Science from ZTF

Lin Yan (Caltech)

The two major ZTF public surveys

- Northern Sky Survey
  - 2 visits/night (g+r) for asteroid rejection, 3-day cadence on average; ~23,675sq deg

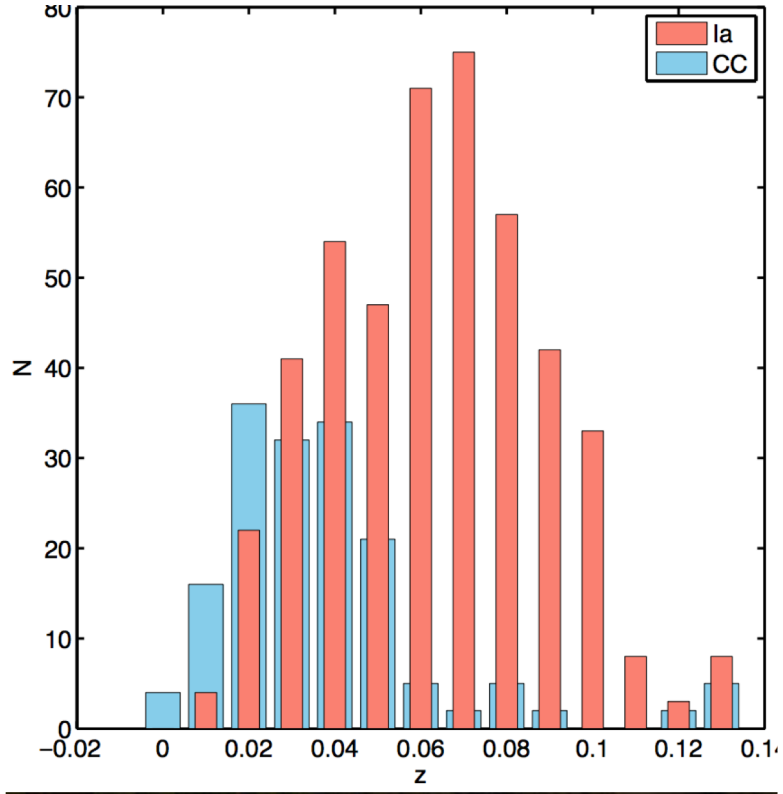
- Galactic Plane Survey
  - Nightly sweep of the Galactic plane (|b|<7; 1 day cadence in g & r), ~ 2800sqdeg

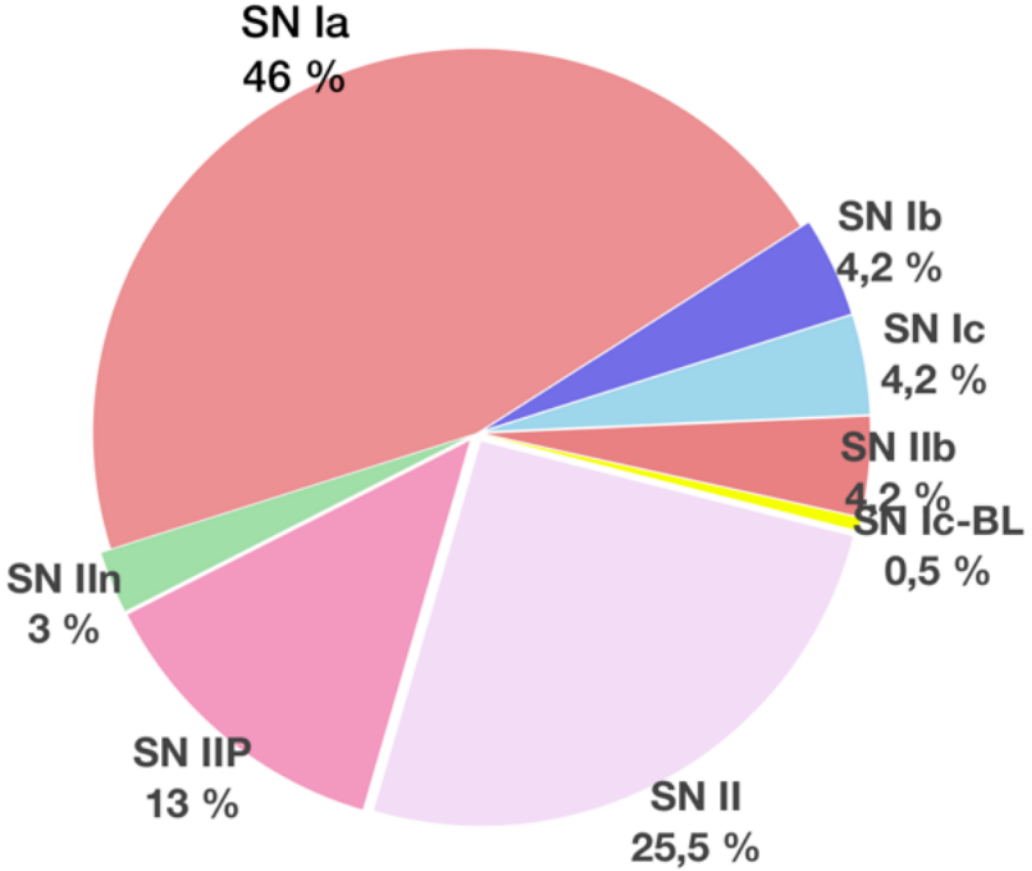
Broad categories:

- Supernova
- Nuclear transients – (TDE, AGN)
- Stellar variables (binary & flaring)
- Asteroids

Supernova – (1) rates and luminosity functions:

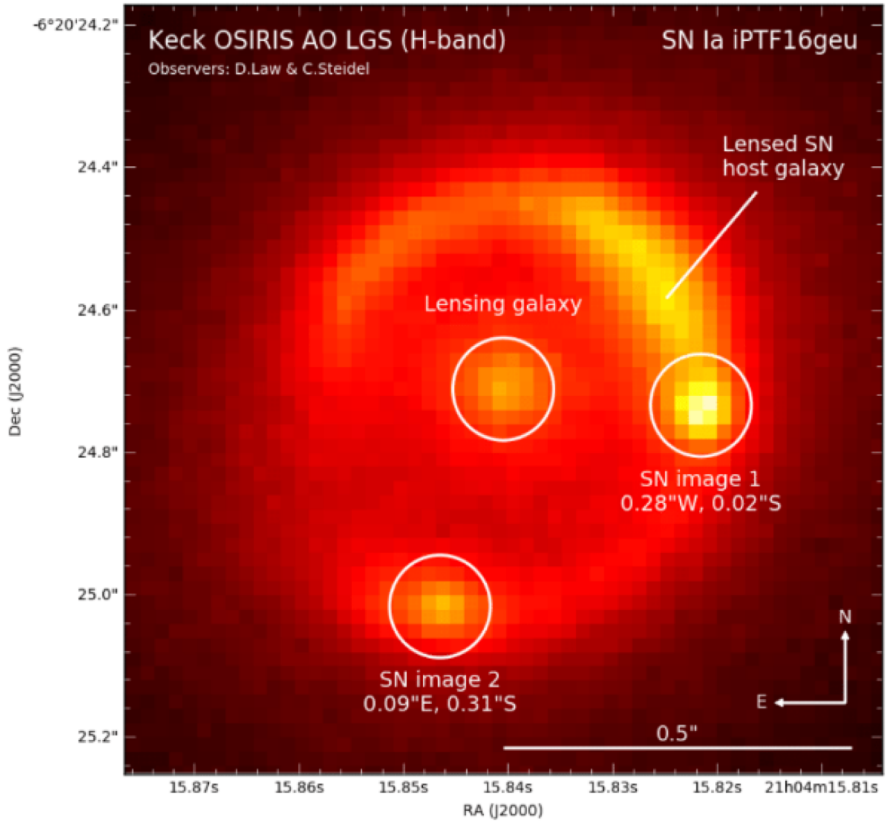
- The ZTF Bright Transient Survey (BTS)
  - All alerts brighter than 18.5mag are spectrally classified, primarily using SEDM on Palomar 60inch
  - Total classified: 622 (477 Ia, 177 ccSN)





