

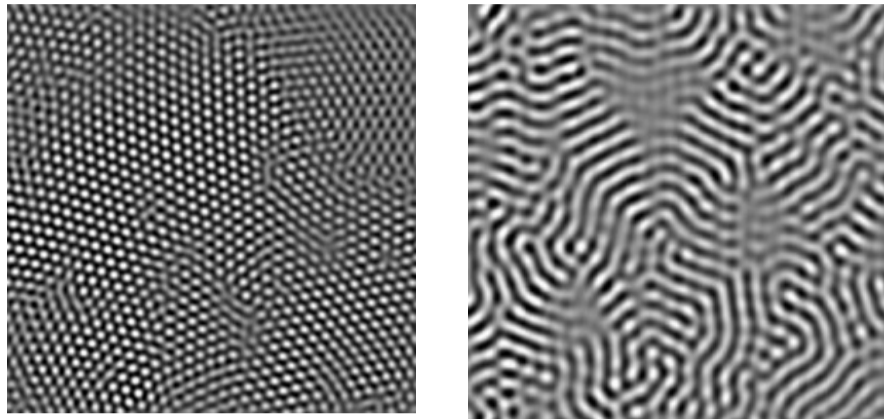
Significant Morphological Differences between Experimental and Simulated Turing Patterns

Christian Scholz*, Stephanie Häffner, Klaus Mecke and Gerd E. Schröder-Turk

Institut für Theoretische Physik, Universität Erlangen/Nürnberg

*Christian.Scholz@physik.uni-erlangen.de

Turing patterns in chemical reactions

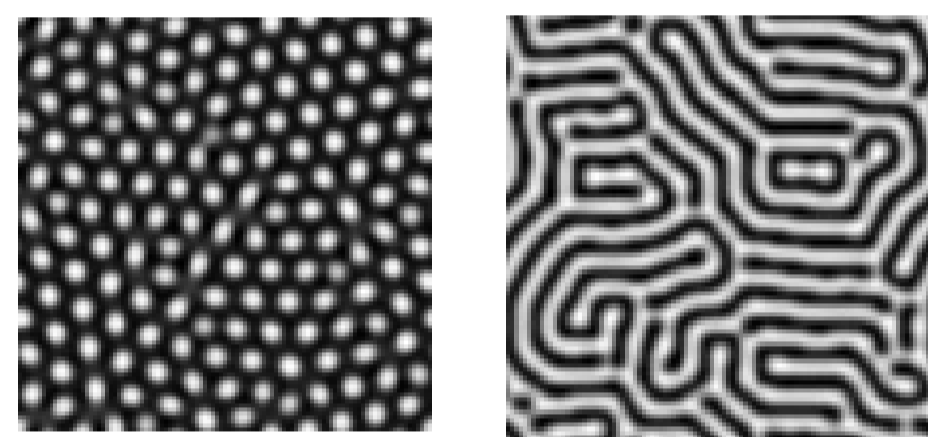


- CIMA (Chlorite-Iodide-Malonic Acid) reaction
- Continuous supply of ...
- Measure Concentrations of Iodine ...
- Hexagonal/Lamellar patterns observed for different concentrations of ...

Turing patterns in Reaction-Diffusion Equations

$$\frac{\partial u}{\partial t} = D_u \nabla^2 u + f(u, v)$$

$$\frac{\partial v}{\partial t} = D_v \nabla^2 v + g(u, v)$$



- Different f, g depending on model (Brusselator, Lengyel-Epstein)
- Stable Hexagonal/Lamellar patterns depending on D and $\frac{\partial f}{\partial u}, \frac{\partial f}{\partial v}, \frac{\partial g}{\partial u}, \frac{\partial g}{\partial v}$

Brusselator

$$f(u, v) = a - (b+1) \cdot u + u^2 \cdot v$$

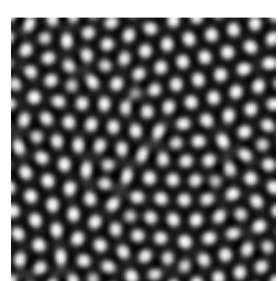
$$g(u, v) = b \cdot u - u^2 \cdot v$$

Lengyel-Epstein

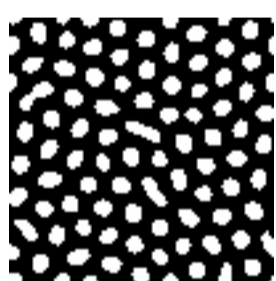
$$f(u, v) = a - u - \frac{4uv}{1+u^2}$$

$$g(u, v) = \sigma b \left(u - \frac{u \cdot v}{1+u^2} \right)$$

Morphological Analysis

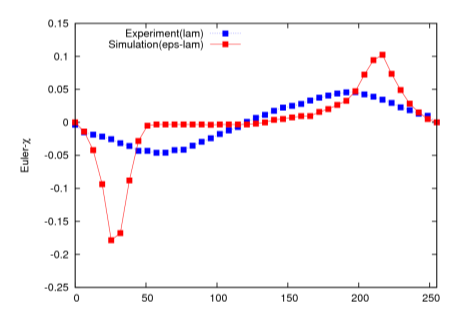
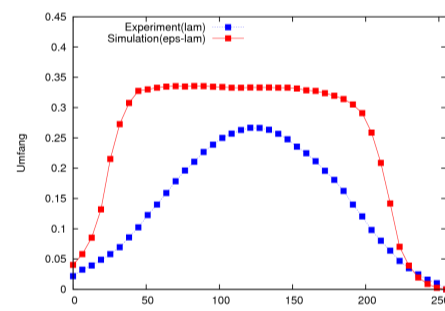
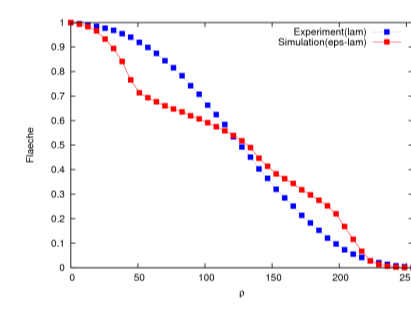


