ASAS-SN: Big Science with Small Telescopes

Patrick Vallely

Midwest Workshop on Supernovae and Transients

02/26/2019

The Ohio State University

Global Collaboration

- T. Jayasinghe, C. S. Kochanek, J. Shields, K. Z. Stanek, T. A. Thompson, P. Vallely, J. Greco, J. F. Beacom (Ohio State)
- K. Auchettl (DARK)
- B. J. Shappee (Hawaii)
- T. W.-S. Holoien (Carnegie Fellow)
- J. L. Prieto (Diego Portales; MAS)

  Subo Dong, Ping Chen, S. Bose (KIAA-PKU)
- J. Brown (Santa Cruz)
- D. Bersier (LJMU)
- M. Stritzinger, S. Holmbo (Aarhus University)
- L. Chomiuk, J. Strader, A. Kawash (Michigan State)
- Anna Franckowiak (DESY)
- P. R. Wozniak (LANL)
- E. Falco (CfA)
- X. Dai (University of Oklahoma)
- N. Morrell (Carnegie Observatories)
- J. Brimacombe (Coral Towers Observatory)
- G. Pojmanski (Warsaw University)
- O. Pejcha, M. Pawlak (Charles University)

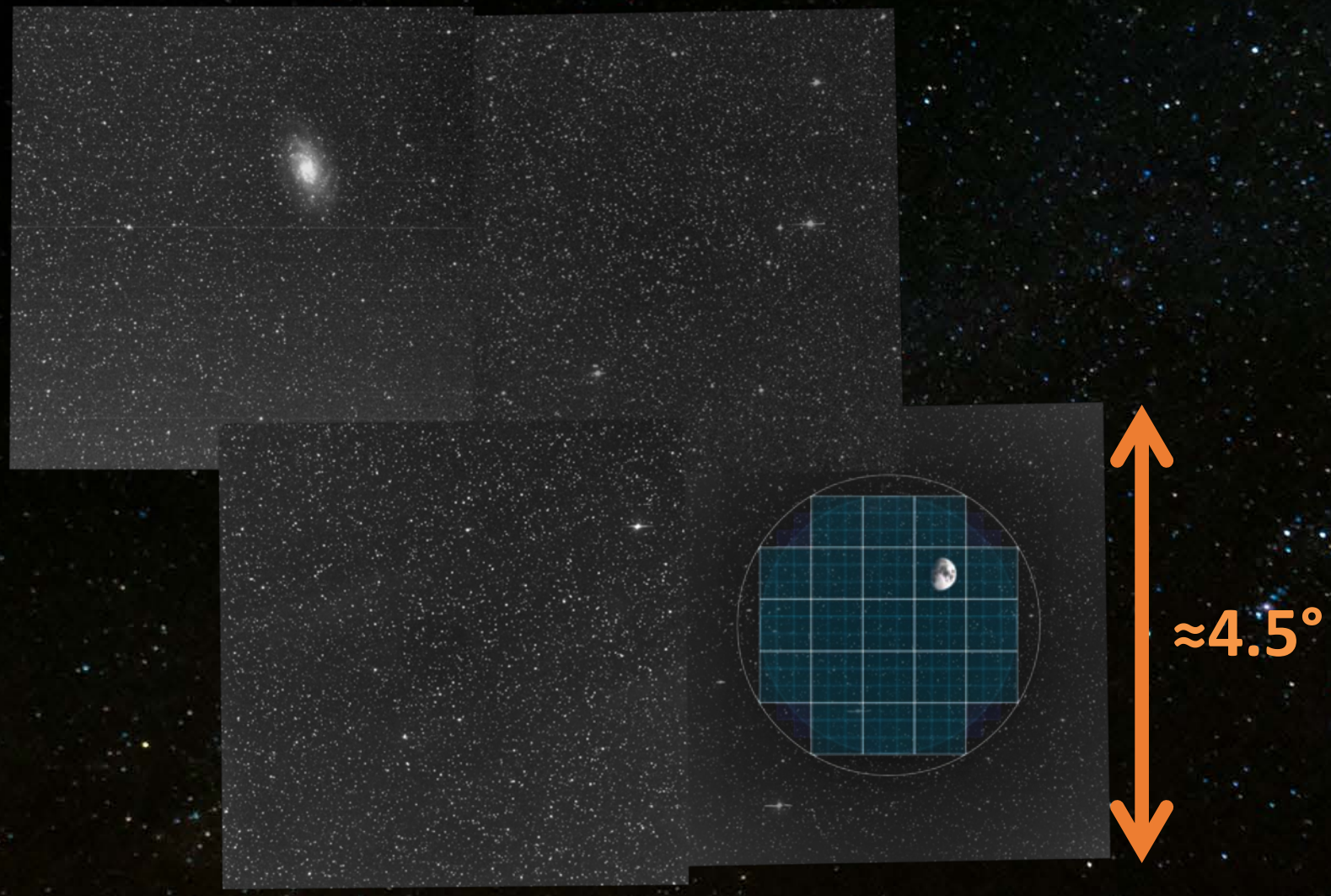
The Sun Never Sets on the ASAS-SN Empire

ASAS-SN Telescope Units

- 4 telescopes per mount
- 14cm lens, 2k × 2k thinned CCDs
- 4.47 × 4.47 degree field-of-view
- 7.8" pixel scale, 2 pixel FWHM
- g-band filters
- Limiting magnitude ≈ 18
- ~1400 images per mount per night
- ~8000 square degrees per mount per night

With 5 mounts, ~40,000 square degrees per night!

ASAS-SN Field of View



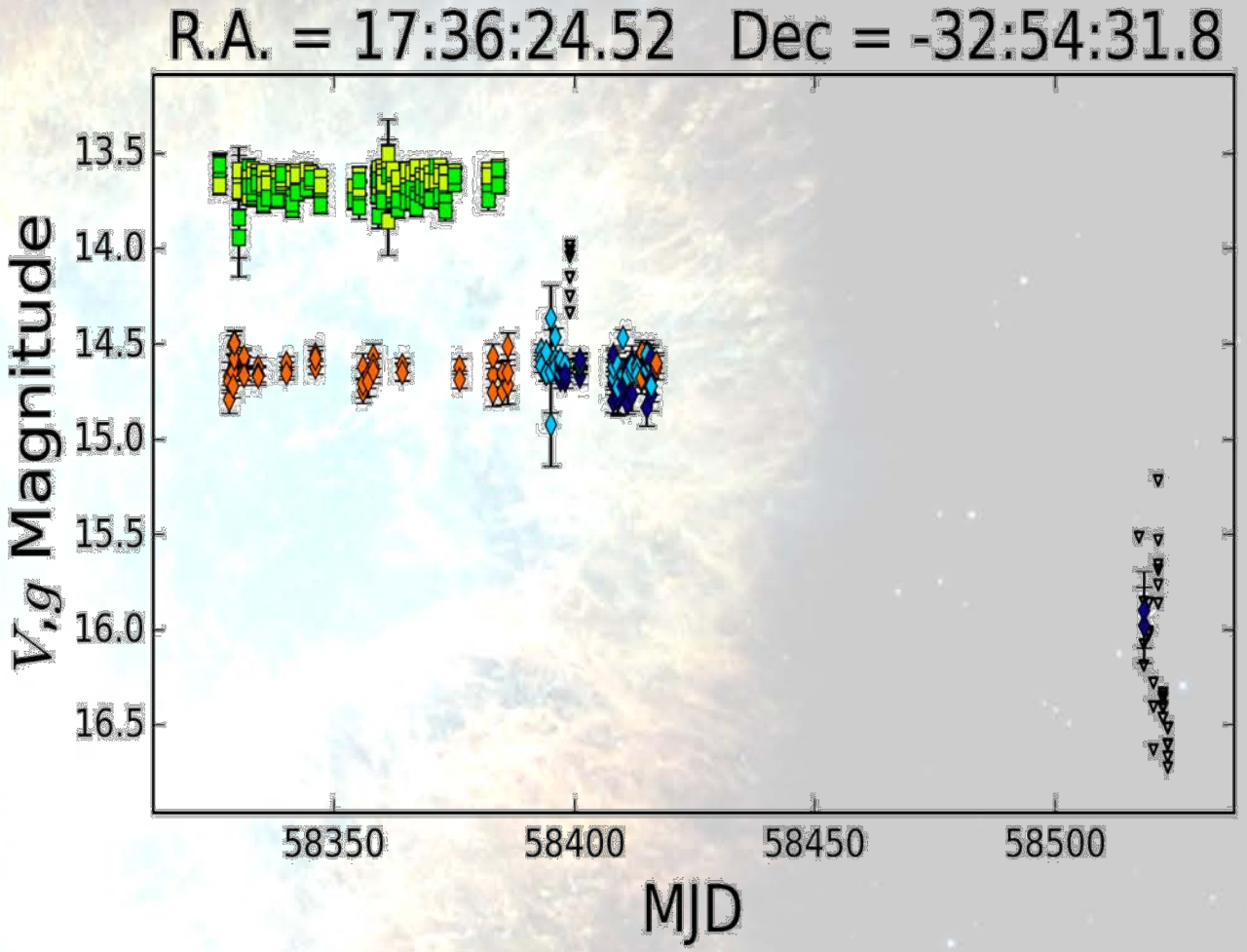
Publicly Available Data!

