
OR GRAUR

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POSITIONS AND PROFESSIONAL EXPERIENCE

2016 – present: *NSF Astronomy & Astrophysics Postdoctoral Fellow*, Harvard University

2016 – present: *Director*, Harvard Science Research Mentoring Program

2013 – present: *Research Associate*, American Museum of Natural History

2014 – 2016: *Assistant Research Scientist*, New York University

2013 – 2014: *Visiting Scientist*, New York University

2013 – 2014: *Assistant Research Scientist*, The Johns Hopkins University

EDUCATION

Tel Aviv University, Tel Aviv, Israel

American Museum of Natural History, New York, NY, USA

2008 – 2013: Ph.D., Physics and Astronomy, awarded on Nov. 21, 2013

Advisor: Prof. Dan Maoz (Tel Aviv University)

Co-Advisor: Prof. Michael Shara (American Museum of Natural History)

Thesis title: *The Type Ia Supernova Rate and Delay-Time Distribution*

My thesis was awarded a Rodger Doxsey Travel Prize and presented at the 221st AAS meeting. It was also turned into a “PhD Comics” animated video that has been viewed > 78,000 times on YouTube.¹

Tel-Aviv University, Tel Aviv, Israel

2003 – 2007: B.Sc., Physics and Astronomy, *Magna cum Laude*

RESEARCH AND TEACHING INTERESTS

Transients, time-domain, and data science: I am interested in understanding the nature of the different stellar systems that give rise to explosive transients, such as supernovae and tidal disruption events. In my work, I also use these transients to learn about diverse areas of physics, from nucleosynthesis to cosmology. I conduct ground- and space-based observations of transients, mostly with the *Hubble Space Telescope* or large imaging and spectroscopic surveys. I am also interested in advanced data-science techniques and how they can be used to mine the vast amount of data that will be accumulated on transients in the coming decades. Through my education and outreach endeavours, I am committed to making science and academia more accessible and diverse, and to preparing students for the next steps in their careers.

Teaching with a focus on data analysis: With a B.Sc. and Ph.D. in Physics and Astronomy, I can teach across the physics curriculum. I am most interested in courses that either introduce students to data analysis and statistics or use data analysis as a teaching tool. I use active learning techniques such as the Socratic method and think-pair-share, as well as combinations between slides and whiteboard tutorials. I continue to look for new ways to improve my teaching and make it more accessible to students from diverse backgrounds.

Mentoring as a vocation: At the American Museum of Natural History, I mentored 17 high-school students and supervised their work on independent, undergraduate-level research projects. At Harvard, I direct my own science research mentoring program (Harvard SRMP²). The goals of this program are to: (1)

¹The Secret Lives (and Deaths) of Stars: <https://youtu.be/TeIgVe1LcRk>

²Harvard Science Research Mentoring Program: <https://projects.iq.harvard.edu/shrimp>

expose high-school students to modern, front-line research; (2) provide them with living scientists as mentors and role models; and (3) teach early-career scientists how to advise students. I have raised ~\$43,000 for this program, which has now gone through two cohorts. Harvard SRMP is a founding partner of the Global SPHERE Network,³ an online database that helps high-school students around the world find local mentoring programs, and program directors to share best practices.

STUDENTS MENTORED

2018 – present: V. Tiwari, graduate student, University of Massachusetts, Dartmouth, supervisor: R. Fisher: *Theoretical implications of late-time Type Ia supernova light curve analysis*.

2015 – 2016: H. Ernsberger, M. Filipchenko, and L. GoldMansour (SRMP class of 2016): *Windows on the Universe: has observable phase space expanded since 1975?*

2014 – 2015: J. Gilbert, W. Hernandez, R. Rinaldi-Rose, and E. Yorgancioglu (SRMP class of 2015): *Measuring the changing periodicity of variable stars over a century*.

2013 – 2014: D. Y. Chen, L. Christie-Dervaux, J. Kruk, and Z. Murray (SRMP class of 2014): *Modernizing the Harvard Observatory catalog of variable stars. Results presented by the students at the 225th AAS meeting (Murray et al. 2015)*.