Supernova – (2) rare events:

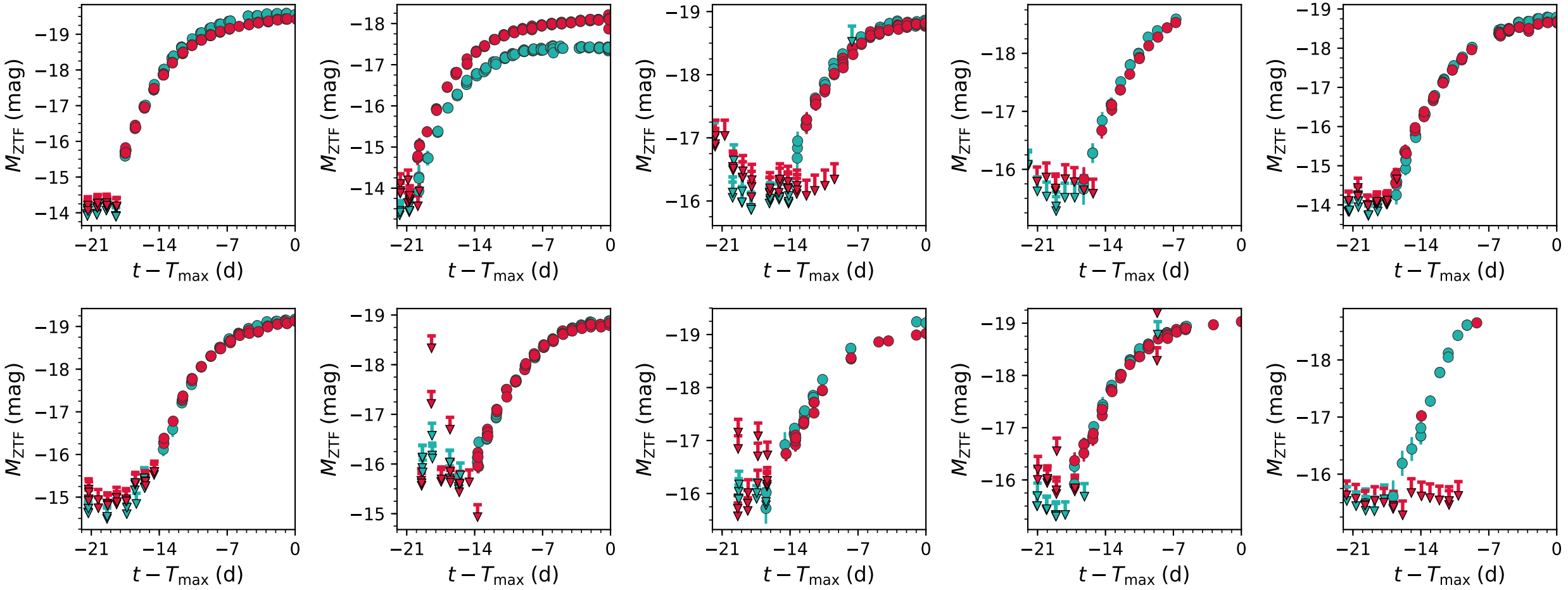
- Fast transients, very luminous (SLSN)
- Ca rich transients at outskirts of galaxies
- Strongly lensed SNe



Goobar et al. 2017

Supernova – (3) Young SN Ia and SN II

ZTF routinely finds young SNe Ia (> 12 in the period from 01 Jun – 15 Sept)