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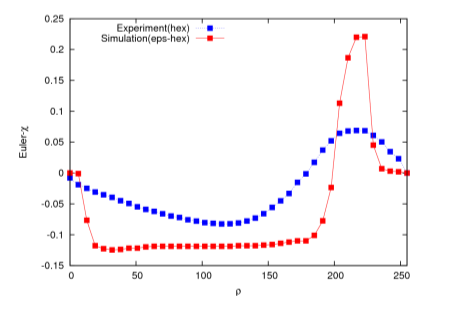
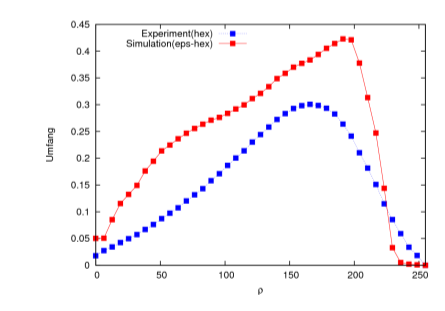
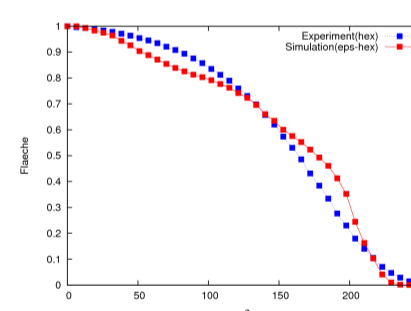


$A(\rho)$
 $v(\rho)$
 $\chi(\rho)$
 Minkowski functionals [1]

lam



hex

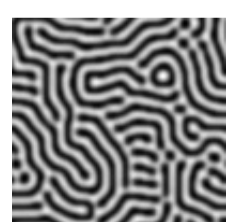


Reaction-Diffusion + Noise = Experiment?

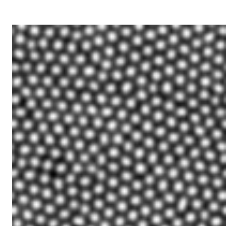
$$\frac{\partial u}{\partial t} = D_u \nabla^2 u + f(u, v) + b_u \cdot \xi_u$$

$$\frac{\partial v}{\partial t} = D_v \nabla^2 v + g(u, v) + b_v \cdot \xi_v$$

$$\xi_i(r, t) \xi_j(r', t') = \delta_{ij} \delta(r - r') \delta(t - t')$$

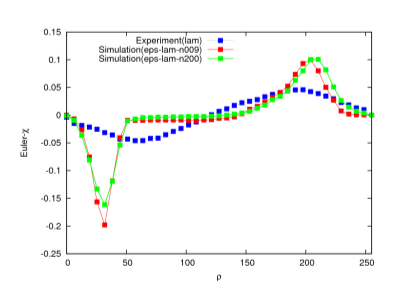
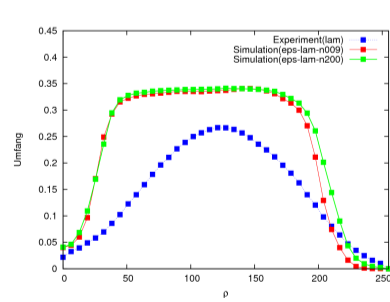
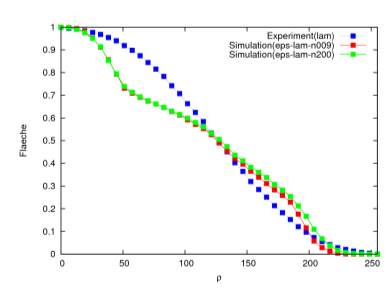


Morph.

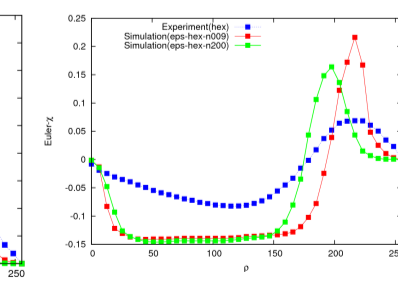
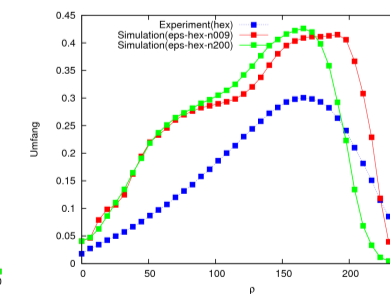
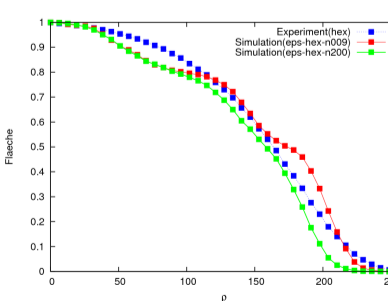


An.

lam



hex



References

[1] K. Mecke, Morphological characterization of patterns in reaction-diffusion systems, Phys. Rev. E 53 53, 4794 (1996)