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Obstacle Mediated Reconnection of Straight Scrolls in an Excitable System

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Oscillatory chemical reactions are widely studied as laboratory models of wave propagation in complex biological systems, particularly the human heart where the presence of spiral and scroll waves can lead to cardiac arrhythmias [1]. Due to the complexity and cost of conducting in-vivo studies on cardiac waves, researchers often use models like the Belousov-Zhabotinsky (BZ) reaction as prototypes. It has been established that the 3D waves formed in a BZ-medium, called scrolled waves, can have different shapes and dynamics depending on their filaments which are nothing but the one-dimensional curves around which they rotate [2]. Here, we report the interaction of two straight scrolls having I-shaped filaments in the presence of a spherical obstacle placed midway between them.

The study is based on experiments with the BZ-reaction and numerical simulations using the Barkley model. We show that in presence of an obstacle, two parallel waves rotating within a specific distance from each other feel an attraction around the obstacle, cross over, and finally form two new U-shaped filaments. It was confirmed that this is solely caused by the obstacle because otherwise the scrolls continue rotating around their individual filaments forever, unaffected by each other. We believe these results will help to gain better insights into the phenomenon of reconnection, which is important from both a fundamental and biomedical perspective.

References

1. Cherry, E. M. and Fenton, F. H. New J. Phys. 2008, 10, 125016.
2. Mahanta, D., Dutta, S., and Steinbock, O. Phys. Rev. E, 2017, 95, 032204.

Biography:

Dr. Dhriti Mahanta completed her MSc in Chemistry from Gauhati University in 2012. She received her PhD from Indian Institute of Technology (IIT) Guwahati for her work on the complex dynamics of patterns formed in chemical systems. Then she joined Saint Louis University, MO, USA as a post-doctoral fellow. There she worked on the nonlinear dynamics of electrochemical systems under Prof. Istvan Z. Kiss. She joined the department of Chemistry, Gauhati University in 2022, where she currently teaches Physical Chemistry in the MSc level and has a research group that studies nonlinear dynamics of reaction diffusion systems.