Reaction and diffusion in several space dimensions – an invitation

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Abstract

We consider the qualitative dynamics of reaction-diffusion systems like

$$u_t = D\Delta u + f(u)$$

in two and three space dimensions. Examples include convective fluids, surface catalysis, heart tissue, and the Belousov-Zhabotinsky medium.

Rotating spiral wave patterns are a characteristic feature of planar excitable media systems. Scroll waves are three-dimensional stacks of rotating spirals, with tips aligned along filament curves.

Elementary singularity theory, properly applied, provides a framework to systematically understand

- nodal properties, in one spatial dimension
- spiral wave annihilation, in two dimensions, and
- crossover collisions of scroll wave filaments, in 3d.

The latter is the only generic possibility for 3d scroll wave filaments to change their topological knot or linking type. For old numerical simulations, joint work with Rolf Mantel, see

www.mathematik.uni-bielefeld.de/documenta/vol-05/21.html

Experimental confirmation has been announced very recently by Marcus Hauser (University of Magdeburg).