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Application of the black hole-fluid analogy: identification of a vortex flow through its characteristic waves

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Black holes are like bells; once perturbed they will relax through the emission of characteristic waves. The frequency spectrum of these waves is independent of the initial perturbation and, hence, can be thought of as a 'fingerprint' of the black hole. Since the 1970s scientists have considered the possibility of using these characteristic modes of oscillation to identify astrophysical black holes. With the recent detection of gravitational waves, this idea has started to turn into reality. Inspired by the black hole-fluid analogy, we demonstrate the universality of the black-hole relaxation process through the observation of characteristic modes emitted by a hydrodynamical vortex flow. The characteristic frequency spectrum is measured and agrees with theoretical predictions obtained using techniques developed for astrophysical black holes. Our findings allow for the first identification of a hydrodynamical vortex flow through its characteristic waves. The flow velocities inferred from the observed spectrum agree with a direct flow measurement. Our approach establishes a non-invasive method, applicable to vortex flows in fluids and superfluids alike, to identify the wave-current interactions and hence the effective field theories describing such systems.

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