Abstract Submitted
for the TSF21 Meeting of
The American Physical Society

Two regimes of tidal-stream circularization by supermassive black holes[1] MICHAEL KESDEN, JOSEPH ROSSI, JUAN SERVIN, University of Texas at Dallas — Stars that approach a supermassive black hole (SMBH) too closely can be disrupted by the tidal gravitational field of the SMBH. The resulting debris forms a tidal stream orbiting the SMBH which can collide with itself due to relativistic apsidal precession. These self-collisions dissipate energy, causing the stream to circularize. We perform kinematic simulations of these stream self-collisions to estimate the efficiency of this circularization as a function of SMBH mass $M_\bullet$ and penetration factor β, the ratio of the tidal radius to the pericenter distance. We uncover two distinct regimes depending on whether the time t_c at which the most tightly bound debris circularizes is greater or less than the time $t_{\rm fb}$ at which the mass fallback rate peaks. The bolometric light curve of energy dissipated in the stream self-collisions has a single peak at $t > t_{\rm fb}$ in the slow circularization regime ($t_c > t_{\rm fb}$), but two peaks (one at $t < t_{\rm fb}$ and a second at $t_{\rm fb}$) in the fast circularization regime ($t_c < t_{\rm fb}$). Tidal streams will circularize in the slow (fast) regime for apsidal precession angles less (greater) than 0.2 radians which occur for $\beta < (>)(M_\bullet/10^6 M_\odot)^{-2/3}$.

[1]The authors were supported by NASA award number 80NSSC18K0639.

Michael Kesden
University of Texas at Dallas

Date submitted: 24 Sep 2021 Electronic form version 1.4