Tidal Disruption Event Demographics with the Zwicky Transient Facility: Volumetric Rates, Luminosity Function, and Implications for the Local Black Hole Mass Function

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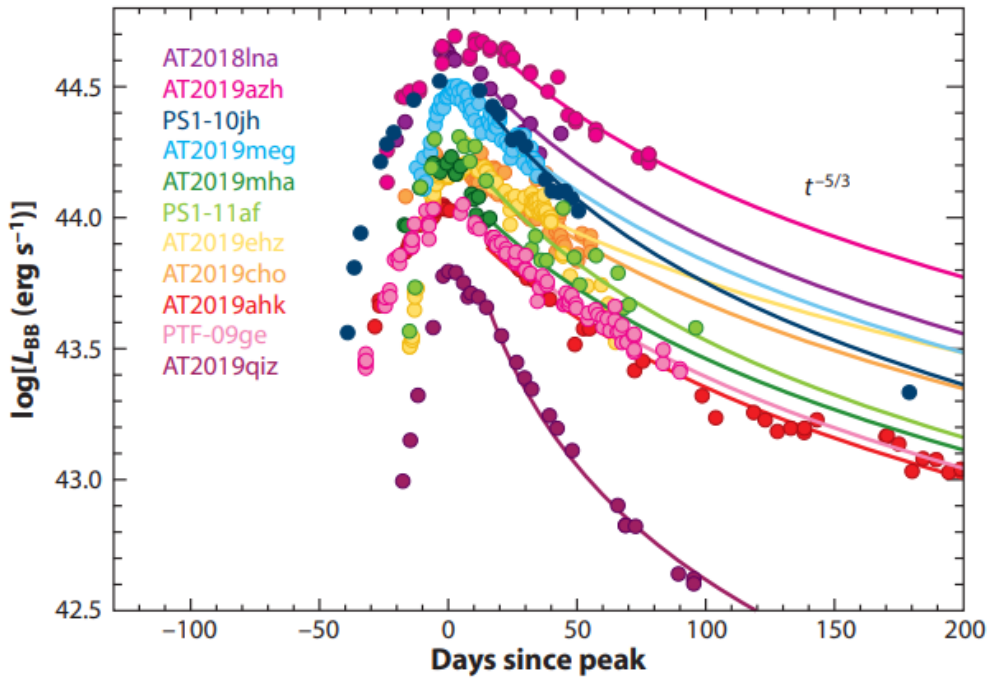
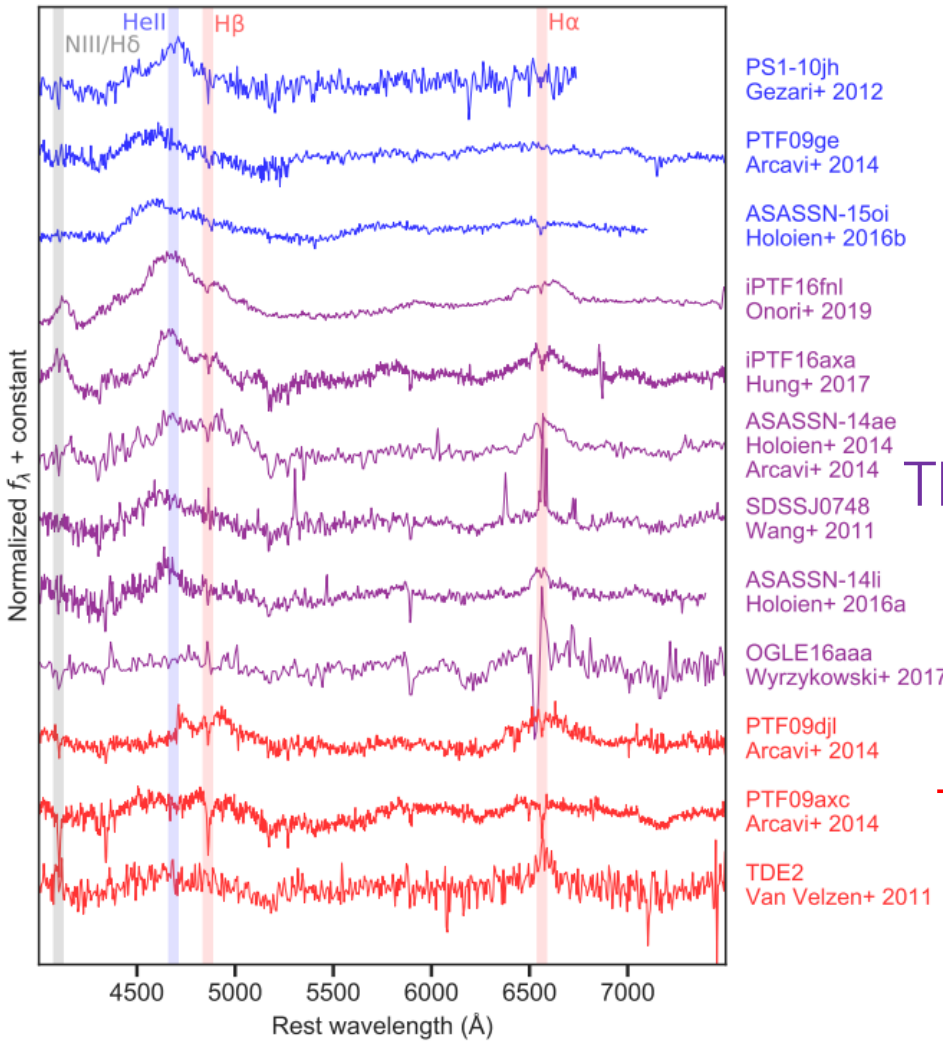
- Introduction
- Sample Construction
- Light-curve Characterization
- Black Hole Mass Estimates
- Discussion
- Summary

