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Special Solutions in Smectic Electroconvection

We discuss electroconvection in a free submicron-thick liquid crystal film in an annular geometry. The film is flat in the xy plane; seen from above it looks like a DVD. (Seen from above, it has two boundaries: concentric circles.) A voltage is applied across the film, from the inner boundary to the outer boundary; this voltage provides a convective forcing. Because of the annular geometry, the dynamics are periodic in the azimuthal direction and the only boundaries are those at which the convective forcing is applied. The liquid crystal is in smectic A phase, forming a nearly-perfect two-dimensional fluid because the film does not change thickness, even while flowing. Also, the inner electrode can be rotated and so the experiment can be used to study the interplay between a stabilizing force applied via the boundary (Couette shear) and convection. We present numerical simulations of special solutions such as convection cells, oscillatory convection cells, undulating convection cells, and localized vortex solutions. This is joint work with Stephen Morris (Physics, University of Toronto).