

Curriculum Vitae

Anthony L. Piro

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Research Summary

My research is focused on theoretical astrophysics with a broad interest in topics involving compact objects, astrophysical explosions, accretion flows, and stellar dynamics. I draw on my expertise in General Relativity, nuclear physics, thermodynamics, condensed matter physics, and fluid and magnetohydrodynamics both to predict new observational phenomena as well as to understand the key underlying physical mechanisms responsible for current observations. Practically, I take a more classical approach to solving these problems — using a combination of analytic and simple numerical models to build physical intuition for complex phenomena.

Education

2006 Doctor of Philosophy in Physics, University of California, Santa Barbara.
2001 Bachelor of Science in Physics, University of California, Santa Barbara.

Academic Positions

2017 – Staff Member, Carnegie Observatories.
2015 – 2017 George Ellery Hale Distinguished Scholar in Theoretical Astrophysics,
Carnegie Observatories.
2014 – 2015 Postdoctoral Research Associate, Carnegie Observatories.
2010 – 2014 Postdoctoral Fellow in Theoretical Astrophysics, Caltech.
2007 – 2010 Theoretical Astrophysics Center Fellow, University of California, Berkeley.

Honors and Awards

- Scialog Fellow, Research Corporation for Science Advancement, 2015 – 2016.
- Prize Postdoctoral Fellowship at the University of California, Berkeley, 2007.
- Offered the NASA Hubble and Princeton Lyman Spitzer Prize Fellowships, 2006.
- Awarded “Best Student Talk” at the annual Theoretical Astrophysics in Southern California Meeting, 2005.
- Invited to the prestigious 54th Annual Nobel Laureates Meeting in Lindau, Germany, 2004.
- Arnold T. Nordsieck Memorial Prize for demonstrating notable promise in physics research by the Department of Physics at the University of California, Santa Barbara, 2001.
- Awarded “Highest Academic Honors” for ranking within the top 2.5 percent of graduating seniors at the University of California, Santa Barbara, 2001.
- Regents Scholar at the University of California, Santa Barbara, 1997.

Public Outreach

- Public lecture at the Huntington Library on “Unraveling the Mysteries of Exploding Stars.”
- Featured guest at the Aspen Science Center Physics Café Series.
- Lectures at the Carnegie Observatories on “Gravitational Waves: A New Window into the Universe” and “Fast Radio Bursts: The Biggest Mystery You Haven’t Heard About.”

- Organized lectures, star viewing parties, and solar telescope viewing at Westridge School for Girls and other local elementary schools.
- Public lecture at Caltech for SN 2014J viewing titled “The Physics of Type Ia Supernovae.”
- Invited for a public lecture at Sonoma State University for the “What Physicists Do” series to present a talk titled “How Exploding Stars Fixed Einstein’s Biggest Mistake.”

Professional Activities and Service

- Co-organizer of the OCIW Distinguished Scientific Visitor Program, 2015 – present.
- Carnegie Observatories and Carnegie-Princeton Fellowship Committee, 2014 – present.
- Carnegie Observatories Time Allocation Committee Member, 2016 – 2017.
- Organized the Carnegie Type Ia Supernova Progenitor Workshop, 2015.
- Advisor for the Summer Undergraduate Research Fellowship (SURF) program at Caltech, 2014 – present.
- Judge for the Gee Undergraduate Research Poster Contest at Caltech, 2014.
- Reviewer for NSF Astronomy and Astrophysics Grants, 2014.
- Judge for the students talks for the SURF program at Caltech, 2013.
- Proposal reviewer for DiRAC, the national HPC resource for the UK astronomy, cosmology, particle physics, and nuclear physics communities, 2013.
- Panelist for the NSF Compact Objects Observations Review, 2012.
- Reviewer for the Israel Science Foundation (ISF) Individual Research Grants, 2012.
- Member of the High Energy Astrophysics Division of the AAS, 2012 – present.
- Member of the American Astronomical Society, 2012 – present.
- Panel Reviewer for the NASA Astrophysics Theory Program, 2010.
- Regular article referee for The Astrophysical Journal, Monthly Notices of the Royal Astronomical Society, and Physical Review Letters, 2005 – present.