2012 – 2013: C. Li, J. Neustadt, and E. H. Rogers (SRMP class of 2013): *Amateur astronomer supernova detection efficiency in CLASH. Students were co-authors on Graur et al. (2014)*.

2012: M. Mirmelstein, undergraduate student, Tel-Aviv University, supervisor: D. Maoz: *Amateur astronomer supernova detection efficiency in CLASH. Student was a co-author on Graur et al. (2014)*.

2012: N. C. Loncke and A. K. Shankar (STARS program, with G. Perez-Giz, NYU): *Creating Type Ia supernova spectral templates*.

2011 – 2012: K. Jedruszczuk, K. Lin, and A. Ovadia (SRMP class of 2012): *Discovery of a supernova at redshift 0.3 in the CLASH survey*

GRANTS AND FELLOWSHIPS

To date, I have brought in > \$500,000 in grants and fellowships, as itemized below.

2018 – ongoing: Science Research Mentoring Program (Director: \$43,000)

2018 – 2021: *Hubble Space Telescope* GO-15415 (PI: \$27,809): *One last peek at SN 2015F*

2016 – 2020: NSF Astronomy and Astrophysics Postdoctoral Fellowship (PI: \$289,000): *Spectral Mining: Transforming Spectroscopic Galaxy Surveys into Transient Surveys*

2016 – 2019: *Hubble Space Telescope* GO-14611 (PI: \$118,309): *Going gently into the night: constraining Type Ia supernova nucleosynthesis using late-time photometry*

2016 – 2019: *Hubble Space Telescope* GO-14618 (CoI: \$15,888): *Ultraviolet Flashers in M87: Rapidly Recurring Novae as SNIa Progenitors*

2016 – 2019: *Hubble Space Telescope* GO-14208 (CoI: \$6,785): *Frontier Fields Supernova Search*

2014 – 2017: *Hubble Space Telescope* GO-13799 (PI: \$24,850): *Constraining Type Ia Supernova Nucleosynthesis and Explosion Models Using Late-Time Photometry of SN2011fe and SN2012cg*

2014 – 2017: *Hubble Space Telescope* GO-13386 (CoI: \$6,646): *Frontier Field Supernova Search*

TALKS AT CONFERENCES AND SEMINARS

I have presented my work in > 40 contributed and invited talks at > 25 institutions worldwide. I have also given 14 contributed and invited talks, as well as 6 posters, at international conferences. In 17-18 January 2016, I organized a workshop at Harvard called “The Transient Universe with the James Webb

³The Global SPHERE Network: <http://www.globalspherenetwork.org>

Space Telescope.”⁴ I invited experts to describe the telescope’s capabilities through the lens of transient studies, and led brainstorming sessions to come up with ideas for proposals for Cycle 1. A complete list of talks is available upon request. Below, I note ten of my most recent invited talks.

- 2018, Nov. 14: Colloquium, Institute for Astronomy, University of Hawaii (upcoming).
- 2018, May 11: Department of Physics, City University of New York, City Tech.
- 2017, Sep. 12: Yale Center for Astronomy and Astrophysics, Yale University.
- 2017, Mar. 17: Department of Astronomy and Astrophysics, University of Toronto.
- 2017, Feb. 17: Center for Cosmology and Particle Physics, New York University.
- 2017, Jan. 27: Department of Astronomy and Astrophysics, Tufts University.
- 2016, Aug. 9–13: Supernovae Through the Ages (Invited conference talk, Easter Island, Chile).
- 2016, May 10: Center for Cosmology and Particle Physics, Ohio State University.
- 2016, Mar. 14: Physics and Astronomy Department, Siena College.
- 2016, Jan. 28: Institute of Cosmology and Gravitation, University of Portsmouth, UK.

OBSERVATIONAL EXPERIENCE

I am an experienced user of the *Hubble Space Telescope*, both as a PI (GO–13799, 14611, 15415) and as an active CoI (GO–12065, 13386, 14208, 14618, 15117). On the ground, I have used the Gemini, Magellan, MMT, and South African Large Telescope observatories, all as a PI. I am a member of the LCOGT Global Supernova Project, and I also make extensive use of archival data, such as the Sloan Digital Sky Survey.

