

# Gautham Narayan

University of Illinois at Urbana-Champaign  
1002 W. Green St., Rm. 129  
Urbana, IL 61801

☎: (309) 531-1810  
✉: [gsn@illinois.edu](mailto:gsn@illinois.edu)  
🌐: <http://gnarayan.github.io/>

## RESEARCH INTERESTS

- Observational Cosmology and Cosmography
- Time-domain Astrophysics, particularly Transient Phenomena
- Wide-field Ultraviolet, Optical and Infrared Surveys
- Multi-messenger Astrophysics & Rapid Follow-up Studies
- Statistics, Data Science and Machine Learning

## PROFESSIONAL APPOINTMENTS

Current:	Assistant Professor, University of Illinois at Urbana-Champaign Aug 2019–present
Previous:	Lasker Data Science Fellow, Space Telescope Science Institute Jun 2017–Aug 2019 Postdoctoral Fellow, National Optical Astronomy Observatory Jul 2013–Jun 2017 <sup>1</sup>

## EDUCATION

Harvard University	Ph.D. Physics, May 2013 Thesis: “ <a href="#">Light Curves of Type Ia Supernovae and Cosmological Constraints from the ESSENCE Survey</a> ” Adviser: Prof. Christopher W. Stubbs A.M. Physics, May 2007
Illinois Wesleyan University	B.S. (Hons) Physics, Summa Cum Laude, May 2005 Thesis: “ <a href="#">Photometry of Outer-belt Objects</a> ” Adviser: Prof. Linda M. French

## AWARDS AND GRANTS

- NASA ADAP “The Stars Like Dust: Building an All-Sky Photometric Reference”, USD 334,711, 2020–present
- LSST Enabling Science Award, USD 27,000, 2020–present
- 2<sup>nd</sup> ever recipient of the Barry M. Lasker Data Science Fellowship, STScI, 2017–9
- Co-I on several *Hubble Space Telescope* programs with grants totaling over USD 1M, 2012–present
- Co-I, grant for developing ANTARES broker, Heising-Simons Foundation, USD 567,000, 2018
- STScI Director’s Discretionary Funding for student research, USD 2500, 2017–9
- LSST Cadence Hackathon, USD 1400, 2018
- Best-in-Show, Art of Planetary Science, Lunar and Planetary Laboratory, U. Arizona, 2015
- Purcell Fellowship, Harvard University, 2005
- Research Honors, Summa Cum Laude, Member of  $\Phi B K$ ,  $\Phi K \Phi$ , IWU, 2005

<sup>1</sup>Formally employed by The University of Arizona CS Dept. from Dec 2014–Apr 2016, but located at NOAO

## RESEARCH HISTORY AND SELECTED PUBLICATIONS

I work at the intersection of cosmology, astrophysics, and data science. Below are brief descriptions of my work on key topics, together with a related publication (full list of publications is at end).

### Machine Learning for Time-Domain Discovery

- Lead developer of machine-learning algorithms for time-series classification on state-of-the-art alert broker system: [ANTARES](#)
- Presently testing ANTARES on Zwicky Transient Facility (ZTF) alerts as test bed for Large Synoptic Survey Telescope (LSST)
- Lead of validation team for Photometric LSST Astronomical Time-Series Classification Challenge ([PLAsTiCC](#)) — public challenge with \$30,000 in prizes for novel algorithms of the entire time-domain sky for statistical studies

**Narayan** et al., '18, "Machine-learning-based Brokers for Real-time Classification of the LSST Alert Stream", *ApJS* Special Issue "Data: Insights and Challenges in a Time of Abundance"

### Understanding the Physics of Rare and Unusual Transients

- Working with student A. Gagliano on 2020oi
- Led or made major contributions to several projects studying unusual SN, including SN 2018oh, SN 2009ku, SN 2008ha, as well as open-source tools to model such events
- Combining work on machine learning with interest in rare & unusual transients by developing novel methods for anomaly detection, incorporating gravitational wave, neutrino and high-energy gamma ray signals into alert-brokers.

**Narayan** et al., '11, "Displaying the Heterogeneity of the SN 2002cx-like Subclass of Type Ia Supernovae with Observations of the Pan-STARRS-1 Discovered SN 2009ku", *ApJL*

### Cosmology and the Nature of Dark Energy

- Led analysis using ESSENCE and literature SNIa to derive cosmological constraints on dark energy equation of state  $w$ ; co-authored analysis on PS1 SNIa Foundation photometric SNIa, RAISIN NIR SNIa
- Co-developed BayeSN with K. Mandel — probabilistic model to infer distance moduli, light curve, and dust properties from UV+Optical+NIR data of low- $z$  SNIa; currently evolving into model for SNIa SED inference at cosmological distances for *WFIRST*, future surveys
- Leading analysis apply BayeSN-SED to combined Foundation, Pan-STARRS & literature samples — will be the largest dataset of confirmed cosmological SNIa

**Narayan** et al., '16, "Light Curves of 213 Type Ia Supernovae from the ESSENCE Survey", *ApJS*

### Operations, Calibration & Optimization of Wide-field Surveys

- Implementing active learning for *TESS* and LSST — targeted observations of least-understood sources to refine machine learning models, and improve survey performance iteratively
- Lead analysis to use *Hubble* imaging and large-aperture spectroscopy to establish faint spectrophotometric standards for LSST and future surveys
- Extensive involvement in transient pipeline development & validation for Pan-STARRS, survey simulations for Foundation, YSE, and analysis of cadence for LSST Wide-Fast-Deep Survey

**Narayan** et al., '19, "Sub-percent Photometry: Faint DA White Dwarf Spectrophotometric Standards for Astrophysical Observatories", *ApJS*

## PROFESSIONAL AFFILIATIONS

I am an active member of several groups and projects, completed and on-going:

The LSST Dark Energy Science Collaboration (DESC)	The PLAsTiCC Team
The LSST Transient & Variable Stars Collaboration (TVS)	The ANTARES Project
The <i>Kepler</i> Extra Galactic Survey (KEGS)	The DA White Dwarf Calibration Team
The Foundation Survey	The Young Supernova Experiment (YSE)
The Pan-STARRS PS1 Science Collaboration	The ESSENCE Collaboration
The Mosaic z-band Legacy Survey (MzLS)	The <i>HST</i> RAISIN & SIRAH Surveys
Member of the American Astronomical Society (2007–present)	

## OBSERVING EXPERIENCE

I am an observational cosmologist with extensive experience with different facilities:

- Co-I on several major *HST* programs with *WFC3*, *ACS* and *STIS* including: GO-12967 (18 orbits), 12999 (8 orbits), 13046 (100 orbits), 13711 (60 orbits), 14216 (100 orbits), 14244 (8 orbits) and 15113 (54 orbits)
- MMT Observatory: 15 nights of Blue Channel spectroscopy on site, 2 nights of remote observing
- Magellan Observatory: 7 nights LDSS3 imaging and long-slit spectroscopy  
1 night of IMACS long-slit spectroscopy
- Gemini Observatory: Analysis of GMOS spectroscopy from ~5 nights of queue observing
- Kitt Peak National Observatory: several nights of imaging on the 4 m with MOSAIC 1.1 & 3
- Cerro-Tololo Inter-American Observatory: 5 nights of imaging on the 0.9 m with Tek2K  
Analysis of 197 nights of MOSAIC-II imaging for ESSENCE/SuperMacho
- WIYN Observatory: 3 nights of imaging on the WIYN 3.5 m with ODI
- F. L. Whipple Observatory: several nights of long-slit spectroscopy on the 1.5 m with FAST  
and imaging on the 1.2 m with Keplercam, both on-site and remote
- Las Cumbres Observatory: Analysis of 120 hours of 1 m SINISTRO imaging

I've helped design, implement, schedule and optimize numerous surveys. Together with Armin Rest and Mark Huber, I adapted the SMSN photpipe pipeline to work on numerous other projects. To date, it has processed ~4 PB of images, including the entirety of the PS1 Medium Deep Survey, and discovered several thousand transient and variable sources. My experience as an observer has also benefited from instructing several undergraduates, graduate students and postdocs.

## SOFTWARE PROFICIENCIES

- Developer on several packages available at <http://github.com/gnarayan>
- Core research strength: inference with bespoke probabilistic and machine learning models
- Extensive experience developing image processing pipelines for ground and space telescopes
- Fluent in Python, C++, IDL and Perl
- Comfortable with C, R, Java, Fortran 95, and IRAF
- Familiarity with Scheme, ML, Haskell, PHP, Ruby and Julia
- Well-versed with several database architectures, provenance, redundancy, and version control
- Proficient with SLURM, HTCondor, PBS, LSF and SGE distributed computing environments
- Some familiarity with Amazon Web Services, Kubernetes and Docker, XSEDE, and Hadoop

## MENTORING AND TEACHING

### **Alex Gagliano** (UIUC), Adviser, 2019–present

- Presently in 2<sup>nd</sup> year of Ph.D Narayan at UIUC
- Working on correlations between supernovae and their host-environments
- Gagliano, Narayan et al. submission imminent
- Winner of the NSF GRF and Illinois Survey Science Fellowship

### **Patrick Aleo** (UIUC), Adviser, 2020–present

- Presently in 2<sup>nd</sup> year of Ph.D Narayan at UIUC
- Working on anomaly detection for transients within ZTF

### **Andrew Engel** (UIUC), Adviser, 2017–present

- Graduated May 2020 - will begin position at LANL over summer
- Working on machine learning for photometric redshifts from galaxies
- Algorithm developed being used in both ANTARES and YSE
- Completing paper on research with Narayan over summer 2020

### **Daniel Muthukrishna** (U. Cambridge), Co-Adviser, 2017–present

- Presently in 3<sup>rd</sup> year of Ph.D with K. Mandel at Cambridge
- Research with Narayan on deep learning for transient classification (RAPID, Muthukrishna et al., 2019)
- Muthukrishna is member of LSST PLAsTiCC team and the ANTARES project

### **Daniel Alcantara** (Bard College), Research Collaborator, 2016–9

- Intern with R. Street at Las Cumbres Observatory working on microlensing detection
- Worked with Narayan to dramatically improve performance of prototype classifier
- Published Alcantara, Bachelet, Narayan and Street, 2019
- Algorithm being used with MARS broker to find microlensing candidates with ZTF

