

#### Erica Hammerstein

University of Maryland



## ZTFbh group 2020

#### Sjoert van Velzen, UMd/NYU (coordinator)



SWG Dinner @ Daisy Mint March 19, 2018

Nadia Blagorodnova, Radboud Suvi Gezari, UMd (previous coordinator) Matthew Graham, Caltech (deputy coordinator) **Tiara Hung**, UCSC (former grad student) **Sara Frederick**, UMd (current grad student) Scott Anderson UW **Charlotte Ward**, UMd (current grad student) Shri Kulkarni, Caltech Peter Nugent, LBNL Tom Barlow, Caltech Brad Cenko, GSFC Lin Yan, Caltech Po-Chieh Yu, NCU Zeljko Ivezic, UW Robert Stein, DESY David Shupe, Caltech/IPAC Nathaniel Roth, UMd and GSFC Daniel Stern, Caltech/JPL

@ Zoom March 2020



August Edinburgh GOT musical, 6



# WINTER CONTRERE

van Velzen, Gezari, et al.

(arXiv:2001.01409, ApJ in press)



# **Photometric selection**



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## Yield of spectroscopically classified TDEs





- 26 TDEs
- TDE-H: 11 sources
- **TDE-H+He\*:** 11 sources \*many with Bowen lines
- TDE-He: 2 source

# ZTF light curves of 24 TDEs



### ZTF TDEs and their hosts

- 1. What are the properties of these galaxies? Are they similar to each other?
- 2. Where do these TDE hosts fit within the context of the local galaxy population?
- 3. What can that tell us about why TDEs happen in these galaxies?

Our TDE search is totally agnostic to host galaxy type!





- 19,000 spectroscopically classified galaxies from main SDSS galaxy sample
- Make use of complete knowledge of TDE luminosities and galaxies we can detect them in
  - Create comparison sample for each TDE based on TDE luminosity and redshift, ZTF reference frame host galaxy detection limit, SDSS spectroscopic magnitude limit
  - 1,000 galaxies/TDE
- Stack sub-samples to create full sample



- TDE hosts have historically appeared to prefer E+A/post-starburst galaxies (see Arcavi+14, French+16, Law-Smith+ 17)
  - Overrepresented by factors of 100-190x, i.e. observed 100 times more in TDE host samples than galaxy population
- Only 2 TDE hosts fall within E+A region, which makes up only ~0.34% of comparison sample
  - Additional 6 hosts within weaker, quiescent Balmer-strong (QBS) region

For masses restricted to TDE host range: E+A overrepresentation = 29x QBS overrepresentation = 17x

Can this be explained using properties of the TDE hosts?



- Results of stellar population synthesis on pre-flare photometry
- 63% of TDE hosts in green valley, compared to 13% of SDSS sample
- Can this property of TDE hosts explain the preference for E+A galaxies?
  - Restrict comparison sample to galaxies within green valley

E+A overrepresentation = 8x

QBS overrepresentation = 9x

- TDE hosts have higher Sérsic indices than galaxies of similar masses
- Both E+A and TDE hosts have distributions in Sérsic index similar to early-type galaxies (ETGs), very different from other green valley galaxies - why?
  - Schawinski et al. 2014 analysis of ETGs and LTGs in green valley
- Can this property of TDE hosts explain the preference for E+A galaxies?
  - Restrict comparison sample to galaxies with  $n_g > 2.0$

E+A overrepresentation = 29xQBS overrepresentation = 21x



#### Can we explain the apparent E+A preference?

Full sample = 29x	<ul> <li>Is there something special about E+A galaxies?</li> </ul>
Green valley cut = 8x	<ul> <li>Simply being green is not good enough</li> <li>Possibly in green valley as a result of recent merger</li> <li>Higher Sérsic indices point towards post-merger systems</li> </ul>
Sérsic cut = 29x	<ul> <li>Concentrated red galaxies are not producing TDEs at elevated rates</li> <li>TDE rate declines with time after merger (Stone+18) which could explain why we don't see red TDE hosts</li> </ul>
Green valley + Sérsic cut = 1x (QBS = 3x)	<ul> <li>Isolated concentrated green valley galaxies</li> <li>Fully accounts for number of E+As observed</li> </ul>







#### High resolution imaging

- Confirm morphology: Is there really 0 a morphology trend with redshift?
- Study asymmetry and Ο concentration to determine likelihood of past mergers
- Are there nuclear stellar Ο overdensities?
- IFU data
  - Stellar populations as a function of Ο galaxy radius
    - Are there younger populations in the centers of these galaxies?
  - SMBH masses Ο

- Case study: PS1-10ih (z = 0.1696)
  - SDSS misses features that are important for Ο morphology and surface brightness profiles
  - SDSS  $n_a = 5.17$ , but fitting bulge + disk profile to Ο HST yields  $n_{h} = 8.03$





#### HST WFC3

1"



- Prior evidence for TDEs in galaxies with AGN line ratios (French+ 17)
- Most TDE hosts with prominent nebular emission lines are consistent (in part) with star formation
- LLAGN or shocks resulting from a recent merger or starburst may lead to AGN ratios

