Mimicking quantum field theory in curved spacetimes with classical open water channel flows

Alexis Bossard[1], Nicolas James[2], Valentin Jules[1], Johan Fourdrinoy[1], Scott Robertson[1] and **Germain Rousseaux**[1]

[1] Institut Pprime, UPR 3346, CNRS-Université de Poitiers-ISAE ENSMA, Site du Futuroscope - Téléport 2, 11 Boulevard Marie et Pierre Curie Bâtiment H3, TSA 51124, 86073 Poitiers Cedex 9, France
[2] LMA, UMR 7348 Site du Futuroscope - Téléport 2, 11 Boulevard Marie et Pierre Curie Bâtiment H3, TSA 61125, 86073 Poitiers Cedex 9, France
`germain.rousseaux@cnrs.fr`

In this talk, we will make a review of the recent achievements of Analogue Gravity in interfacial hydrodynamics with the purpose of probing field theory with tabletop experiments in the laboratory. We will present our daily measurements of analogue Hawking radiation with water waves on the top of a decelerating inhomogeneous current (or cataract jumps) emulating the scattering of light waves by an analogue horizon. After recalling the historical free surface flow regimes classification without dispersion, we will introduce a brand new one (cf. Fig. 1) above a bottom obstacle in a water channel that are amenable to Analogue Gravity experiments akin to a Quantum Gravity like behavior where the Planck scale role is played by the capillary length controlled by surface tension in an aquatic analogue of a gravitational spacetime. Hydrodynamic regimes reproducing analogous black holes (or waterfalls) with an accelerating current differ from one experiment to the other depending on the obstacle size because of a breaking of the similitude rules induced by surface tension that was reputed not to have any effect [1].

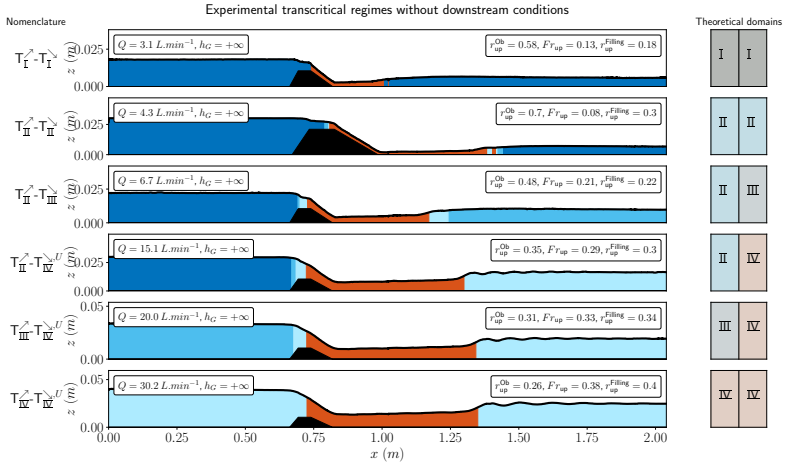

Figure 1. Examples of aquatic black holes flows produced in the laboratory with a metric open water channel. Free surface deformations are detected with a subpixel detection method of the side meniscus. The colours correspond to the many speed regimes controlled by a subtle cocktail between geometry, dispersion and dissipation.

Références

1. A. Bossard, N. James, V. Jules, J. Fourdrinoy, S. Robertson and G. Rousseaux, On the art of designing effective space-times with free surface flows in Analogue Gravity, *Comptes Rendus. Physique*, Volume **25**, 457–511 (2024). doi : 10.5802/*crphys*.215. https ://comptes-rendus.academie-sciences.fr/physique/articles/10.5802/crphys.215/