Introduction

- Tidal Disruption Events (TDEs)



Suvi Gezari, ARA&A, 2021



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Sjoert van Velzen et al., Space Sci Rev, 2020

Sample Construction - ZTF

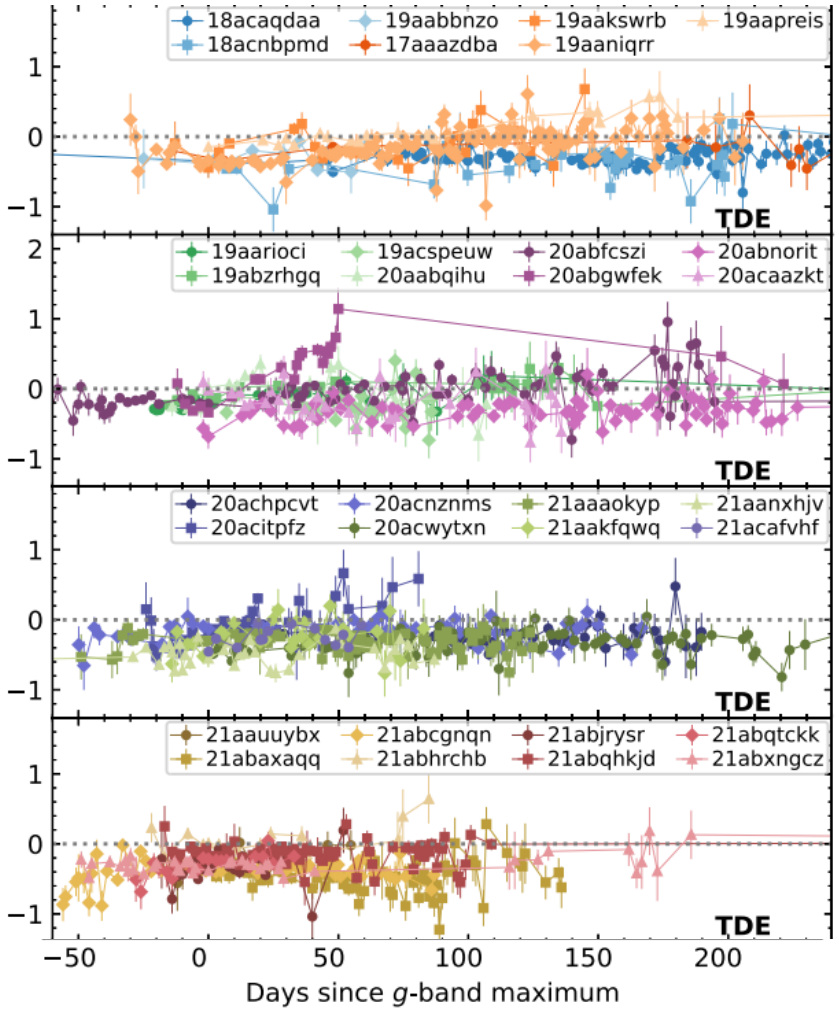
- Palomar Oschin Schmidt 48 inch telescope (P48)
- 47 deg^2 camera to scan the entire northern visible sky at decl. > −35°.2
- Filters: g, r, and i
- Typical survey depth is ~20.5 mag
- Northern sky survey cadence of 3 days (1g+1r, ZTF-I) and 2 days (ZTF-II)