Mentoring Experience

Undergrads: Michaelangelo Lucas, Caltech
 Marc E. Muhleisen, Caltech (1 publication)

Grad students: David Vartanyan, Princeton (1 publication in preparation)
 Patryk Pjanka, Princeton

Postdocs: Viktoriya Morozova, Caltech, now at Princeton (6 publications)
 Benjamin J. Shappee, Carnegie, now faculty at U Hawaii (11 publications)
 Maria R. Drout, Carnegie (9 publications)
 K. Decker French, Carnegie

Funding and Observing Awards

- “Supernova Light Curves Influenced by Hidden CSM Interaction,” Research Corporation for Science Advancement Sciolog Grant, 1 year, \$100,000 (Co-PI)
- “Collaborative Research: The Carnegie Supernova Project - Pushing the Precision of Type Ia Supernovae as Cosmological Standard Candles,” NSF Astronomy and Astrophysics Research Grant, 3 years, \$419,692 (Co-PI)
- “Swope Supernova Survey,” Awarded over 200 nights to use the 1m Swope Telescope to follow supernovae, gravitational wave counterparts, and other explosive transients (PI)

Teaching Experience

- Ay 125: High Energy Astrophysics, Caltech (guest lecturer).
- Freshman Seminar 001: Cosmic Explosions, Caltech (guest lecturer).
- Astronomy 10: General Astronomy, University of California, Berkeley.
- Physics 10: Concept of Physics, University of California, Santa Barbara.

Invited Talks and Colloquia

Jet Propulsion Laboratory (October 2017)

The Physics of Extreme-Gravity Stars, Nordita, Stockholm, Sweden (June 2017)

Supernovae: The LSST Revolution Workshop, Northwestern University (June 2017)

Fast Radio Bursts: New Probes of Physics and Cosmology, Aspen Center for Physics (February 2017)

Supernova Workshop, International Space Science Institute, Bern, Switzerland (October 2016)

Supernovae Through the Ages, Easter Island, Chile (August 2016)

UC Berkeley (April 2016)

Radio Transient Workshop, University of Nevada, Las Vegas (April 2016)

Transient Thinkshop, Bormio, Italy (January 2016)

Northwestern University (October 2015)

Synoptic Surveys: Boutique & Experiments, Caltech (August 2015)

Galactic Archaeology and Precision Stellar Astrophysics, Kavli Institute for Theoretical Physics (January 2015)

Cerro Tololo Inter-American Observatory, Coquimbo, Chile (November 2014)

GMT Community Science Meeting, Washington, D. C. (October 2014)

Las Cumbres Observatory Global Telescope Network (July 2014)

Carnegie Supernova Project Meeting, St. George Island, Florida (June 2014)

Caltech (June 2014)

UC Los Angeles (May 2014)

Goddard Space Flight Center (April 2014)

Carnegie Observatories (January 2014)

UC Santa Barbara (October 2013)

iPTF Workshop, Caltech (August 2013)

Monash University (July 2013)

Ohio State University (July 2013)

Indiana University (February 2013)

University of Washington (January 2013)

Harvard-Smithsonian Center for Astrophysics (October 2012)

Gravitational Wave and Electromagnetic Studies of Compact Binary Mergers, The Kavli Institute for Theoretical Physics (August 2012)

UC Santa Cruz (April 2012)

University of Arizona (March 2012)

Ohio State University (March 2012)

Jet Propulsion Laboratory (February 2012)

San Luis Obispo (October 2011)
University of Minnesota (October 2011)
Caltech (January 2011)
Harvard-Smithsonian Center for Astrophysics (December 2009)
Caltech (November 2009)
Kavli Institute of Theoretical Physics (August 2009)
UC Santa Cruz (February 2009)
Northwestern University (May 2008)
Johns Hopkins University (October 2007)
Harvard-Smithsonian Center for Astrophysics (December 2005)
Princeton University (December 2005)
Stanford Linear Accelerator Center (November 2005)
UC Berkeley (November 2005)
Michigan State University (January 2005)
The Astrophysics of CVs and Related Objects, Strasbourg, France (July 2004)
Neutron Stars on Fire, Institute for Advanced Study, Princeton (May 2003)

Publication Summary

82 publications, 57 of which are first or second author, with over 2300 citations and a lifetime *h*-index of 30.