### **Tayeb Zaidi** (Macalester College), Honors Thesis Adviser, 2016–7

- Worked with Narayan on ANTARES as summer REU student at NOAO in 2015
- Continued work on time-series classification for Senior Honors (earned April 2017)
- Published Narayan, Zaidi, Soraisam et al., 2018, adapted for LSST PLAsTiCC

### **Previous REU Students**

- Marcus Lee (NOAO, 2014) was the first indigenous (Tohono O’odham) student to complete REU program at NOAO
- Linoy Kotler (STScI, 2018) worked on wavelet-based classification of Foundation photometric SNIa sample and is now at Rice University

I’ve authored papers with grad students from the U. Arizona Computer Science Dept. on ANTARES, particularly Zhe Wang and Shuo Yang. I work closely with students Qinan Wang (JHU) and Stephen Thorp (Cambridge). I have served on the prelim committee for Alejandro Cardenas-Avendano (UIUC Physics) & Sunny Tang (UIUC Astro)

ASTR 596, Fundamentals of Data Science, UIUC, Spring 2020  
 ZTF Summer School, Pasadena, Aug. 2018  
 LSST Data Science Fellowship Program, [Session 5](#), Baltimore, Jan. 2018  
**Instructor for:** LSST Data Science Fellowship Program, [Session 3](#), Tucson, Apr. 2017  
 NOAO Teen Astronomy Cafe, [“How Stars Die”](#), Tucson, Nov. 2017  
 NOAO Big Data Workshop for Tucson High School Students, Tucson, Jan. 2017  
 Python Workshop for NOAO/NSO REU Students, Tucson, Summer 2014 & 2015

I’ve additionally served as a Teaching Assistant at Harvard, as Teaching Assistant, Lab Assistant and Tutor at Illinois Wesleyan, and as guest lecturer for Astro 102 (Instructors: C. Salyk and K. Garmany) at the Tohono O’odham Community College.

## INVITED COLLOQUIA/SEMINARS/CONFERENCES, 2015–PRESENT

Kentucky Area Astronomy Annual Meeting - Louisville, KY, Mar 2020  
 LSST DESC Annual Meeting - Tucson, AZ, Jan 2020  
 Kavli Visitor, University of Cambridge, Institute of Astronomy, Dec 2019  
 LSST TVS and SMWLW workshop - Newark, DE, Oct 2019  
 SNIa Cosmology Analysis Meeting - KICP Chicago, IL, Oct 2019  
 Inference for Multi-messenger Astrophysics - Berkeley, CA, May 2019  
 University of Delaware, Astronomy Seminar - Newark, DE, May 2019  
 University of Illinois, LSST Seminar - Urbana-Champaign, IL, Apr. 2019  
 Iowa State University, Dept. of Physics & Astronomy Colloquium - Ames, IA, Apr. 2019  
 Louisiana State University, Dept. of Physics & Astronomy Colloquium - Baton Rouge, LA, Mar. 2019  
 University of Wisconsin, Dept. of Physics Colloquium - Milwaukee, WI, Mar. 2019  
 University of Alabama, Dept. of Physics & Astronomy Colloquium - Tuscaloosa, AL, Mar. 2019  
 Michigan Technological University, Dept. of Physics Colloquium - Houghton, MI, Feb. 2019  
 University of Illinois, Dept. of Astronomy Colloquium - Urbana-Champaign, Feb. 2019  
 University of Minnesota, Dept. of Physics and Astronomy Colloquium - St. Paul, Nov. 2018  
 LSST Cadence Hackathon - New York, NY, Sep. 2018  
 Machine Learning for Science and Engineering - Pittsburgh, Jun. 2018  
 NSF Workshop on Multi Messenger Astrophysics - College Park, May 2018  
 LSST Photometric Classification Challenge “PLAsTiCC” Sprint Week - New York, NY, May. 2018  
 Python in Astronomy - New York, NY, Apr. 2018  
 New Advances in NIR type Ia Supernova Science - Pittsburgh, PA, Apr. 2018  
 LSST PLAsTiCC Workshop - New York, NY, Jul. 2017  
 Supernovae: The LSST Revolution - Evanston, IL, Jun. 2017  
 Building the Infrastructure for Time-Domain Alert Science in the LSST Era - Tucson, AZ, May 2017  
 Hot Wiring the Transient Universe V - Philadelphia, PA, Oct. 2016  
 Photometric Classification of Supernovae workshop - Chicago, IL, Apr. 2016  
 LSST Joint Technical Meeting - Santa Cruz, CA, Feb 2016

## SERVICE & PUBLIC OUTREACH WORK

Chair, SNe Across LSST, Originally Apr. 28-30, 2020, rescheduled due to COVID-19  
 Panelist, NSF Review Panel, Mar 2020  
 Speaker, Astronomy on Tap - Urbana-Champaign, “The Myth and Mythology of the Planets”, Feb 2020  
 Organizer, Astronomy on Tap - Urbana-Champaign, Nov 2019–present  
 SOC, Managing Follow-up Observations in the Era of ZTF and LSST, Sep. 30–Oct. 4, 2019  
 Speaker, Astronomy on Tap - Urbana-Champaign, “Making a Movie of the Night Sky”, Sep. 2019  
 Chair, Enabling Multi Messenger Astrophysics in the Big Data Era, Apr. 25–26, 2019  
 SOC, Deep Learning for Multimessenger Astrophysics: Real-time Discovery at Scale, Oct. 2018  
 LOC, Building the Infrastructure for Time-Domain Alert Science in the LSST Era, May 2017  
 Organizer, Astronomy on Tap - Tucson/Space Drafts, 2015–2017  
 Organizer, NOAO FLASH Talk Series, 2015–2017  
 Organizer, NOAO Coffee Hour Series, 2014–5  
 Reviewer for the AAS Journals, ongoing  
 Speaker, Space Telescope Public Lecture Series, [Chasing Supernovae with Kepler](#), Sep. 2018  
 Guest, Three Body Problems Podcast, [Bringing Data Science Into Astronomy](#), Sept. 2018  
 Scientist, TED-Ed Original Videos ([Pt. 1](#)) ([Pt. 2](#))  
 Speaker, 365 Days of Astronomy Podcast ([Pt. 1](#)) ([Pt. 2](#))  
 Speaker, Youth for Astronomy and Engineering, Nov. 2018  
 Speaker, NerdNite Baltimore, Mar. 2018  
 Panelist, Tucson Comic Con and TUSCon, Nov. 2015 and 2016  
     [“Robots in Space”](#) and [“The Physics of Space Battles”](#)  
 Speaker, Astronomy on Tap - Tucson with the Tucson Symphony Orchestra, Oct. 2016  
     [“A Trip through Gustav Holst’s Planets”](#)  
 Speaker, Astronomy on Tap - Tucson, Jan. 2015  
     [“If You Only Knew The Power of The Dark Side”](#)  
 Speaker, Green Valley Astronomy Club, Sahuarita, AZ, May 2016  
 Volunteer, Science Night, Elvira Elementary School, Tucson, AZ, Mar. 2015 and Mar. 2017  
 Volunteer, Astronomy Night, Arizona Sonoran Desert Museum, Jul. 2015  
 Volunteer, Kitt Peak National Observatory Open Night for the Tohono O’odham Nation, May 2015  
 Volunteer, Tucson Festival of Books, Mar. 2015

I’ve led public stargazing at the Museum of Science in Boston (2011–2), the Table Mountain star party, WA (2006) and throughout my time as an undergraduate at Illinois Wesleyan’s Mark Evans Observatory (2001–5).

## REFERENCES

- Prof. Christopher Stubbs      Dept. of Physics, Harvard University  
17 Oxford St., Lyman 355  
Cambridge, MA, 02138  
USA  
(617) 495 1454  
[stubbs@physics.harvard.edu](mailto:stubbs@physics.harvard.edu)
- Dr. Armin Rest                Space Telescope Science Institute  
3700 San Martin Dr., #434  
Baltimore, MD, 21218  
USA  
(410) 338 4358  
[arest@stsci.edu](mailto:arest@stsci.edu)
- Dr. Thomas Matheson        National Optical Astronomy Observatory  
950 N. Cherry Ave., CSDC  
Tucson, AZ, 85719  
USA  
(520) 318 8517  
[matheson@noao.edu](mailto:matheson@noao.edu)
- Prof. Renée Hložek            Dept. of Astronomy & Astrophysics, University of Toronto  
Dunlap Institute for Astronomy and Astrophysics  
50 St. George St.  
Toronto, ON  
Canada M5S 3H4  
+1 (416) 978 4971  
[hlozek@dunlap.utoronto.ca](mailto:hlozek@dunlap.utoronto.ca)
- Prof. Kaisey Mandel            Institute for Astronomy, University of Cambridge  
Statistical Laboratory, DPMMS & Kavli Institute for Cosmology  
University of Cambridge  
Wilberforce Rd.  
Cambridge, CB3 0WB  
United Kingdom  
+44 (01223)-7-46428  
[kmandel@ast.cam.ac.uk](mailto:kmandel@ast.cam.ac.uk)
- Prof. Ryan Foley              Dept. of Astronomy & Astrophysics, University of California, Santa Cruz  
1156 High St., ISB 345  
Santa Cruz, CA, 95064  
USA  
(831) 459 2835  
[foley@ucsc.edu](mailto:foley@ucsc.edu)
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## LIST OF PUBLICATIONS

h-index: 29, 3794 citations. (Mendeley/Scopus/Google Scholar)

Publications are listed with 1<sup>st</sup> author or major contributor first.