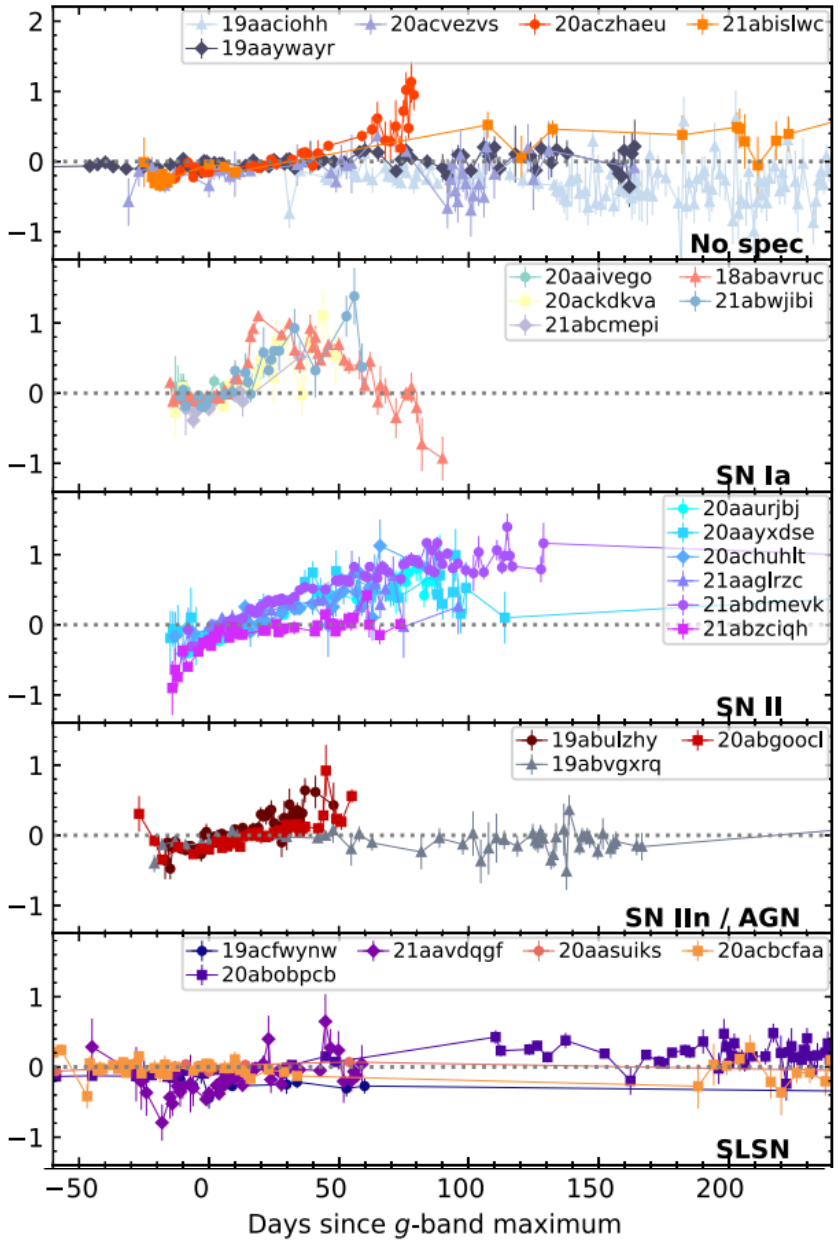
Sample Construction – Selecting TDE Candidates