Sky Patrol:

https://asas-sn.osu.edu/

Variable Star Database:

https://asas-sn.osu.edu/variables

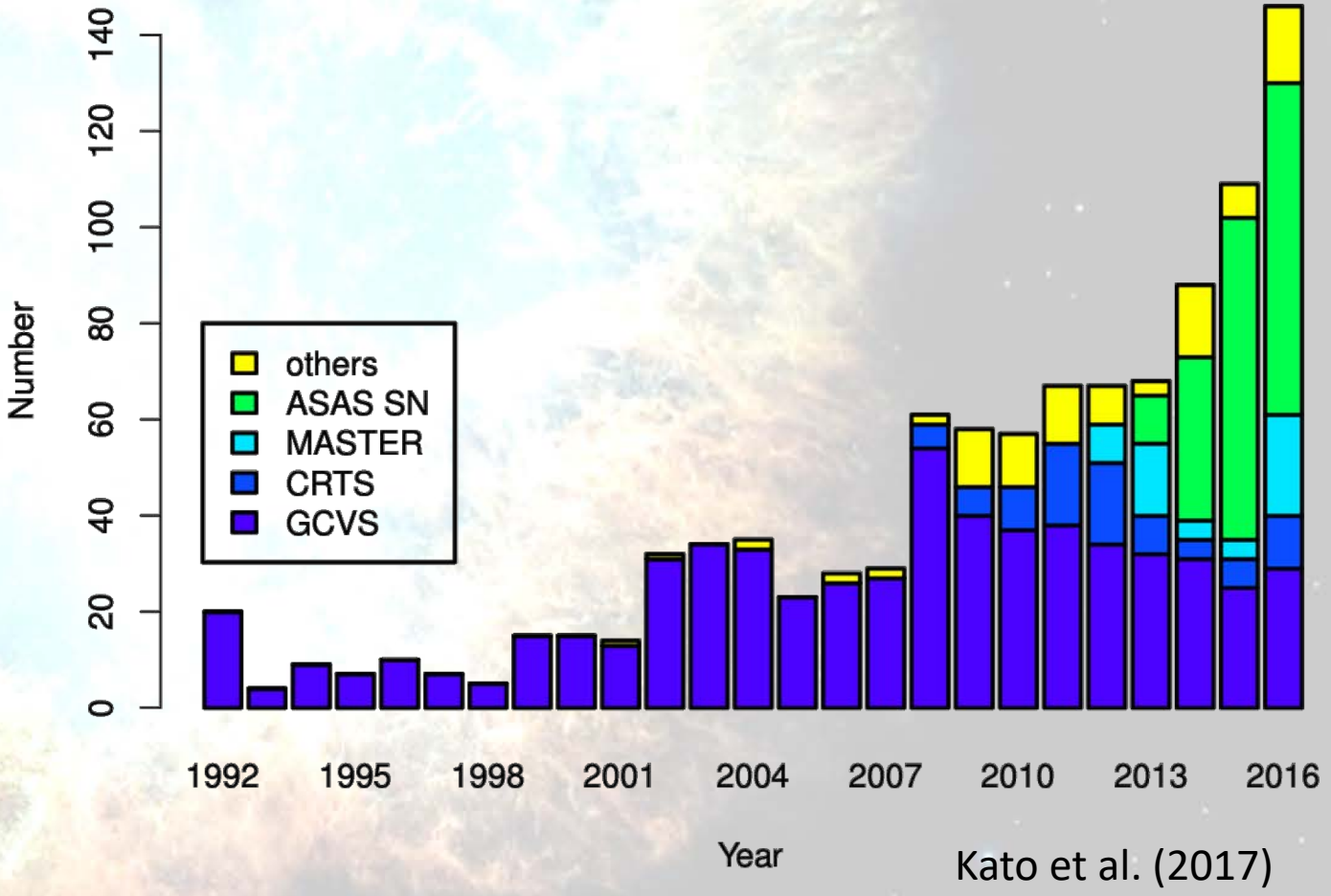


Supernovae:

http://www.astronomy.ohio-state.edu/~assassin/sn_list.html

CVs – Vermin of the Transient Sky

- Disk instabilities in accreting white dwarf systems
- Not very luminous ~10$L_{\odot}$
- But there are a lot of them!

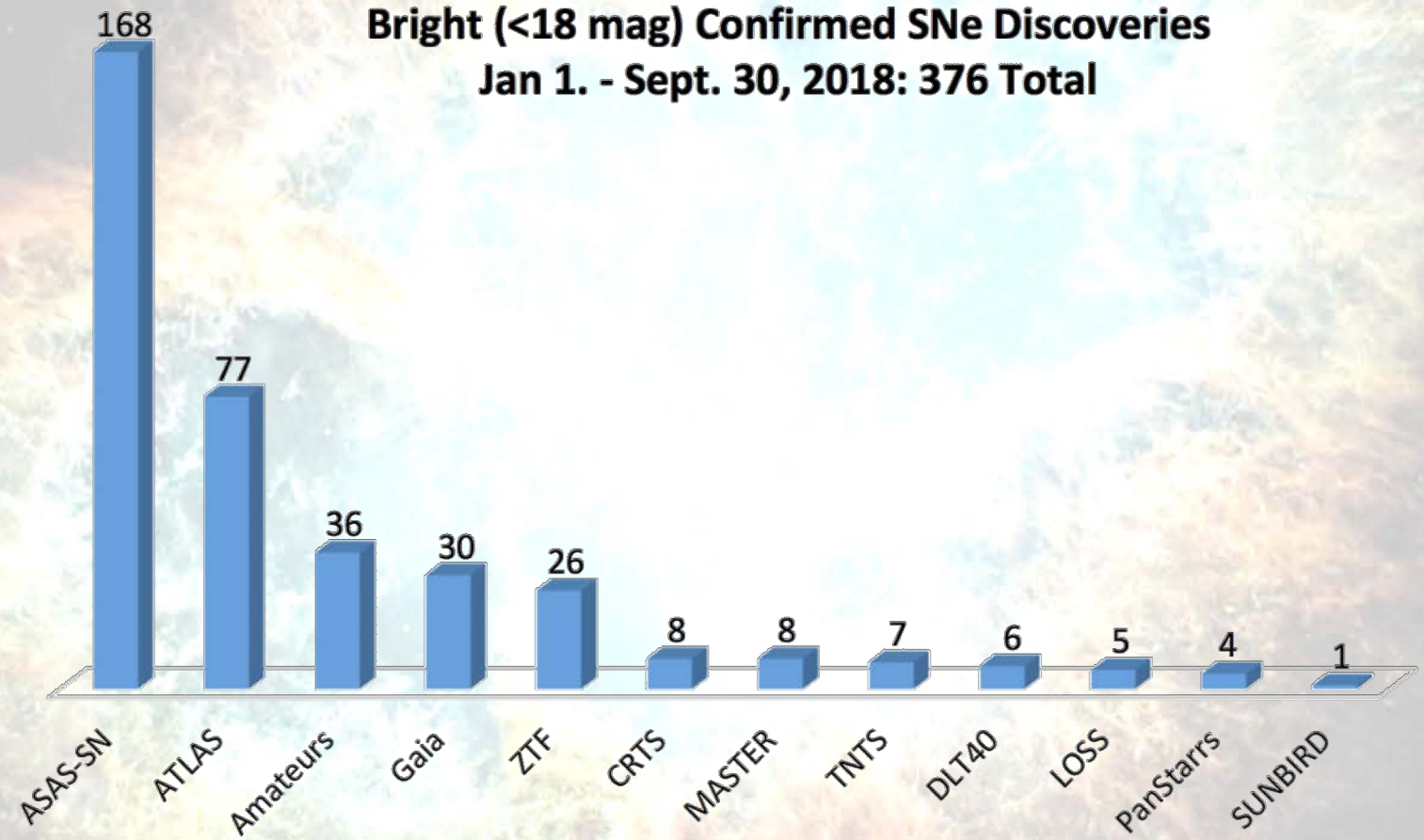


Kato et al. (2017)

