Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Solid object impact creates supersonic air flow STEPHAN GEKLE, IVO PETERS, Physics of Fluids, U Twente, The Netherlands, JOSE MANUEL GORDILLO, Universidad de Sevilla, Spain, DEVARAJ VAN DER MEER, DETLEF LOHSE, Physics of Fluids, U Twente, The Netherlands — When an object impacts on a water surface a sizeable cavity is formed below the surface which subsequently collapses due to hydrostatic pressure. The surrounding air is first sucked into the expanding cavity while at a later stage it is squeezed out of the - then shrinking - cavity. We measure this air flow using high-speed imaging of fine smoke particles. Numerical simulations combining a boundary-integral method with a fully compressible Euler solver reveal the intricate structure of the gas dynamics. Despite an impact velocity of merely 1 m/s and a cavity overpressure of only 0.02 atmospheres the air flow is shown to attain supersonic speeds. Consequently, there are significant effects of this air flow close to pinch-off which can be observed consistently in experiment and numerics: (i) the cavity wall is not smoothly curved but exhibits a kink and (ii) the cavity neck is pushed upwards.

Stephan Gekle
Physics of Fluids, U Twente, The Netherlands

Date submitted: 31 Jul 2009 Electronic form version 1.4