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Beller Lectureship: Predictions for Observational Signatures of the Tidal Disruption of Stars

LINDA STRUBBE, Canadian Institute for Theoretical Astrophysics

A star that wanders too close to a massive black hole (BH) is shredded by the BH's tidal gravity; soon afterwards, stellar gas starts falling back to the BH, releasing a flare of energy as gas accretes. For days to months following disruption, the gas feeds the BH at a highly super-Eddington rate; i.e., radiation pressure in the flow is strong compared to the BH's gravity. During this phase, radiation pressure likely drives gas back outwards in a wind and produces a large optical luminosity and characteristic spectrum of blueshifted absorption lines. In some cases, magnetic fields may drive a relativistic jet as well, bright in radio and hard X-rays. Then weeks to months later, the BH feeding rate falls to sub-Eddington, and should produce a radiative accretion disk, bright in soft X-rays to ultraviolet. A few years or more after that, the feeding rate falls below $\sim$0.01 of the Eddington rate, and the flow may transition to a radiatively inefficient disk, perhaps accompanied once again by a jet. I will review panchromatic predictions for emission signatures from all of these structures, discuss their observability in new and upcoming transient surveys, and compare with observations of tidal disruption event candidates so far.