### Primary Publications

- [1] **Models and Simulations for the Photometric LSST Astronomical Time Series Classification Challenge (PLAS-TiCC).** R. Kessler, **G. Narayan**, A. Avelino, E. Bachelet, R. Biswas, P. J. Brown, D. F. Chernoff, A. J. Connolly, M. Dai, S. Daniel, R. Di Stefano, M. R. Drout, L. Galbany, S. González-Gaitán, M. L. Graham, R. Hložek, E. E. O. Ishida, J. Guillochon, S. W. Jha, D. O. Jones, K. S. Mandel, D. Muthukrishna, A. O'Grady, C. M. Peters, J. R. Pierel, K. A. Ponder, A. Prša, S. Rodney, V. A. Villar, LSST Dark Energy Science Collaboration, and Transient and Variable Stars Science Collaboration. *Publ. Astron. Soc. Pac.*, Sep 2019. 131(1003):p. 094501.
- [2] **A machine learning classifier for microlensing in wide-field surveys.** D. Godines, E. Bachelet, **G. Narayan**, and R. A. Street. *Astronomy and Computing*, Jul 2019. 28:100298.
- [3] **Subpercent Photometry: Faint DA White Dwarf Spectrophotometric Standards for Astrophysical Observatories.** **G. Narayan**, T. Matheson, A. Saha, T. Axelrod, A. Calamida, E. Olszewski, J. Claver, K. S. Mandel, R. C. Bohlin, and J. B. Holberg. *Astrophys. J. Suppl. Ser.*, Apr 2019. 241(2):20.
- [4] **RAPID: Early Classification of Explosive Transients Using Deep Learning.** D. Muthukrishna, **G. Narayan**, K. S. Mandel, R. Biswas, and R. Hložek. *Publ. Astron. Soc. Pac.*, Nov. 2019. 131(1005):p. 118002.
- [5] **Machine-learning-based Brokers for Real-time Classification of the LSST Alert Stream.** **G. Narayan**, T. Zaidi, M. D. Soraism, Z. Wang, M. Lochner, T. Matheson, A. Saha, S. Yang, Z. Zhao, J. Kececioglu, C. Scheidegger, R. T. Snodgrass, T. Axelrod, T. Jenness, R. S. Maier, S. T. Ridgway, R. L. Seaman, E. M. Evans, N. Singh, C. Taylor, J. Toeniskoetter, E. Welch, S. Zhu, and ANTARES Collaboration. *Astrophys. J. Suppl. Ser.*, May 2018. 236:9.
- [6] **Photometry and Spectroscopy of Faint Candidate Spectrophotometric Standard DA White Dwarfs.** A. Calamida, T. Matheson, A. Saha, E. Olszewski, **G. Narayan**, J. Claver, C. Shanahan, J. Holberg, T. Axelrod, and R. Bohlin. *Astrophys. J.*, Feb 2019. 872(2):199.
- [7] **Light Curves of 213 Type Ia Supernovae from the ESSENCE Survey.** **G. Narayan**, A. Rest, B. E. Tucker, R. J. Foley, W. M. Wood-Vasey, P. Challis, C. Stubbs, R. P. Kirshner, C. Aguilera, A. C. Becker, S. Blondin, A. Clocchiatti, R. Covarrubias, G. Damke, T. M. Davis, A. V. Filippenko, M. Ganeshalingam, A. Garg, P. M. Garnavich, M. Hicken, S. W. Jha, K. Krisciunas, B. Leibundgut, W. Li, T. Matheson, G. Miknaitis, G. Pignata, J. L. Prieto, A. G. Riess, B. P. Schmidt, J. M. Silverman, R. C. Smith, J. Sollerman, J. Spyromilio, N. B. Suntzeff, J. L. Tonry, and A. Zenteno. *Astrophys. J. Suppl. Ser.*, May 2016. 224:3.
- [8] **Toward a Network of Faint DA White Dwarfs as High-precision Spectrophotometric Standards.** **G. Narayan**, T. Axelrod, J. B. Holberg, T. Matheson, A. Saha, E. Olszewski, J. Claver, C. W. Stubbs, R. C. Bohlin, S. Deustua, and A. Rest. *Astrophys. J.*, May 2016. 822:67.
- [9] **Displaying the Heterogeneity of the SN 2002cx-like Subclass of Type Ia Supernovae with Observations of the Pan-STARRS-I Discovered SN 2009ku.** **G. Narayan**, R. J. Foley, E. Berger, M. T. Botticella, R. Chornock, M. E. Huber, A. Rest, D. Scolnic, S. Smartt, S. Valenti, A. M. Soderberg, W. S. Burgett, K. C. Chambers, H. A. Flewelling, G. Gates, T. Grav, N. Kaiser, R. P. Kirshner, E. A. Magnier, J. S. Morgan, P. A. Price, A. G. Riess, C. W. Stubbs, W. E. Sweeney, J. L. Tonry, R. J. Wainscoat, C. Waters, and W. M. Wood-Vasey. *Astrophys. J. Lett.*, Apr. 2011. 731:L11.
- [10] **Type Ia Supernova Light Curve Inference: Hierarchical Models in the Optical and Near-infrared.** K. S. Mandel, **G. Narayan**, and R. P. Kirshner. *Astrophys. J.*, Apr. 2011. 731:L20.
- [11] **SN 2006bt: A Perplexing, Troublesome, and Possibly Misleading Type Ia Supernova.** R. J. Foley, **G. Narayan**, P. J. Challis, A. V. Filippenko, R. P. Kirshner, J. M. Silverman, and T. N. Steele. *Astrophys. J.*, Jan. 2010. 708:pp. 1748–1759.
- [12] **Survey requirements for accurate and precise photometric redshifts for Type Ia supernovae.** Y. Wang, **G. Narayan**, and M. Wood-Vasey. *Mon. Not. R. Astron. Soc.*, Nov. 2007. 382:pp. 377–381.
- [13] **The Complete Light-curve Sample of Spectroscopically Confirmed SNe Ia from Pan-STARRS1 and Cosmological Constraints from the Combined Pantheon Sample.** D. M. Scolnic, D. O. Jones, A. Rest, Y. C. Pan, R. Chornock, R. J. Foley, M. E. Huber, R. Kessler, **G. Narayan**, A. G. Riess, S. Rodney, E. Berger, D. J. Brout, P. J. Challis, M. Drout, D. Finkbeiner, R. Lunnan, R. P. Kirshner, N. E. Sanders, E. Schlafly, S. Smartt, C. W. Stubbs, J. Tonry, W. M. Wood-Vasey, M. Foley, J. Hand, E. Johnson, W. S. Burgett, K. C. Chambers, P. W. Draper, K. W. Hodapp, N. Kaiser, R. P. Kudritzki, E. A. Magnier, N. Metcalfe, F. Bresolin, E. Gall, R. Kotak, M. McCrum, and K. W. Smith. *Astrophys. J.*, Jun. 2018. 859:101.
- [14] **Cosmological Constraints from Measurements of Type Ia Supernovae Discovered during the First 1.5 yr of the Pan-STARRS1 Survey.** A. Rest, D. Scolnic, R. J. Foley, M. E. Huber, R. Chornock, **G. Narayan**, J. L. Tonry, E. Berger, A. M. Soderberg, C. W. Stubbs, A. Riess, R. P. Kirshner, S. J. Smartt, E. Schlafly, S. Rodney, M. T. Botticella, D. Brout, P. Challis, I. Czekala, M. Drout, M. J. Hudson, R. Kotak, C. Leibler, R. Lunnan, G. H. Marion, M. McCrum, D. Milisavljevic, A. Pastorello, N. E. Sanders,



- K. Smith, E. Stafford, D. Thilker, S. Valenti, W. M. Wood-Vasey, Z. Zheng, W. S. Burgett, K. C. Chambers, L. Denneau, P. W. Draper, H. Flewelling, K. W. Hodapp, N. Kaiser, R.-P. Kudritzki, E. A. Magnier, N. Metcalfe, P. A. Price, W. Sweeney, R. Wainscoat, and C. Waters. *Astrophys. J.*, Nov. 2014. 795:44.
- [15] **Systematic Uncertainties Associated with the Cosmological Analysis of the First Pan-STARRS1 Type Ia Supernova Sample.** D. Scolnic, A. Rest, A. Riess, M. E. Huber, R. J. Foley, D. Brout, R. Chornock, **G. Narayan**, J. L. Tonry, E. Berger, A. M. Soderberg, C. W. Stubbs, R. P. Kirshner, S. Rodney, S. J. Smartt, E. Schlafly, M. T. Botticella, P. Challis, I. Czekala, M. Drout, M. J. Hudson, R. Kotak, C. Leibler, R. Lunnan, G. H. Marion, M. McCrum, D. Milisavljevic, A. Pastorello, N. E. Sanders, K. Smith, E. Stafford, D. Thilker, S. Valenti, W. M. Wood-Vasey, Z. Zheng, W. S. Burgett, K. C. Chambers, L. Denneau, P. W. Draper, H. Flewelling, K. W. Hodapp, N. Kaiser, R.-P. Kudritzki, E. A. Magnier, N. Metcalfe, P. A. Price, W. Sweeney, R. Wainscoat, and C. Waters. *Astrophys. J.*, Nov. 2014. 795:45.
- [16] **Seeing Double: ASASSN-18bt Exhibits a double-power-law Rise in the Early-Time  $\{em K2\}$  Light Curve.** B. J. Shappee, T. W.-s. Holoiu, M. R. Drout, K. Auchettl, M. D. Stritzinger, C. S. Kochanek, K. Z. Stanek, E. Shaya, **G. Narayan**, J. S. Brown, S. Bose, D. Bersier, J. Brimacombe, P. Chen, S. Dong, S. Holmbo, B. Katz, J. A. Munoz, R. L. Mutel, R. S. Post, J. L. Prieto, J. Shields, D. Tallon, T. A. Thompson, P. J. Vally, S. Villanueva, Jr., L. Denneau, H. Flewelling, A. N. Heinze, K. W. Smith, B. Stalder, J. L. Tonry, H. Weiland, T. Barclay, G. Barentsen, A. M. Cody, J. Dotson, F. Foerster, P. Garnavich, M. Gully-santiago, C. Hedges, S. Howell, D. Kasen, S. Margheim, R. Mushotzky, A. Rest, B. E. Tucker, A. Villar, A. Zenteno, G. Beerman, R. Bjella, G. Castillo, J. Coughlin, B. Elsaesser, S. Flynn, R. Gangopadhyay, K. Griest, M. Hanley, J. Kampmeier, R. Kloetzel, L. Kohnert, C. Labonde, R. Larsen, K. A. Larson, K. M. Mccalmont-evertson, C. McGinn, L. Migliorini, J. Moffatt, M. Muszynski, V. Nystrom, D. Osborne, M. Packard, C. A. Peterson, M. Redick, L. H. Reedy, S. E. Ross, B. Spencer, K. Steward, J. E. Van Cleve, J. V. D. M. Cardoso, T. Weschler, A. Wheaton, J. Bulger, T. B. Lowe, E. A. Magnier, A. S. B. Schultz, C. Z. Waters, M. Willman, E. Baron, Z. Chen, J. M. Derkacy, F. Huang, L. Li, W. Li, X. Li, L. Rui, H. Sai, L. Wang, L. Wang, X. Wang, D. Xiang, J. Zhang, J. Zhang, K. Zhang, T. Zhang, X. Zhang, X. Zhao, P. J. Brown, J. J. Hermes, J. Nordin, S. Points, G. M. Strampelli, and A. Zenteno. *ArXiv e-prints*, Jul. 2018.
- [17] **GALEX and Pan-STARRS1 Discovery of SN IIP 2010aq: The First Few Days After Shock Breakout in a Red Supergiant Star.** S. Gezari, A. Rest, M. E. Huber, **G. Narayan**, K. Forster, J. D. Neill, D. C. Martin, S. Valenti, S. J. Smartt, R. Chornock, E. Berger, A. M. Soderberg, S. Mattila, E. Kankare, W. S. Burgett, K. C. Chambers, T. Dombeck, T. Grav, J. N. Heasley, K. W. Hodapp, R. Jedicke, N. Kaiser, R. Kudritzki, G. Luppino, R. H. Lupton, E. A. Magnier, D. G. Monet, J. S. Morgan, P. M. Onaka, P. A. Price, P. H. Rhoads, W. A. Siegmund, C. W. Stubbs, J. L. Tonry, R. J. Wainscoat, M. F. Waterson, and C. G. Wynn-Williams. *Astrophys. J. Lett.*, Sep. 2010. 720:pp. L77–L81.

