Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Numerical and Experimental Study of the Dynamics of Imploding Hydraulic Jumps AMY-LEE GUNTER, OTHMAN SMADI, Concordia University, CHARLES KIYANDA, University of Illinois at Urbana-Champaign, LYES KADEM, HOI DICK NG, Concordia University — The dynamics of imploding hydraulic jumps is investigated in this study. Experimental and numerical studies are performed to identify the critical conditions at which circular shallow water waves can be produced and amplify as they propagate toward the center without wave breaking. These conditions enable water waves to behave analogously to gaseous shock waves through the hydraulic analogy. The stability of the imploding jumps is also analyzed by introducing obstacles in the path of the implosion. Experimentally, a gate-type water table is constructed and the creation of a circular converging hydraulic jump is achieved by retracting the gate which separate two volumes of water by mean of three pneumatic pistons. A CCD camera is used to visualize the dynamics of the implosion. The acquired images are processed on Matlab using an image processing toolbox based algorithm which detects the shape and trajectory of the imploding wave. To compare the characteristics of the imploding jump and the mechanism of wave breaking, numerical simulations using Volume of Fluid (VOF) and Smoothed Particles Hydrodynamics (SPH) methods are performed. The experimental and numerical results are compared with the Chester-Chisnell-Whitham (CCW) approximate solution of the shallow water wave equations.

Hoi Dick Ng
Concordia University

Date submitted: 07 Aug 2009 Electronic form version 1.4