PROFESSIONAL SERVICE

- 2017 – present: *Co-chair*, Dark Energy Spectroscopic Instrument (DESI) time-domain working group.
- 2017 – present: *Member*, Large Synoptic Survey Telescope (LSST) Dark Energy (DESC) and Transients and Variable Stars (TVSCC) science collaborations.
- 2016 – present: *Member*, Dark Energy Spectroscopic Instrument (DESI) survey.
- 2016 – present: *Member*, BUFFALO *Hubble Space Telescope* supernova survey.
- 2016: *Panelist*, Space Telescope Science Institute time allocation committee.
- 2016: *Panelist*, NSF grant review panel.
- 2015: *Panelist*, NASA grant review panel.
- 2014: *Panelist*, NSF grant review panel.
- 2014 – 2016: *Scientific advisor*, Science Bulletins,⁵ American Museum of Natural History.
- 2013 – 2016: *Member*, Frontier Fields *Hubble Space Telescope* supernova survey.
- 2013: *Advisor*, *Dark Universe*,⁶ planetarium show, American Museum of Natural History.
- 2012 – 2014: *Organizer*, Astrophysics seminar, American Museum of Natural History.
- 2010 – 2013: *Member*, CLASH *Hubble Space Telescope* supernova survey.

BEYOND ASTROPHYSICS

I am a published writer. My first collection of short stories (*The War Painter*, Toby Press, Jerusalem 2009) was published in Israel to critical acclaim. I have published 20 short stories in Hebrew, two of which were also published in English in American literary journals. One of these (the titular “The War Painter”) was also translated into Spanish and published in the Ecuadorean anthology *El Pueblo del Libro* (Libresa, Quito 2007). I am currently working on a new book, in English. Besides writing, I am an avid bird watcher and amateur ornithologist, as well as a couch scholar of Roman history.

⁴The Transient Universe with JWST: <http://transientjwst.weebly.com/videos.html>

⁵AMNH Science Bulletins: <https://www.youtube.com/playlist?list=PL03468DEB0456E448>

⁶*Dark Universe*: <https://www.amnh.org/exhibitions/space-show/dark-universe>

SUMMARY

As of October 2018, a total of 41 peer-reviewed papers published in leading journals, of which 11 are first-author papers, with 2 additional first-author papers under review. The following citation data for these papers were gathered from NASA ADS:

Total citations (refereed papers): 1682 Citations excluding self-citations: 1499
Citations/paper: ≈ 40 h-index: 24 i10-index: 33

Hyperlinks to the papers are highlighted in blue.

FIRST- AND SECOND-AUTHOR REFEREED PUBLICATIONS

17. **Graur, O.**, 2018, *Late-Time Observations of Type Ia Supernova SN 2014J with the Hubble Space Telescope Wide Field Camera 3*, submitted to *The Astrophysical Journal*, [arXiv:1810.07258](#)
16. **Graur, O.**, 2018, *The Harvard Science Research Mentoring Program*, submitted to *American Journal of Physics*, [arXiv:1809.08078](#)
15. **Graur, O.** et al., 2018, *Late-time observations of ASASSN-14lp strengthen the case for a correlation between the peak luminosity of Type Ia supernovae and the shape of their late-time light curves*, *The Astrophysical Journal*, 866, 10
14. **Graur, O.** et al., 2018, *Observations of SN 2015F suggest a correlation between the intrinsic luminosity of Type Ia supernovae and the shape of their light curves > 900 days after explosion*, *The Astrophysical Journal*, 859, 79
13. **Graur, O.** et al., 2018, *A dependence of the tidal disruption event rate on stellar surface mass density and stellar velocity dispersion*, *The Astrophysical Journal*, 853, 39
12. Maoz, D. & **Graur, O.**, 2017, *Star formation, supernovae, iron, and α : consistent cosmic and Galactic histories*, *The Astrophysical Journal*, 848, 25
11. **Graur, O.** et al., 2017, *LOSS Revisited — II: The relative rates of different types of supernovae vary between low- and high-mass galaxies*, *The Astrophysical Journal*, 837, 121
10. **Graur, O.** et al., 2017, *LOSS Revisited — I: Unraveling correlations between supernova rates and galaxy properties, as measured in a reanalysis of the Lick Observatory Supernova Search*, *The Astrophysical Journal*, 837, 120
9. Leigh, N. W. C. & **Graur, O.**, 2016, *A novel mechanism for the distance-redshift relation*, *Classical and Quantum Gravity*, 34, 035014.
8. **Graur, O.** et al., 2016, *Late-Time Photometry of Type Ia Supernova SN 2012cg Reveals the Radioactive Decay of ^{57}Co* , *The Astrophysical Journal*, 819, 31
7. **Graur, O.**, Bianco, F. B., & Modjaz, M., 2015, *A unified explanation for the supernova rate-galaxy mass dependence based on supernovae discovered in Sloan galaxy spectra*, *Monthly Notices of the Royal Astronomical Society*, 450, 905
6. **Graur, O.**, Maoz, D., & Shara, M. M., 2014, *Progenitor constraints on the Type-Ia supernova SN2011fe from pre-explosion Hubble Space Telescope He II narrow-band observations*, *Monthly Notices of the Royal Astronomical Society Letters*, 442, L28