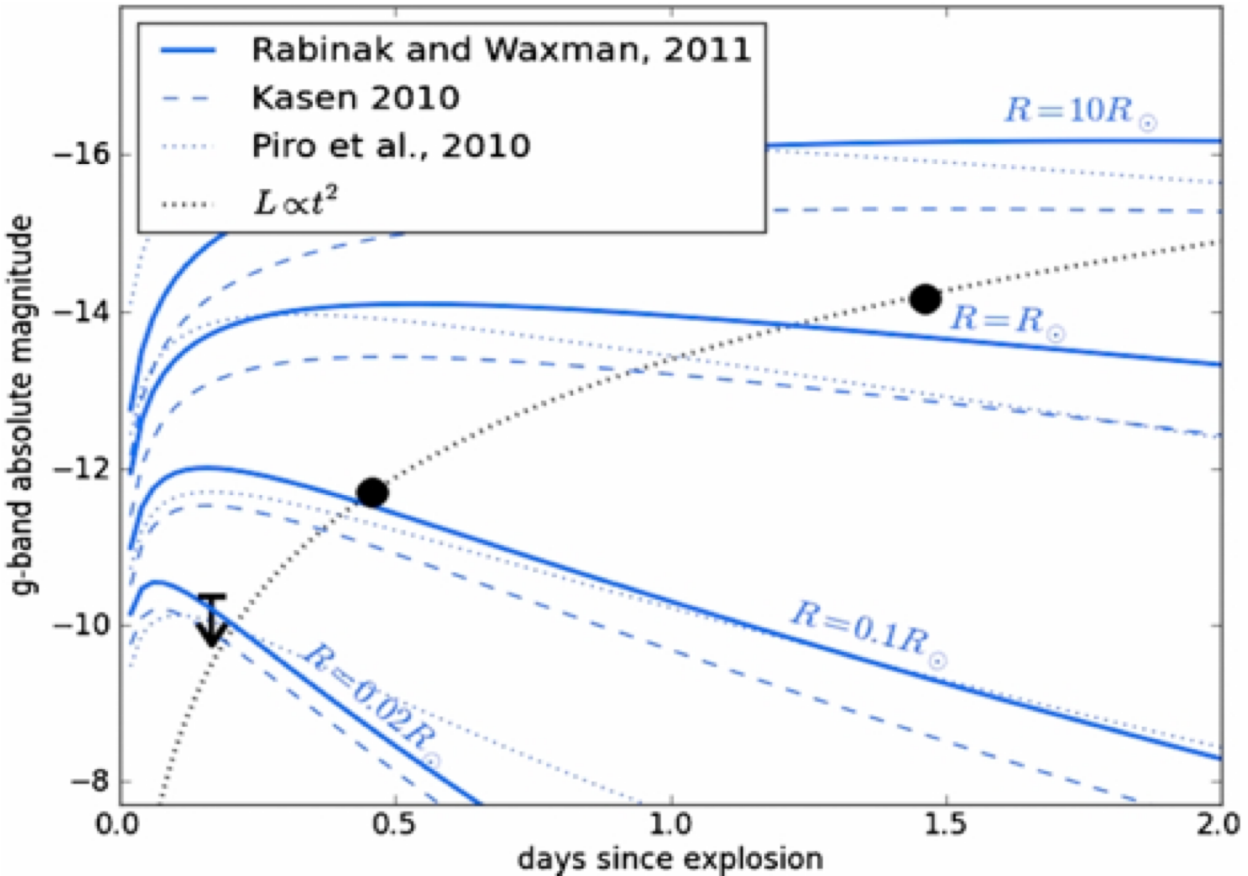


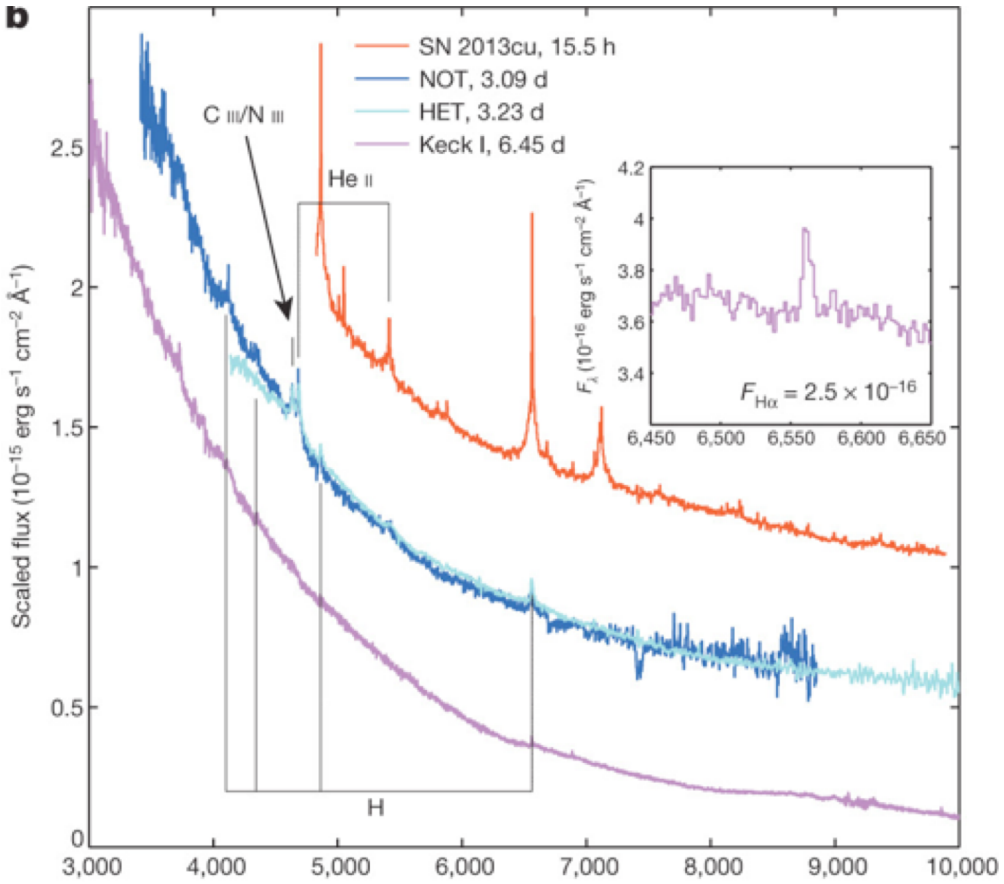
Keck ToO program is particularly important for obtaining early spectra to search for unburned C & velocity of the ejecta

