

Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Self-organization of hydrodynamically entrained sperm cells into an array of vortices INGMAR RIEDEL, Max Planck Institute for Molecular Cell Biology and Genetics, Pfotenhauerstr. 108, 01307 Dresden, Germany, KARSTEN KRUSE, Max Planck Institute for the Physics of Complex Systems, Noethnitzer Str. 38, 01187 Dresden, Germany, JONATHON HOWARD, Max Planck Institute for Molecular Cell Biology and Genetics, Pfotenhauerstr. 108, 01307 Dresden, Germany — The emergence of spatiotemporal patterns is of great interest in many scientific disciplines. Here we report a new dynamically self-organized pattern formed by hydrodynamically entrained sperm cells at planar surfaces. The sperm cells form vortices resembling quantized rotating waves. These vortices form an array with local hexagonal order. Using a novel order parameter, we show that the array is only formed above a critical sperm density. Supported by numerical simulation we suggest a mechanism for the appearance of the array and we estimate the strength of the hydrodynamic coupling between the cells. The vortex array represents a new chiral active gel and may serve as an experimentally accessible model for the metachronal wave of ciliated epithelia and other non-equilibrium phenomena in general. Finally we discuss the biological implications of our work.

Ingmar Riedel
Max Planck Institute for Molecular Cell Biology and Genetics
Pfotenhauerstr. 108, 01307 Dresden, Germany

Date submitted: 04 Dec 2004

Electronic form version 1.4