## Unrefereed Publications

- [18] **Astro2020 APC White Paper: Elevating the Role of Software as a Product of the Research Enterprise.** A. M. Smith, D. Norman, K. Cruz, V. a. Desai, E. Bellm, B. Lundgren, F. Economou, B. D. Nord, C. Schafer, **G. Narayan**, J. Harrington, E. Tollerud, B. Sipőcz, T. Pickering, M. S. Peeples, B. Berriman, P. Teuben, D. Rodriguez, A. Gradwohl, L. Shamir, A. Allen, J. R. Brownstein, A. Ginsburg, M. Sinha, C. Hummels, B. Smith, H. Stevance, A. Price-Whelan, B. Cherinka, C.-k. Chan, J. Kartaltepe, M. Turk, B. Weiner, M. Modjaz, R. J. Nemiroff, W. Kerzendorf, I. Laginja, C. Dong, B. Merin, J. Sobeck, D. Buzasi, J. K. Faherty, I. Momcheva, A. Connolly, and V. Z. Golkhou. *arXiv e-prints*, Jul 2019. arXiv:1907.06981.
- [19] **Discovery Frontiers of Explosive Transients: An ELT and LSST Perspective.** M. Graham, D. Milisavljevic, A. Rest, J. C. Wheeler, R. Chornock, R. Margutti, J. Rho, C.-H. Lee, S.-C. Yoon, C. D. Kilpatrick, **G. Narayan**, N. Smith, G. G. Williams, N. Sravan, P. Cowperthwaite, D. Coppejans, G. Terreran, A. Baleschi, V. Z. Golkhou, and S. Starrfield. *Bull. Am. Astron. Soc.*, May 2019. 51(3):339.
- [20] **Cyberinfrastructure Requirements to Enhance Multi-messenger Astrophysics.** P. Chang, G. Allen, W. Anderson, F. B. Bianco, J. S. Bloom, P. R. Brady, A. Brazier, S. B. Cenko, S. M. Couch, T. DeYoung, E. Deelman, Z. B. Etienne, R. J. Foley, D. B. Fox, V. Z. Golkhou, D. R. Grant, C. Hanna, K. Holley-Bockelmann, D. A. Howell, E. A. Huerta, M. W. G. Johnson, M. Juric, D. L. Kaplan, D. S. Katz, A. Keivani, W. Kerzendorf, C. Kopper, M. T. Lam, L. Lehner, Z. Marka, S. Marka, J. Nabrzyski, **G. Narayan**, B. W. O'Shea, D. Petravick, R. Quick, R. A. Street, I. Taboada, F. Timmes, M. J. Turk, A. Weltman, and Z. Zhang. *Bull. Am. Astron. Soc.*, May 2019. 51(3):436.
- [21] **Petabytes to Science.** A. E. Bauer, E. C. Bellm, A. S. Bolton, S. Chaudhuri, A. J. Connolly, K. L. Cruz, V. Desai, A. Drlica-Wagner, F. Economou, N. Gaffney, J. Kavelaars, J. Kinney, T. S. Li, B. Lundgren, R. Margutti, **G. Narayan**, B. Nord, D. J. Norman, W. O'Mullane, S. Padhi, J. E. G. Peek, C. Schafer, M. E. Schwamb, A. M. Smith, E. J. Tollerud, A.-M. Weijmans, and A. S. Szalay. *arXiv e-prints*, May 2019. arXiv:1905.05116.
- [22] **The Next Generation of Cosmological Measurements with Type Ia Supernovae.** D. Scolnic, S. Perlmutter, G. Aldering, D. Brout, T. Davis, A. Filippenko, R. Foley, R. Hložek, R. Hounsell, D. Jones, P. Kelly, D. Rubin, A. Riess, S. Rodney, J. Roberts-Pierel, Y. Wang, J. Asorey, A. Avelino, C. Bavdhanekar, P. J. Brown, A. Challinor, C. Ballard, A. Cooray, S. Dhawan, G. Dimitriadis, C. Dvorkin, J. Guy, W. Handley, R. E. Keeley, J.-P. Kneib, B. L'Huillier, M. Lattanzi, K. Mandel, J. Mertens, M. Rigault, P. Motloch, S. Mukherjee, **G. Narayan**, A. Nomerotski, L. Page, L. Pogossian, G. Puglisi, M. Raveri, N. Regnault, A. Rest, C. Rojas-Bravo, M. Sako, F. Shi, S. Sridhar, A. Suzuki, Y.-D. Tsai, W. M. Wood-Vasey, Y. Copin, G.-B. Zhao, and N. Zhu. *Astro2020: Decadal Survey on Astronomy and Astrophysics*, May 2019. 2020:p. 270.
- [23] **Multi-Messenger Astrophysics: Harnessing the Data Revolution.** G. Allen, W. Anderson, E. Blaufuss, J. S. Bloom, P. Brady, S. Burke-Spolaor, S. B. Cenko, A. Connolly, P. Couvares, D. Fox, A. Gal-Yam, S. Gezari, A. Goodman, D. Grant, P. Groot, J. Guillochon, C. Hanna, D. W. Hogg, K. Holley-Bockelmann, D. A. Howell, D. Kaplan, E. Katsavounidis, M. Kowalski, L. Lehner, D. Muthukrishna, **G. Narayan**, J. E. G. Peek, A. Saha, P. Shawhan, and I. Taboada. *ArXiv e-prints*, Jul. 2018.

- [24] **The Photometric LSST Astronomical Time-series Classification Challenge (PLAsTiCC): Data set.** The PLAsTiCC team, T. Allam, Jr., A. Bahmanyar, R. Biswas, M. Dai, L. Galbany, R. Hložek, E. E. O. Ishida, S. W. Jha, D. O. Jones, R. Kessler, M. Lochner, A. A. Mahabal, A. I. Malz, K. S. Mandel, J. R. Martínez-Galarza, J. D. McEwen, D. Muthukrishna, **G. Narayan**, H. Peiris, C. M. Peters, K. Ponder, C. N. Setzer, The LSST Dark Energy Science Collaboration, T. LSST Transients, and Variable Stars Science Collaboration. *ArXiv e-prints*, Sep. 2018.
- [25] **PanSTARRS1 Observations of the Kepler/K2 Campaign 16 and 17 Fields.** J. L. Dotson, A. Rest, G. Barentsen, M. Gully-Santiago, S. W. Fleming, P. Garnavich, B. E. Tucker, D. Kasen, **G. Narayan**, E. Shaya, R. Olling, S. Margheim, A. Zenteno, A. Villar, K. C. Chambers, H. A. Flewelling, M. E. Huber, E. A. Magnier, C. Z. Waters, A. S. B. Schultz, J. Bulger, T. B. Lowe, M. Willman, S. J. Smartt, and K. W. Smith. *Research Notes of the American Astronomical Society*, Sep. 2018. 2(3):178.
- [26] A. Saha, Z. Wang, T. Matheson, **G. Narayan**, R. Snodgrass, J. Kececioglu, C. Scheidegger, T. Axelrod, T. Jenness, S. Ridgway, R. Seaman, C. Taylor, J. Toeniskoetter, E. Welch, S. Yang, and T. Zaidi. **ANTARES: Progress towards building a ‘Broker’ of time-domain alerts.** In *Observatory Operations: Strategies, Processes, and Systems VI*, vol. 9910 of *Proceedings of the SPIE*. Nov. 2016.
- [27] A. Saha, T. Matheson, R. Snodgrass, J. Kececioglu, **G. Narayan**, R. Seaman, T. Jenness, and T. Axelrod. **ANTARES: a prototype transient broker system.** In *Observatory Operations: Strategies, Processes, and Systems V*, vol. 9149 of *Proceedings of the SPIE*. Jul. 2014 p. 914908.
- [28] **KEGS Discovery of 28 Supernova Candidates in the K2 Campaign 17 Field with DECam.** **G. Narayan**, A. Rest, G. M. Strampelli, A. Zenteno, D. J. James, R. C. Smith, B. E. Tucker, P. Garnavich, S. Margheim, D. Kasen, R. Olling, E. Shaya, F. F. Buron, and V. A. Villar. *The Astronomer’s Telegram*, May 2018. 11663.

and several other TNS alerts, ATEls, and CBATs.

