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Route to Turbulence in Sheared Annular Electroconvection PE-ICHUN TSAI, STEPHEN W. MORRIS, Dept. of Physics, University of Toronto, ZAHIR A. DAYA, Defence R&D Canada — We studied the route to turbulence of a 2D, electrically-driven annular film, using direct numerical simulation. The film can simultaneously be sheared by rotating the inner edge of the annulus. The simulation models a laboratory experiment which consists of a weakly conducting liquid crystal film suspended between concentric electrodes. The film convects when a sufficiently large voltage V is applied. The flow is driven by a surface charge density inversion unstable to the applied potential. The important dimensionless parameters are a Rayleigh-like number Ra, proportional to V^2, a Prandtl-like number Pr and the radius ratio α, characterizing the annular geometry. The applied shear has Reynolds number Re. The simulation uses a pseudo-spectral method with radial Chebyshev polynomials and azimuthal Fourier modes. The numerical results show a suppression of the onset of convection under the influence of shear that quantitatively agrees with previous theoretical and experimental results. Just above onset under shear, the numerical results reveal a Ruelle-Takens- Newhouse scenario in which there are bifurcations between various periodic and quasi-periodic flows. With increasing Ra, at constant applied Re, we observe subcritical bifurcations, indicated by sudden increases in convective charge transport. These jumps are also seen experimentally, and correspond to bifurcations between different azimuthal mode numbers.

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