A Systematic Survey for CO Toward Galactic Supernova Remnants.* (2016) ApJ, 816, 1
18. Kilpatrick, C.D., Bieging, J.H., & Rieke, G.H. *Interaction Between Cassiopeia A and Nearby Molecular Clouds.* (2014), ApJ, 796 144

Contributing Author, selected publications (* student led)

19. (*)Franz, N., Subrayan, B., **Kilpatrick, C. D.**, Hosseinzadeh, G., et al. *Optimizing Kilonova Searches: A Case Study of the Type IIb SN 2025ulz in the Localization Volume of the Low-Significance Gravitational Wave Event S250818k.* (2025), ApJL, 994, L45
20. (*)Coulter, D. A., **Kilpatrick, C. D.**, Jones, D. O., Foley, R.J., et al. *The Gravity Collective: A Comprehensive Analysis of the Electromagnetic Search for the Binary Neutron Star Merger GW190425.* (2025), ApJ, 988, 169
21. (*)Rest, S., Rest, A., **Kilpatrick, C. D.**, Jencson, J. E., et al. *ATClean: A Novel Method for Detecting Low-luminosity Transients and Application to Pre-explosion Counterparts from SN 2023ixf.* (2025), ApJ, 979, 114
22. Jacobson-Galan, W., Davis, K. W., **Kilpatrick, C. D.**, Dessart, L., et al. *SN 2024ggi in NGC 3621: Rising Ionization in a Nearby, Circumstellar-material-interacting Type II Supernova.* (2024), ApJ, 972, 177
23. (*)Santos, A., **Kilpatrick, C. D.**, Bom, C. R., Darc, P., et al. *The S-PLUS Transient Extension Program: imaging pipeline, transient identification, and survey optimization for multimessenger astronomy.* (2024), MNRAS, 529, 59
24. (*)Gordon, A. C., Fong, W., **Kilpatrick, C. D.**, Eftekhari, T., et al. *The Demographics, Stellar Populations, and Star Formation Histories of Fast Radio Burst Host Galaxies: Implications for the Progenitors.* (2023), ApJ, 954, 80
25. (*)Vazquez, J., **Kilpatrick, C. D.**, Dimitriadis, G., Foley, R.J., et al. *The Type II-P Supernova 2019mhm and Constraints on Its Progenitor System.* (2023), ApJ, 949, 75
26. Hosseinzadeh, G., **Kilpatrick, C. D.**, Dong, Y., Sand, D. J., et al. *Weak Mass Loss from the Red Supergiant Progenitor of the Type II SN 2021yja.* (2022), ApJ, 933, 14
27. (*)Gagliano, A., Izzo, L., **Kilpatrick, C. D.**, Mockler, B., et al. *An Early-Time Optical and Ultraviolet Excess in the type-Ic SN 2020oi.* (2022), ApJ, 924, 55
28. (*)Rastinejad, J. C., Fong, W., **Kilpatrick, C. D.**, Paterson, K., et al. *Probing Kilonova Ejecta Properties Using a Catalog of Short Gamma-Ray Burst Observations.* (2021), ApJ, 916, 89
29. Safarzadeh, M., Ramirez-Ruiz, E., & **Kilpatrick, C. D.** *LB-1 Is Inconsistent with the X-Ray Source Population and Pulsar-Black Hole Binary Searches in the Milky Way.* (2020), ApJS, 901, 116
30. (*)Jacobson-Galán, W. V., Margutti, R., **Kilpatrick, C. D.**, Hiramatsu, D., et al. *SN 2019ehk: A Double-peaked Ca-rich Transient with Luminous X-Ray Emission and Shock-ionized Spectral*

Features. (2020), ApJ, 898, 166

31. Foley, R. J., Coulter, D. A., **Kilpatrick, C. D.**, Piro, A. L., et al. *Updated parameter estimates for GW190425 using astrophysical arguments and implications for the electromagnetic counterpart.* (2020), MNRAS, 494, 190
32. Dimitriadis, G., Rojas-Bravo, C., **Kilpatrick, C. D.**, Foley, R.J., et al. *Nebular Spectroscopy of Kepler's Brightest Supernova.* (2019), ApJL, 870, L14
33. (*)Jacobson-Galan, W.V., Dimitriadis, G., Foley, R.J., **Kilpatrick, C.D.** *Constraining Type Ia Supernova Progenitor Scenarios with Extremely Late-time Photometry of Supernova SN 2013aa.* (2018), ApJ, 857, 88
34. Drout, M.R., Piro, A.L., Shappee, B.J., **Kilpatrick, C. D.**, et al. *Light Curves of the Neutron Star Merger GW170817/SSS17a: Implications for r-process nucleosynthesis.* (2017), Science, 358, 1570
35. (*)Coulter, D.A., Foley, R.J., **Kilpatrick, C.D.**, Drout, M.R., et al. *Swope Supernova Survey 2017a (SSS17a), the optical counterpart to a gravitational wave source.* (2017), Science, 358, 1556
36. (*)Murguia-Berthier, A., Ramirez-Ruiz, E., **Kilpatrick, C.D.**, Foley, R.J., et al. *A Neutron Star Binary Merger Model for GW170817/GRB 170817A/SSS17a.* (2017), ApJL, 848, 34
37. Pan, Y.-C., **Kilpatrick, C.D.**, Simon, J.D., Xhakaj, E., et al. *The Old Host-galaxy Environment of SSS17a, the First Electromagnetic Counterpart to a Gravitational-wave Source.* (2017), ApJL, 848, 30
38. Smith, N., **Kilpatrick, C.D.**, Mauerhan, J.C., Andrews, J. E., et al. *Endurance of SN 2005ip after a decade: X-rays, radio and Hα like SN 1988Z require long-lived pre-supernova mass-loss.* (2017), MNRAS, 466, 3021