## Other Publications

- [29] **A Classification Algorithm for Time-domain Novelties in Preparation for LSST Alerts. Application to Variable Stars and Transients Detected with DECam in the Galactic Bulge.** M. D. Soraisam, A. Saha, T. Matheson, C.-H. Lee, **G. Narayan**, A. K. Vivas, C. Scheidegger, N. Oppermann, E. W. Olszewski, S. Sinha, S. R. Desantis, and ANTARES Collaboration. *Astrophys. J.*, Apr. 2020. 892(2):112.
- [30] **Constraining Type Ia supernova progenitor systems with stellar population age dating.** T. Takaro, R. J. Foley, C. McCully, W.-f. Fong, S. W. Jha, **G. Narayan**, A. Rest, M. Stritzinger, and K. McKinnon. *Mon. Not. R. Astron. Soc.*, Mar. 2020. 493(1):pp. 986–1002.
- [31] **Optical Polarimetry of the Tidal Disruption Event AT2019DSG.** C.-H. Lee, T. Hung, T. Matheson, M. Soraisam, **G. Narayan**, A. Saha, C. Stubens, and N. Wolf. *Astrophys. J. Lett.*, Mar. 2020. 892(1):L1.
- [32] **ZTF18abhjrcf: The First R Coronae Borealis Star from the Zwicky Transient Facility Public Survey.** C.-H. Lee, T. Matheson, M. Soraisam, **G. Narayan**, A. Saha, C. Stubens, and N. Wolf. *Astronomical J.*, Feb. 2020. 159(2):61.
- [33] **Delay Time Distributions of Type Ia Supernovae from Galaxy and Cosmic Star Formation Histories.** L.-G. Strolger, S. A. Rodney, C. Pacifici, **G. Narayan**, and O. Graur. *Astrophys. J.*, Feb. 2020. 890(2):140.
- [34] **The Foundation Supernova Survey: Measuring Cosmological Parameters with Supernovae from a Single Telescope.** D. O. Jones, D. M. Scolnic, R. J. Foley, A. Rest, R. Kessler, P. M. Challis, K. C. Chambers, D. A. Coulter, K. G. Dettman, M. M. Foley, M. E. Huber, S. W. Jha, E. Johnson, C. D. Kilpatrick, R. P. Kirshner, J. Manuel, **G. Narayan**, Y. C. Pan, A. G. Riess, A. S. B. Schultz, M. R. Siebert, E. Berger, R. Chornock, H. Flewelling, E. A. Magnier, S. J. Smartt, K. W. Smith, R. J. Wainscoat, C. Waters, and M. Willman. *Astrophys. J.*, Aug 2019. 881(1):19.
- [35] **Presto-Color: A Photometric Survey Cadence for Explosive Physics and Fast Transients.** F. B. Bianco, M. R. Drout, M. L. Graham, T. A. Pritchard, R. Biswas, **G. Narayan**, I. Andreoni, P. S. Cowperthwaite, T. Ribeiro, W. t. S. o. t. LSST Transient, and Variable Stars Collaboration. *Publ. Astron. Soc. Pac.*, Jun 2019. 131(1000):p. 068002.
- [36] **Mapping the Interstellar Reddening and Extinction toward Baade’s Window Using Minimum Light Colors of ab-type RR Lyrae Stars: Revelations from the De-reddened Color-Magnitude Diagrams.** A. Saha, A. K. Vivas, E. W. Olszewski, V. Smith, K. Olsen, R. Blum, F. Valdes, J. Claver, A. Calamida, A. R. Walker, T. Matheson, **G. Narayan**, M. Soraisam, K. Cunha, T. Axelrod, J. S. Bloom, S. B. Cenko, B. Frye, M. Juric, C. Kaleida, A. Kunder, A. Miller, D. Nidever, and S. Ridgway. *Astrophys. J.*, Mar 2019. 874(1):30.
- [37] **K2 Observations of SN 2018oh Reveal a Two-component Rising Light Curve for a Type Ia Supernova.** G. Dimitriadis, R. J. Foley, A. Rest, D. Kasen, A. L. Piro, A. Polin, D. O. Jones, A. Villar, **G. Narayan**, D. A. Coulter, C. D. Kilpatrick, Y. C. Pan, C. Rojas-Bravo, O. D. Fox, S. W. Jha, P. E. Nugent, A. G. Riess, D. Scolnic, M. R. Drout, K2 Mission Team, G. Barentsen, J. Dotson, M. Gully-Santiago, C. Hedges, A. M. Cody, T. Barclay, S. Howell, KEGS, P. Garnavich, B. E. Tucker, E. Shaya, R. Mushotzky, R. P. Olling, S. Margheim, A. Zenteno, Kepler spacecraft Team, J. Coughlin, J. E. Van Cleve, J. V. d. M. Cardoso, K. A. Larson, K. M. McCalmont-Everton, C. A. Peterson, S. E. Ross, L. H. Reedy, D. Osborne, C. McGinn, L. Kohnert, L. Migliorini, A. Wheaton, B. Spencer, C. Labonde, G. Castillo, G. Beerman, K. Steward, M. Hanley, R. Larsen, R. Gangopadhyay, R. Kloetzel, T. Weschler, V. Nystrom, J. Mofatt, M. Redick, K. Griest, M. Packard, M. Muszynski, J. Kampmeier, R. Bjella, S. Flynn, B. Elsaesser, Pan-STARRS, K. C. Chambers, H. A.

