Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Low-order modelling of films over arbitrary, highly curved substrates[1] ALEX WRAY, DEMETRIOS PAPAGEORGIOU, OMAR MATAR, Imperial College London — Low-order modelling of free surface flows typically relies upon careful and judicious consideration of various length scales intrinsic to a problem. In a planar geometry, this typically consists of a single "aspect ratio" comparing the characteristic length of typical waves to the thickness of the layer. This has given rise to classic "thin-film" or "long-wave" models. Curvature of the underlying substrate complicates the situation by incorporation of two additional length scales: the radii of curvature. In such situations, modelling has typically relied on some potentially prohibitive symmetry assumption (Craster & Matar 2006), or the assumption that the substrate shape is slowly varying (even where that assumption is violated e.g. Kalliadasis, Bielarz, Homsy 2000). We show that even when substrate variations are not assumed to be small, a set of boundary-layer equations may be extracted under the assumption that the waves are long. We show that the resultant equations are soluble and that the models produced are highly accurate, providing exceptional agreement with solutions of the full Navier-Stokes equations. They are also shown to out-perform existing thin-film models by orders of magnitude.

[1]EPSRC Doctoral Prize Fellowship (AWW)

Omar Matar
Imperial College London

Date submitted: 26 Jul 2015 Electronic form version 1.4