Scroll wave instabilities in a chemical excitable medium

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Cardiac arrhythmiae are associated to the development of spatiotemporal patterns of electrical activity on the heart muscle. Since the thickness of the heart tissue cannot be neglected, these reaction-diffusion patterns are truly three-dimensional. As evidenced by theoretical and numerical studies, the additional third dimension induces a variety of dynamic behaviour which is not seen in two dimensional systems.

Using “optical tomography” we experimentally study the dynamics of a three-dimensional reaction-diffusion system. Scroll waves are prepared and their responses towards perturbations are investigated. In experiments, we reproduced the three types of scroll wave instabilities known from theory: (i) twist-induced instability, (ii) 3D-meandering instability, and (iii) the negative line-tension instability. Further studies on scroll wave dynamics are in progress.