5. Frederiksen, T. F., **Graur, O.**, et al., 2014, *Spectroscopic identification of a redshift 1.55 supernova host galaxy from the Subaru Deep Field Supernova Survey*, *Astronomy & Astrophysics*, 563, 140
4. **Graur, O.** et al., 2014, *Type-Ia Supernova Rates to Redshift 2.4 from CLASH: the Cluster Lensing And Supernova survey with Hubble* *The Astrophysical Journal*, 783, 28
3. **Graur, O.** & Maoz, D., 2013, *Discovery of 90 Type-Ia supernovae among 700,000 Sloan spectra: the Type-Ia supernova rate versus galaxy mass and star-formation rate at redshift ~ 0.1* , *Monthly Notices of the Royal Astronomical Society*, 430, 1746
2. **Graur, O.** et al., 2011, *Supernovae in the Subaru Deep Field: the rate and delay-time distribution of Type Ia supernovae out to redshift 2*, *Monthly Notices of the Royal Astronomical Society*, 417, 916
1. Finkelman, I., **Graur, O.** & Brosch, N., 2011, *A candidate polar-ring galaxy in the Subaru Deep Field*, *Monthly Notices of the Royal Astronomical Society*, 412, 208

OTHER REFEREED PUBLICATIONS

26. Chakrabarti, S. et al. (**Graur, O.**: 3/5), 2018, *The supernova rate beyond the optical radius*, *The Astrophysical Journal Letters*, 863, 1
25. Rodney, S. A. et al. (**Graur, O.**: 11/35), 2018, *Two peculiar fast transients in a strongly lensed host galaxy*, *Nature Astronomy*, 2, 324
24. Kelly, P. L. et al. (**Graur, O.**: 33/45), 2018, *Extreme magnification of an individual star at redshift 1.5 by a galaxy-cluster lens*, *Nature Astronomy*, 2, 334
23. Riess, A. G. et al. (**Graur, O.**: 8/34), 2018, *Type Ia Supernova Distances at $z > 1.5$ from the Hubble Space Telescope Multi-Cycle Treasury Programs: The Early Expansion Rate*, *The Astrophysical Journal*, 853, 126
22. Shen, K. J., Toonen, S., & **Graur, O.**, 2017, *The evolution of the Type Ia supernova luminosity function*, *The Astrophysical Journal Letters*, 851, 50
21. Molino, A. et al. (**Graur, O.**: 24/44), 2017, *CLASH: accurate photometric redshifts with 14 HST bands in massive galaxy cluster cores*, *Monthly Notices of the Royal Astronomical Society*, 470, 95
20. Shivvers, I. et al. (**Graur, O.**: 9/14), 2017, *Revisiting the Lick Observatory Supernova Search volume-limited sample: updated classifications and revised stripped-envelope supernova fractions*, *Publications of the Astronomical Society of the Pacific*, 129, 054201
19. Modjaz, M. et al. (**Graur, O.**: 4/4), 2016, *The Spectroscopic SN-GRB Connection: Systematic Spectral Comparisons Between Type Ic Supernovae and Broad-Lined Type Ic Supernovae with and without Gamma-Ray Bursts*, *The Astrophysical Journal*, 832, 108
18. Kelly, P. L. et al. (**Graur, O.**: 20/23), 2016, *SN Refsdal: Classification as a Luminous and Blue SN 1987A-like Type II Supernova*, *The Astrophysical Journal*, 831, 205
17. Baldassare, V. et al. (**Graur, O.**: 5/9), 2016, *Follow-up spectroscopy of dwarf galaxies with AGN signatures: weeding out sources with transient broad H-alpha emission*, *The Astrophysical Journal*, 829, 57,

