Classical analogue of an interstellar travel through a hydrodynamic wormhole

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The classical theory of space-time, namely general relativity, suggests but does not demonstrate the existence of so-called wormholes allowing for interstellar journeys. Alternative proposals such as quantum gravity theories are developed nowadays to allow for wormhole travels by assuming hypothetical trans- Planckian effects at tiny scales. Here we show experimentally that analogue traversable and bidirectional wormholes exist in hydrodynamics following a suggestion by Wheeler. Using a water channel, we sent free surface waves on a countercurrent in an analogue gravity setup aiming at showing that hydrodynamic wormhole travels are controlled by a cascade of dispersive scales including surface tension effects: the capillary wavelength plays the role of a Planckian scale below which long gravity waves are transformed into short capillary waves that are able to move at speeds higher than the "flow" of space-time. Whereas our results do not apply to putative astrophysical wormholes per se, we anticipate that they will trigger new ideas to explore quantum gravity physics. [1].

[1] L.-P. Euvé, and G. Rousseaux, Classical analogue of an interstellar travel through a hydrodynamic wormhole (PRD Kaleidoscope Select), Physical Review D, **96** (6), 064042-1/15 (2017).

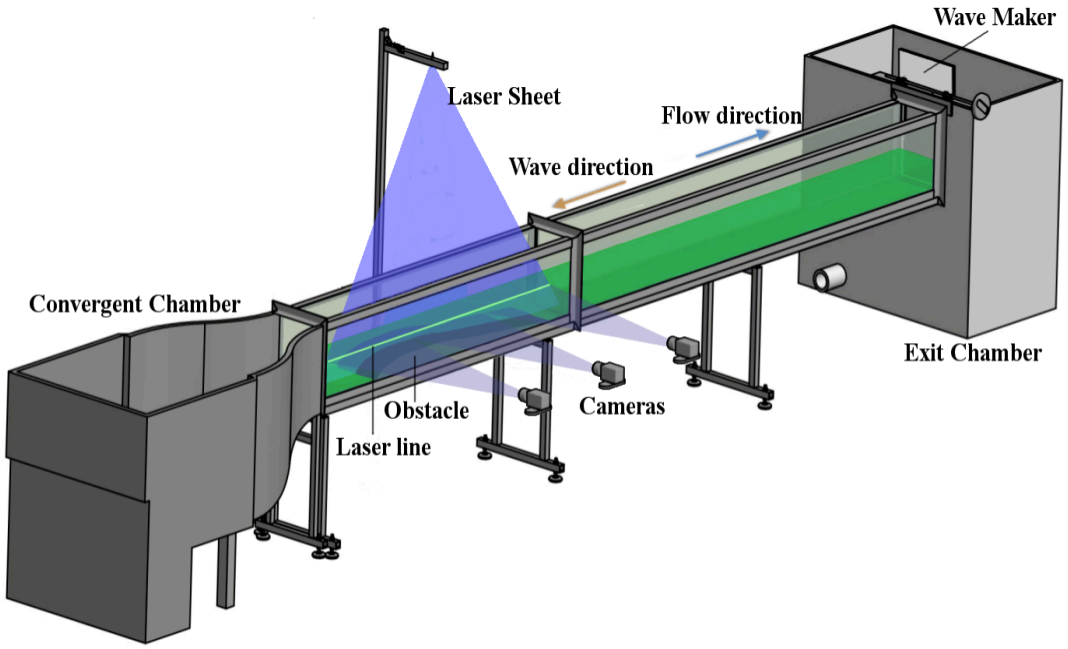

Figure 1: Water channel in which a current circulates over a bottom obstacle. The velocity gradients play the role of an effective space-time for free surface waves, which propagate analogously to light waves in the curved space-time induced by a gravitational mass.