Universität Bremen

CENTER OF APPLIED SPACE TECHNOLOGY AND MICROGRAVITY ZARM

Fluid Dynamics Seminar

Date: Wednesday, May 3rd 2017 at 13:00

Location: ZARM, Room 1730

Capillary Channel Flows
The CCF-Experiment on the International Space Station

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012106-6 Bronowicki *et al.* Phys. Fluids **27**, 012106 (2015)

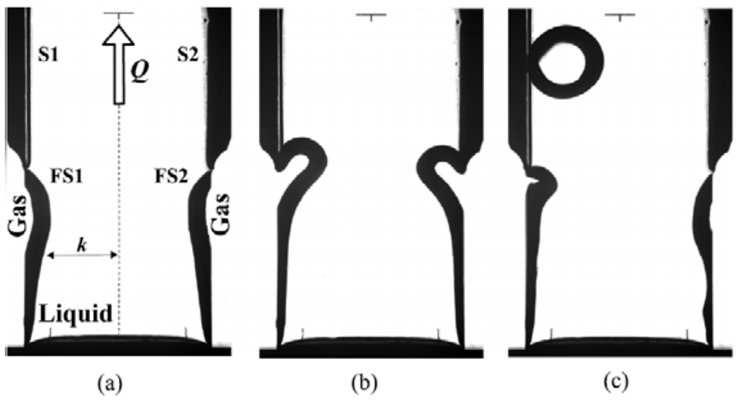

FIG. 3. HSHR camera images showing the parallel plates channel. Flow is from bottom to the top. Both sliders (S1, S2) are partially open. The sliders and the free surfaces (FS1, FS2) appear black (due to refraction of the light source). The interface's inner most contour is denoted with k. Different flow regimes are depicted: (a) stable flow; (b) shortly after exceeding the stability limit, bubbles formation can be observed; (c) unstable two phase flow with gas bubbles being ingested into the flow path.

Due to the reduced importance of gravitational forces in low Bond number flows, capillary forces play a much more dominant role in their fluid mechanics. This makes capillary channels a weight and cost efficient method of liquid management in reduced gravity environments like Space, because they utilize surface tension to transport and position liquids instead of having to rely on pumps or other moving parts. One of the application areas of capillary channels is within fluid management systems where capillary forces are used to acquire liquid and preserve a continuous, bubble-free path between two specific points, e.g. within a tank between the liquid bulk and an outlet.

Since 2011, a series of experiments have been performed in the Microgravity Science Glovebox aboard the International Space Station. The hardware was controlled via telescience from ground stations in Bremen, Germany, and in Portland, Oregon. The experiments were performed on open capillary channels with different cross section shapes. Stability limits of steady and accelerated single phase flow were determined for various channel lengths. The experiments also included studies on the effects of two-phase flow on the stability of the free surface of a capillary channel and on the feasibility of passive phase separation in an open tapered capillary channel. The results of the experiments are being used to help validate computer simulations and to improve the existing models.

The hardware has been operated for more than 140 days. An abundance of free surface flow data has been generated and is still being evaluated. This talk will give an overview of the experiment hardware and show some of the scientific results. Theoretical considerations consist of one-dimensional models with stream tube assumptions, and three-dimensional time dependent simulations with computation fluid dynamics tools.