SCATTERING OF SURFACE WAVES ON AN ANALOGUE BLACK HOLE

Léo-Paul Euvé[1], Scott James Robertson[2], Nicolas James[3], Alessandro Fabbri[2,4,5,6] and Germain Rousseaux[1]

[1]Institut Pprime (UPR 3346), CNRS–Universit´e de Poitiers–ISAE ENSMA, 11 Boulevard Marie et Pierre Curie T´el´eport 2–BP 30179, 86962 Futuroscope Chasseneuil Cedex, France
[2]Laboratoire de Physique Th´eorique (UMR 8627), CNRS, Univ. Paris-Sud, Universit´e Paris-Saclay, 91405 Orsay, France
[3]Laboratoire de Math´ematiques et Applications (UMR 7348), CNRS–Universit´e de Poitiers, 11 Boulevard Marie et Pierre Curie–T´el´eport 2–BP 30179, 86962 Futuroscope Chasseneuil Cedex, France
[4]Centro Fermi - Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi, Piazza del Viminale 1, 00184 Roma, Italy
[5]Dipartimento di Fisica dell'Universit`a di Bologna and INFN sezione di Bologna, Via Irnerio 46, 40126 Bologna, Italy
[6]Departamento de F´ısica Te´orica and IFIC, Universidad de Valencia-CSIC, C. Dr. Moliner 50, 46100 Burjassot, Spain

We have realized a stationary transcritical flow of water in a flume that possesses the analogue of a black hole horizon for long-wavelength surface waves. The horizon has been probed via the scattering of an incident co-current wave, which partially scatters into counter-current waves on either side of the horizon, yielding three outgoing waves (of which one is anomalous) rather than two in the absence of transcriticality. The measured scattering coefficients are in good agreement with the predictions of the non-dispersive theory, where the kinematical description in terms of an effective spacetime metric is exact. We also show the emergence of characteristic peaks in the two-point correlation function of free surface deformations, one of which indicates the presence of a horizon and in quantum settings would be used to demonstrate the presence of the thermal analogue Hawking effect.