Contribution ID: **10** Type: **not specified**

Spin-eccentricity interplay in merging binary black holes

Thursday 4 September 2025 10:10 (20 minutes)

Orbital eccentricity and spin precession are precious observables to infer the formation history of binary black holes with gravitational-wave data. We present a post-Newtonian, multi-timescale analysis of the binary dynamics able to capture both precession and eccentricity over long inspirals. We show that the evolution of an eccentric binary can be reduced that of effective source on quasi-circular orbits, coupled to a post-Newtonian prescription for the secular evolution of the eccentricity. Our findings unveil an interplay between precession and eccentricity: the spins of eccentric binaries precess on shorter timescales and their nutation amplitude is altered compared to black holes on quasi-circular orbits, consequently affecting the so-called spin morphology. Even if binaries circularize by the time they enter the sensitivity window of our detectors, their spin orientations retain some memory of the past evolution on eccentric orbits, thus providing a new link between gravitational-wave detection and astrophysical formation. At the same time, we point out that residual eccentricity should be considered a source of systematics when reconstructing the past history of black-hole binaries using the spin orientations.

Author: FUMAGALLI, Giulia (Istituto Nazionale di Fisica Nucleare)

Co-author: Prof. GEROSA, Davide (University of Milano-Bicocca)

Presenter: FUMAGALLI, Giulia (Istituto Nazionale di Fisica Nucleare)

Session Classification: Contributed talks