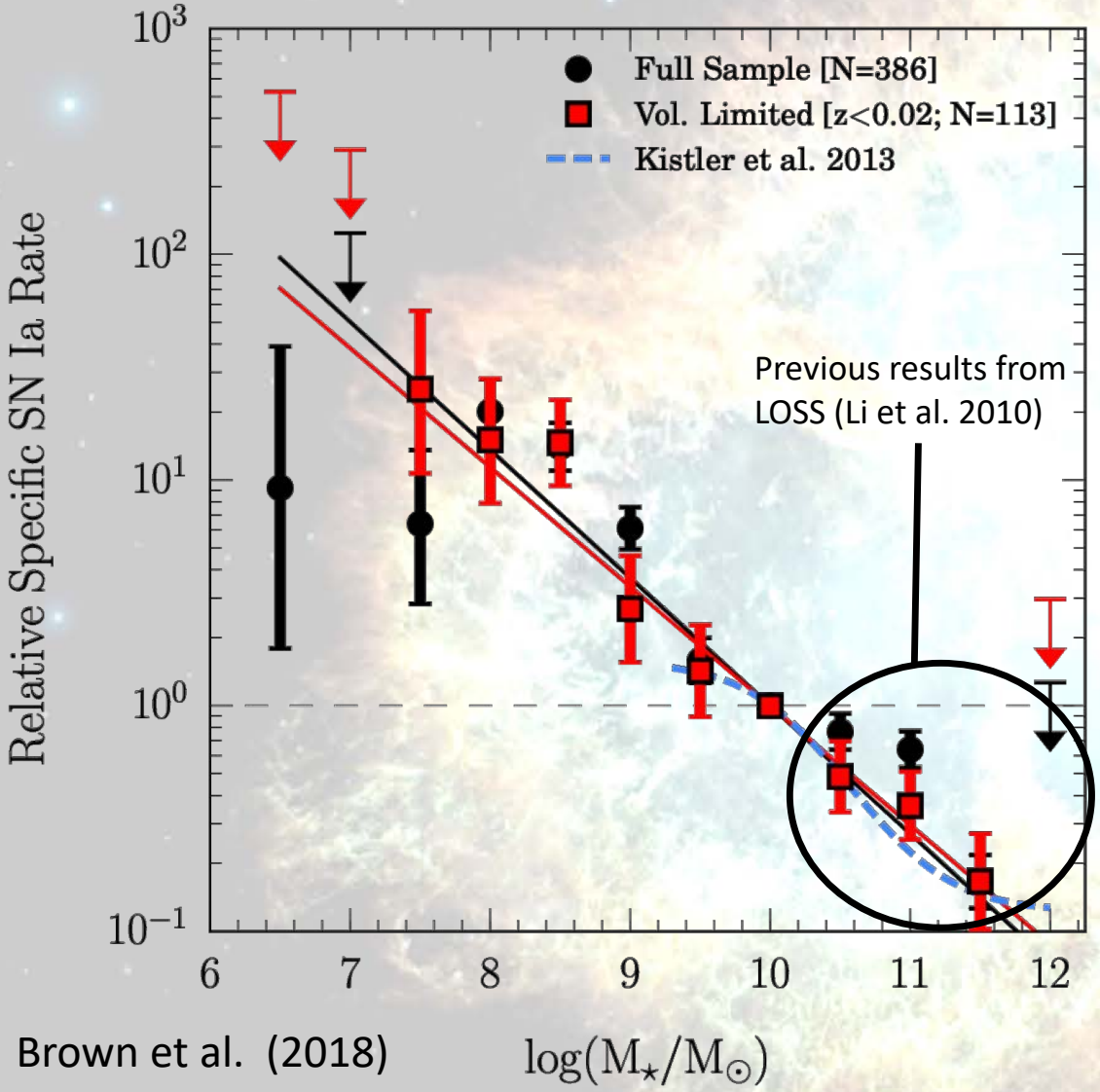
Comet C/2017 O1 (ASASSN1)

Image Credit: Damian Peach

Lots of Nearby Supernovae



Clean Sample for Calculating Rates

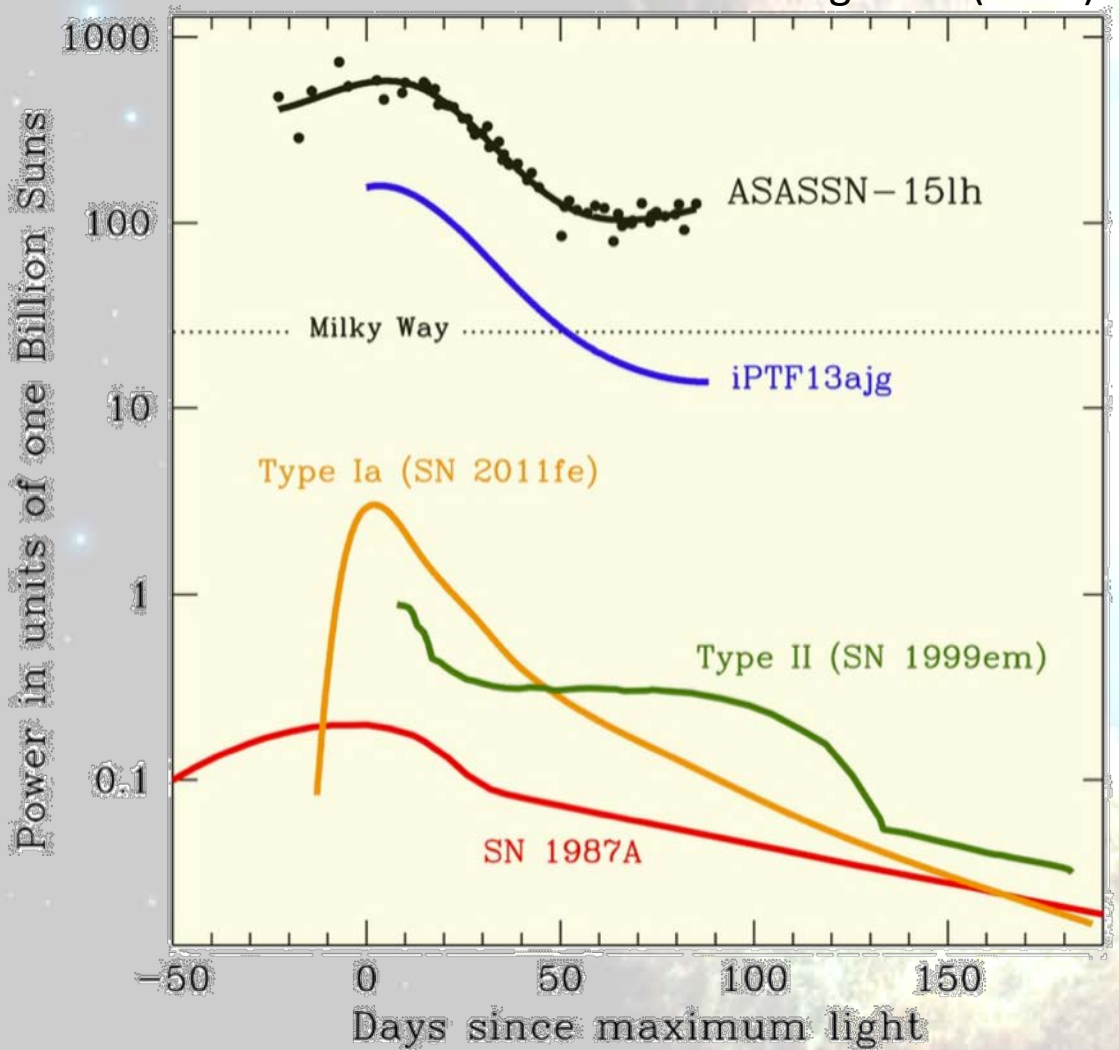


Brown et al. (2018)

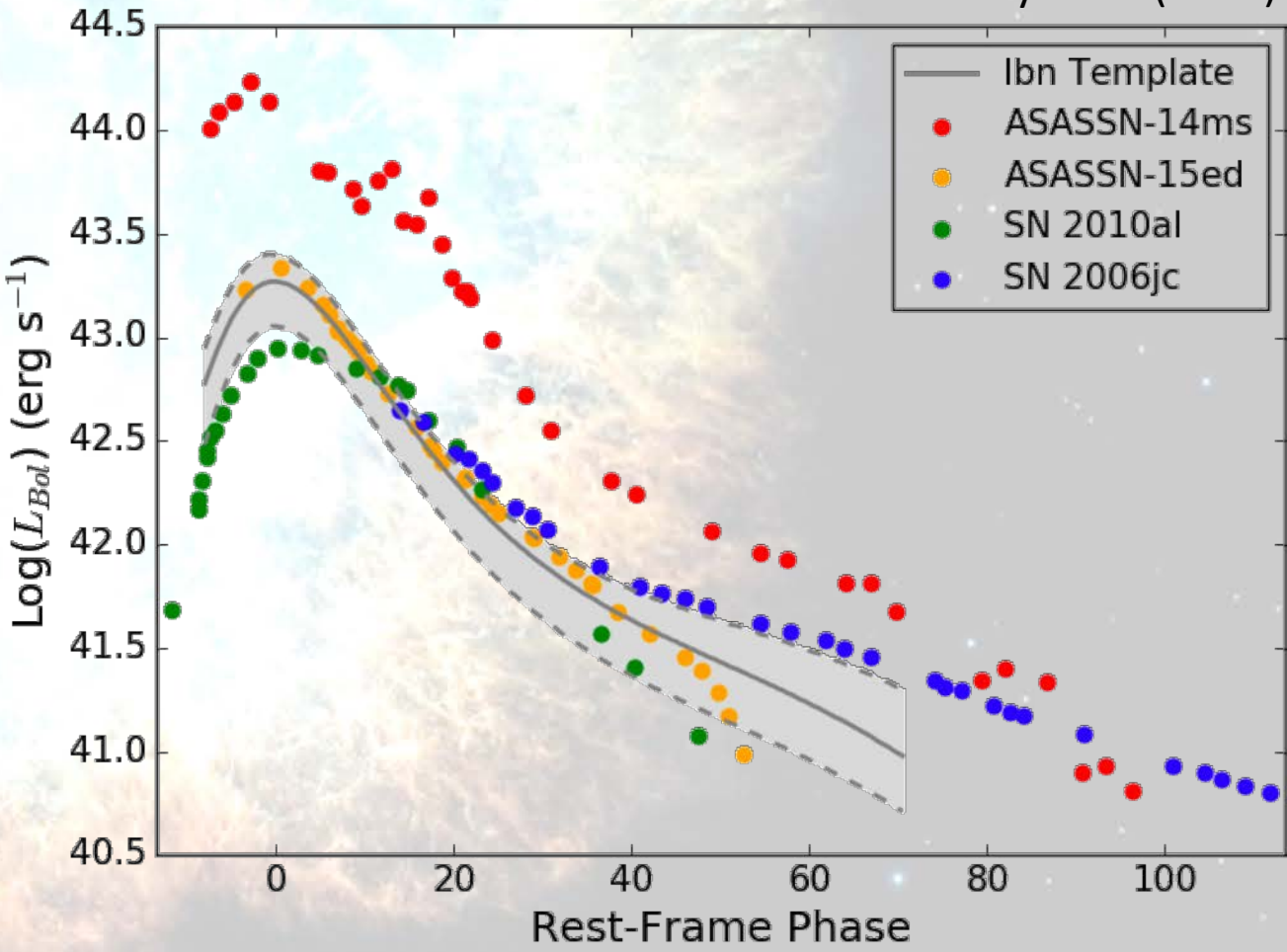
- For example, rate of Type Ia SNe per unit host stellar mass as a function of stellar mass
- Over almost 6! decades in stellar mass
- Basically, the specific rate is $\propto M^{-1/2}$
- Not dominated by age/star formation