Journal Publications

1. L. Tartaglia, ..., **A. L. Piro**, et al., "The Early Detection and Follow-up of the Highly Obscured Type II Supernova 2016IJA/DLT16AM," 2017, submitted to *Ap. J.*
2. **A. L. Piro** & J. A. Kollmeier, "Evidence for Cocoon Emission from the Early Light Curve of SSS17a," 2017, submitted to *Ap. J. L.* (arXiv:1710.05822)
3. A. McWilliam, **A. L. Piro**, et al. "Evidence for a Sub-Chandrasekhar Mass Type Ia Supernova in the Ursa Minor Dwarf Galaxy," 2017, submitted to *Ap. J.* (arXiv:1710.05030)
4. J. Schwab, H. Martínez-Rodríguez, **A. L. Piro**, & C. Badenes, "Exploring the Carbon Simmering Phase: Reaction Rates, Mixing, and the Convective Urca Process," 2017, accepted to *Ap. J.*
5. B. P. Abbott, ..., **A. L. Piro**, et al. "A gravitational-wave standard siren measurement of the Hubble constant," 2017, *Nature*, 551, 85.
6. A. Murguía-Berthier, ..., **A. L. Piro**, et al. "A Neutron Star Binary Merger Model for GW170817/GRB170817A/SSS17A," *Ap. J. L.*, 848, L34.
7. Y.-C. Pan, ..., **A. L. Piro**, et al. "The Host Environment of SSS17a: The First Electromagnetic Counterpart to a Gravitational Wave Source," 2017, *Ap. J. L.*, 848, L30.
8. M. R. Siebert, ..., **A. L. Piro**, et al. "The Unprecedented Properties of the First Electromagnetic Counterpart to a Gravitational Wave Source," 2017, *Ap. J. L.*, 848, L26.
9. B. P. Abbott, ..., **A. L. Piro**, et al. "Multi-messenger Observations of a Binary Neutron Star Merger," 2017, *Ap. J. L.*, 848, L12.
10. C. D. Kilpatrick, ..., **A. L. Piro**, et al., "Electromagnetic Evidence that SSS17a is the Result of a Binary Neutron Star Merger," 2017, accepted to *Science*.

