SYSS 4 Structure Formation and Self-Organization in non-equilibrium Systems III

Time: Friday 10:15–12:45 Room: HSZ 04

Invited Talk

SYSS 4.1 Fri 10:15 HSZ 04

Experiments on structure formation in complex continua — •Ingo Rehberg, Christof Krülle, Reinhard Richter, and Wolfgang Schöpf — Universität Bayreuth

We compare experiments with with respect to their pattern forming properties. In particular we investigate the dynamics of gelified liquid crytals (1) under the influence of an electric field, magnetic fluids driven by magnetic fields (2) and granular matter fluidized by vibration(3,4).

1) Planar-fingerprint transition in a thermoreversible liquid crystalline gel Alberto de Lózar, Wolfgang Schöpf, Ingo Rehberg, Oscar Lafuente and Günter Lattermann, Physical Review E 71 , 051707-1 (2005)

2) Fluid pumped by magnetic stress Robert Krauss, Mario Liu, Bert Reimann, Reinhard Richter, and Ingo Rehberg, Applied Physics Letters 86 , 024102-1 (2005)

3) Sublimation in a vibrated granular monolayer: coexistance of gas and solid A. Götzendorfer, J. Kreft, C.A. Kruelle, and I. Rehberg, Physical Review Letters 95 , 135704 (2005).

4) A horizontal Brazil-nut effect and its reverse T. Schnautz, R. Brito, C.A. Kruelle, and I. Rehberg, Physical Review Letters 95 , 028001 (2005).

Invited Talk

SYSS 4.2 Fri 10:45 HSZ 04

Coarsening versus lengthscale persistence in nonequilibrium pattern-forming systems — •Chaouqi Misbah[1] and Paolo Politi[2] — [1]Laboratoire de Spectrométrie Physique, CNRS, Univ. J. Fourier, Grenoble 1, BP87, F-38402 Saint Martin d'Hères, France — [2]Istituto dei Sistemi Complessi, Consiglio Nazionale delle Ricerche, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Italy

Global evolution of nonequlibrium pattern-formming systems can be broadly classified into two important classes: (i) those which present a persistent length scale, (ii) those which undergo a perpetual coarsening. A general criterion about coarsening for a class of nonlinear evolution equations describing one dimensional pattern-forming systems will be presented. This criterion allows one to discriminate between the situation where a coarsening process takes place and the one where the wavelength is fixed in the course of time. An intermediate scenario may occur, namely 'interrupted coarsening'. The power of the criterion lies in the fact that the statement about the occurrence of coarsening, or selection of a length scale, can be made by only inspecting the behavior of the branch of steady-state periodic solutions. The criterion states that coarsening occurs if $\lambda'(A) > 0$ while a lengthscale selection prevails if $\lambda'(A) < 0$, where λ is the wavelength of the pattern, and A the amplitude of the profile (prime refers to differentiation). This is established thanks to the analysis of the phase diffusion equation of the pattern. The phase diffusion coefficient (which carries a kinetic information)is connected to $\lambda'(A)$, which refers to a pure steady-state property. The relationship between kinetics and the behavior of the branch of steady-state solutions, is established fully analytically for a class of equations. Another result which emerges from this study is that the exploitation of the phase diffusion equation enables us to determine in a rather straightforward manner the dynamical coarsening exponent. Our calculation is exemplified on several nonlinear equations, showing that the exact exponent is captured. Contrary to many situations where the one dimensional character has proven essential for the derivation of the coarsening exponent, the present idea can be used, in principle, at any dimension. Some speculations about the extension of the present results will be outlined.

Invited Talk

SYSS 4.3 Fri 11:15 HSZ 04

Spatio-temporal chaos and defects in pattern-forming systems — •H. Riecke — Department of Engineering Sciences and Applied Mathematics, Evanston

Many systems undergo bifurcations from a spatially homogeneous state to a state that exhibits spatio-temporal structures. In simple cases the resulting patterns are ordered in space and time. Often, however, they are spatio-temporally chaotic. What is the origin of such states, what mechanisms maintain them, how can they be characterized? For patterns that are stripe-like (lamellar) these questions have been addressed in quite some detail for various systems. In more detail I will present results for spatio-temporal chaos arising from patterns with hexagonal planform. They arise, for instance, in non-Boussinesq fluid convection. I will focus on three states: defect chaos of whirling hexagons, penta-hepta defect chaos in which penta-hepta defects induce the nucleation of dislocations, and whirling chaos driven by the interplay of defects and an oscillatory whirling mode. Our results are based on Ginzburg-Landau, Swift-Hohenberg, and Navier-Stokes equations.

Invited Talk

SYSS 4.4 Fri 11:45 HSZ 04

Self-organization and collective decision making in animal societies — •Jean-Louis Deneubourg — Unit if Social Ecology, Universite Libre de Bruxelles, 1050 Bruxelles, Belgium

This talk gives an overview on the collective decision making process in animal societies. Experiments with ants and other social insects show the formation of various self-organized patterns. As an example, route choice experiments with ants indicate that crowding is avoided by a change of the temporal organization of the ants.

Invited Talk

SYSS 4.5 Fri 12:15 HSZ 04

Time-delayed feedback control of noise-induced patterns — •Eckehard Schöll, Alexander Balanov, Johanne Hizanidis, and Grischa Stegemann — Institut für Theoretische Physik, Technische Universität Berlin, 10623 Berlin

Effects of time-delayed feedback on spatio-temporal patterns induced by Gaussian white noise are studied. It is shown that such a feedback in the form proposed earlier by Pyragas for the control of deterministic chaos can be used for effective manipulation of the coherence and the timescales of stochastically oscillating patterns. This is illustrated for globally coupled reaction-diffusion systems.