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On a nearly constant Froude number observed in circular hydraulic jumps LAURENT LIMAT, MSC, Matière et Systèmes Complexes, UMR7057 of CNRS and Univ. Paris Diderot, Paris, France, ALEXIS DUCHESNE, GRASP, Group for Research and Applications of Statistical Physics, Univ. of Lige, Belgium, LUC LEBON, MSC, Matière et Systèmes Complexes, UMR7057 of CNRS and Univ. Paris Diderot, Paris, France, ENRIQUE CERDA, Departamento de Física, Universidad de Santiago de Chile, Chile, MEDERIC ARGENTINA, INLN, Institut Non-Linéaire de Nice, UMR 7335 of CNRS and Univ. of Nice-Sophia Antipolis, France — Circular hydraulic jumps are reminiscent of a shock for surface waves, but the flow is viscous, and analogous to boundary layer detachment. This yields [1] a scaling $\mathrm{R_J} \propto \mathrm{Q}^{5/8}\nu^{3/8}\mathrm{g}^{-1/8}$ that links the jump radius $\mathrm{R_J}$ to flow rate Q, viscosity ν and gravity g. In a recent experiment [2], with a jet of radius φ impacting a horizontal disk of radius R, we observed that the Froude number Fr at the jump exit was constant, which yields a modified scaling $\mathrm{R_J}(\mathrm{Log}(\mathrm{R}/\mathrm{R_J}))^{3/8} \approx (2^{-11/8}3^{-3/8}\pi^{-5/8}/\mathrm{Fr})\,\mathrm{Q}^{5/8}\nu^{-3/8}\mathrm{g}^{-1/8}$ in good agreement with experiment. We show that this behavior is universal but Fr depends on phi/R. We also investigate the behavior of Fr (and more generally of the structure of the hydraulic jump) in the case of confinement walls. Theoretically, these results cannot be recovered by connecting two domains of negligible interface slope with a localized shock. Instead, a generalized inertial lubrication theory [3] seems able to explain these behaviors, that we relate to finite slope effects at the free surface. [1] T. Bohr et al., JFM 254, 635 (1993). [2] A. Duchesne et al., EPL 107, 54002 (2014). [3] N Rojas et al., PRL 104, 187801 (2010).

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