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Inclination distributions in tidal disruption events by spinning supermassive black holes

Most galaxies host a supermassive black hole (SMBH) at their centers, yet a large fraction of SMBHs are quiescent and only observable through their transient interactions with stellar objects. As a star approaches an SMBH, the tidal gravitational forces can overwhelm the star's self-gravity, resulting in a tidal disruption event (TDE). The disrupted debris accretes onto the black hole, potentially powering an electromagnetic flare that can last for years. The stellar orbital distribution for disrupted stars is expected to be isotropic in inclinations, where the inclination is the angle of orbital angular momentum relative to the SMBH spin. This distribution will have notable observational consequences, such as inclination-dependent relativistic precession, energy reservoir at the innermost stable circular orbits for the accretion disk, or observable quasi-periodic oscillations. Our research highlights the importance of the orbital inclinations and evaluates their distribution which are a result of an interplay between tidal gravitational forces, direct capture by the event horizon, and two-body scattering that dictates the loss cone refilling. Finally, we integrate the inclination distributions to get total TDE rates for SMBHs with different masses and spins. Our results have significant implications for the observable properties of TDEs, which are to be explored as a part of future work.

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