Supernovae: Some of the Best and Brightest!

Dong et al. (2016)

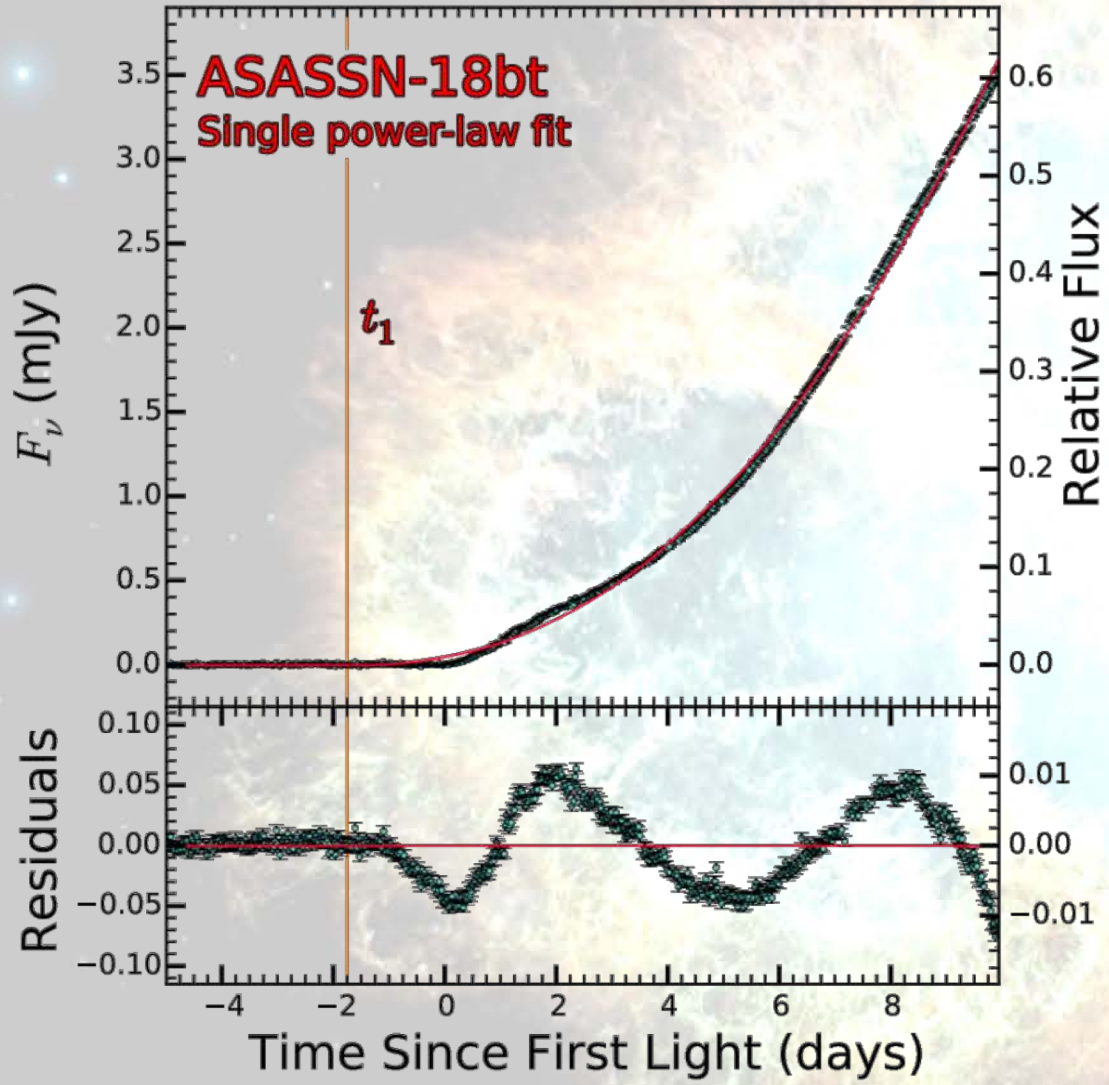


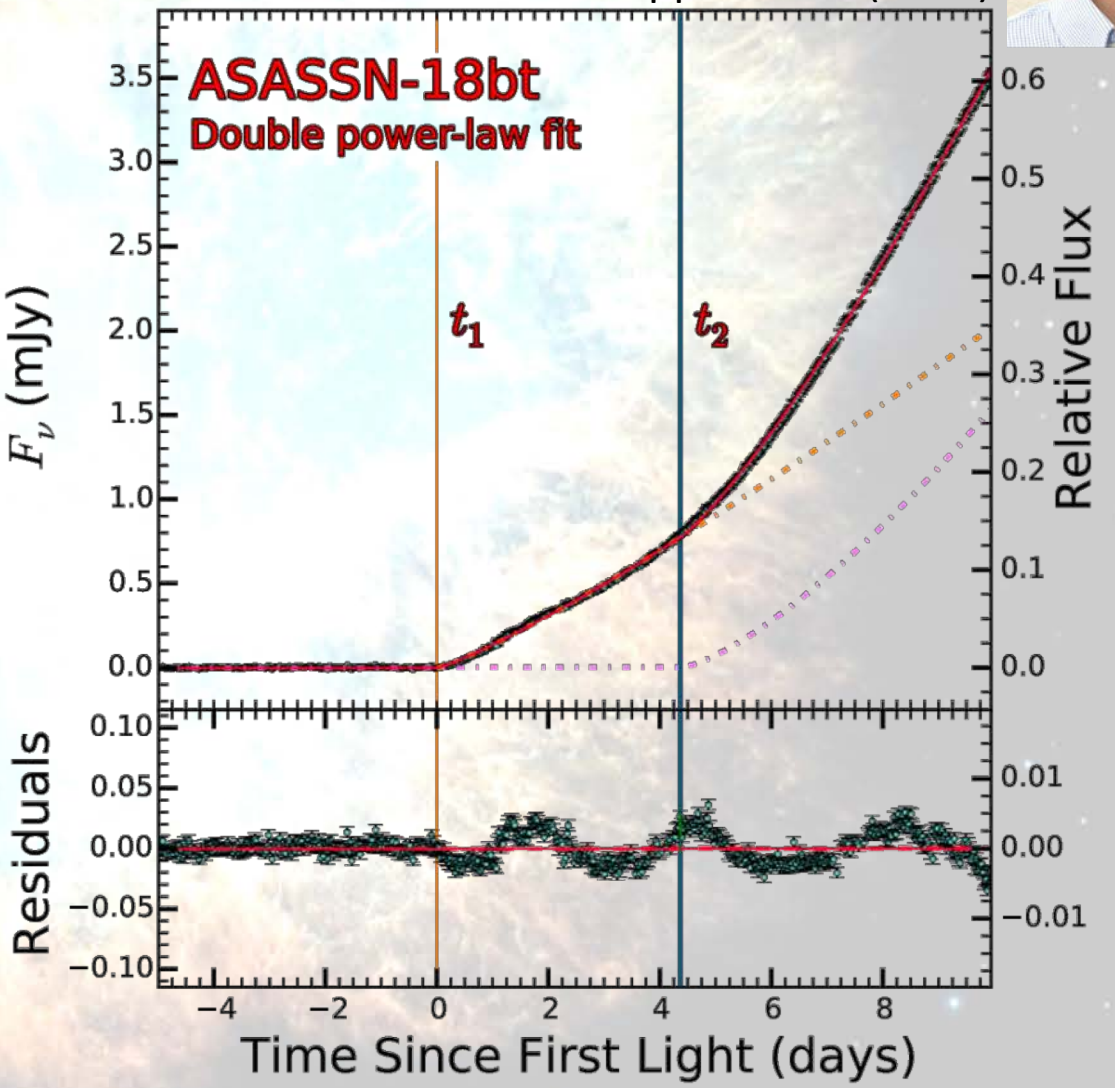
Vallely et al. (2018)