Table 1
Steps for Selecting TDE Candidates

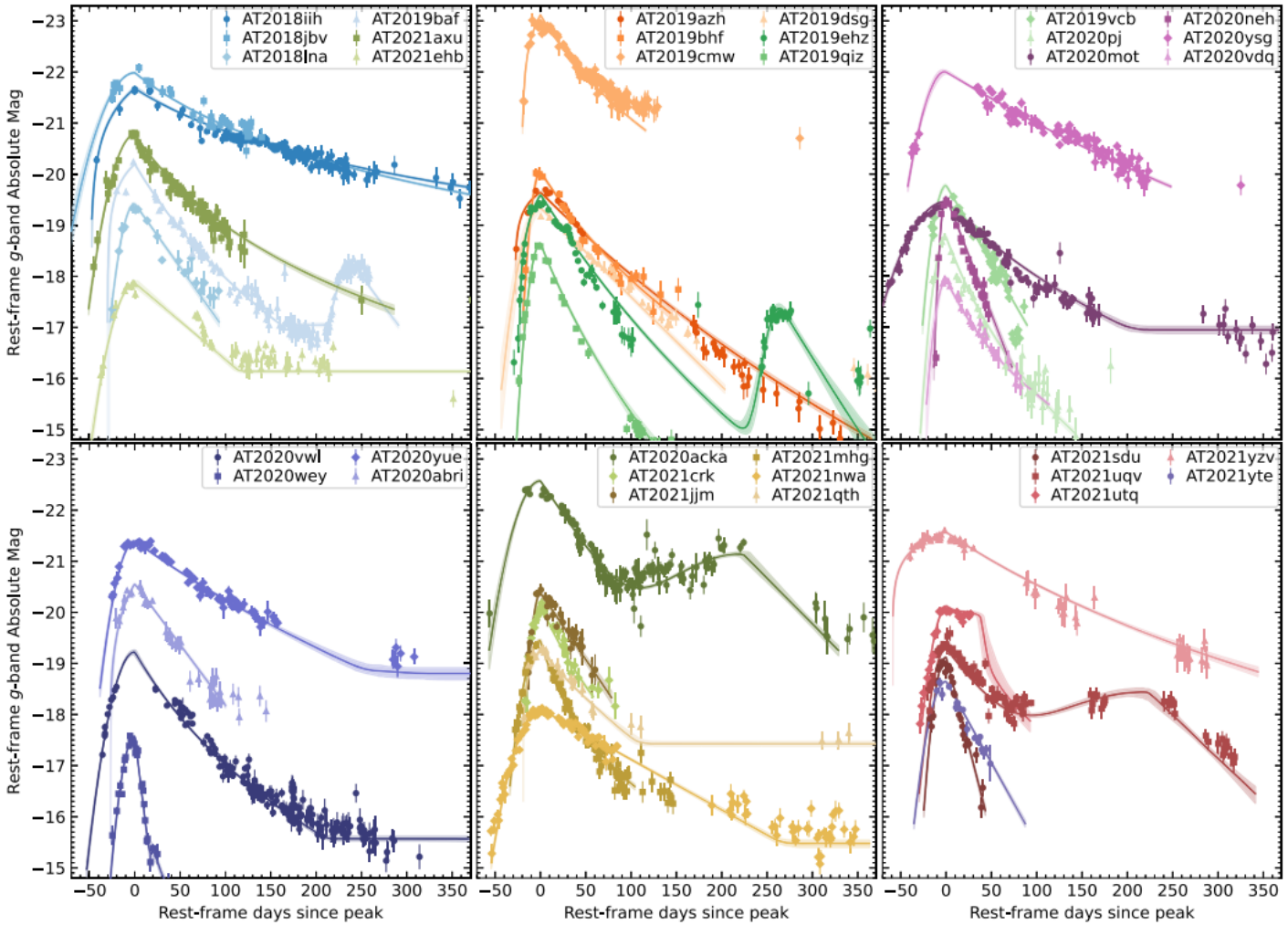
Step	Criteria	# TDE Candidates
1	Initial cuts to select nuclear transients	890,266
2	More detailed cuts to select nuclear transients	143,731
3	Cuts on peak magnitude, transient duration, and number of detections	9426
4	Cuts on the peak color, PS1 machine-learning classification, and IR variability; remove known quasars	1390
5	Alert photometry: cuts on color, cooling rate, and rise and decline timescales	174
6	Forced photometry: cuts on color, cooling rate, and rise and decline timescales	90
7	Cuts on peak magnitude (of forced photometry)	55
8	Spectroscopic classification for 50 objects; photometric and contextual classification for 5 objects	33

