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Black hole spin evolution in black hole binaries RICCARDO BARBIERI, Universita' Degli Studi Di Pavia, DAVIDE GEROSA, California Institute of Technology, GIOVANNI ROSOTTI, Institute of Astronomy, Cambridge, UK —
The spin directions of a supermassive black hole binary before the merger are crucial parameters in influencing the emitted gravitational-wave signal and whether or not the post-merger black hole receives a kick strong enough to dislodge it from the host galaxy. The interaction between each black hole and its surrounding accretion disc is the key player in setting the spin directions. Lense-Thirring precession and gas accretion both act to align the black-hole spin angular momentum of the disc. We study the disc-spin alignment problem combining two approaches: (i) we first use semi-analytical solutions to capture the Lense-Thirring effect for each individual black hole and its surrounding material; we then (ii) perform a set of simulations with the GANDALF smoothed-particle hydrodynamics code to provide initial conditions to describe the binary systems. This two-step process critically allows us to capture all the relevant lengthscales of the problem. We finally discuss the implications of our findings in the context of LISA future detections of misaligned black hole binary mergers and their gravitational kicks.

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