Effect of asymmetric heating on convective systems

D. Merkt

Brandenburg University of Technology Cottbus (BTU)
Theoretical physics, Erich-Weinert-Strasse 1, D-03044 Cottus, Germany
e-mail: merkt@physik.tu-cottbus.de

ABSTRACT

Systems with asymmetrical periodicities are a well known mechanism for biased transport in many areas of science (nanotransport, biology, ...). Also in hydrodynamics such ratchet configurations may be of certain interest, e.g. a rectified fluid motion is a desired feature for lab-on-the-chip devices, etc. Therefore thin films and channels are the configurations of main interest.

Here we focus on convection based systems and the effect of asymmetrical periodic realizations. Usually an asymmetric lower boundary is considered, e.g. a sawtooth profile of the bottom plate or two phase-shifted periodic boundary plates. Our investigations deal with thermal Marangoni effect at the free top surface. An experimental realization for a rectified motion based on such a Bénard-Marangoni configuration can be found in [1]. We consider the Bénard-Marangoni convection with an undeformable interface and allow for an nonuniform heating from below like

$$T(x, z = 0, t) \propto \sin(kx) + a \sin(2kx)$$

with parameters a and k representing a typical ratchet configuration. Since we have incorporated the asymmetry in the heating we still can work with a spatial rectangular geometrie. Obviously this system does not have any purley conductive state and a biased meanflow may arise. Due to the fact that we cannot use the standard techniques like linear stability analysis in a simple and straightforward way, we focus here on results of direct numerical simulations. First we derive and discuss the governing equations. Thereafter we perform numerical experiments to investigate the meanflow for such asymmetries and interpret our results.

REFERENCES

[1] A.Stroock et. al *Fluid Ratchet based on Marangoni-Bénard Convection*, Langmuir **19**, 4358, 2003.