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Studying Droplet dynamics by depth-averaged simulation<sup>1</sup> MATHIAS NAGEL, FRANÇOIS GALLAIRE, Laboratory of Fluid Mechanics and Instabilities - EPFL — Droplets in flat micro channels are deformable, avoid obstacles, interact with one another and undergo separation and coealescence. For the simulation of these micro fluidic two-phase flows we propose a depth-averaged model derived from the Stokes equation, the so called Brinkman equation. This equation is solved by the Boundary Element Method, which leads to a meshless numerical algorithm. A flow solver based on the depth-averaged model computes the dynamic evolution of the droplet in the 2D flow plane and retains the dominant effects in the thin/depth-averaged direction. In addition we developed a set of modified boundary conditions that account for 3D effects like film formation, droplet break-up or capillary action on cavities. We present results for droplet breakup in flow focussing devices and interaction between two droplets. In both cases the numerical results show a good agreement with experiments. The reduction from 3D to 2D by depth averaging and 2D to 1D by transformation of the equations to boundary integrals leads to a significant simplification. Yet the model reproduces essentially the physics to describe these confined two-phase flows.

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François Gallaire Laboratory of Fluid Mechanics and Instabilities - EPFL

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