- Flewelling, M. E. Huber, E. A. Magnier, C. Z. Waters, A. S. B. Schultz, J. Bulger, T. B. Lowe, M. Willman, S. J. Smartt, K. W. Smith, DECam, S. Points, G. M. Strampelli, ASAS-SN, J. Brimacombe, P. Chen, J. A. Muñoz, R. L. Mutel, J. Shields, P. J. Vallely, J. Villanueva, S., PTSS/TNTS, W. Li, X. Wang, J. Zhang, H. Lin, J. Mo, X. Zhao, H. Sai, X. Zhang, K. Zhang, T. Zhang, L. Wang, J. Zhang, E. Baron, J. M. DerKacy, L. Li, Z. Chen, D. Xiang, L. Rui, L. Wang, F. Huang, X. Li, L. Cumbres Observatory, G. Hosseinzadeh, D. A. Howell, I. Arcavi, D. Hiramatsu, J. Burke, S. Valenti, ATLAS, J. L. Tonry, L. Denneau, A. N. Heinze, H. Weiland, B. Stalder, Konkoly, J. Vinkó, K. Sárneczky, A. Pál, A. Bódi, Z. Bognár, B. Csák, B. Cseh, G. Csörnyei, O. Hanyecz, B. Ignác, C. Kalup, R. Könyves-Tóth, L. Kriskovics, A. Ordasi, I. Rajmon, A. Sódor, R. Szabó, R. Szakáts, G. Zsidi, ePESSTO, S. C. Williams, J. Nordin, R. Cartier, C. Frohmaier, L. Galbany, C. P. Gutiérrez, I. Hook, C. Inserra, M. Smith, U. o. Arizona, D. J. Sand, J. E. Andrews, N. Smith, and C. Bilinski. *Astrophys. J.*, Jan 2019. 870(1):L1.
- [38] **Photometric and Spectroscopic Properties of Type Ia Supernova 2018oh with Early Excess Emission from the Kepler 2 Observations.** W. Li, X. Wang, J. Vinkó, J. Mo, G. Hosseinzadeh, D. J. Sand, J. Zhang, H. Lin, PTSS/TNTS, T. Zhang, L. Wang, J. Zhang, Z. Chen, D. Xiang, L. Rui, F. Huang, X. Li, X. Zhang, L. Li, E. Baron, J. M. Derkacy, X. Zhao, H. Sai, K. Zhang, L. Wang, LCO, D. A. Howell, C. McCully, I. Arcavi, S. Valenti, D. Hiramatsu, J. Burke, KEGS, A. Rest, P. Garnavich, B. E. Tucker, **G. Narayan**, E. Shaya, S. Margheim, A. Zenteno, A. Villar, UCSC, G. Dimitriadis, R. J. Foley, Y. C. Pan, D. A. Coulter, O. D. Fox, S. W. Jha, D. O. Jones, D. N. Kasen, C. D. Kilpatrick, A. L. Piro, A. G. Riess, C. Rojas-Bravo, ASAS-SN, B. J. Shappee, T. W. S. Holoien, K. Z. Stanek, M. R. Drout, K. Auchettl, C. S. Kochanek, J. S. Brown, S. Bose, D. Bersier, J. Brimacombe, P. Chen, S. Dong, S. Holmbo, J. A. Muñoz, R. L. Mutel, R. S. Post, J. L. Prieto, J. Shields, D. Tallon, T. A. Thompson, P. J. Vallely, J. Villanueva, S., Pan-STARRS, S. J. Smartt, K. W. Smith, K. C. Chambers, H. A. Flewelling, M. E. Huber, E. A. Magnier, C. Z. Waters, A. S. B. Schultz, J. Bulger, T. B. Lowe, M. Willman, Konkoly/Texas, K. Sárneczky, A. Pál, J. C. Wheeler, A. Bódi, Z. Bognár, B. Csák, B. Cseh, G. Csörnyei, O. Hanyecz, B. Ignác, C. Kalup, R. Könyves-Tóth, L. Kriskovics, A. Ordasi, I. Rajmon, A. Sódor, R. Szabó, R. Szakáts, G. Zsidi, U. o. Arizona, P. Milne, J. E. Andrews, N. Smith, C. Bilinski, Swift, P. J. Brown, ePESSTO, J. Nordin, S. C. Williams, L. Galbany, J. Palmerio, I. M. Hook, C. Inserra, K. Maguire, R. Cartier, A. Razza, C. P. Gutiérrez, U. o. North Carolina, J. J. Hermes, J. S. Reding, B. C. Kaiser, ATLAS, J. L. Tonry, A. N. Heinze, L. Denneau, H. Weiland, B. Stalder, K2 Mission Team, G. Barentsen, J. Dotson, T. Barclay, M. Gully-Santiago, C. Hedges, A. M. Cody, S. Howell, Kepler Spacecraft Team, J. Coughlin, J. E. Van Cleve, J. V. d. M. Cardoso, K. A. Larson, K. M. McCalmont-Everton, C. A. Peterson, S. E. Ross, L. H. Reedy, D. Osborne, C. McGinn, L. Kohnert, L. Migliorini, A. Wheaton, B. Spencer, C. Labonde, G. Castillo, G. Beerman, K. Steward, M. Hanley, R. Larsen, R. Gangopadhyay, R. Kloetzel, T. Weschler, V. Nystrom, J. Moffatt, M. Redick, K. Griest, M. Packard, M. Muszynski, J. Kampmeier, R. Bjella, S. Flynn, and B. Elsaesser. *Astrophys. J.*, Jan 2019. 870(1):12.
- [39] **Seeing Double: ASASSN-18bt Exhibits a Two-component Rise in the Early-time K2 Light Curve.** B. J. Shappee, T. W. S. Holoien, M. R. Drout, K. Auchettl, M. D. Stritzinger, C. S. Kochanek, K. Z. Stanek, E. Shaya, **G. Narayan**, ASAS-SN, J. S. Brown, S. Bose, D. Bersier, J. Brimacombe, P. Chen, S. Dong, S. Holmbo, B. Katz, J. A. Muñoz, R. L. Mutel, R. S. Post, J. L. Prieto, J. Shields, D. Tallon, T. A. Thompson, P. J. Vallely, J. Villanueva, S., ATLAS, L. Denneau, H. Flewelling, A. N. Heinze, K. W. Smith, B. Stalder, J. L. Tonry, H. Weiland, Kepler/K2, T. Barclay, G. Barentsen, A. M. Cody, J. Dotson, F. Foerster, P. Garnavich, M. Gully-Santiago, C. Hedges, S. Howell, D. Kasen, S. Margheim, R. Mushotzky, A. Rest, B. E. Tucker, A. Villar, A. Zenteno, Kepler Spacecraft Team, G. Beerman, R. Bjella, G. Castillo, J. Coughlin, B. Elsaesser, S. Flynn, R. Gangopadhyay, K. Griest, M. Hanley, J. Kampmeier, R. Kloetzel, L. Kohnert, C. Labonde, R. Larsen, K. A. Larson, K. M. McCalmont-Everton, C. McGinn, L. Migliorini, J. Muszynski, V. Nystrom, D. Osborne, M. Packard, C. A. Peterson, M. Redick, L. H. Reedy, S. E. Ross, B. Spencer, K. Steward, J. E. Van Cleve, J. V. d. M. Cardoso, T. Weschler, A. Wheaton, Pan-STARRS, J. Bulger, K. C. Chambers, H. A. Flewelling, M. E. Huber, T. B. Lowe, E. A. Magnier, A. S. B. Schultz, C. Z. Waters, M. Willman, PTSS/TNTS, E. Baron, Z. Chen, J. M. Derkacy, F. Huang, L. Li, W. Li, X. Li, J. Mo, L. Rui, H. Sai, L. Wang, L. Wang, X. Wang, D. Xiang, J. Zhang, J. Zhang, K. Zhang, X. Zhang, X. Zhao, P. J. Brown, J. J. Hermes, J. Nordin, S. Points, A. Sódor, G. M. Strampelli, and A. Zenteno. *Astrophys. J.*, Jan 2019. 870(1):13.
- [40] **Extending Supernova Spectral Templates for Next-generation Space Telescope Observations.** J. D. R. Pierel, S. Rodney, A. Avelino, F. Bianco, A. V. Filippenko, R. J. Foley, A. Friedman, M. Hicken, R. Hounsell, S. W. Jha, R. Kessler, R. P. Kirshner, K. Mandel, **G. Narayan**, D. Scolnic, and L. Strolger. *Publ. Astron. Soc. Pac.*, Nov. 2018. 130(11):p. 114504.
- [41] **The Photometric LSST Astronomical Time-series Classification Challenge PLAsTiCC: Selection of a Performance Metric for Classification Probabilities Balancing Diverse Science Goals.** A. I. Malz, R. Hložek, J. Allam, T., A. Bahmanyar, R. Biswas, M. Dai, L. Galbany, E. E. O. Ishida, S. W. Jha, D. O. Jones, R. Kessler, M. Lochner, A. A. Mahabal, K. S. Mand el, J. R. Martínez-Galarza, J. D. McEwen, D. Muthukrishna, **G. Narayan**, H. Peiris, C. M. Peters, K. Ponder, C. N. Setzer, (the LSST Dark Energy Science Collaboration, t. LSST Transients, and Variable Stars Science Collaboration. *Astronomical J.*, Nov. 2019. 158(5):171.
- [42] **MOSFiT: Modular Open Source Fitter for Transients.** J. Guillochon, M. Nicholl, V. A. Villar, B. Mockler, **G. Narayan**, K. S. Mandel, E. Berger, and P. K. G. Williams. *Astrophys. J. Suppl. Ser.*, May 2018. 236:6.
- [43] **Overview of the DESI Legacy Imaging Surveys.** A. Dey, D. J. Schlegel, D. Lang, R. Blum, K. Burleigh, X. Fan, J. R. Findlay, D. Finkbeiner, D. Herrera, S. Juneau, M. Landriau, M. Levi, I. McGreer, A. Meisner, A. D. Myers, J. Moustakas, P. Nugent, A. Patej, E. F. Schlafly, A. R. Walker, F. Valdes, B. A. Weaver, C. Yèche, H. Zou, X. Zhou, B. Abareshi, T. M. C. Abbott, B. Abolfathi, C. Aguilera, S. Alam, L. Allen, A. Alvarez, J. Annis, B. Ansarinejad, M. Aubert, J. Beechert, E. F. Bell, S. Y. BenZvi, F. Beutler, R. M. Bielby, A. S. Bolton, C. Briceño, E. J. Buckley-Geer, K. Butler, A. Calamida, R. G. Carlberg, P. Carter, R. Casas, F. J. Castander, Y. Choi, J. Comparat, E. Cukanovaite, T. Delubac, K. DeVries, S. Dey, G. Dhungana, M. Dickinson, Z. Ding, J. B. Donaldson, Y. Duan, C. J. Duckworth, S. Eftekharzadeh, D. J. Eisenstein, T. Etourneau, P. A. Fagrellius, J. Farihi, M. Fitzpatrick, A. Font-Ribera, L. Fulmer, B. T. Gänsicke, E. Gaztanaga, K. George, D. W. Gerdes, S. G. A. Gontcho, C. Gorgoni, G. Green, J. Guy, D. Harmer, M. Hernand ez, K. Honschdel, L. W. Huang, D. J. James, B. T. Jannuzi, L. Jiang, R. Joyce, A. Karcher, S. Karkar, R. Kehoe, J.-P. Kneib, A. Kueter-Young, T.-W. Lan, T. R. Lauer, L. Le Guillou, A. Le Van Suu, J. H. Lee, M. Lesser, L. Perreault Levasseur, T. S. Li, J. L. Mann, R. Marshall, C. E. Martínez-Vázquez, P. Martini, H. du Mas des Bourboux, S. McManus, T. G. Meier, B. Ménard, N. Metcalfe, A. Muñoz-Gutiérrez, J. Najita, K. Napier, **G. Narayan**, J. A. Newman, J. Nie, B. Nord, D. J. Norman, K. A. G. Olsen, A. Paat, N. Palanque-Delabrouille, X. Peng, C. L. Poppett, M. R. Poremba, A. Prakash, D. Rabinowitz, A. Raichoor, M. Rezaie, A. N. Robertson, N. A. Roe, A. J. Ross, N. P. Ross, G. Rudnick, S. Safonova, A. Saha,