11. B. J. Shappee, J. D. Simon, M. R. Drout, **A. L. Piro**, et al., “Early Spectra of the Gravitational Wave Source GW170817: Evolution of a Neutron Star Merger,” 2017, accepted to *Science*.
12. M. R. Drout, **A. L. Piro**, et al., “Light Curves of the Neutron Star Merger GW170817/SSS17a: Implications for the R-Process,” 2017, accepted to *Science*.
13. D. A. Coulter,..., **A. L. Piro**, et al., “Swope Supernova Survey 17a (SSS17a), the Optical Counterpart to a Gravitational Wave Source,” 2017, accepted to *Science*.
14. V. S. Morozova, **A. L. Piro**, & S. Valenti, “Measuring the Progenitor Mass and Dense Circumstellar Material of Type II Supernovae,” 2017, submitted to *Ap J*. (arXiv:1709.04928)
15. A. A. Miller, Y. Cao, **A. L. Piro**, et al. “Early Observations of the Type Ia Supernova iPTF 16abc: Evidence for Strong Ejecta Mixing and/or Interaction with Diffuse Material,” 2017, submitted to *Ap J*. (arXiv:1708.07124)
16. C. D. Kilpatrick,..., **A. L. Piro**, et al., “Connecting the Progenitors, Pre-explosion Variability, and Giant Outbursts of LBVs with Gaia16cfr,” 2017, accepted in *M. N. R. A. S.* (arXiv:1706.09962)
17. **A. L. Piro**, M. E. Muhleisen, et al., “Numerically Modeling the First Peak of the Type IIb SN 2016gkg,” 2017, *Ap J*, 846, 94.
18. **A. L. Piro**, B. Giacomazzo, & R. Perna, “The Fate of Neutron Star Binary Mergers,” 2017, *Ap J. L.*, 844, L19.
19. H. Martínez-Rodríguez,..., **A. L. Piro**, et al., “Observational Evidence for High Neutronization in Supernova Remnants: Implications for Type Ia Supernova Progenitors,” 2017, *Ap J*, 843, 35.
20. **A. L. Piro** & S. Burke-Spolaor, “What if the fast radio bursts 110220 and 140514 are from the same source?” 2017, *Ap J. L.*, 841, L30.
21. V. S. Morozova, **A. L. Piro**, & S. Valenti, “Unifying Type II Supernova Light Curves with Dense Circumstellar Material,” 2017, *Ap J*, 838, 28.
22. I. Arcavi,..., **A. L. Piro**, et al., “Constraints on the Progenitor of SN 2016gkg From Its Shock-Cooling Light Curve,” 2017, *Ap J. L.*, 837, L2.
23. B. J. Shappee, **A. L. Piro**, et al., “Evidence Against a Non-degenerate Companion in SN 2012cg,” 2016, submitted to *Ap J*. (arXiv:1610.07601)
24. B. J. Shappee, **A. L. Piro**, et al. “The Young and Bright Type Ia Supernova ASASSN-14lp: Discovery, Early-Time Observations, First-Light Time, Distance to NGC 4666, and Progenitor Constraints,” 2016, *Ap J*, 826, 144.
25. V. S. Morozova, **A. L. Piro**, et al., “Numerical Modeling of the Early Light Curves of Type IIP Supernovae,” 2016, *Ap J*, 826, 109.
26. **A. L. Piro** & J. A. Kollmeier, “Ultrahigh-Energy Cosmic Rays from the ‘En Caul’ Birth of Magnetars,” 2016, *Ap J*, 826, 97.
27. **A. L. Piro** & V. S. Morozova, “Exploring the Potential Diversity of Early Type Ia Supernova Light Curves,” 2016, *Ap J*, 826, 96.
28. H. Martínez-Rodríguez, **A. L. Piro**, J. Schwab, & C. Badenes, “Neutronization During Carbon Simmering in Type Ia Supernova Progenitors,” 2016, *Ap J*, 825, 57.
29. **A. L. Piro**, “The Impact of a Supernova Remnant on Fast Radio Bursts,” 2016, *Ap J. L.*, 824, L32.
30. S. Valenti,..., **A. L. Piro**, et al., “The Diversity of Type II Supernova vs. The Similarity in Their Progenitors,” 2016, *M. N. R. A. S.*, 459, 3939.
31. V. S. Morozova, **A. L. Piro**, et al., “Light Curves of Core-Collapse Supernovae with Substantial Mass Loss Using the New Open-Source Supernova Explosion Code (SNEC),” 2015, *Ap J*, 814, 63

