Contribution ID: **146** Type: **not specified**

V. Gennari: Observing black hole's vibrations

Tuesday 20 December 2022 15:00 (15 minutes)

Ringdown offers a unique possibility to study the spacetime in extreme curvature regimes, to test general relativity and better understand the nature of black holes. The ringdown corresponds to the last phase of black hole binary coalescences, when the newly formed black hole relaxes to its stationary Kerr state by emitting gravitational waves. The linear theory of black hole perturbations predicts that the ringdown is made by a sum of different modes of vibration, which are exponentially damped harmonics oscillations. The excitation of different modes depends on the specific process that perturbs the black hole, and for quasi-circular binary coalescences only one fundamental mode dominates the ringdown emission. Besides, asymmetries in the system can excite higher subdominant modes of vibration. The measurement of the frequencies and damping times of these higher modes allows to directly test the black hole paradigm, by comparing the predicted values against the observations. We describe the first time domain analysis with an effective one-body ringdown model on the third catalog of gravitational waves events GWTC-3, to assess the observability of higher modes. We report a marginal detection of one higher mode in one event, for the first time on this event and the second time in ringdown-only analyses. This work sets the bases towards the positive identification and characterisation of higher modes in the ringdown signals with future, more sensitive gravitational wave detectors, and opens the concrete possibility of conducting multimodal tests of general relativity in the strong field regime.

Session Classification: Session 7 B