- F. J. Sánchez, E. Savary, H. Schweiker, A. Scott, H.-J. Seo, H. Shan, D. R. Silva, Z. Slepian, C. Soto, D. Sprayberry, R. Staten, C. M. Stillman, R. J. Stupak, D. L. Summers, S. Sien Tie, H. Tirado, M. Vargas-Magaña, A. K. Vivas, R. H. Wechsler, D. Williams, J. Yang, Q. Yang, T. Yapici, D. Zaritsky, A. Zenteno, K. Zhang, T. Zhang, R. Zhou, and Z. Zhou. *Astronomical J.*, May 2019. 157(5):168.
- [44] **Absolute Magnitudes and Colors of RR Lyrae Stars in DECam Passbands from Photometry of the Globular Cluster M5.** A. K. Vivas, A. Saha, K. Olsen, R. Blum, E. W. Olszewski, J. Claver, F. Valdes, T. Axelrod, C. Kaleida, A. Kunder, **G. Narayan**, T. Matheson, and A. Walker. *Astronomical J.*, Sep. 2017. 154:85.
- [45] **The GALEX Time Domain Survey. II. Wavelength-Dependent Variability of Active Galactic Nuclei in the Pan-STARRS1 Medium Deep Survey.** T. Hung, S. Gezari, D. O. Jones, R. P. Kirshner, R. Chornock, E. Berger, A. Rest, M. Huber, **G. Narayan**, D. Scolnic, C. Waters, R. Wainscoat, D. C. Martin, K. Forster, and J. D. Neill. *Astrophys. Journal*, Dec. 2016. 833:226.
- [46] **CfAIR2: Near-infrared Light Curves of 94 Type Ia Supernovae.** A. S. Friedman, W. M. Wood-Vasey, G. H. Marion, P. Challis, K. S. Mandel, J. S. Bloom, M. Modjaz, **G. Narayan**, M. Hicken, R. J. Foley, C. R. Klein, D. L. Starr, A. Morgan, A. Rest, C. H. Blake, A. A. Miller, E. E. Falco, W. F. Wyatt, J. Mink, M. F. Skrutskie, and R. P. Kirshner. *Astrophys. J. Suppl. Ser.*, Sep. 2015. 220:9.
- [47] **PS1-10jh Continues to Follow the fallback Accretion Rate of a Tidally Disrupted Star.** S. Gezari, R. Chornock, A. Lawrence, A. Rest, D. O. Jones, E. Berger, P. M. Challis, and **G. Narayan**. *Astrophys. J. Lett.*, Dec. 2015. 815:L5.
- [48] **The Changing Fractions of Type Ia Supernova NUV–Optical Subclasses with Redshift.** P. A. Milne, R. J. Foley, P. J. Brown, and **G. Narayan**. *Astrophys. J.*, Apr. 2015. 803:20.
- [49] **Toward Characterization of the Type IIP Supernova Progenitor Population: A Statistical Sample of Light Curves from Pan-STARRS1.** N. E. Sanders, A. M. Soderberg, S. Gezari, M. Betancourt, R. Chornock, E. Berger, R. J. Foley, P. Challis, M. Drout, R. P. Kirshner, R. Lunnan, G. H. Marion, R. Margutti, R. McKinnon, D. Milisavljevic, **G. Narayan**, A. Rest, E. Kankare, S. Mattila, S. J. Smartt, M. E. Huber, W. S. Burgett, P. W. Draper, K. W. Hodapp, N. Kaiser, R. P. Kudritzki, E. A. Magnier, N. Metcalfe, J. S. Morgan, P. A. Price, J. L. Tonry, R. J. Wainscoat, and C. Waters. *Astrophys. J.*, Feb. 2015. 799:208.
- [50] **Zooming In on the Progenitors of Superluminous Supernovae With the HST.** R. Lunnan, R. Chornock, E. Berger, A. Rest, W. Fong, D. Scolnic, D. O. Jones, A. M. Soderberg, P. M. Challis, M. R. Drout, R. J. Foley, M. E. Huber, R. P. Kirshner, C. Leibler, G. H. Marion, M. McCrum, D. Milisavljevic, **G. Narayan**, N. E. Sanders, S. J. Smartt, K. W. Smith, J. L. Tonry, W. S. Burgett, K. C. Chambers, H. Flewelling, R.-P. Kudritzki, R. J. Wainscoat, and C. Waters. *Astrophys. J.*, May 2015. 804:90.
- [51] **Selection of Burst-like Transients and Stochastic Variables Using Multi-band Image Differencing in the PAN-STARRS1 Medium-deep Survey.** S. Kumar, S. Gezari, S. Heinis, R. Chornock, E. Berger, A. Rest, M. E. Huber, R. J. Foley, **G. Narayan**, G. H. Marion, D. Scolnic, A. Soderberg, A. Lawrence, C. W. Stubbs, R. P. Kirshner, A. G. Riess, S. J. Smartt, K. Smith, W. M. Wood-Vasey, W. S. Burgett, K. C. Chambers, H. Flewelling, N. Kaiser, N. Metcalfe, P. A. Price, J. L. Tonry, and R. J. Wainscoat. *Astrophys. J.*, Mar. 2015. 802:27.
- [52] **Possible Detection of the Stellar Donor or Remnant for the Type Iax Supernova 2008ha.** R. J. Foley, C. McCully, S. W. Jha, L. Bildsten, W.-f. Fong, **G. Narayan**, A. Rest, and M. D. Stritzinger. *Astrophys. J.*, Sep. 2014. 792:29.
- [53] **Rapidly Evolving and Luminous Transients from Pan-STARRS1.** M. R. Drout, R. Chornock, A. M. Soderberg, N. E. Sanders, R. McKinnon, A. Rest, R. J. Foley, D. Milisavljevic, R. Margutti, E. Berger, M. Calkins, W. Fong, S. Gezari, M. E. Huber, E. Kankare, R. P. Kirshner, C. Leibler, R. Lunnan, S. Mattila, G. H. Marion, **G. Narayan**, A. G. Riess, K. C. Roth, D. Scolnic, S. J. Smartt, J. L. Tonry, W. S. Burgett, K. C. Chambers, K. W. Hodapp, R. Jedicke, N. Kaiser, E. A. Magnier, N. Metcalfe, J. S. Morgan, P. A. Price, and C. Waters. *Astrophys. J.*, Oct. 2014. 794:23.
- [54] **Hydrogen-poor Superluminous Supernovae and Long-duration Gamma-Ray Bursts Have Similar Host Galaxies.** R. Lunnan, R. Chornock, E. Berger, T. Laskar, W. Fong, A. Rest, N. E. Sanders, P. M. Challis, M. R. Drout, R. J. Foley, M. E. Huber, R. P. Kirshner, C. Leibler, G. H. Marion, M. McCrum, D. Milisavljevic, **G. Narayan**, D. Scolnic, S. J. Smartt, K. W. Smith, A. M. Soderberg, J. L. Tonry, W. S. Burgett, K. C. Chambers, H. Flewelling, K. W. Hodapp, N. Kaiser, E. A. Magnier, P. A. Price, and R. J. Wainscoat. *Astrophys. J.*, Jun. 2014. 787:138.
- [55] **The Ultraviolet-bright, Slowly Declining Transient PS1-11af as a Partial Tidal Disruption Event.** R. Chornock, E. Berger, S. Gezari, B. A. Zauderer, A. Rest, L. Chomiuk, A. Kamble, A. M. Soderberg, I. Czekala, J. Dittmann, M. Drout, R. J. Foley, W. Fong, M. E. Huber, R. P. Kirshner, A. Lawrence, R. Lunnan, G. H. Marion, **G. Narayan**, A. G. Riess, K. C. Roth, N. E. Sanders, D. Scolnic, S. J. Smartt, K. Smith, C. W. Stubbs, J. L. Tonry, W. S. Burgett, K. C. Chambers, H. Flewelling, K. W. Hodapp, N. Kaiser, E. A. Magnier, D. C. Martin, J. D. Neill, P. A. Price, and R. Wainscoat. *Astrophys. J.*, Jan. 2014. 780:44.
- [56] **Slowly fading super-luminous supernovae that are not pair-instability explosions.** M. Nicholl, S. J. Smartt, A. Jerkstrand, C. Inserra, M. McCrum, R. Kotak, M. Fraser, D. Wright, T.-W. Chen, K. Smith, D. R. Young, S. A. Sim, S. Valenti, D. A. Howell, F. Bresolin, R. P. Kudritzki, J. L. Tonry, M. E. Huber, A. Rest, A. Pastorello, L. Tomasella, E. Cappellaro, S. Benetti, S. Mattila, E. Kankare, T. Kangas, G. Leloudas, J. Sollerman, F. Taddia, E. Berger, R. Chornock, **G. Narayan**, C. W. Stubbs, R. J. Foley, R. Lunnan, A. Soderberg, N. Sanders, D. Milisavljevic, R. Margutti, R. P. Kirshner, N. Elias-Rosa, A. Morales-Garoffolo, S. Taubenberger, M. T. Botticella, S. Gezari, Y. Urata, S. Rodney, A. G. Riess, D. Scolnic, W. M. Wood-Vasey, W. S. Burgett, K. Chambers, H. A. Flewelling, E. A. Magnier, N. Kaiser, N. Metcalfe, J. Morgan, P. A. Price, W. Sweeney, and C. Waters. *Nature*, Oct. 2013. 502:pp. 346–349.