Supernova – (3) Young SN Ia and SN II

understand physics of shock breakout & shock heating;
observe progenitor wind

measure progenitor radius and distinguish progenitors

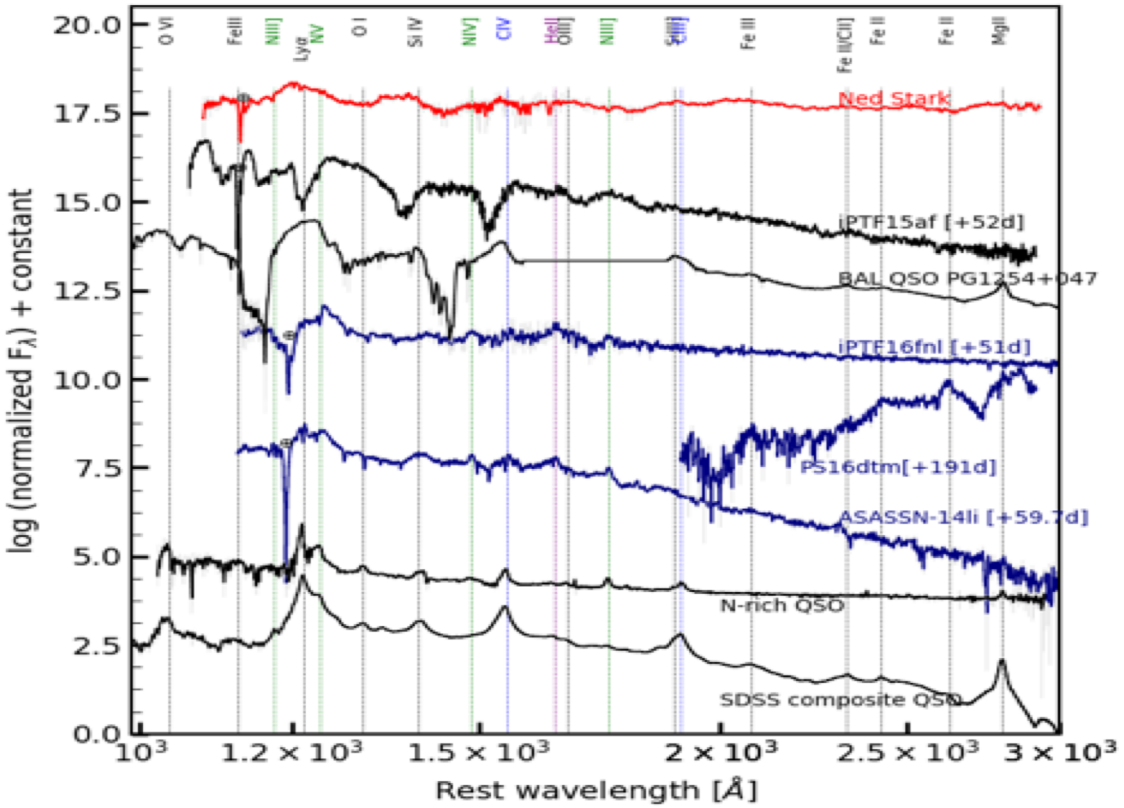




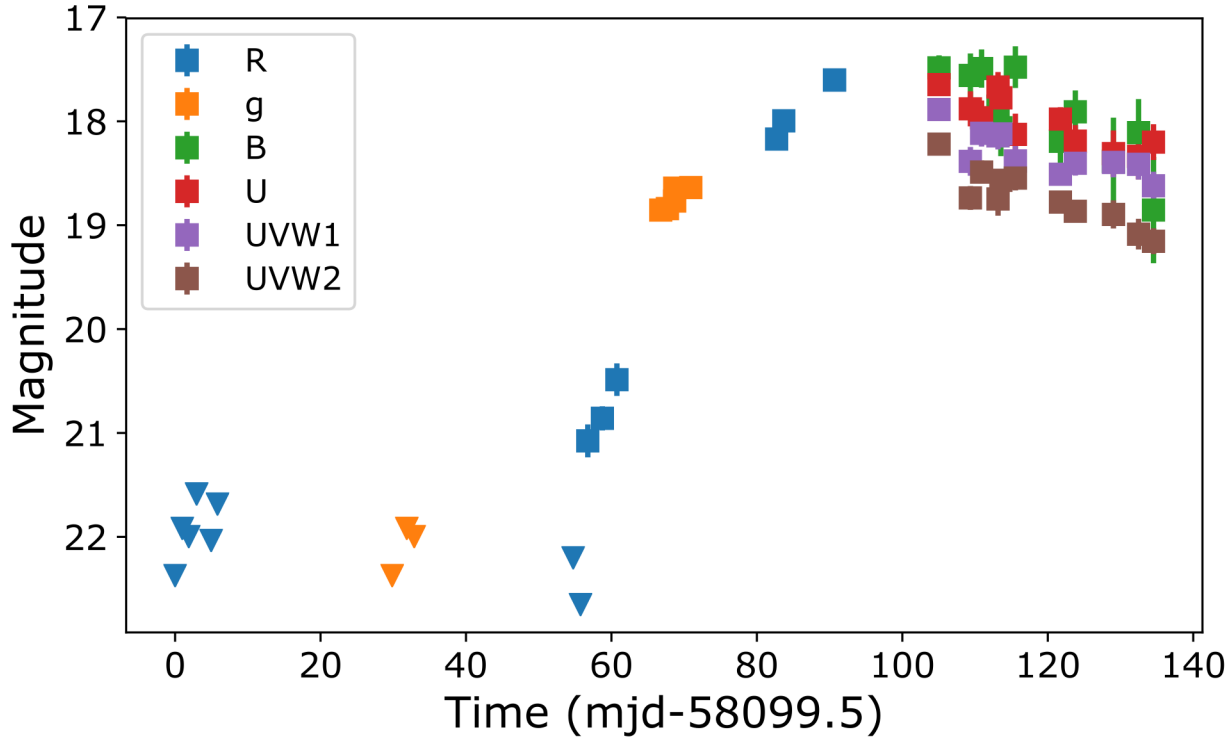
Bloom+ 2011; Gal-Yam+2013

Nuclear Transients

- Tidal Disruption Events



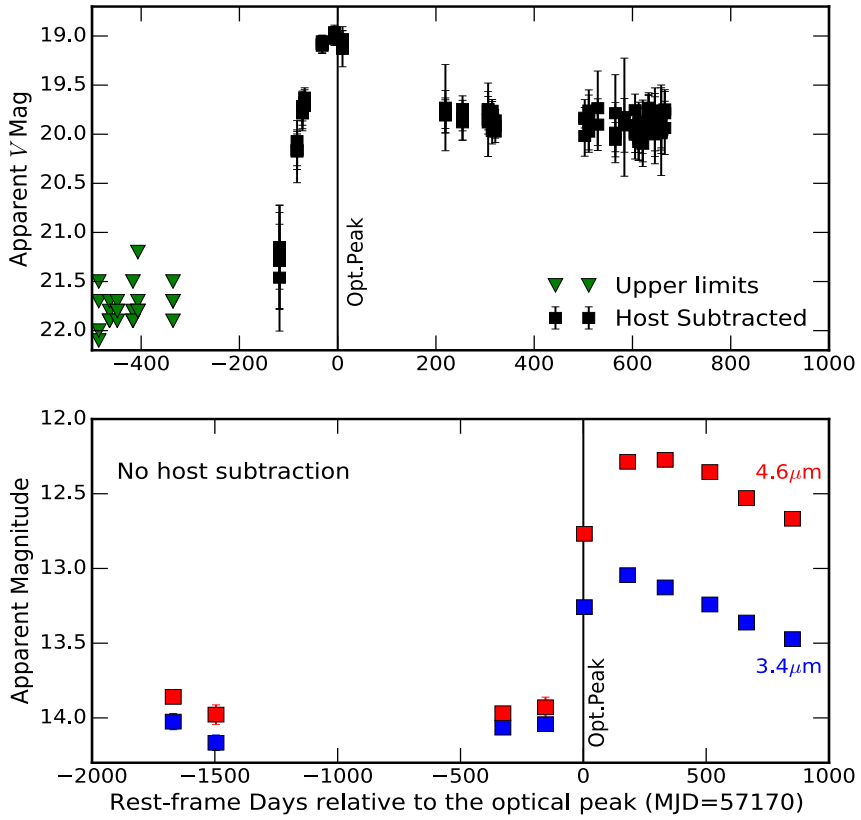
The First ZTF TDE – Van Velzen et al. 2019 in press

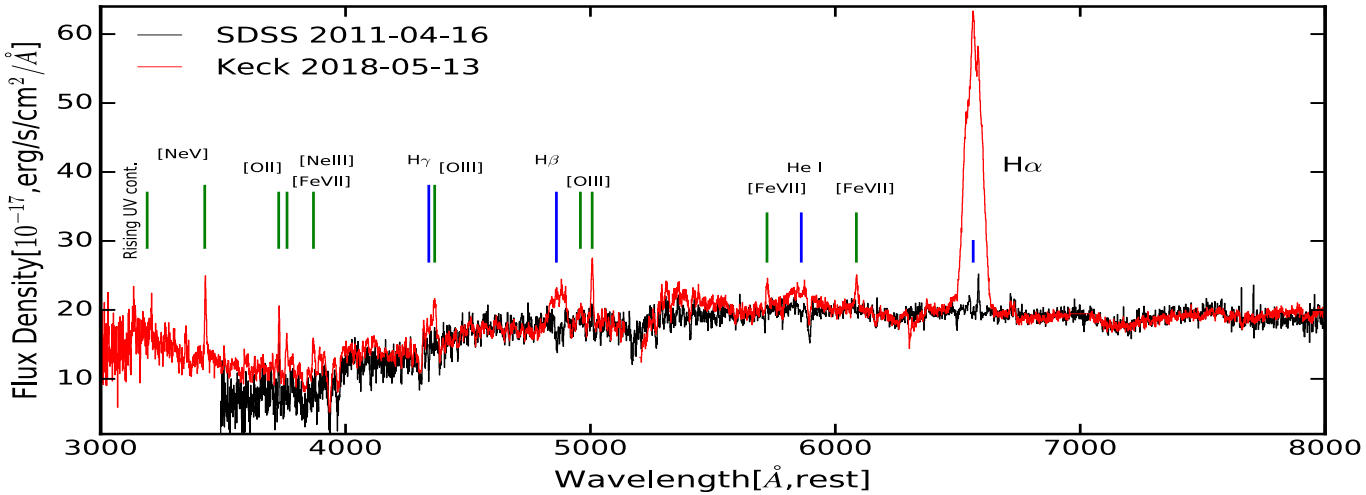


Blagorodnova+ 2019 in press

Changing-Look AGNs

- A rapid “turn-on” of type-I AGN from quiescent state < 200days much longer than the viscous infall time. Challenging the current AGN accretion disk

