Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Drops in Taylor-Couette flow: from toroidal rings to liquid sheaths LAWRENCE LAU, PETER SPELT, Imperial College London, CHRIS LAWRENCE, Institute for Energy Technology, Norway, OMAR MATAR, Imperial College London — We study the deformation of a water drop in Taylor-Couette flow using numerical simulations and direct experimentation. Our experimental results demonstrate that either toroidal rings or sheath-like configurations are formed when the inner shaft is rotated. This is in agreement with results from axisymmetrical direct numerical simulations, obtained with a level-set method to track the deforming interface. The simulations show that ridges observed in experiments at the ends of spreading sheaths contain swirling vortex rings, which are accompanied by rings in the outer fluid. The simulations further elucidate the onset of sheath formation. An analytical model based on lubrication theory and the integral method has also been developed to investigate the dynamics of a thin sheath, especially at later stages of the evolution of sheaths. Results from this model are compared with those from direct numerical simulations and experiments. A parametric study is carried out to investigate the influence of the the viscosity ratio, interfacial tension and droplet size on the dynamics. Comparisons between the three approaches yield favourable agreement.

Omar Matar
Imperial College London

Date submitted: 18 Jul 2006 Electronic form version 1.4