Detecting stellar tidal disruptions: from optical to radio

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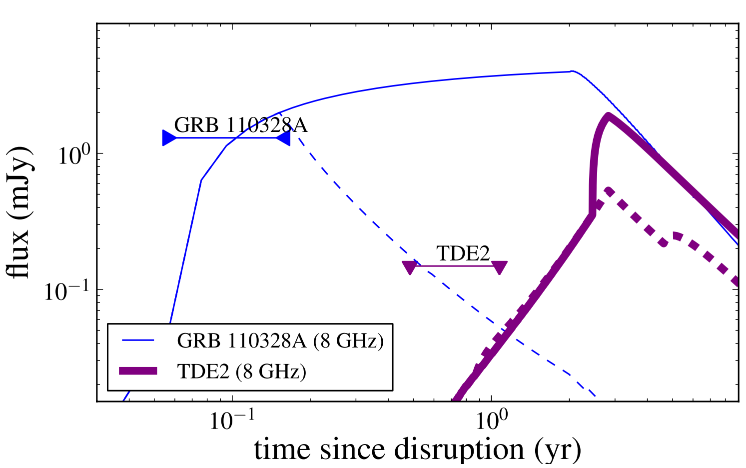
Abstract

When a star passes too close to a massive black hole, the star is tidally disrupted.

A few candidate examples of flares that occur when the debris of the disruption falls back onto the black hole have been identified in UV and X-ray surveys. The first detection of two tidal flares in SDSS [1] has opened the way for obtaining a large sample: we can expect tens to hundreds events per year.

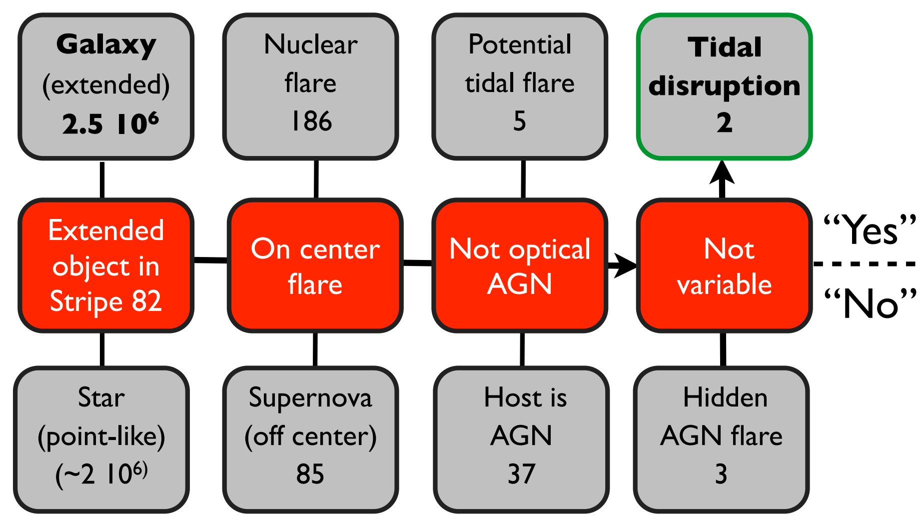
Using jet-disk coupling we built a robust model for the radio emission of tidal disruptions. We reproduce the flux of the recent tidal flare candidate GRB 110328A [3] and find that near-future radio surveys (eg, LOFAR) will be able to test whether the majority of these events are accompanied by a radio-loud jet.