Astronomer's Telegram: 68 total, 31 first author Gamma-ray Coordinates Network Circulars: 75 total, 16 first author

Press Coverage

"The mystery of the universe's missing exploding stars"
National Geographic Apr 22, 2026

"Webb Telescope unveils doomed star hidden in dust"
NU, NASA, ESA Oct 8, 2025

"Oddball supernova reveals star's death throes before exploding"
CNN, RAS, NU, UCSC, Carnegie Press Releases May 5, 2021

"Astronomers Find the Progenitor to a Unique Type of Supernova"
NASA Science; STScI Nov 15, 2018

"Early-career researchers make waves with Science's Breakthrough of the Year"
Science Magazine Dec 21, 2017

"The Slack Chat That Changed Astronomy"
The Atlantic Oct 17, 2017

"Scientists detect gravitational waves from a new kind of nova"
The Washington Post Oct 16, 2017

"In a First, Gravitational Waves Linked to Neutron Star Crash"
National Geographic Oct 16, 2017

"Scientists Spot the Spark From Ancient Collision of Neutron Stars"
Smithsonian Magazine Oct 16, 2017

"Dawn of an Era: Astronomers Hear and See Cosmic Collision"
Discover Magazine Oct 16, 2017

Scientific Presentations and Meetings

Contributed talk, IAU Symposium 406, Turku, Finland	May 2026
Invited seminar, Swinburne Centre for Astrophysics & Supercomputing, Melbourne, AUS	Feb 2026
Invited colloquium, Monash U., Melbourne, AUS	Feb 2026
Invited seminar, U. Melbourne, Melbourne, AUS	Feb 2026
Invited talk, Transients in Middle Earth, Christchurch, NZ	Feb 2026
Contributed talk, GWPAW 2025, Atlanta, GA	Dec 2025
Contributed talk, SN100: 100 Years of Supernova Science, Stockholm, Sweden	Aug 2025
Contributed talk, Transients From Space, STScI, Baltimore, MD	Mar 2025
Contributed talk, FRB2024, Khao Lak, Thailand	Nov 2024
Science Organizing Committee, Keck Science Meeting, Pasadena, CA	Sep 2024
Invited seminar, Carnegie Mellon U., Pittsburgh, PA	Aug 2024
Invited talk, Fink-Brazil: Enabling Rubin Discoveries	May 2024
Contributed talk, AAS 243: 2023ixf Special Session, New Orleans, LA	Jan 2024
Invited talk, SuperVirtual 2023	Nov 2023
Contributed talk, SN remnants in complex environments, Leiden, Netherlands	Oct 2023
Contributed talk, SuperNova EXplosions (SNeX), Haifa, Israel	Aug 2023
Invited talk, SN Early Warning System (SNEWS) general meeting, Purdue U., West Lafayette, IN	Jul 2023
Contributed talk, Transient & Variable Universe 2023, UIUC, Urbana, IL	Jun 2023
Invited colloquium, Catholic U. of America, Washington, DC	Apr 2023
Invited colloquium, Louisiana State U., Baton Rouge, LA	Mar 2023
Invited colloquium, UW–Madison, Madison, WI	Feb 2023
Invited colloquium, UW–Milwaukee, Milwaukee, WI	Feb 2023
Invited colloquium, Texas Tech U., Lubbock, TX	Feb 2023
Invited colloquium, Purdue U., West Lafayette, IN	Jan 2023
Invited speaker, TDAMM Workshop, Annapolis, MD	Aug 2022
Invited panelist, Physics & Astrophysics at the Extreme, Cambridge, MA	Aug 2022
Invited attendee, r-process Workshop, Seattle, WA	May 2022
Invited talk, Purdue Astrophysics Seminar, West Lafayette, IN	Apr 2022
Invited colloquium, Stony Brook U., Stony Brook, NY	Feb 2022
Invited colloquium, Virginia Tech, Blacksburg, VA	Jan 2022
Contributed talk, SuperVirtual Conference, remote	Nov 2021
Contributed talk, CfA Seminar, Cambridge, MA	Nov 2021
Invited talk, Flatiron Institute GW Meeting, New York, NY	Oct 2021
Contributed talk, Keck Science Meeting, San Diego, CA	Sep 2021
Plenary talk, FRB2021, virtual	Jul 2021
Invited physics colloquium, Illinois Institute of Technology, Chicago, IL	Apr 2020
Invited astronomy symposium, UC Davis, Davis, CA	Jan 2020
Invited attendee, GW workshop, Aspen Center for Physics, Aspen, CO	Aug 2019
Contributed talk, Fifty One Ergs, Raleigh, NC	May 2019
Contributed talk, STScI Spring Symposium, Baltimore, MD	Apr 2019
Invited talk, Adventures in Astrophysics, Aptos, CA	Aug 2018
Contributed talk, Shocking Supernovae, Stockholm, Sweden	May 2018
Contributed talk, Deciphering the Violent Universe, Playa del Carmen, Mexico	Dec 2017
Contributed talk, Keck Science Meeting, Santa Cruz, CA	Sep 2017
Contributed talk, Fifty One Ergs, Corvallis, OR	Jun 2017
Invited talk, Supernova Remnants on the Beach, Santa Cruz, CA	May 2017
Invited panel member, CSI: Cassiopeia A, Princeton, NJ	Apr 2017
Contributed talk, IAU Symposium 331: SN 1987A, 30 Years Later, Réunion	Feb 2017
Contributed talk, Supernova Remnants, Chania, Greece	Jun 2016
Dissertation talk, 227th AAS Meeting, Kissimmee, FL	Jan 2016
Poster, 223rd AAS Meeting, Washington, DC	Jan 2014