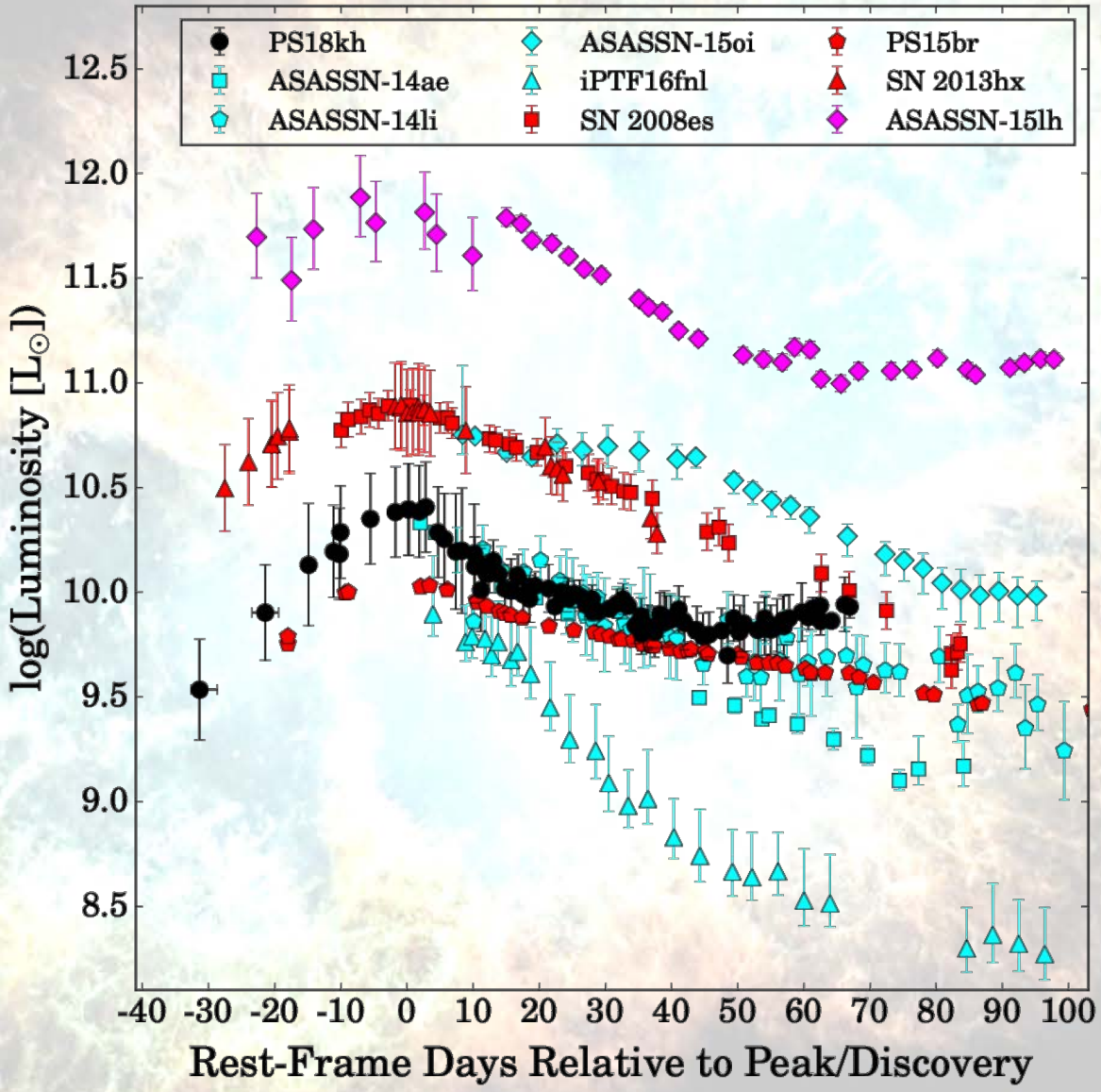
The Brightest Kepler SN: ASASSN-18bt

Shappee et al. (2019)



