

Practice Science Motivation (1 page)

~~Summary of Subfields Supported by TDE Science Astronomical Subfield Decadal Subsection
How TDE Observations are Useful TDE Emission B-Q2a—Transients Powered by Black
Holes B-Q2a Since TDEs are powered by Black Holes, they are directly applicable. Multimessenger
astronomy B-DA8 There has been some evidence of neutrino detections from nearby TDEs.
Galaxy Nuclei D-Q4d Radio observations of TDEs provide circumnuclear ($r < 1$ pc) contents
and density profiles. Black Holes B-Q2a, B-Q4b, D-Q3b, TDEs provide measurement of the
mass of a central SMBH independent of galaxy properties and scaling relations (e.g. $M-\sigma$).
They also provide a means to discover and study the elusive intermediate mass black hole.
Shock Physics B-Q2b Radio observations of TDEs reveal the properties of the shock front
as it propagates through the circumnuclear medium. Jet Physics B-Q2a, B-Q3a Prompt
radio observations of TDEs will capture the early-time jet evolution minutes to days after
the initial launch.~~

A primary science goal of the 2023 Astronomy Decadal ~~, and a personal interest of mine,~~
is the continued prompt multiwavelength followup of transient events. These violent and
explosive transient events provide a unique probe of high energy phenomenon and environ-
ments that are impossible to reproduce on the surface of the Earth. Of particular interest
are tidal disruption events (TDEs; [2023 Decadel, Subsection B-Q2a](#)). TDEs occur when a
star approaches within the tidal radius of a supermassive black hole (SMBH) and is torn
apart, releasing emission across the electromagnetic spectrum. Understanding the emission
from TDEs on their own and how it relates to other transient emission is an open ques-
tion in astronomy and a key focus of the 2023 Astronomy Decadal. ~~The relevant Decadal
subsections are listed in the first part of Table .~~

Studying TDEs will not only further our understanding of them but also many other areas
of astronomy. For instance, studying TDE emission provides a probe the SMBH properties,
the sub-parsec galactic nuclei environment, jet evolution and fundamental physics, and shock
physics. For instance, using radio observations of TDEs we are able to study the density and
particle makeup of the previously quiescent galactic nuclei [at a sub-parsec scale\(2023 Decadel,
Section D-Q4d\)](#). [Studying the density and structure of the galactic nuclei on such small
scales will help us better understand both SMBH accretion and how it affects the evolution
and structure of galaxies as a whole.](#) ~~A summary of areas of astronomy probed by TDE
observations, as well as the relevant Astronomy 2020 Decadal (sub)sections corresponding to
each of these areas, is given in Table .~~ Overall, this makes multiwavelength observations of
TDEs necessary to further our fundamental understanding of high energy, dense astronomical
environments.

In particular, ~~as described in Table ,~~ prompt radio/millimeter observations of TDEs
allow us to study the early evolution of jets ([2023 Decadel, Subsections B-Q2a and B-Q3a](#)).
As the jets evolve outwards, they shock the previously quiescent circumnuclear medium,
producing synchrotron emission visible in the radio and millimeter. Fitting a *complete*
spectral energy distribution of TDEs allows us to extract properties of the jet, shock front,
and ambient circumnuclear medium. Since this SED normally peaks around 1-10 GHz
(depending on the time of the observation), observations with sensitive telescopes like the
Very Large Array (VLA) and Atacama Large Millimeter Array (ALMA) necessary to study
TDE radio/millimeter emission and further our understanding of jet evolution. A list of
recently radio bright TDEs is given in Table 1 as examples of objects that require followup.

Although, for a true study of this nature, we would need “Target of Opportunity” (ToO) observations within days after the initial optical or X-ray detection.

Table 1: Sample of Radio Bright TDEs for Observations

IAU Name	RA [hours]	Declination [degree]	Redshift	Approximate Flux Density at 6GHz [μ Jy]
AT2022dyt	10:00:08.008	+26:27:38.57	0.072	75
AT2022wtn	23:23:23.778	+10:41:07.99	0.049	300
AT2021sdu	01:11:23.924	+50:34:29.67	0.059	75
AT2020zso	22:22:17.130	-07:15:59.08	0.061	150
AT2018cqh	02:33:46.930	-01:01:28.38	— ¹	10 ⁵
AT2018hyz	10:06:50.871	+01:41:34.08	0.04573	10 ⁵

¹No redshift publicly available for AT2018cqh on the Transient Name Server (TNS).