32. **A. L. Piro**, “Using Double-peaked Supernova Light Curves to Study Extended Material,” 2015, *Ap J. L.*, 808, L51.
33. **A. L. Piro**, “Searching for Companions,” 2015, *Nature Phys.*, 11, 445.
34. J. U. Ness,..., **A. L. Piro**, et al., “Short-period X-ray oscillations in super-soft novae and persistent SSS,” 2015, *Astron. Astrophys.*, 578, 39.
35. E. Y. Hsiao,..., **A. L. Piro**, et al., “Strong near-infrared carbon in the Type Ia supernova iPTF13ebh,” 2015, *Astron. Astrophys.*, 578, 9.
36. **A. L. Piro**, “Turbulent Mixing on Helium-Accreting White Dwarfs,” 2015, *Ap J.*, 801, 137.
37. D. Clausen, **A. L. Piro**, & C. D. Ott, “The Black Hole Formation Probability,” 2015, *Ap J.*, 799, 190.
38. C. J. White,..., **A. L. Piro**, et al., “Slow-Speed Supernovae from the Palomar Transient Factory: Two Channels,” 2015, *Ap J.*, 799, 52.
39. R. E. Firth,..., **A. L. Piro**, et al., “The Rising Light Curves of Type Ia Supernovae,” 2015, *M. N. R. A. S.*, 446, 3895.
40. **A. L. Piro** & T. A. Thompson, “The Signature of Single-Degenerate Accretion Induced Collapse,” 2014, *Ap J.*, 794, 28.
41. **A. L. Piro** & V. S. Morozova, “Transparent Helium in Stripped Envelope Supernovae,” 2014, *Ap J. L.*, 792, L11.
42. E. Nakar & **A. L. Piro**, “Supernovae with Two Peaks in the Optical Light Curve and the Signature of Progenitors with Low-mass Extended Envelopes,” 2014, *Ap J.*, 788, 193.
43. P. Mösta,..., **A. L. Piro**, et al., “Magnetorotational Core-collapse Supernovae in Three Dimensions,” 2014, *Ap J.*, 785, 29.
44. **A. L. Piro** & E. Nakar, “Constraints on Shallow ^{56}Ni from the Early Lightcurves of Type Ia Supernovae,” 2014, *Ap J.*, 784, 85.
45. B. D. Metzger & **A. L. Piro**, “Optical and X-ray Emission From Stable Millisecond Magnetars Formed From the Merger of Binary Neutron Stars,” 2014, *M. N. R. A. S.*, 439, 3916.
46. **A. L. Piro**, T. A. Thompson, & C. S. Kochanek, “Reconciling ^{56}Ni Production in Type Ia Supernovae with Double Degenerate Scenarios,” 2013, *M. N. R. A. S.*, 438, 3456.
47. **A. L. Piro** & E. Nakar, “What Can We Learn from the Rising Lightcurves of Radioactively-Powered Supernovae?,” 2013, *Ap J.*, 769, 67.
48. **A. L. Piro**, “Taking the ‘Un’ out of ‘Unnovae’,” 2013, *Ap J. L.*, 768, L14.
49. **A. L. Piro** & S. R. Kulkarni, “Radio Transients from the Accretion Induced Collapse of White Dwarfs,” 2013, *Ap J. L.*, 762, L17.
50. **A. L. Piro** & E. Thrane, “Gravitational Waves from Fallback Accretion onto Neutron Stars,” 2012, *Ap J.*, 761, 63.
51. **A. L. Piro**, “Radioactively-Powered Rising Lightcurves of Type Ia Supernovae,” 2012, *Ap J.*, 759, 83.
52. **A. L. Piro**, “Magnetic Interactions in Coalescing Neutron Star Binaries,” 2012, *Ap J.*, 755, 80.
53. D. Tsang, J. S. Read, T. Hinderer, **A. L. Piro**, & R. Bondarescu, “Resonant Shattering of Neutron Star Crusts,” 2012, *Phys. Rev. Lett.*, 108, 011102.
54. **A. L. Piro**, “Tidal Interactions in Merging White Dwarf Binaries,” 2011, *Ap J. L.*, 740, L53.
55. **A. L. Piro**, “g-Mode Excitation During the Pre-explosive Simmering of Type Ia Supernovae,” 2011, *Ap J. L.*, 738, L5.
56. **A. L. Piro**, & Christian D. Ott, “Supernova Fallback Accretion onto Magnetars and Propeller-powered Supernovae,” 2011, *Ap J.*, 736, 108.