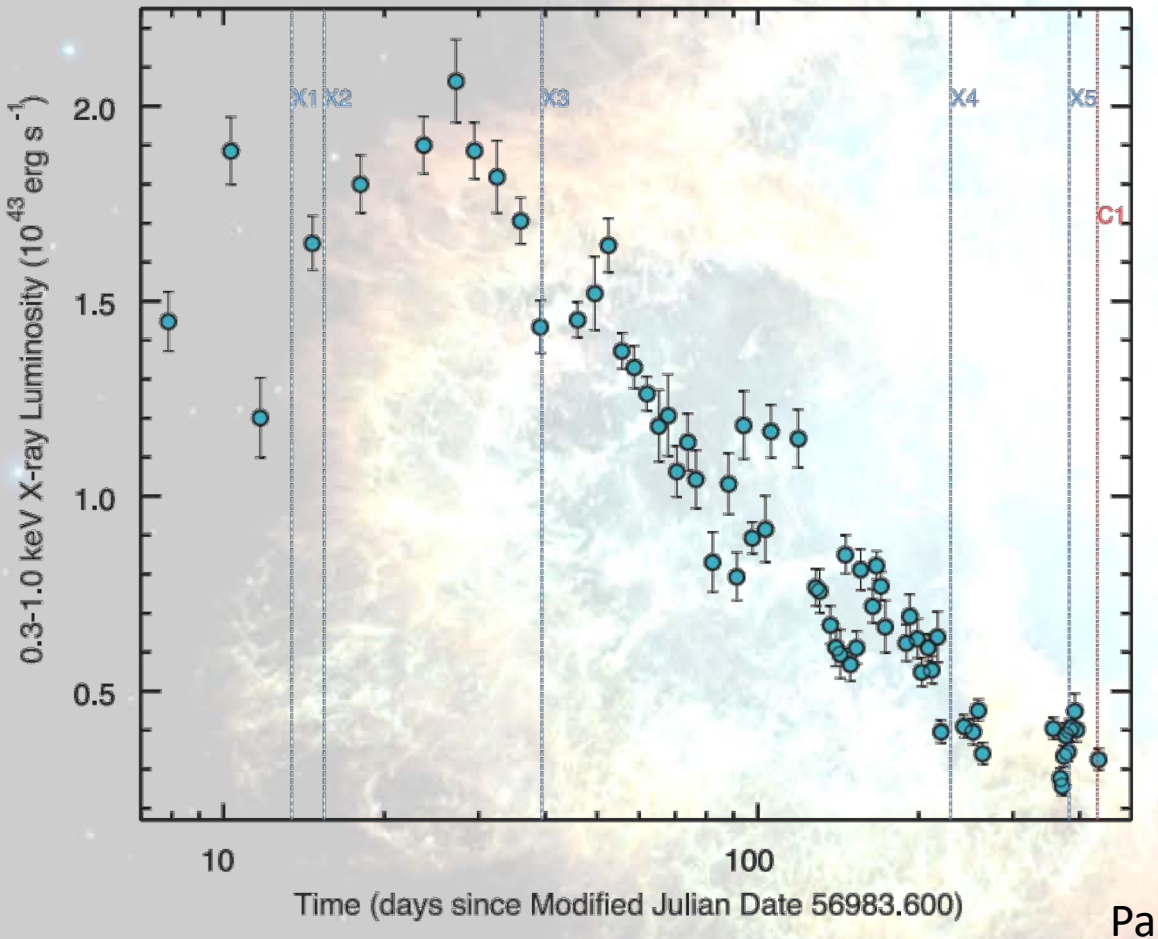


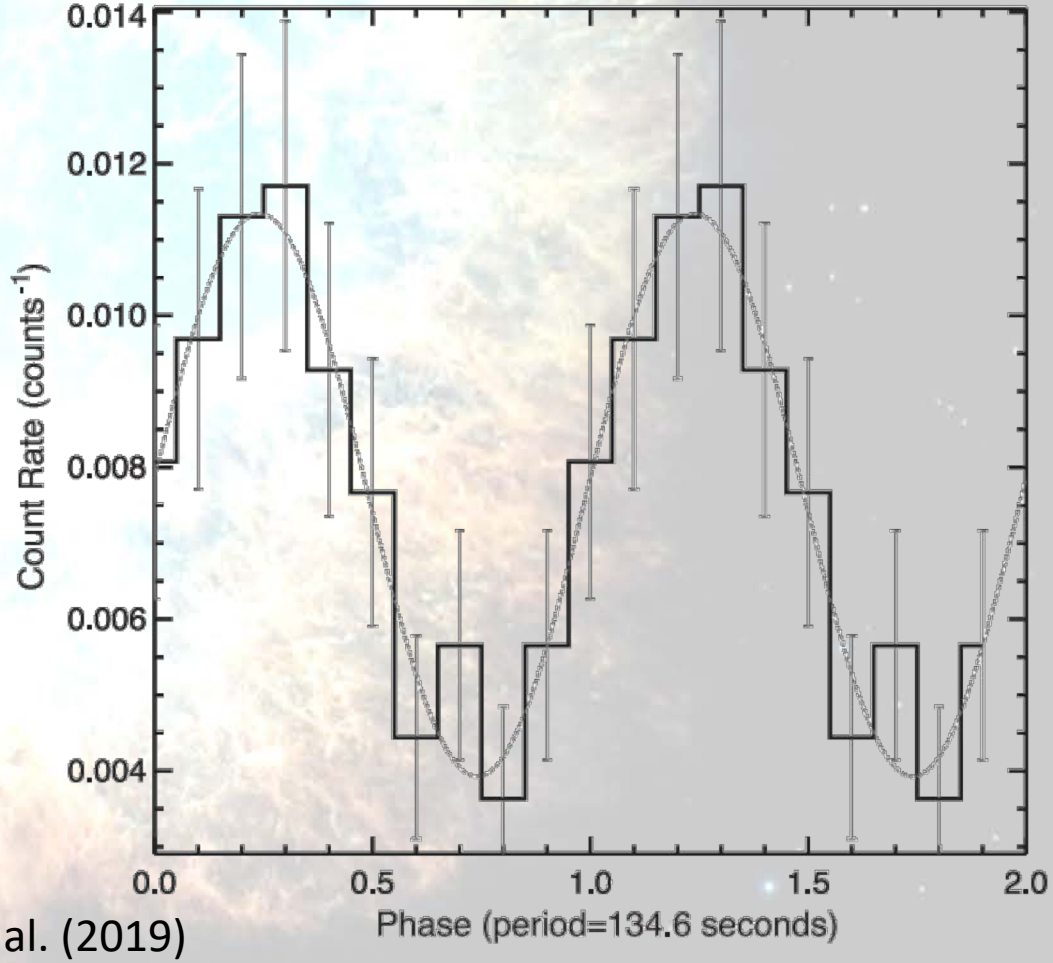
Many of the Best Studied TDEs



Holoien et al. (2018)

ASASSN-14li – The Gift That Keeps on Giving

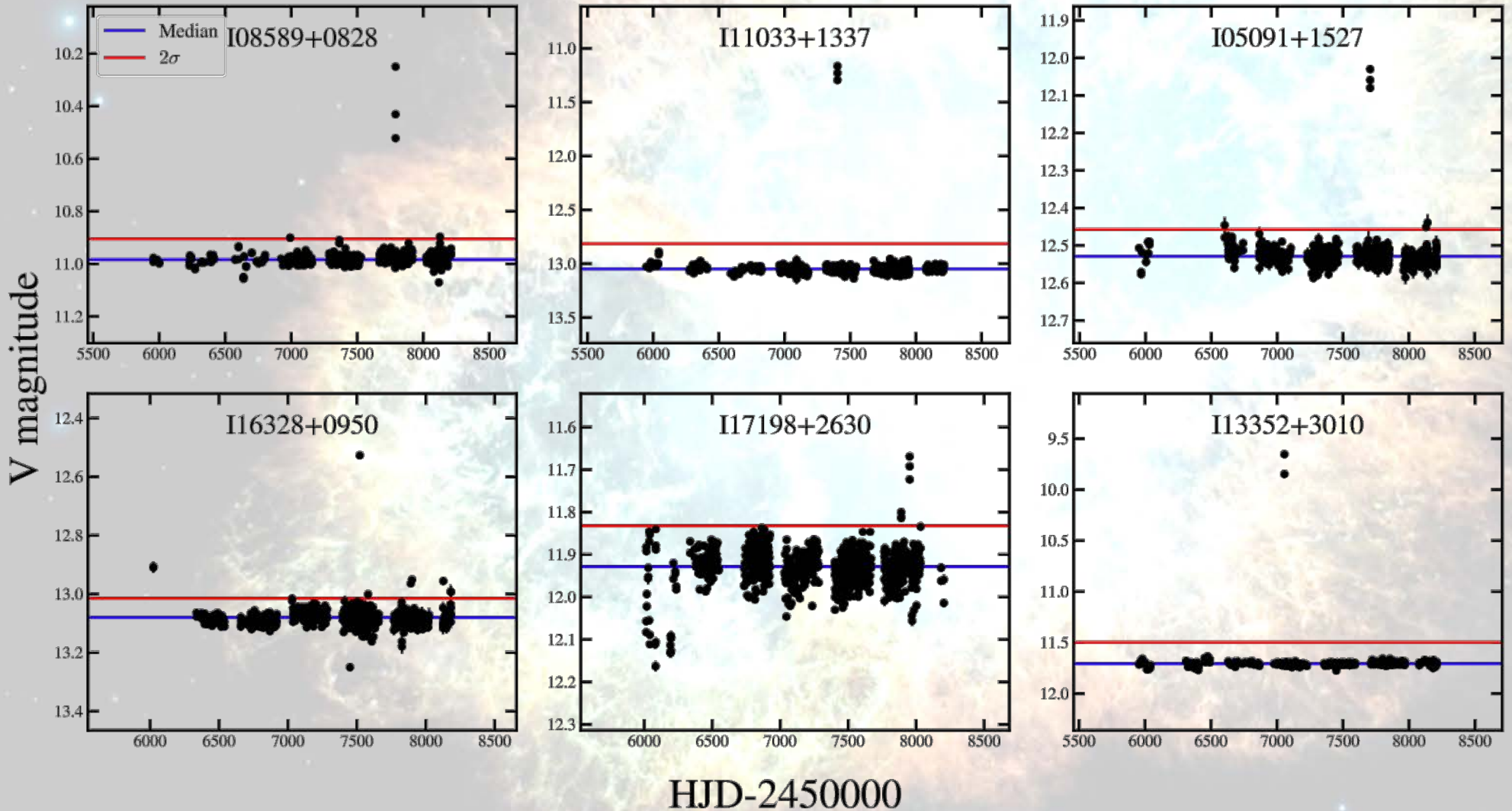




Pasham et al. (2019)

Both Active and Inactive M-Dwarfs Flare

Rodríguez et al. (2019, in prep)