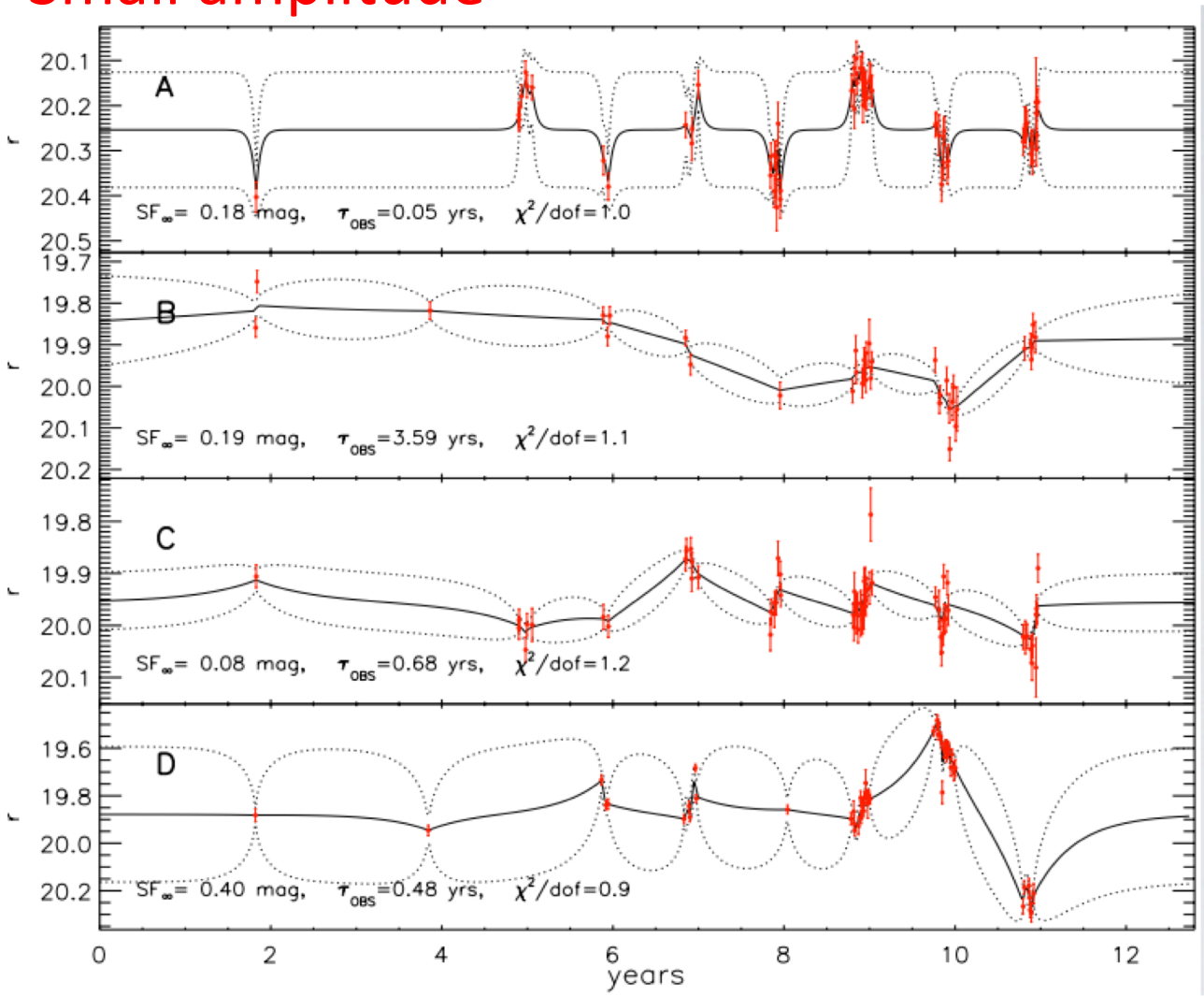




Yan+ 2019 in press

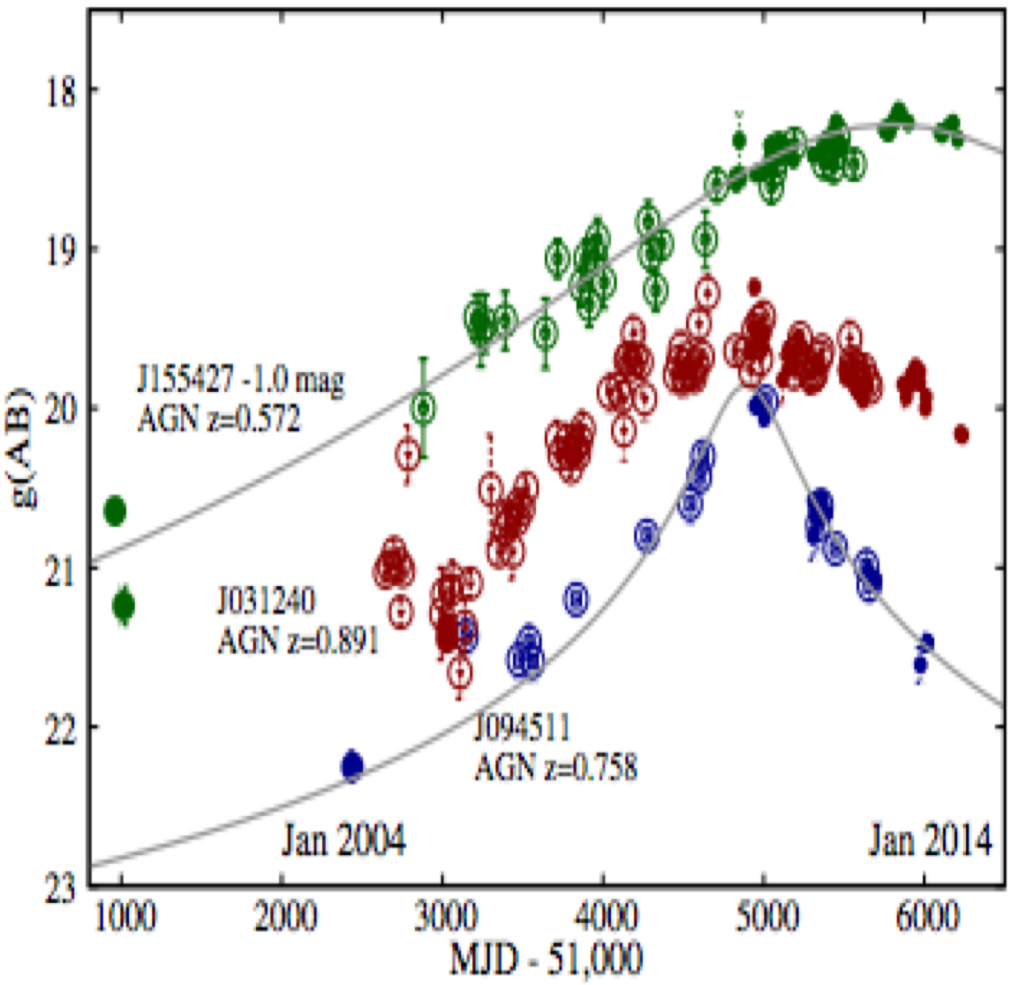
AGN variabilities:

Small amplitude



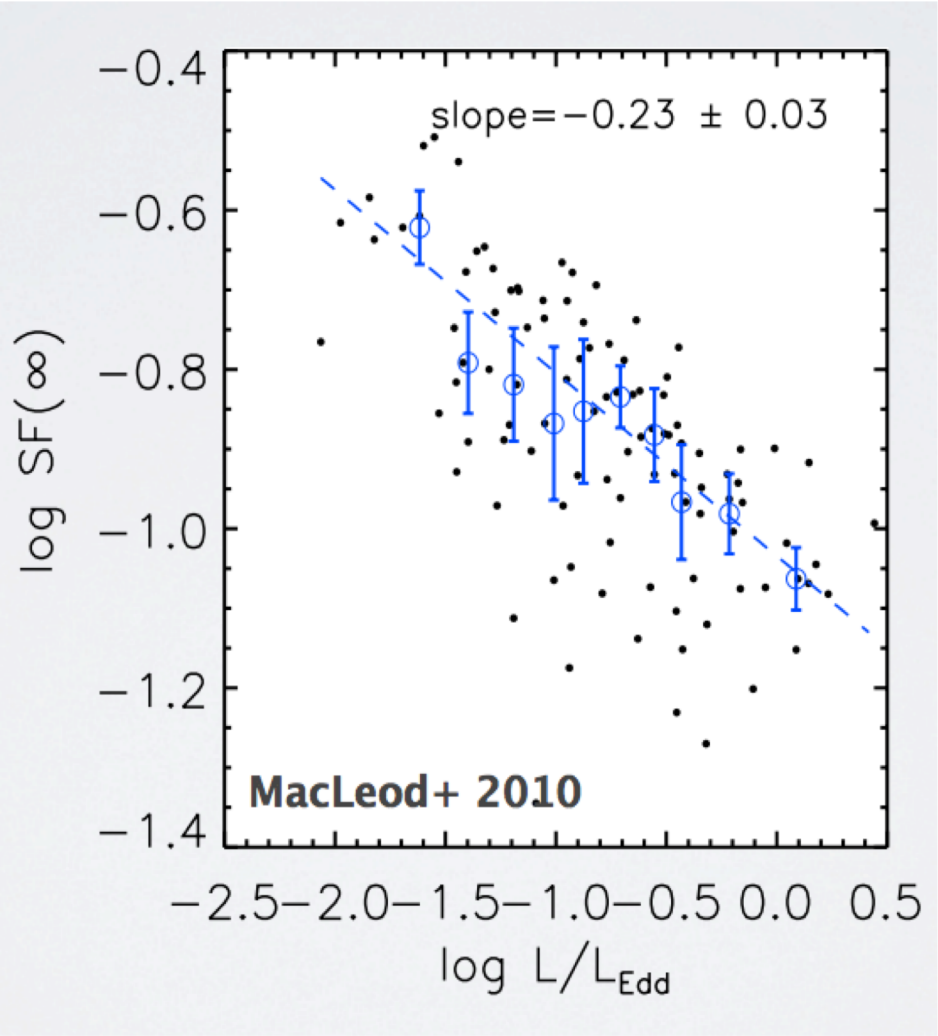
McLeod+ 2010

Large amplitude



Lawrence+ 2016

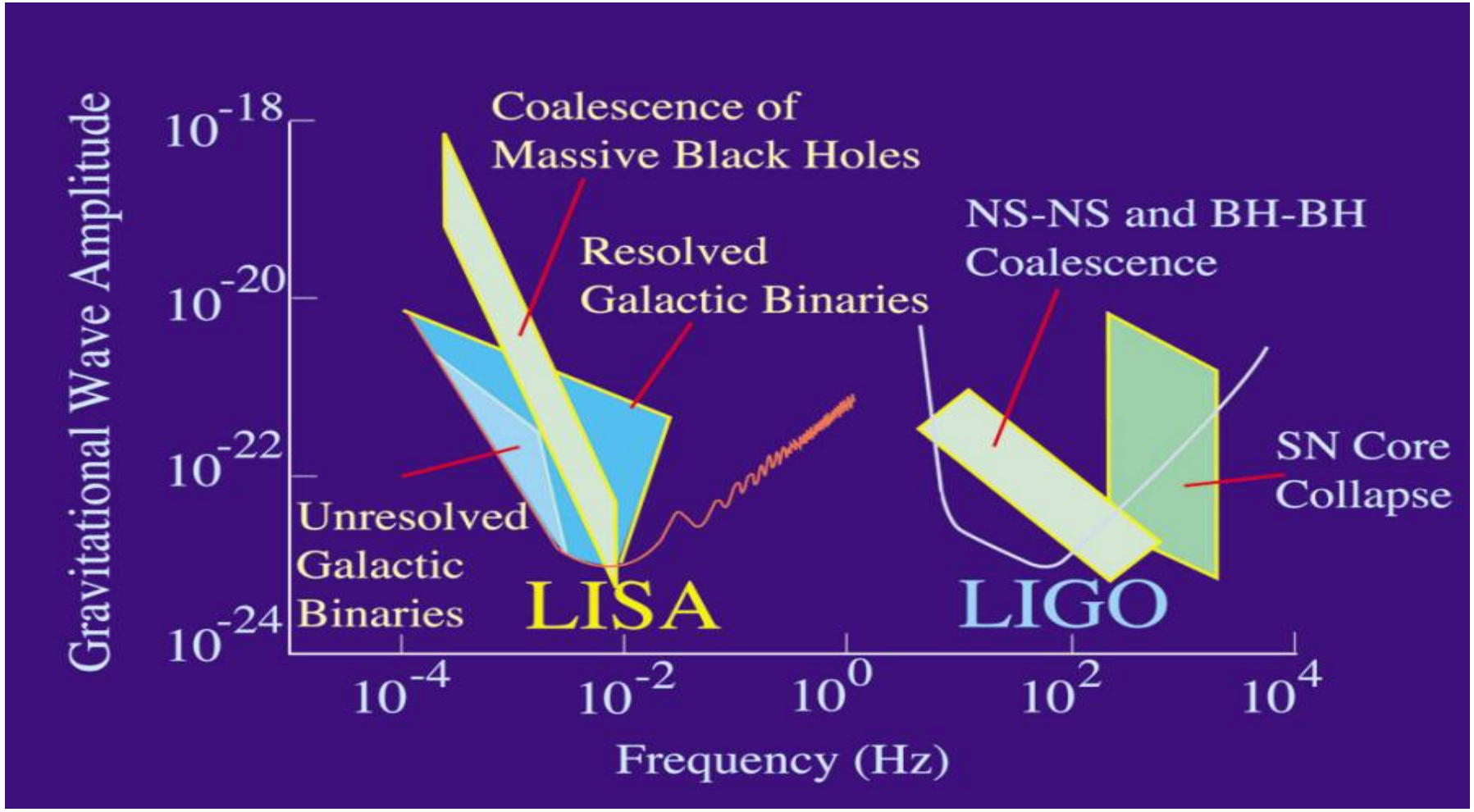
AGN variabilities – accretion physics



Damped Random Walk model –

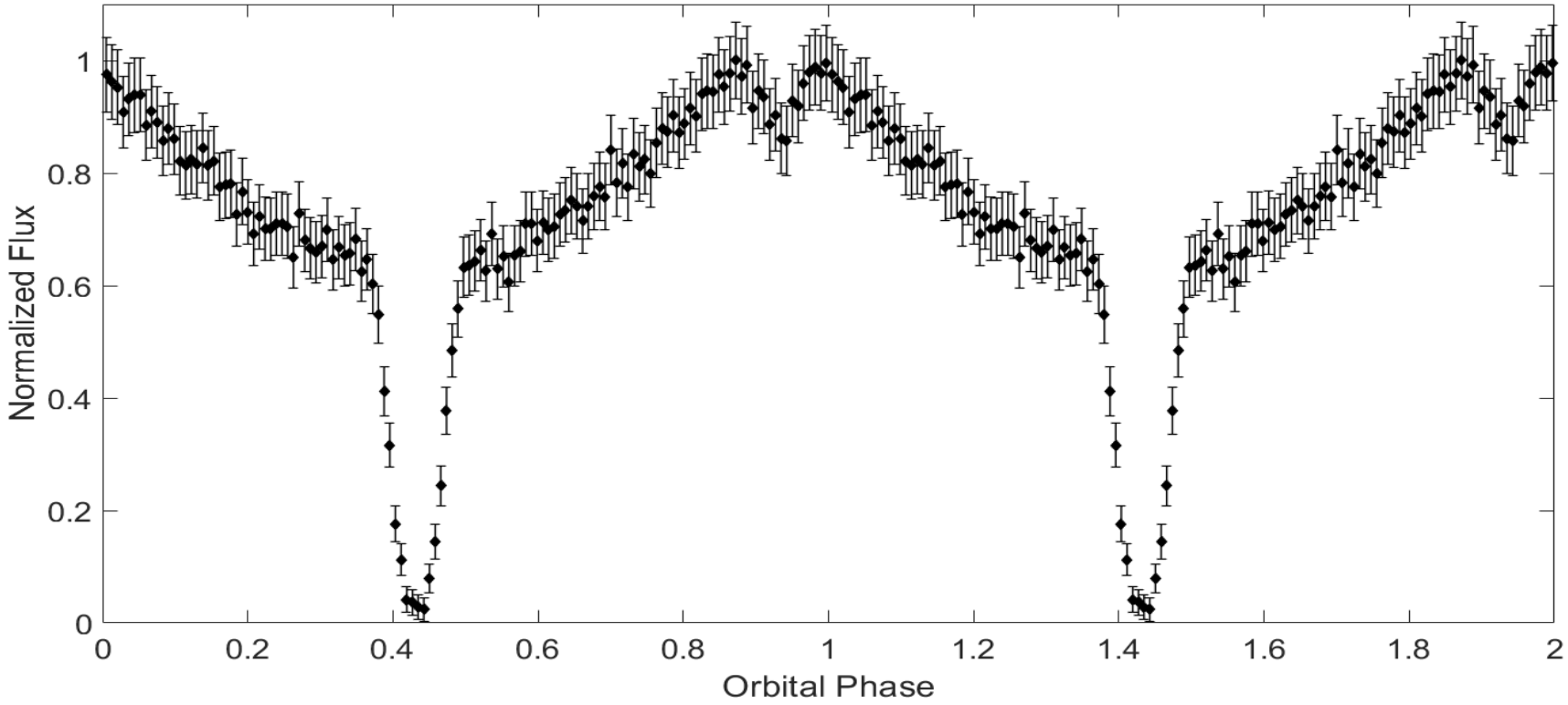
Is Eddington ratio the driver of AGN variability?