16. Liu, Y. et al. (**Graur, O.:** 4/4), 2016, *Analyzing the Largest Spectroscopic Dataset of Stripped Supernovae to Improve their Identifications and Constrain their Progenitors*, *The Astrophysical Journal*, 827, 90
15. Bianco, F. B. et al. (**Graur, O.:** 7/7), 2016, *Monte Carlo Method for Calculating Oxygen Abundances and Their Uncertainties from Strong-Line Flux Measurements*, *Astronomy & Computing*, 16, 54
14. Rodney, S.A. et al. (**Graur, O.:** 8/19), 2016, *SN Refsdal: Photometry and Time Delay Measurements of the First Einstein Cross Supernova*, *The Astrophysical Journal*, 820, 50
13. Kelly, P. L. et al. (**Graur, O.:** 11/22), 2016, *Déjà Vu All Over Again: the Reappearance of Supernova Refsdal*, *The Astrophysical Journal Letters*, 819, L8
12. Strolger, L.-G. et al. (**Graur, O.:** 4/9), 2015, *The Rate of Core Collapse Supernovae to Redshift 2.5 from the CANDELS and CLASH Supernova Surveys*, *The Astrophysical Journal*, 813, 93
11. Rodney, S. A. et al. (**Graur, O.:** 10/12), 2015, *Two Type Ia Supernovae at Redshift ~ 2 : Improved Classification and Redshift Determination with Medium-Band Infrared Imaging*, *The Astronomical Journal*, 150, 156
10. Rodney, S. A. et al. (**Graur, O.:** 12/30), 2015, *Illuminating a Dark Lens : A Type Ia Supernova Magnified by the Frontier Fields Galaxy Cluster Abell 2744*, *The Astrophysical Journal*, 811, 70
9. Kelly, P. L. et al. (**Graur, O.:** 10/31), 2015, *Multiple Images of a Highly Magnified Supernova Formed by an Early-Type Cluster Galaxy Lens*, *Science*, 347, 1123
8. Rodney, S. A. et al. (**Graur, O.:** 5/38), 2014, *Type Ia Supernova Rate Measurements to Redshift 2.5 from CANDELS: Searching for Prompt Explosions in the Early Universe*, *The Astronomical Journal*, 148, 13
7. Patel, B. et al. (**O. Graur:** 6/45), 2014, *Three Gravitationally Lensed Supernovae Behind CLASH Galaxy Clusters*, *The Astrophysical Journal*, 786, 9
6. Jones, D. O. et al. (**Graur, O.:** 15/25), 2013, *The Discovery of the Most Distant Known Type Ia Supernova at Redshift 1.914*, *The Astrophysical Journal*, 768, 166
5. Coe, D. et al. (**Graur, O.:** 35/46), 2012, *CLASH: Precise New Constraints on the Mass Profile of Abell 2261*, *The Astrophysical Journal*, 757, 22
4. Zitrin, A. et al. (**Graur, O.:** 25/48), 2012, *CLASH: New Multiple-Images Constraining the Inner Mass Profile of MACS J1206.2-0847*, *The Astrophysical Journal*, 749, 97
3. Rodney, S. A. et al. (**Graur, O.:** 16/26), 2012, *A Type-Ia Supernova at Redshift 1.55 in Hubble Space Telescope Infrared Observations from CANDELS*, *The Astrophysical Journal*, 746, 5
2. Postman, M. et al. (**Graur, O.:** 8/45), 2012, *The Cluster Lensing and Supernova Survey with Hubble: An Overview*, *The Astrophysical Journal Supplement Series*, 199, 25
1. Zitrin, A. et al. (**Graur, O.:** 25/41), 2011, *The Cluster Lensing and Supernova Survey with Hubble (CLASH): Strong Lensing Analysis of Abell 383 from 16-Band HST WFC3/ACS Imaging*, *The Astrophysical Journal*, 742, 117

