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Dynamics of pattern formation in the models of early cancerogenesis

In this talk we will explore a mechanism of pattern formation arising in the processes described by a system of a single reaction-diffusion equation couples with ordinary differential equations. Such models are very different from classical Turing-type models and the spatial structure of the pattern emerging from the destabilisation of the spatially homogeneous steady state cannot be concluded based on linear stability analysis. The models exhibit qualitatively new patterns of behaviour of solutions, including a strong dependence of the emerging pattern on initial conditions and quasi-stability followed by rapid growth of solutions. In numerical simulations, solutions having the form of periodic or irregular spikes are observed. Recently we have proposed models of spatially-distributed growth of clonal populations of precancerous cells, which remained under control of endogenous or exogenous growth factors diffusing in the extracellular medium and binding to the cell surface. We found conditions for emergence of growth patterns, which took the form of spike-type spatially inhomogeneous steady states. This multifocality is as expected from the field theory of carcinogenesis.

In this talk we approach the question of stability of spike solutions, which is essential for their observability in experiments. We study existence and stability of regular spatially inhomogeneous stationary solution of periodic type and of discontinuous patterns.

The talk is a based on a series of joint works with Marek Kimmel (Rice University), Kanako Suzuki (Tohoku University), Grzegorz Karch (University of Wroclaw) and Steffen Härting (University of Heidelberg)