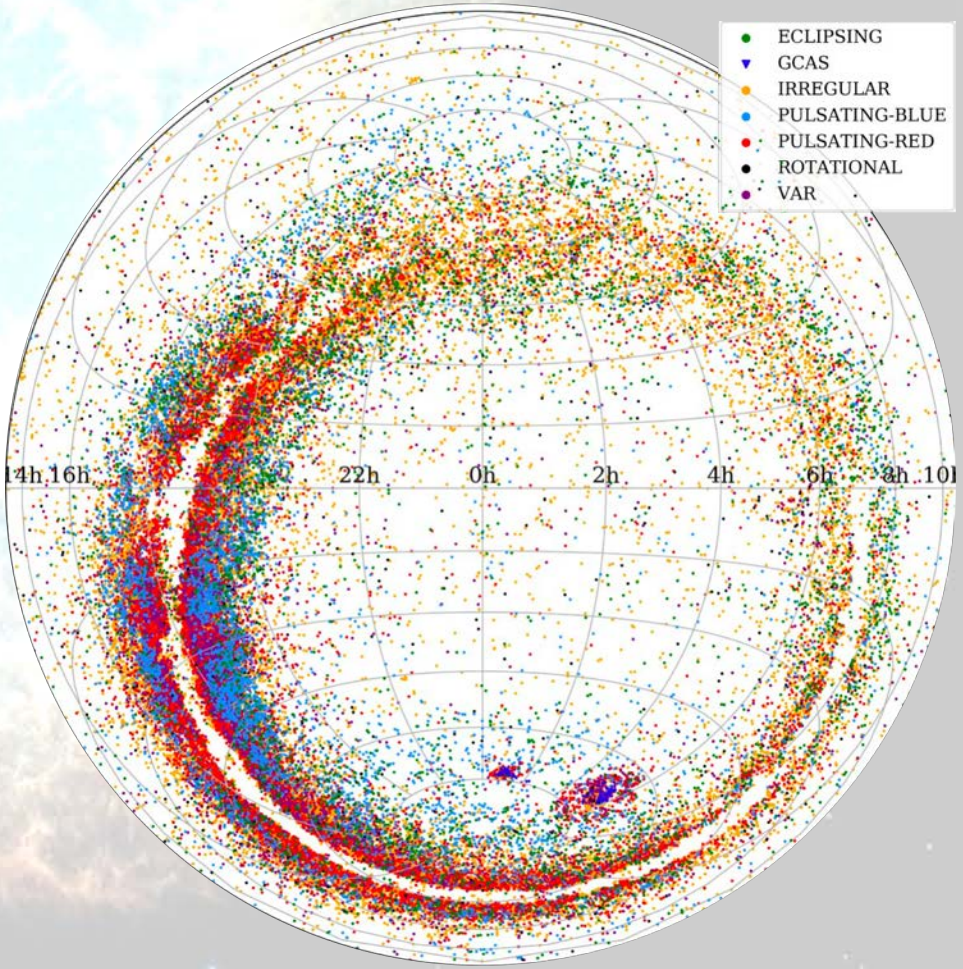


← Active

← Inactive

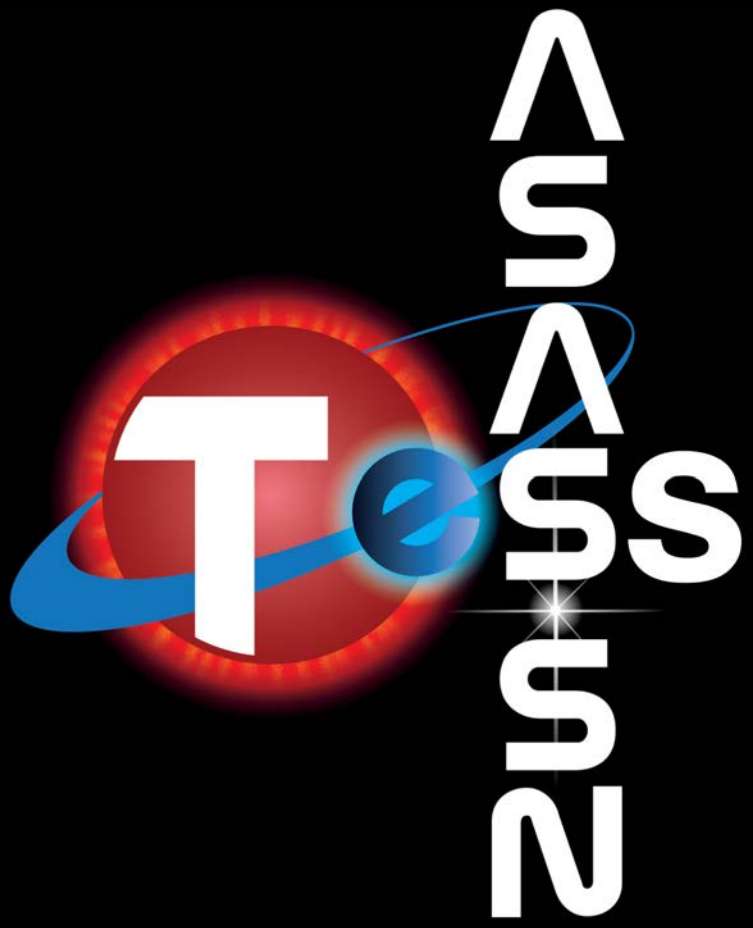
ASAS-SN Variable Stars

- 66,000 new variables discovered serendipitously while searching for supernovae (Jayasinghe et al. 2017)
- Complete, homogeneous reclassification of 400,000 variable stars with ASAS-SN data (Jayasinghe et al. 2018)
- 7,000 new variables in the Southern TESS Continuous Viewing Zone (Jayasinghe et al. 2019)



- **https://asas-sn.osu.edu/variables**

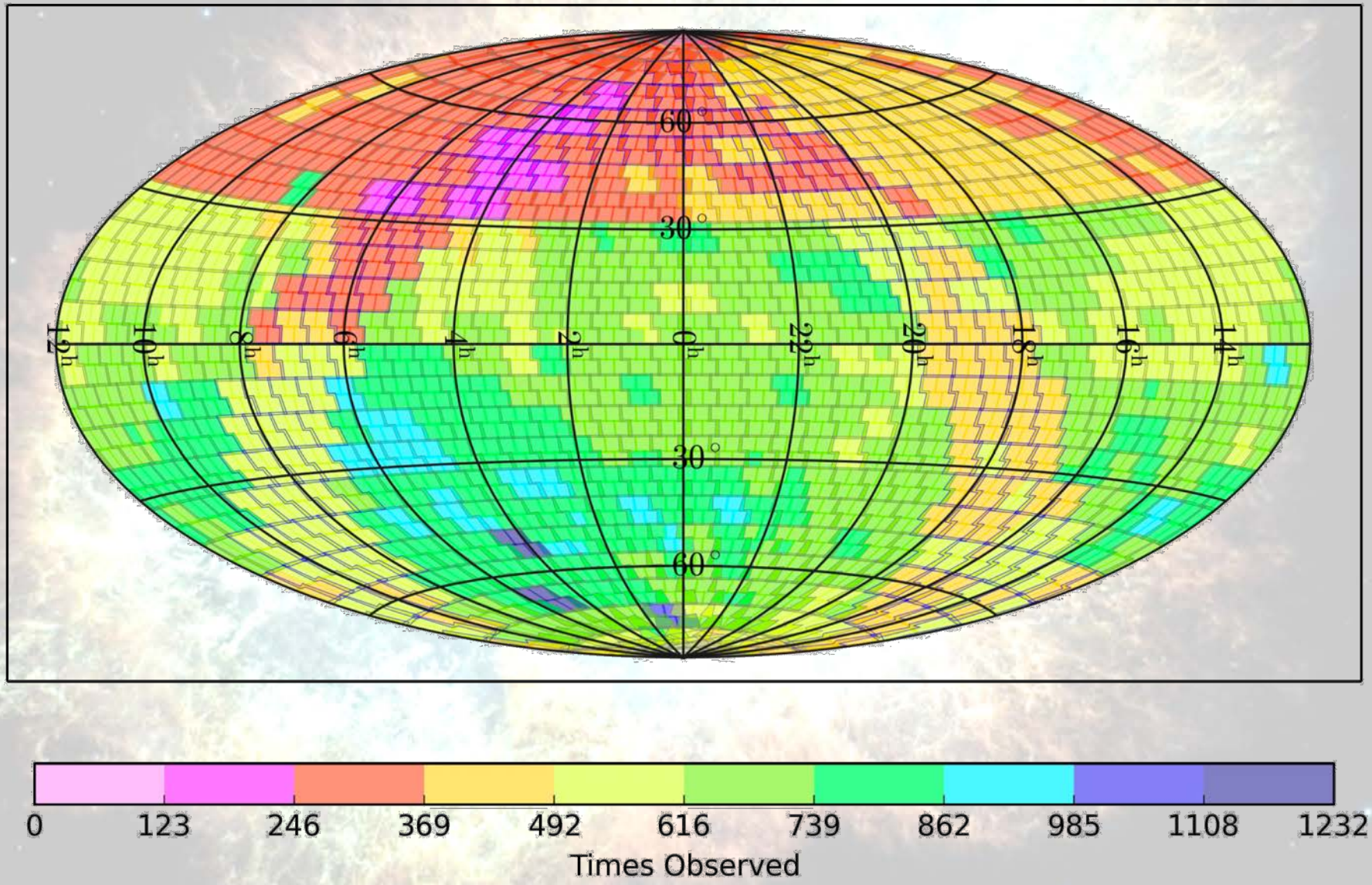
Big Science with Small Telescopes: In Space



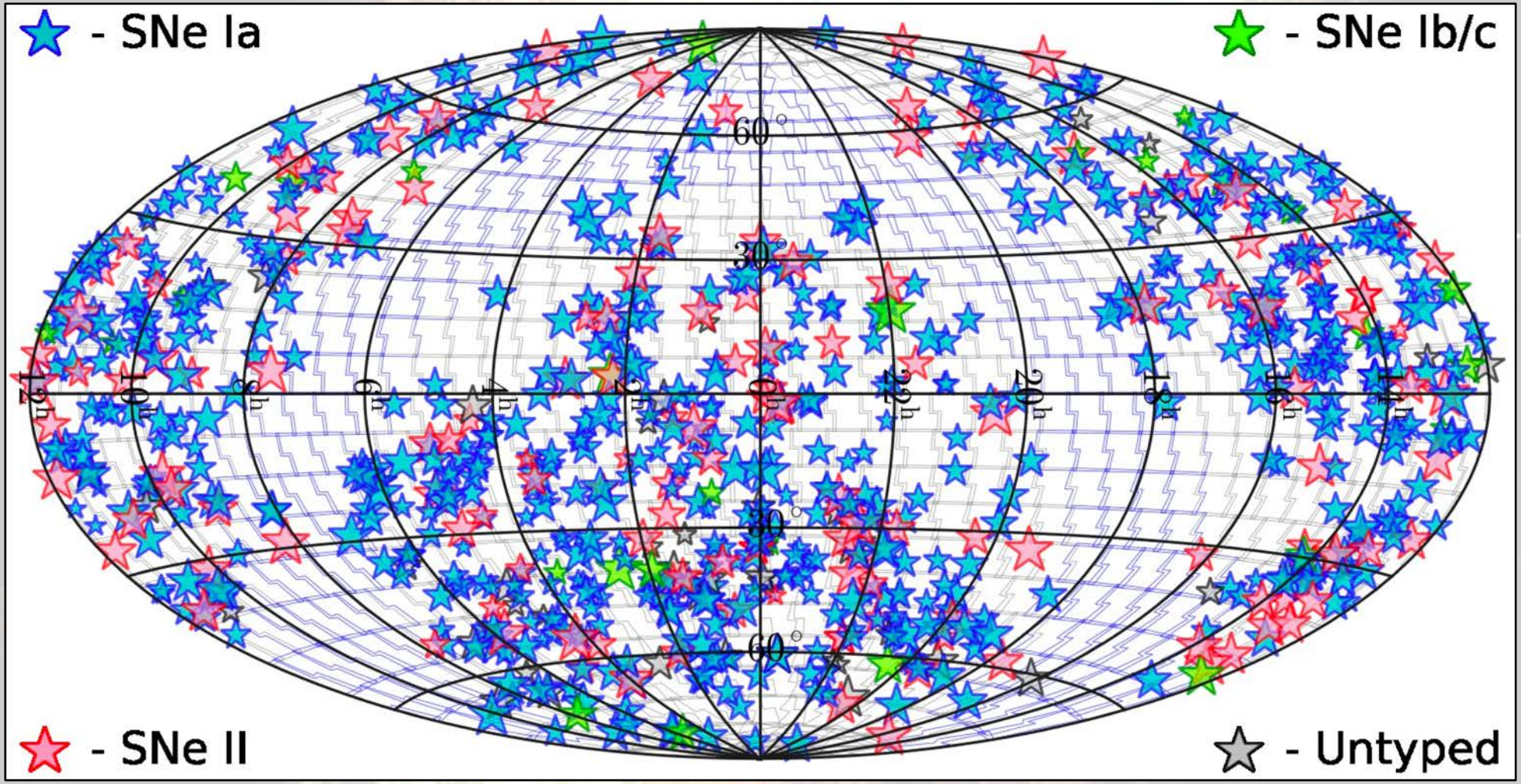
- Closely monitor the 2300 sq. deg. TESS fields
- Identify all transients down to g~18.0
  - Obtain spectroscopic and photometric follow-up
- Over 20 ASAS-SN supernovae discovered in TESS fields already!

