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Extreme Tidal Disruption Events as probes of Nuclear Star Cluster

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Nuclear star clusters (NSCs), found in most galaxies, appear as compact stellar systems located around supermassive black holes (SMBHs) in their centers. They often contain a mix of old and young stars and frequently exhibit signs of recurrent star formation. SMBHs define the loss cone of small angular momentum orbits that plunge to the immediate vicinity of the event horizon, where tidal forces exceed the star's self-gravity. Tidal disruption event (TDE) occurs when a star approaches the black hole on an orbit whose pericenter is close to the critical radius (R_t). A fraction of the star's material becomes ejected, while the rest remains bound on a new trajectory. The orbital dynamics of stellar debris is qualitatively different due to relativistic precession and frame dragging. We explore the mechanisms that bring stars close enough to R_t and below it. This can happen by chance (depending on the NSC's distribution function), but the orbital decay can also be enhanced by the hydrodynamical influence of the interstellar environment (e.g., a gaseous or dusty accretion disc or torus) or gravitational radiation losses (Extreme Mass Ratio Inspiral). The rate of TDEs, the emerging radiation signal, and the corresponding duty cycle of its (quasi-)periodicity should reflect the mechanisms of orbital decay that operate in a given galactic nucleus.

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