General relativistic hydrodynamic simulations of double tidal disruption events

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Tidal disruption events (TDEs) are astrophysical phenomena in which a star is torn apart by the gravitational force of a supermassive black hole. This happens when a star passes too close to a black hole for extreme tidal forces to break it apart, leading to a bright tidal disruption flare (TDF). During tidal disruption, some of the star's material remains gravitationally bound to the black hole, forming an accretion disk around it, and some is ejected. Studying these phenomena helps us better understand the physics behind black holes and the accretion processes, as well as obtain information about the stars involved. However, most stars are binary systems, so a more realistic case of tidal disruption events would be to consider a binary system approaching a supermassive black hole. This type of phenomenon called double tidal disruption events (DTDEs) is a topic of current interest, where its dynamics have mainly been studied. The most studied case of this configuration is when one star of the binary system is ejected at high speed, usually known as Hyper-Velocity Stars (HVS), while the other star stays in an orbit gravitationally bound to the black hole. More recently, studies have focused on other types of results, such as that due to the extreme tidal forces experienced by the binary system, the stars end up colliding, or that a double disruption may even occur in sequence.

The problem that is proposed to be studied is the hydrodynamics of double tidal disruption events in a totally relativistic regime. In particular, general relativity hydrodynamic simulations will be carried out to study the case of the conditions necessary for the center of mass of a binary system that approaches the black hole on a parabolic trajectory to result, upon reaching the tidal radius, in a star of the binary system becoming gravitationally bound to an elliptical orbit and the other star will be disrupted. In this proposed situation, it would be necessary to study the cases in which there is a rotating black hole and one without rotation, as well as to carry out cases in which the plane of rotation of the binary system is inclined with respect to the plane of rotation of the black hole and also cases in which the direction of rotation of the black hole and that of the binary system are equal or opposite.