57. H. B. Perets,..., **A. L. Piro**, et al., "A Faint Type of Supernova from a White Dwarf with a Helium-rich Companion," 2010, *Nature*, 465, 322.
58. **A. L. Piro**, P. Chang, & N. N. Weinberg, "Shock Breakout from Type Ia Supernova," 2010, *Ap J.*, 708, 598.
59. B. D. Metzger, **A. L. Piro** & E. Quataert, "Nickel-rich Outflows from Accretion Discs formed by the Accretion-Induced Collapse of White Dwarfs," 2009, *M. N. R. A. S.*, 396, 1659.
60. D. A. Perley,..., **A. L. Piro**, et al., "GRB 080503: Implications of a Naked Short Gamma-Ray Burst Dominated by Extended Emission," 2009, *Ap J.*, 696, 1871.
61. B. D. Metzger, **A. L. Piro** & E. Quataert, "Neutron-rich Freeze-out in Viscously Spreading Accretion Disks Formed from Compact Object Mergers," 2009, *M. N. R. A. S.*, 396, 304.
62. B. D. Metzger, **A. L. Piro** & E. Quataert, "Time-Dependent Models of Accretion Disks Formed from Compact Object Mergers," 2008, *M. N. R. A. S.*, 390, 781.
63. **A. L. Piro**, "The Internal Shear of Type Ia Supernova Progenitors During Accretion and Simmering," 2008, *Ap. J.*, 679, 616.
64. **A. L. Piro** & P. Chang, "Convection during the Late Stages of Simmering in Type Ia Supernovae," 2008, *Ap. J.*, 678, 1158.
65. **A. L. Piro** & L. Bildsten, "Neutronization During Type Ia Supernova Simmering," 2008, *Ap. J.*, 673, 1009.
66. **A. L. Piro** & L. Bildsten, "Turbulent Mixing in the Surface Layers of Accreting Neutron Stars," 2007, *Ap. J.*, 663, 1252.
67. **A. L. Piro** & E. Pfahl, "Fragmentation of Collapsar Disks and the Production of Gravitational Waves," 2007, *Ap. J.*, 658, 1173
68. **A. L. Piro** & L. Bildsten, "The Energy Dependence of Neutron Star Surface Modes and X-ray Burst Oscillations," 2006, *Ap. J.*, 638, 968.
69. **A. L. Piro**, "Shear Waves and Giant Flare Oscillations from Soft Gamma-Ray Repeaters," 2005, *Ap. J. L.*, 634, L153.
70. T. J. MacCarone, A. Kundu, S. E. Zepf, **A. L. Piro**, & L. Bildsten, "The Discovery of X-ray Binaries in the Sculptor Dwarf Spheroidal Galaxy," 2005, *M. N. R. A. S.*, 364, L61.
71. **A. L. Piro** & L. Bildsten, "Surface Modes on Bursting Neutron Stars and X-ray Burst Oscillations," 2005, *Ap. J.*, 629, 438.
72. **A. L. Piro**, P. Arras, & L. Bildsten, "White Dwarf Heating and Subsequent Cooling in Dwarf Nova Outbursts," 2005, *Ap. J.*, 628, 401.
73. **A. L. Piro** & L. Bildsten, "Neutron Star Crustal Interface Waves," 2005, *Ap. J.*, 619, 1054.
74. **A. L. Piro** & L. Bildsten, "A Spreading Layer Origin for Dwarf Nova Oscillations," 2004, *Ap. J. L.*, 616, L155.
75. **A. L. Piro** & L. Bildsten, "Spreading of Accreted Material on White Dwarfs," 2004, *Ap. J.*, 610, 977.
76. **A. L. Piro** & L. Bildsten, "Unstable Nonradial Oscillations on Helium Burning Neutron Stars," 2004, *Ap. J.*, 603, 252.
77. **A. L. Piro** & L. Bildsten, "Transient X-Ray Binaries in Elliptical Galaxies," 2002, *Ap. J. L.*, 571, L103.

Conference Proceedings

1. B. D. Metzger, **A. L. Piro**, E. Quataert, & T. A. Thompson, "Observable Signatures of the Accretion-Induced Collapse of White Dwarfs," 2009, in the proceedings of "Neutron Stars and Gamma-Ray Bursts," held in Cairo and Alexandria, Egypt (arXiv:0908.1127).

2. **A. L. Piro** & L. Bildsten, "Accreting, Mixing, and X-ray Bursting," 2007, in the proceedings of "A Population Explosion: The Nature and Evolution of X-ray Binaries in Diverse Environments" held in St. Petersburg Beach, Florida, October 28-November 2, 2007, eds. R. M. Bandyopadhyay, S. Wachter, D. Gelino, & C. R. Gelino.
3. **A. L. Piro** & L. Bildsten, "The Turbulent Story of X-ray Bursts: Effects of Shear Mixing on Accreting Neutron Stars," 2007, in the proceedings of "Forty Years of Pulsars: Millisecond Pulsars, Magnetars and More" held in Montreal, Canada, August 12-17, 2007, eds. C. Bassa, Z. Wang, A. Cumming, V. Kaspi (arXiv:0710.3163).
4. T. J. Maccarone, A. Kundu, S. E. Zepf, **A. L. Piro**, & L. Bildsten, "X-ray binaries in Sculptor," 2005, in the proceedings of IAU Symposium 230, eds. E. J. A. Meurs and G. Fabbiano (astro-ph/0511101).
5. **A. L. Piro** & L. Bildsten, "The Spreading Layer and Dwarf Nova Oscillations," 2005, in the proceedings of "The Astrophysics of Cataclysmic Variables and Related Objects," eds. J. M. Hameury and J. P. Lasota (ASP Conf. Ser.) (astro-ph/0409648).