Fritz-Haber-Institut der Max-Planck-Gesellschaft, Humboldt-Universität zu Berlin, Max-Delbrück-Centrum für Molekulare Medizin, Otto-von-Guericke-Universität Magdeburg, Physikalisch-Technische Bundesanstalt, Technische Universität Berlin, Universität Potsdam

Berlin Center for Studies of Complex Chemical Systems

Seminar

Complex Nonlinear Processes in Chemistry and Biology

Honorary Chairman: G. Ertl
Organizers: M. Bär, C. Beta, H. Engel, M. Falcke, M. J. B. Hauser, J. Kurths, A. S. Mikhailov, P. Plath, L. Schimansky-Geier, and H. Stark

Friday, October 31, 2014, at 16:00
Address: Richard-Willstätter-Haus, Faradayweg 10, 14195 Berlin, U-Bahnhof Thielplatz (U3)

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Front propagation in channels with spatially modulated cross-section

The problem of front propagation in a three-dimensional channel with spatially varying cross-section Q(x) is reduced to an equivalent reaction-diffusion-advection equation with boundary-induced advection term. Treating the advection term as a weak perturbation, an equation of motion for the front position is derived. We analyze channels whose cross-sections vary periodically with L along the propagation direction of the front. Taking the Schlögl model as representative example, we calculate analytically the nonlinear dependence of the front velocity on the ratio L/l where l denotes the intrinsic front width. Our analytical results agree well with the results obtained by numerical simulations. In particular, the peculiarity of boundary-induced propagation failure for a finite range of L/l values is predicted by analytical calculations. Moreover, we demonstrate that the front velocity is determined by the suppressed diffusivity of the reactants for $L \ll l$.

Secondly, we present a method to control the position $\phi(t)$ of TW solutions to RD systems in modulated channels according to a prespecified protocol of motion. Given this protocol, the channel's cross-section Q(x) is found as the solution of the perturbatively derived integral equation. Noteworthy, such a boundary control can be expressed in terms of the uncontrolled wave profile and its propagation velocity, rendering detailed knowledge of the reaction kinetics unnecessary.

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