BLACK HOLES IN DENSE STAR CLUSTERS
Aspen Center for Physics
2015 Aspen Winter Conference January 17–22, 2015

TITLE: How does the Debris from a Stellar Tidal Disruption Join an Accretion Flow?

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In the tidal disruption of a star by a black hole, the process by which debris forms a disk and generates flares and/or jets is not well-understood. The classic picture assumes that formation occurs quickly, such that the rate at which matter returns to the black hole is the same as the accretion rate of the disk. As it stands there are inconsistencies with observed candidates and classical theory: observed peak luminosities are 2--3 orders of magnitude below expectations and observed color temperatures are ~1 order of magnitude cooler than expectations. We investigate the issue of disk formation by combining a post-Newtonian hydrodynamics simulation of the star itself as it is torn apart with a fully general relativistic hydrodynamics simulation of the subsequent motion of the stellar debris as it orbits the black hole. The characteristic length scale at which the tidal streams merge to form an accretion flow is much larger than classical expectation. Furthermore, the time for accumulation of mass into the flow is significantly longer than the characteristic orbital period of most tightly-bound tidal streams. Although the accretion rate still rises sharply and then decays roughly as a power-law, its maximum is 0.1 times the previous expectation, and the timescale of the peak is 5 times longer than previously predicted. The geometric mean of the black hole mass and stellar mass inferred from a measured event timescale is therefore 0.2 times the value given by classical theory.