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 la, 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



R g 18 В U UVW1



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



AGN variabilities:

Small amplitude



Large amplitude



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 -0.1∆ mag 0 В 0.1 $^{-40}$ -20 RV (km/s) 0 20 40 8000 8050 8100 8150 BJD-2450000 [days]

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 Comet A chunk of ice and rock originating from the outer A chunk of ice and rock of gmating from the outer solar system, often accompanied by a coma and tail. • Discover, characterize, and monitor T**Asteroiu** A rock in orbit generally between Mars and Jupiter. Sometimes Asteroids get bounced towards Earth. Asteroid small bodies in the solar system • Enable rapid response on transient **Meteoroids** A space rock that's bigger than a dust grain but smaller than an asteroid. If it strikes Earth it is then a Meteorite events • Comets **Nieteon** The streak of light seen when a space rock enters the Main Belt Asteroids The streak of fight seen when a space rock enters the atmosphere and starts burning up. A.K.A. "falling star. • Near Earth Asteroids Meteorite If a meteor doesn't entirely burn up, a piece of space rock that lands on Earth is called a meteorite Centaurs • Interstellar objects NOME THO Illustration by Tim Lillis The New York Times SPACE ROCK **Vikipedia** pages for Asteroid and Comet

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

2019AQ₃
(19mag discovered by ZTF)