NON-REFEREED PUBLICATIONS

4. **Graur, O.**, 2018, *Education and public outreach as an integral part of a scientist's career*, invited guest editorial for *American Journal of Physics*, **86**(10), 725.
3. DESI Collaboration, 2016, *The DESI Experiment Part II: Instrument Design*, [arXiv:1611.00037](#)
2. DESI Collaboration, 2016, *The DESI Experiment Part I: Science, Targeting, and Survey Design*, [arXiv:1611.00036](#)
1. **Graur, O.** et al., 2015, *Stripped-envelope supernova rates and host-galaxy properties*, Astronomy in Focus, as presented at the IAU XXIX General Assembly, 2015. [Proceedings of the International Astronomical Union, Volume 29B, 2016, pp. 257-258](#)

PUBLICATIONS IN PREPARATION

2. French, K. D. et al., invited book chapter about the host galaxies of tidal disruption events.
1. Tiwari, V., **Graur, O.**, & Fisher, R., implications of the late-time correlation between Type Ia supernova luminosity and light-curve shape on various explosion models.

ASTRONOMICAL CIRCULARS AND BULLETINS

14. *RELICS Discovery of a Probable Lens-magnified SN behind Galaxy Cluster Abell 1763*
Rodney, S. A. et al. (**Graur, O.**: 27/52), July 2016, [ATel 9224](#)
13. *Hubble Space Telescope Discovery of a Probable Caustic-Crossing Event in the MACS1149 Galaxy Cluster Field*
Kelly, P. L. et al. (**Graur, O.**: 19/45), May 2016, [ATel 9097](#)
12. *Discovery and Classification of HFF15Cru, a Type Ia Supernova in Abell 370*
Graham, M. L. et al. (**Graur, O.**: 10/24), January 2016, [ATel 8545](#)
11. *Detection of a SN near the center of the galaxy cluster field MACS1149 consistent with predictions of a new image of Supernova Refsdal*
Kelly, P. L. et al. (**Graur, O.**: 13/21), December 2015, [ATel 8402](#)
10. *Spectroscopic classification of HFF14Jan as a Type Ia supernova*
Foley, R. J., **Graur, O.**, et al., December 2014, [ATel 6774](#)
9. *Supernova candidate HFF14Jan discovered in HST observations of a $z=0.24$ spiral galaxy in the foreground of the Abell 370 galaxy cluster*
Graur, O. et al., November 2014, [ATel 6758](#)
8. *Hubble Space Telescope discovery of a multiply imaged, gravitationally lensed supernova*
Kelly, P. L. et al. (**Graur, O.**: 10/33), November 2014, [ATel 6729](#)
7. *Probable Foreground SN at $z=0.39$ SN in MACS0744.9+392 galaxy cluster field*
Kelly, P. L. et al. (**Graur, O.**: 6/6), September 2014, [ATel 6499](#)
6. *Discovery of a Type Ia SN in MACSJ1423*
Rodney, S. A. et al. (**Graur, O.**: 4/5), February 2013, [ATel 4778](#)

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5. *Type-Ia SN 2012fr: no progenitor detected in pre-explosion HST image to $M_V \sim -5.9$ mag*
Graur, O. & Maoz, D., November 2012, [ATel 4535](#)
 4. *Type-Ia SN 2012cg: no progenitor detected in HST pre-explosion images to $M_V \sim -6.0$ mag and $M_I \sim -5.4$ mag*
Graur, O. & Maoz, D., June 2012, [ATel 4226](#)
 3. *No progenitor detected to $M_V \sim -7$ mag for Type-Ic SN 2012cw*
Graur, O. & Maoz, D., June 2012, [ATel 4199](#)
 2. *Type Ia Supernova at $z = 0.261$ Discovered in HST imaging from CLASH*
Frederiksen, T. F., **Graur, O.**, et al., November 2011, [ATel 3731](#)
 1. *HST MCT SN Discovery*
Rodney, S. A., **Graur, O.**, & Frederiksen, T. F., June 2011, [ATel 3451](#)