Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Structure of a Steady Bathtub Vortex ANDERS ANDERSEN, Department of Physics and Center for Fluid Dynamics, Technical University of Denmark, DK-2800 Kgs. Lyngby, Denmark, LASSE BØHLING, Glass and Time, IMF-UFA, Roskilde University, DK-4000 Roskilde, Denmark, DAVID FABRE, Universite de Toulouse, INPT, UPS; Institut de Mecanique des Fluides de Toulouse (IMFT), Allee du Professeur Camille Soula, F-31400, Toulouse, France — Bathtub vortex flows constitute an important class of concentrated vortex flows which are characterised by intense axial down-flow and stress free surface. We use direct numerical simulations to explore the flow structure of a steady bathtub vortex in a cylindrical tank with a central drain-hole. We find that the qualitative structure of the meridional flow does not depend on the radial Reynolds number, whereas we observe a weak overall rotation at low radial Reynolds number and a concentrated vortex above the drain-hole at high radial Reynolds number. We present a simple analytical model which shows the same qualitative dependence on the radial Reynolds number as the simulations and which compares favourably with the results for the radial velocity and the azimuthal velocity at the surface. Finally, we describe the height dependence of the radius of the vortex core and the maximum of the azimuthal velocity at high radial Reynolds number, and we show that the data on the radius of the vortex core and the maximum of the azimuthal velocity as functions of height collapse on single curves by appropriate scaling.

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Date submitted: 02 Aug 2010 Electronic form version 1.4