Tidal Disruption Events with LSST (and other time domain surveys)

Brenna Mockler (UCSC & NBI)

in collaboration with:
Enrico Ramirez-Ruiz (UCSC & NBI), James Guillochon (Harvard), Jamie Law-Smith (UCSC & NBI), Katie Auchettl (NBI)
\[ \beta \equiv \frac{r_t}{r_{peri}} \]

sims: Law-Smith et al. 2017
$dM/dt$ as a function of impact parameter ($\beta$)

Guillochon & Ramirez-Ruiz 2013
\( M_h \) dependence in TDEs

- TDE light curves can provide strong constraints on BH mass

\[
\dot{M}_{\text{peak}} \propto M_h^{-1/2} M_*^2 R_*^{-3/2}
\]

\[
t_{\text{peak}} \propto M_h^{1/2} M_*^{-1} R_*^{3/2}
\]
Effect of varying $M_h$

Hotwired 2019 (CIERA)

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Effect of varying $M_*$

Graph showing the effect of varying $M_*$ on the time it takes for a certain process to occur.

- $M_*$ ($M_\odot$):
  - 0.1
  - 1.0
  - 5.0
  - 10.0

- $M_h = 1e6M_\odot$

- Time (days):
  - 13 days
  - 20 days
  - 22 days
  - 24 days

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MOSFiT light curve fitting

- Fit light curves to models for a variety of transients
- Can use parts of existing models to build new models

Guillochon+2017, Nicholl+2017, Villar+2017, Mockler+2018 and more
M$_h$ (M$_{\odot}$) vs. $\sigma_*$ (km/s)

- MOSFiT
- McConnell & Ma '13
- Xiao et al. 2011

$\sigma$ from: Thomas + 2013; Wevers + 2017; Blagorodnova + 2017; Gezari + 2017

Mockler+2018

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TDEs with LSST
(and other large transient surveys)

- There will be many: >~30,000 in LSST alone

- Need to distinguish from other nuclear transients

- What biases will TDE “impostors” introduce to the inferred $M_h$ distribution?
Hotwired 2019 (CIERA)

Kasliwal, adapted from Kulkarni +2007
TDEs are bright and blue

SNe data from Siebert et al. 2017, originally from open SNe catalog (Guillochon et al. 2017)
TDEs have minimal color evolution

[Graph showing color evolution of various TDEs with time, annotated with different SN events and color indices.]
TDEs have minimal color evolution

Mockler+2019 in prep

Hotwired 2019 (CIERA)
TDEs remain blue

Hotwired 2019 (CIERA)

Mockler+2019 in prep
TDEs remain blue

Hotwired 2019 (CIERA)

Missing TDEs?

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Summary

- Simple observational cuts \((\text{color}, \Delta m_{15})\) can separate TDEs from most other nuclear transients.

- If we mistake SNe for TDEs, we will likely mistake them for TDEs from lower mass SMBHs \((< 10^6 M_\odot)\).