Questions?

All-Sky All The Time: Annual Coverage

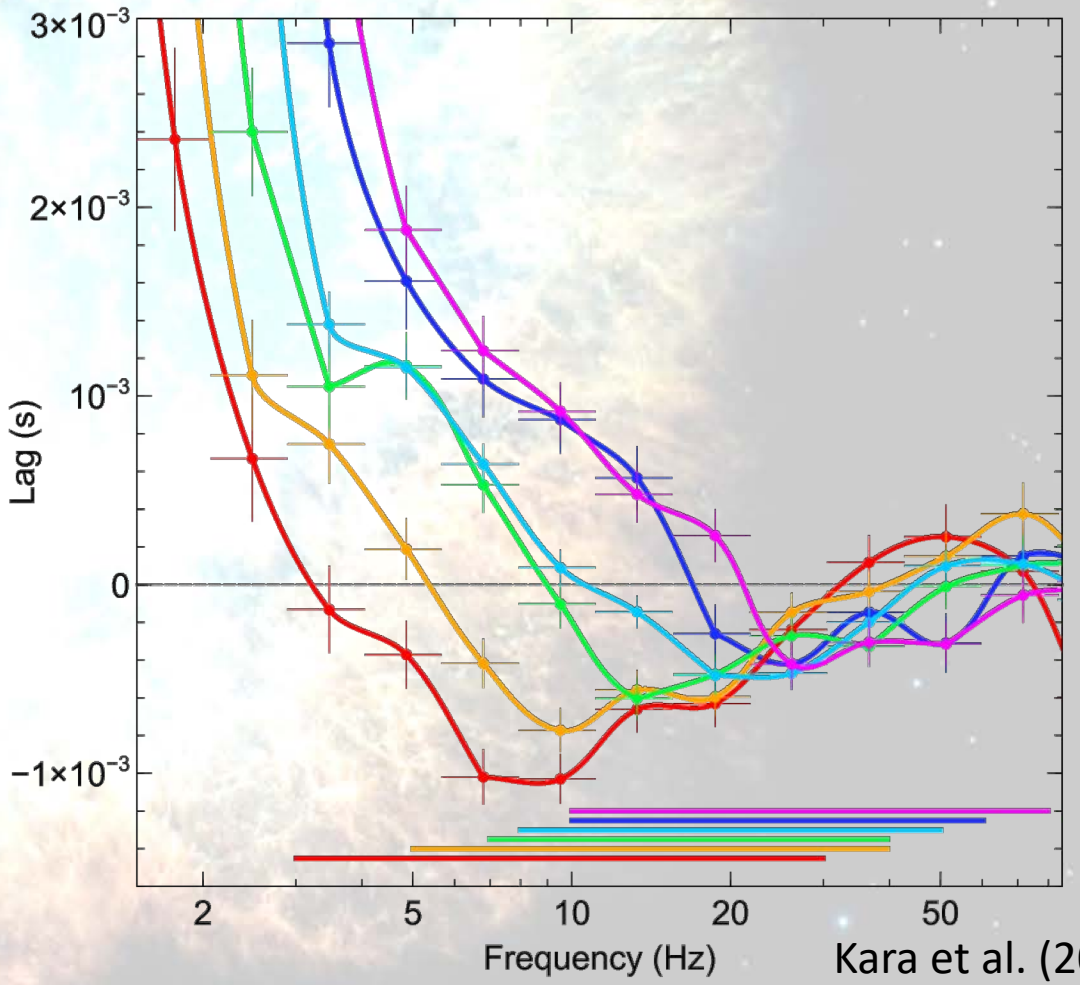


ASAS-SN Supernovae Discoveries



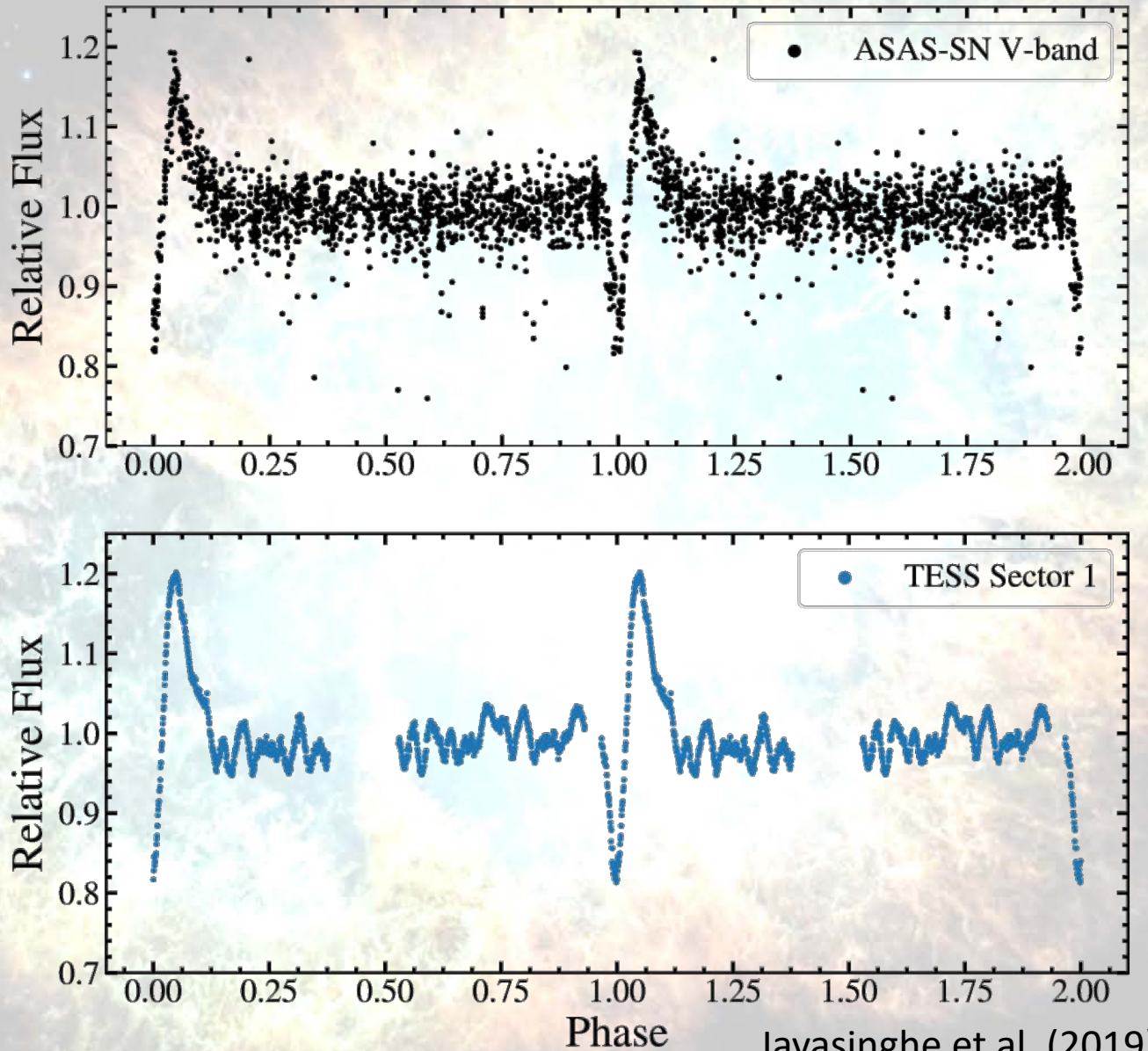
X-Ray Reverberation Mapping of ASASSN-18ey

Image credit: Aurore Simonnet /
NASA's Goddard Space Flight Center



Kara et al. (2019)

TESS Heartbeat Star



Jayasinghe et al. (2019)

Preliminary TESS Light Curves