- [57] **PSI-10afx at  $z = 1.388$ : Pan-STARRS1 Discovery of a New Type of Superluminous Supernova.** R. Chornock, E. Berger, A. Rest, D. Milisavljevic, R. Lunnan, R. J. Foley, A. M. Soderberg, S. J. Smartt, A. J. Burgasser, P. Challis, L. Chomiuk, I. Czekala, M. Drout, W. Fong, M. E. Huber, R. P. Kirshner, C. Leibler, B. McLeod, G. H. Marion, **G. Narayan**, A. G. Riess, K. C. Roth, N. E. Sanders, D. Scolnic, K. Smith, C. W. Stubbs, J. L. Tonry, S. Valenti, W. S. Burgett, K. C. Chambers, K. W. Hodapp, N. Kaiser, R.-P. Kudritzki, E. A. Magnier, and P. A. Price. *Astrophys. J.*, Apr. 2013. 767:162.
- [58] **PSI-10bzj: A Fast, Hydrogen-poor Superluminous Supernova in a Metal-poor Host Galaxy.** R. Lunnan, R. Chornock, E. Berger, D. Milisavljevic, M. Drout, N. E. Sanders, P. M. Challis, I. Czekala, R. J. Foley, W. Fong, M. E. Huber, R. P. Kirshner, C. Leibler, G. H. Marion, M. McCrum, **G. Narayan**, A. Rest, K. C. Roth, D. Scolnic, S. J. Smartt, K. Smith, A. M. Soderberg, C. W. Stubbs, J. L. Tonry, W. S. Burgett, K. C. Chambers, R.-P. Kudritzki, E. A. Magnier, and P. A. Price. *Astrophys. J. Lett.*, Jul. 2013. 771:97.
- [59] **SN 2010ay is a Luminous and Broad-lined Type Ic Supernova within a Low-metallicity Host Galaxy.** N. E. Sanders, A. M. Soderberg, S. Valenti, R. J. Foley, R. Chornock, L. Chomiuk, E. Berger, S. Smartt, K. Hurley, S. D. Barthelmy, E. M. Levesque, **G. Narayan**, M. T. Botticella, M. S. Briggs, V. Connaughton, Y. Terada, N. Gehrels, S. Golenetskii, E. Mazets, T. Cline, A. von Kienlin, W. Boynton, K. C. Chambers, T. Grav, J. N. Heasley, K. W. Hodapp, R. Jedicke, N. Kaiser, R. P. Kirshner, R.-P. Kudritzki, G. A. Luppino, R. H. Lupton, E. A. Magnier, D. G. Monet, J. S. Morgan, P. M. Onaka, P. A. Price, C. W. Stubbs, J. L. Tonry, R. J. Wainscoat, and M. F. Waterson. *Astrophys. J.*, Sep. 2012. 756:184.
- [60] **Ultraluminous Supernovae as a New Probe of the Interstellar Medium in Distant Galaxies.** E. Berger, R. Chornock, R. Lunnan, R. Foley, I. Czekala, A. Rest, C. Leibler, A. M. Soderberg, K. Roth, **G. Narayan**, M. E. Huber, D. Milisavljevic, N. E. Sanders, M. Drout, R. Margutti, R. P. Kirshner, G. H. Marion, P. J. Challis, A. G. Riess, S. J. Smartt, W. S. Burgett, K. W. Hodapp, J. N. Heasley, N. Kaiser, R.-P. Kudritzki, E. A. Magnier, M. McCrum, P. A. Price, K. Smith, J. L. Tonry, and R. J. Wainscoat. *Astrophys. J. Lett.*, Aug. 2012. 755:L29.
- [61] **CfA4: Light Curves for 94 Type Ia Supernovae.** M. Hicken, P. Challis, R. P. Kirshner, A. Rest, C. E. Cramer, W. M. Wood-Vasey, G. Bakos, P. Berlind, W. R. Brown, N. Caldwell, M. Calkins, T. Currie, K. de Kleer, G. Esquerdo, M. Everett, E. Falco, J. Fernandez, A. S. Friedman, T. Groner, J. Hartman, M. J. Holman, R. Hutchins, S. Keys, D. Kipping, D. Latham, G. H. Marion, **G. Narayan**, M. Pahre, A. Pal, W. Peters, G. Perumpilly, B. Ripman, B. Sipocz, A. Szentgyorgyi, S. Tang, M. A. P. Torres, A. Vaz, S. Wolk, and A. Zezas. *Astrophys. J. Suppl. Ser.*, Jun. 2012. 200:12.
- [62] **An ultraviolet-optical flare from the tidal disruption of a helium-rich stellar core.** S. Gezari, R. Chornock, A. Rest, M. E. Huber, K. Forster, E. Berger, P. J. Challis, J. D. Neill, D. C. Martin, T. Heckman, A. Lawrence, C. Norman, **G. Narayan**, R. J. Foley, G. H. Marion, D. Scolnic, L. Chomiuk, A. Soderberg, K. Smith, R. P. Kirshner, A. G. Riess, S. J. Smartt, C. W. Stubbs, J. L. Tonry, W. M. Wood-Vasey, W. S. Burgett, K. C. Chambers, T. Grav, J. N. Heasley, N. Kaiser, R.-P. Kudritzki, E. A. Magnier, J. S. Morgan, and P. A. Price. *Nature*, May 2012. 485:pp. 217–220.
- [63] **Pan-STARRS1 Discovery of Two Ultraluminous Supernovae at  $z \sim 0.9$ .** L. Chomiuk, R. Chornock, A. M. Soderberg, E. Berger, R. A. Chevalier, R. J. Foley, M. E. Huber, **G. Narayan**, A. Rest, S. Gezari, R. P. Kirshner, A. Riess, S. A. Rodney, S. J. Smartt, C. W. Stubbs, J. L. Tonry, W. M. Wood-Vasey, W. S. Burgett, K. C. Chambers, I. Czekala, H. Flewelling, K. Forster, N. Kaiser, R.-P. Kudritzki, E. A. Magnier, D. C. Martin, J. S. Morgan, J. D. Neill, P. A. Price, K. C. Roth, N. E. Sanders, and R. J. Wainscoat. *Astrophys. J.*, Dec. 2011. 743:114.
- [64] **Direct Confirmation of the Asymmetry of the Cas A Supernova with Light Echoes.** A. Rest, R. J. Foley, B. Sinnott, D. L. Welch, C. Badenes, A. V. Filippenko, M. Bergmann, W. A. Bhatti, S. Blondin, P. Challis, G. Damke, H. Finley, M. E. Huber, D. Kasen, R. P. Kirshner, T. Matheson, P. Mazzali, D. Minniti, R. Nakajima, **G. Narayan**, K. Olsen, D. Sauer, R. C. Smith, and N. B. Suntzeff. *Astrophys. J.*, May 2011. 732:3.
- [65] **On the Interpretation of Supernova Light Echo Profiles and Spectra.** A. Rest, B. Sinnott, D. L. Welch, R. J. Foley, **G. Narayan**, K. Mandel, M. E. Huber, and S. Blondin. *Astrophys. J.*, May 2011. 732:2.
- [66] **Precise Throughput Determination of the PanSTARRS Telescope and the Gigapixel Imager Using a Calibrated Silicon Photodiode and a Tunable Laser: Initial Results.** C. W. Stubbs, P. Doherty, C. Cramer, **G. Narayan**, Y. J. Brown, K. R. Lykke, J. T. Woodward, and J. L. Tonry. *Astrophys. J. Suppl. Ser.*, Dec. 2010. 191:pp. 376–388.
- [67] **Supernova 2009kf: An Ultraviolet Bright Type IIP Supernova Discovered with Pan-STARRS 1 and GALEX.** M. T. Botticella, C. Trundle, A. Pastorello, S. Rodney, A. Rest, S. Gezari, S. J. Smartt, **G. Narayan**, M. E. Huber, J. L. Tonry, D. Young, K. Smith, F. Bresolin, S. Valenti, R. Kotak, S. Mattila, E. Kankare, W. M. Wood-Vasey, A. Riess, J. D. Neill, K. Forster, D. C. Martin, C. W. Stubbs, W. S. Burgett, K. C. Chambers, T. Dombek, H. Flewelling, T. Grav, J. N. Heasley, K. W. Hodapp, N. Kaiser, R. Kudritzki, G. Luppino, R. H. Lupton, E. A. Magnier, D. G. Monet, J. S. Morgan, P. M. Onaka, P. A. Price, P. H. Rhoads, W. A. Siegmund, W. E. Sweeney, R. J. Wainscoat, C. Waters, M. F. Waterson, and C. G. Wynn-Williams. *Astrophys. J. Lett.*, Jul. 2010. 717:pp. L52–L56.
- [68] **CfA3: 185 Type Ia Supernova Light Curves from the CfA.** M. Hicken, P. Challis, S. Jha, R. P. Kirshner, T. Matheson, M. Modjaz, A. Rest, W. M. Wood-Vasey, G. Bakos, E. J. Barton, P. Berlind, A. Bragg, C. Briceño, W. R. Brown, N. Caldwell, M. Calkins, R. Cho, L. Ciupik, M. Contreras, K.-C. Dendy, A. Dosaj, N. Durham, K. Eriksen, G. Esquerdo, M. Everett, E. Falco, J. Fernandez, A. Gaba, P. Garnavich, G. Graves, P. Green, T. Groner, C. Hergenrother, M. J. Holman, V. Hradecky, J. Huchra, B. Hutchison, D. Jerius, A. Jordan, R. Kilgard, M. Krauss, K. Luhman, L. Macri, D. Marrone, J. McDowell, D. McIntosh, B. McNamara, T. Megeath, B. Mochejska, D. Munoz, J. Muzerolle, O. Naranjo, **G. Narayan**, M. Pahre, W. Peters, D. Peterson, K. Rines, B. Ripman, A. Roussanova, R. Schild, A. Sicilia-Aguilar, J. Sokoloski, K. Smalley, A. Smith, T. Spahr, K. Z. Stanek, P. Barmby, S. Blondin, C. W. Stubbs, A. Szentgyorgyi, M. A. P. Torres, A. Vaz, A. Vikhlinin, Z. Wang, M. Westover, D. Woods, and P. Zhao. *Astrophys. J.*, Jul. 2009. 700:pp. 331–357.

- [69] **Time Dilation in Type Ia Supernova Spectra at High Redshift.** S. Blondin, T. M. Davis, K. Krisciunas, B. P. Schmidt, J. Sollerman, W. M. Wood-Vasey, A. C. Becker, P. Challis, A. Clocchiatti, G. Damke, A. V. Filippenko, R. J. Foley, P. M. Garnavich, S. W. Jha, R. P. Kirshner, B. Leibundgut, W. Li, T. Matheson, G. Miknaitis, **G. Narayan**, G. Pignata, A. Rest, A. G. Riess, J. M. Silverman, R. C. Smith, J. Spyromilio, M. Stritzinger, C. W. Stubbs, N. B. Suntzeff, J. L. Tonry, B. E. Tucker, and A. Zenteno. *Astrophys. J.*, Aug. 2008. 682:pp. 724–736.
- [70] **Exploring the Outer Solar System with the ESSENCE Supernova Survey.** A. C. Becker, K. Arraki, N. A. Kaib, W. M. Wood-Vasey, C. Aguilera, J. W. Blackman, S. Blondin, P. Challis, A. Clocchiatti, R. Covarrubias, G. Damke, T. M. Davis, A. V. Filippenko, R. J. Foley, A. Garg, P. M. Garnavich, M. Hicken, S. Jha, R. P. Kirshner, K. Krisciunas, B. Leibundgut, W. Li, T. Matheson, A. Miceli, G. Miknaitis, **G. Narayan**, G. Pignata, J. L. Prieto, A. Rest, A. G. Riess, M. E. Salvo, B. P. Schmidt, R. C. Smith, J. Sollerman, J. Spyromilio, C. W. Stubbs, N. B. Suntzeff, J. L. Tonry, and A. Zenteno. *Astrophys. J. Lett.*, Jul. 2008. 682:pp. L53–L56.
- [71] **Observational Constraints on the Nature of Dark Energy: First Cosmological Results from the ESSENCE Supernova Survey.** W. M. Wood-Vasey, G. Miknaitis, C. W. Stubbs, S. Jha, A. G. Riess, P. M. Garnavich, R. P. Kirshner, C. Aguilera, A. C. Becker, J. W. Blackman, S. Blondin, P. Challis, A. Clocchiatti, A. Conley, R. Covarrubias, T. M. Davis, A. V. Filippenko, R. J. Foley, A. Garg, M. Hicken, K. Krisciunas, B. Leibundgut, W. Li, T. Matheson, A. Miceli, **G. Narayan**, G. Pignata, J. L. Prieto, A. Rest, M. E. Salvo, B. P. Schmidt, R. C. Smith, J. Sollerman, J. Spyromilio, J. L. Tonry, N. B. Suntzeff, and A. Zenteno. *Astrophys. J.*, Sep. 2007. 666:pp. 694–715.
- [72] **The ESSENCE Supernova Survey: Survey Optimization, Observations, and Supernova Photometry.** G. Miknaitis, G. Pignata, A. Rest, W. M. Wood-Vasey, S. Blondin, P. Challis, R. C. Smith, C. W. Stubbs, N. B. Suntzeff, R. J. Foley, T. Matheson, J. L. Tonry, C. Aguilera, J. W. Blackman, A. C. Becker, A. Clocchiatti, R. Covarrubias, T. M. Davis, A. V. Filippenko, A. Garg, P. M. Garnavich, M. Hicken, S. Jha, K. Krisciunas, R. P. Kirshner, B. Leibundgut, W. Li, A. Miceli, **G. Narayan**, J. L. Prieto, A. G. Riess, M. E. Salvo, B. P. Schmidt, J. Sollerman, J. Spyromilio, and A. Zenteno. *Astrophys. J.*, Sep. 2007. 666:pp. 674–693.
- [73] **Physical characteristics of Comet Nucleus C/2001 OG<sub>108</sub> (LONEOS).** P. A. Abell, Y. R. Fernández, P. Pravec, L. M. French, T. L. Farnham, M. J. Gaffey, P. S. Hardsen, P. Kušnirák, L. Šarounová, S. S. Sheppard, and **G. Narayan**. *Icarus*, Dec. 2005. 179:pp. 174–194.