Sample Construction – False & True Positives

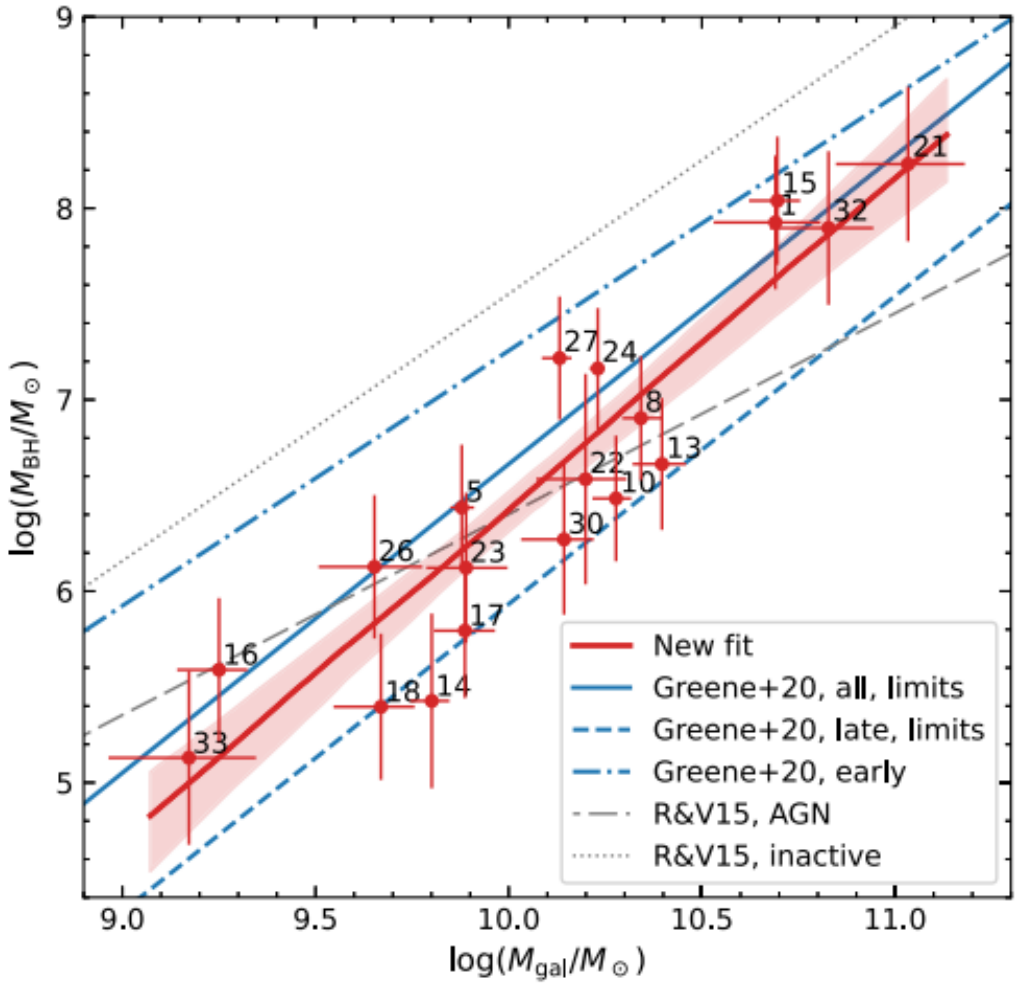




Light-curve Characterization



Black Hole Mass Estimates



Discussion

- Correlations between TDE Photometric and Galaxy Properties
- Luminosity Functions
- Rate Dependence on R_{bb}
- Optical TDE Black Hole Mass Function
- Rate Enhancement in Green Galaxies and Suppression in Blue Galaxies
- TDE Rates: The Tension between Observations and Losscone Models
- Implications of the Local BHMF

Summary

- Among the a complete flux-limited sample of 55 blue nuclear transients systematically selected with ZTF, 33 are classified as TDEs.
- Recovered a number of correlations between MBH and photometric properties.
- Find the rates of optically loud and X-ray loud TDEs are comparable.
- the TDE sample can also be used to address the origin of TDE's UV and optical emission, and to train machine-learning algorithms for real-time photometric selection of TDE candidates.