Wave propagation and oscillations in excitable media, especially the Belousov Zhabothinsky reaction, are gravity dependent

Wolfgang Hanke[1] *and Florian Kohn*[1]
[1]University of Hohenheim, Inst. Physiol., Stuttgart, Germany

Pattern formation, oscillations and wave propagation as processes in excitable media are controlled by small external forces including gravity. The Belousov–Zhabothinsky (BZ) reaction, the best studied system, exhibits temporal as well as spatial patterns. Wave propagation dependence on gravity has been studied in fluid- and in gel-type BZ systems in a drop tower [1], in parabolic flights, sounding rockets and centrifuges [2]. The propagation velocity always became slower at higher gravity levels. Tcan be explained due to interactions of gravity with diffusion and convection.

In a stirred bulk BZ system stable oscillations exist in the absence of diffusion, sedimentation, buoyancy and convection. Such an oscillating reaction can be stabilized with a period in the minute range for hours even in a closed system. In parabolic flight missions such a system can be investigated under gravity conditions changing between 1g, 1.8g and μ-g just on this timescale. Here we have found that the temporal pattern formation of an oscillating BZ reaction locks to the period of the gravity changes during the parabolic flight, when the period of the BZ-system is shorter at the beginning than the period of the gravity changes. Additionally, the BZ-system is destabilized due to the partially stochastic nature of the gravity changes. These results point out to a gravity dependence of chemical rate constants as given in a formal description of the BZ [3].

The BZ-reaction is the perfect system for such studies and serves as a model for self-organization and pattern formation in biological systems, as there are propagating action potentials and spreading depression waves, which have also been investigated in their dependence on gravity changes [2].

1. Fujieda et al., Effect of microgravity on the spatial oscillation behavior of Belousov-Zhabotinsky reactions catalyzed by ferroin, *J. Phys. Chem., A*, **101,** 7926-7928 (1997)
2. Wiedemann, M., Kohn, F.P.M., Rösner, H. and Hanke, W.R.L. Self-organization and pattern-formation in neuronal systems under conditions of variable gravity. Springer, ISBN 978-3-642-14471-4 (2011)
3. Klink, O., Hanke, W. and Fernandes de Lima, V.M. Stochastic gravitational forcing of an oscillating chemical reaction. Micogravity sci. technol., DOI: 10.1007/s12217-011-9260-y, **XXV**, 1-6 (2011)