Stellar variables – (1) compact binaries



A new ZTF eclisping, double WD system:

6.9 *minutes Orbit*

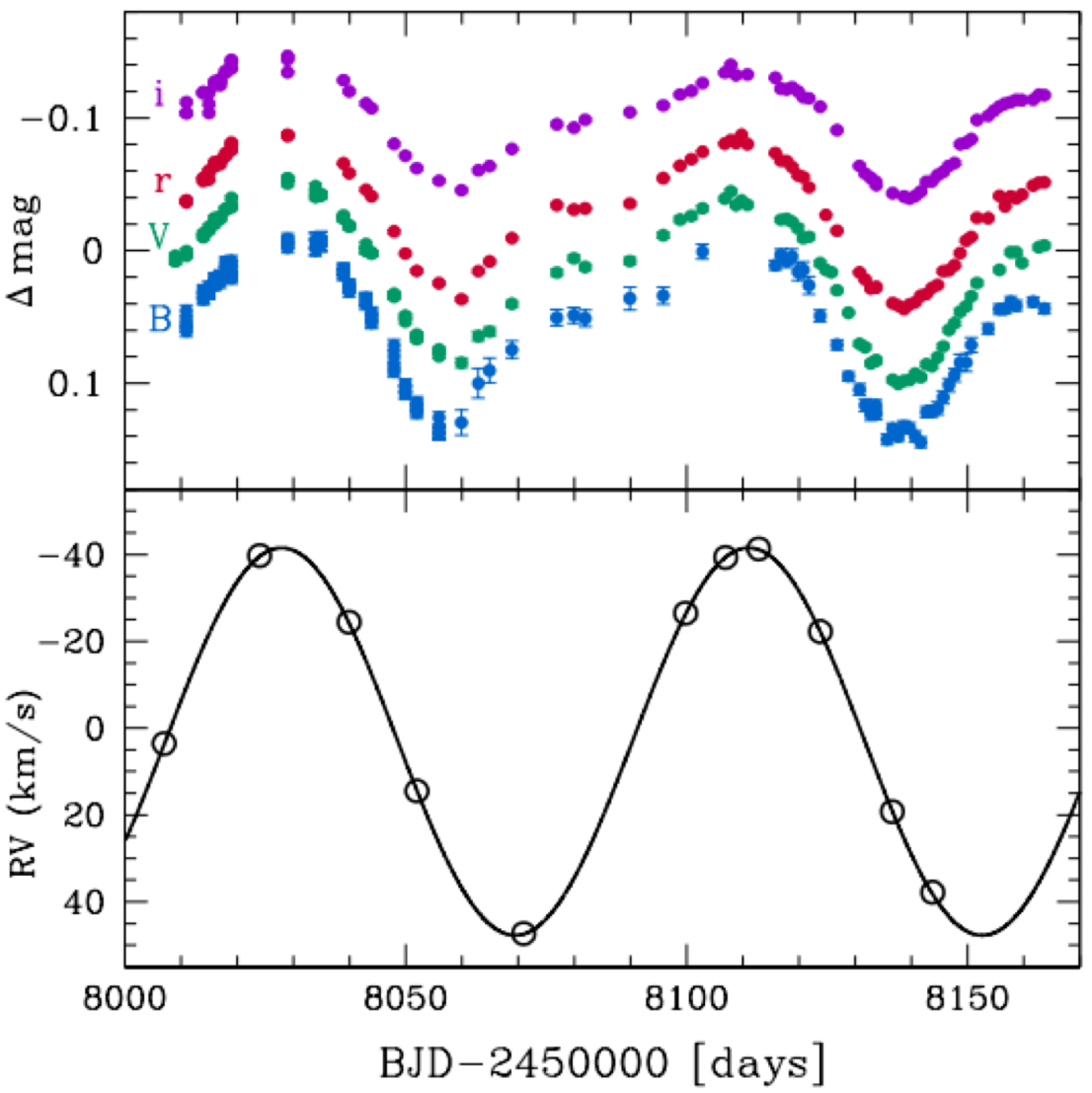


Burdge+ 2019 in prep

Binaries with BH:

- A black-hole (2.5 – 5.8Msun) + a red giant with a period of 83 days

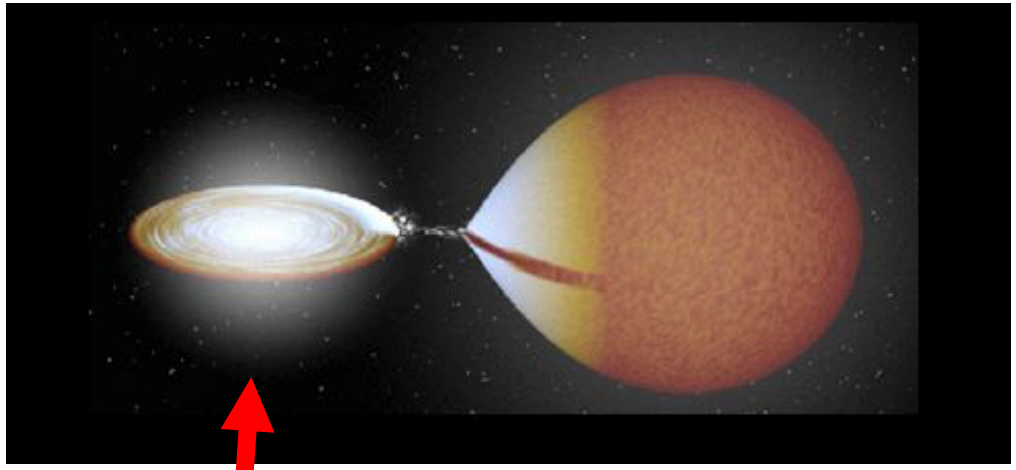
ASAS-SN light curves



Thompson + 2018 Nature

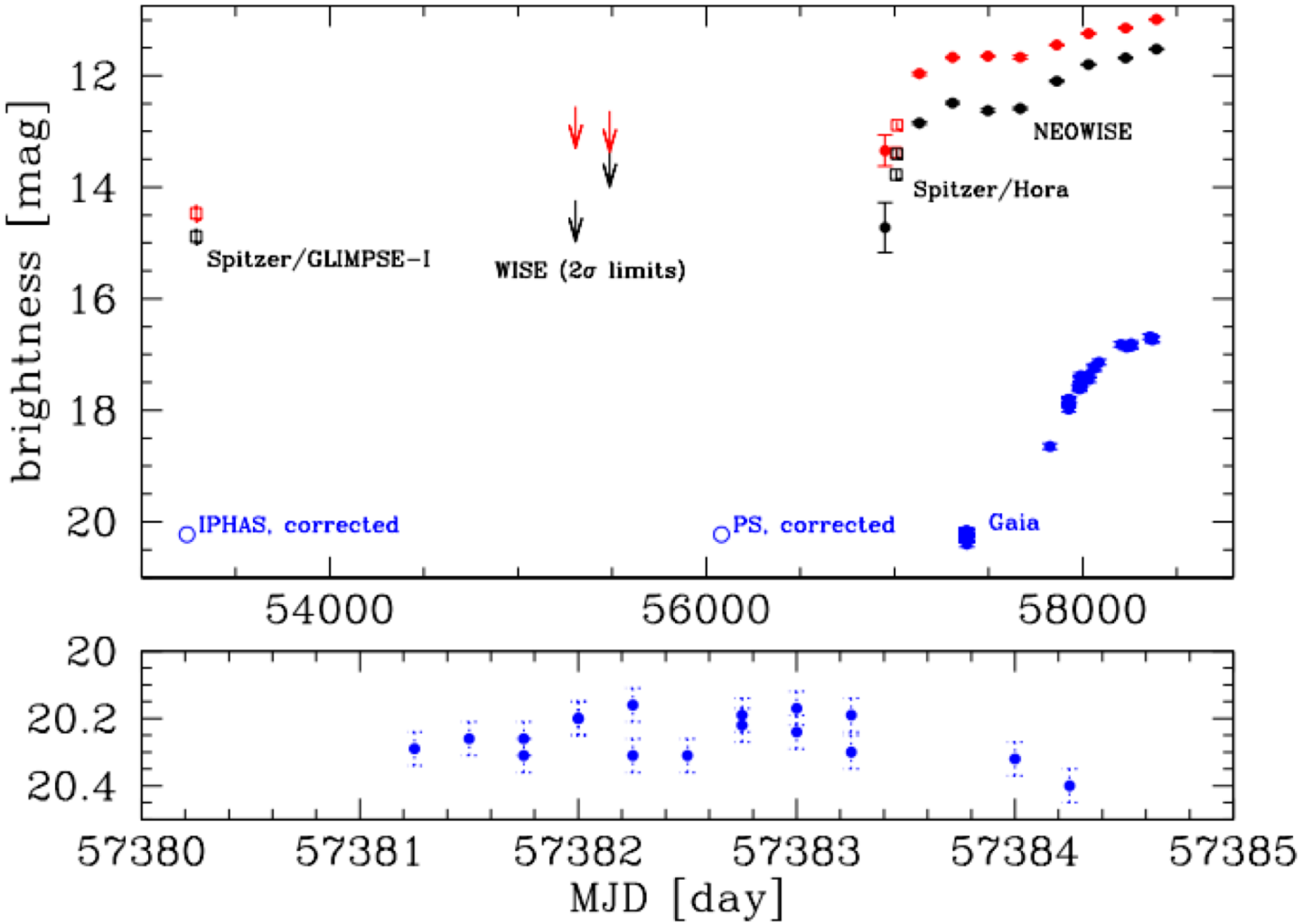
Cataclysmic Variables from ZTF

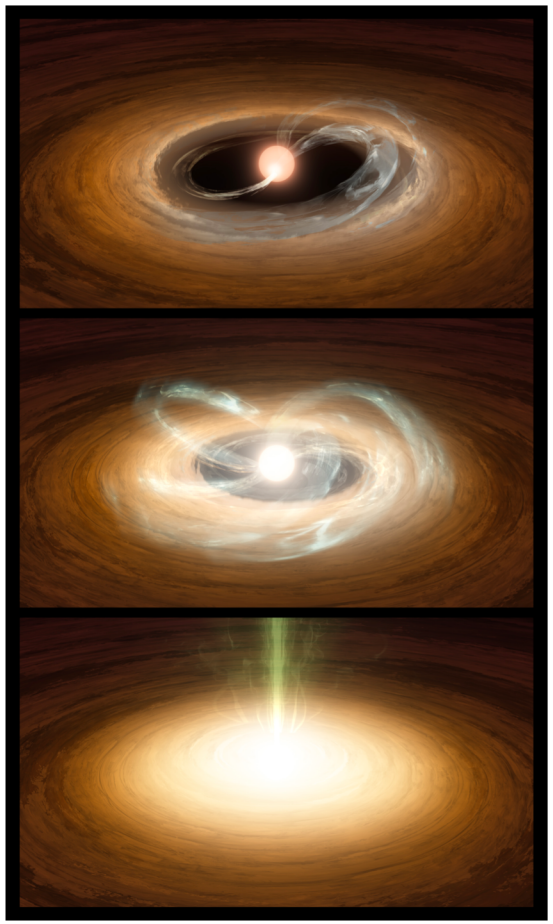
- Paula Szkody (UW) and Jan van Roestal (Caltech) have large programs



Accreting white dwarf

Young stars – FU Orionis (~25 total so far)

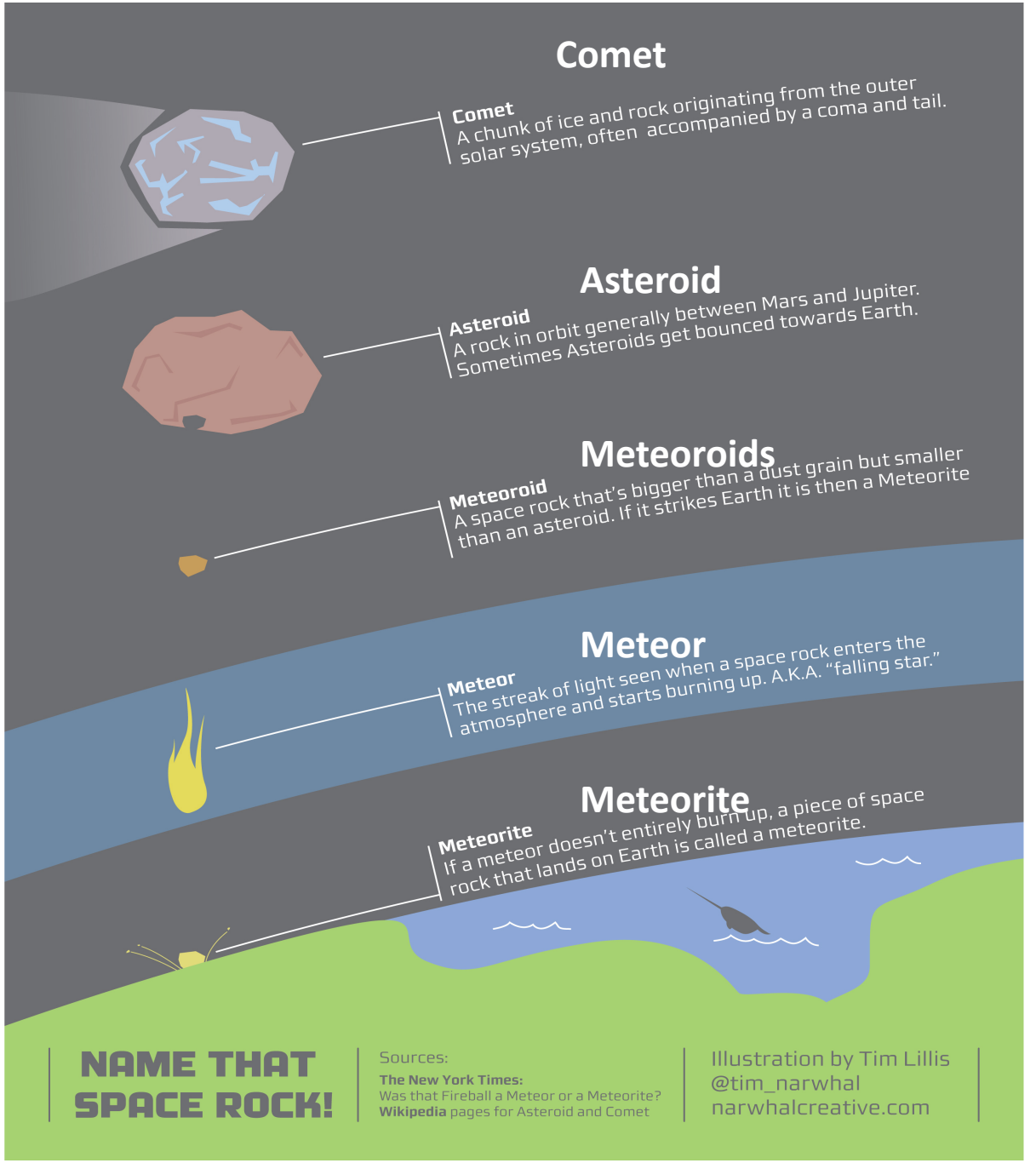




Gaia17bpi, Hillenbrand+ 2018 ApJ

ZTF Solar System Science

- **Discover**, **characterize**, and **monitor** small bodies in the solar system
- Enable **rapid response** on transient events
- Comets
- Main Belt Asteroids
- Near Earth Asteroids
- Centaurs
- Interstellar objects



Most recent near Earth asteroid (~10km) from ZTF:

- $2019AQ_3$

(19mag discovered by ZTF)