Radio observations

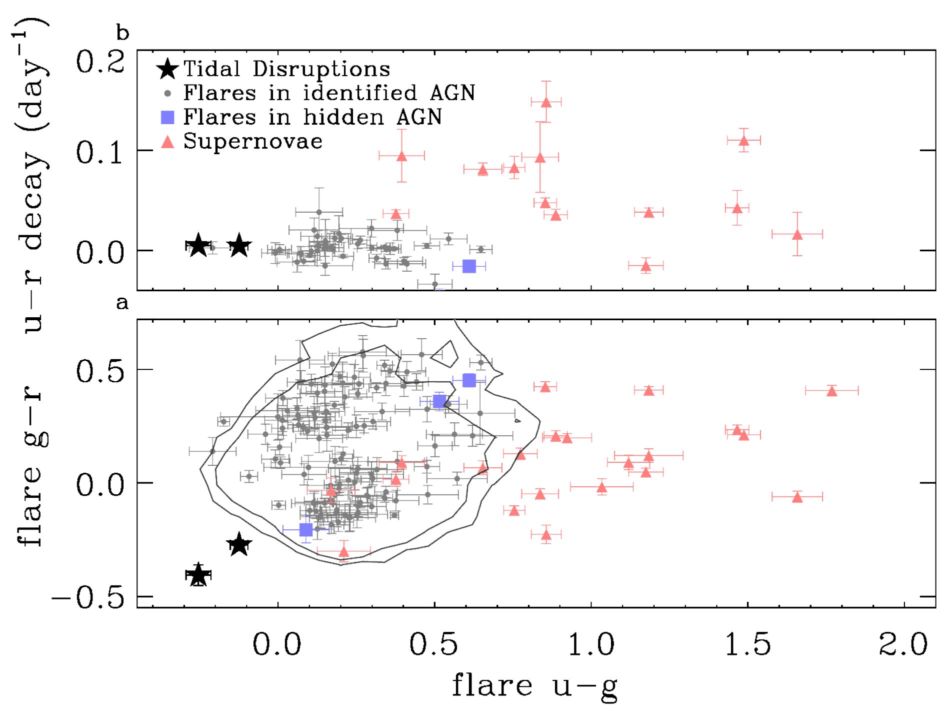


Predicted light curves for scenario a (solid) and c (dashed) and radio observations of tidal flare candidates TDE2 [1] and GRB 110328A [3]. The radio flux of the latter is reproduced if we assume a small angle between the observer and the jet [2].

Optical discovery



Getting from 10^6 galaxies to 2 tidal flares [1].



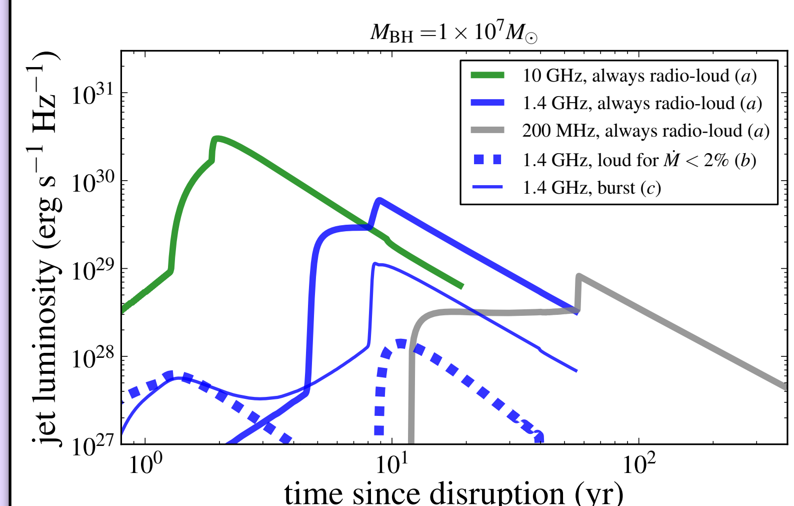
Tidal flares compared to AGN and supernovae [1].

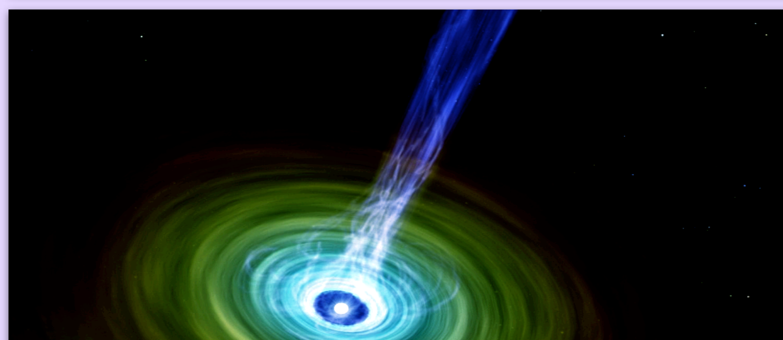
Radio jet model

To estimate the synchrotron luminosity of the core of the jet that should accompany a tidal flare, we follow the well-established the jet-disk symbioses model [4]. We consider three different scenarios for the fraction of the accretion power that is fed into the jet:

$$q_j = \begin{cases} 0.2 & \text{all times} & (a) \\ 2\times10^{-3} & \dot{M}(t) > 2\%\dot{M}_{\rm Edd} & (b) \\ 0.2 & t < t_{\rm fallback} & (c) \end{cases}$$

here, $t_{\rm fallback}$ is the fallback time after disruption (~ 0.1 yr). This yields the light curves show below.





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[1] van Velzen, S., Farrar, G.R., et al. 2010, arXiv:1009.1627
[2] van Velzen, S., Körding, E. and Falcke H. 2011, arXiv:1104.4105
[3] GCN 11823, 11824; Bloom et al. 2011, arXiv:1104.3257
[4]Falcke, H. Bierman, P.L 1995, A&A, 293