



## CONTENTS

Preface	v
Committee Members	vi
<b>Chapter 1 Experiment: fluids, instabilities, and chaos</b>	
Chaos in semiconductors	
R. P. Huebener, K. M. Mayer, J. Parisi, J. Peinke, B. Röhrich	3
The physics of laser chaos	
F. T. Arecchi	13
Spin-wave turbulence	
P. Bryant, C. Jeffries, K. Nakamura	25
Chaotic dynamics in Ge photoconductors	
R. M. Westervelt, E. G. Gwinn, S. W. Teitworth	37
The multifractal spectrum of the dissipation field in turbulent flows	
C. Meneveau, K. R. Sreenivasan	49
Convection in a binary mixture	
G. Ahlers, D. S. Cannell, R. S. Heinrichs	77
The masking of symmetry by degeneracy in the dynamics of interacting modes	
F. Simonelli, J. P. Gollub	87
The transition to finite-amplitude traveling-wave convection in binary fluid mixtures	
P. Kolodner, A. Passner, H. L. Williams, C. M. Surko	97
Spatio-temporal complexity at the onset of convection in a binary fluid	
V. Steinberg, E. Moses, J. Fineberg	109
<b>Chapter 2 Theory: fluids, instabilities, and chaos</b>	
Spatial self-organization of vorticity in chaotic shearing flows	
P. Marcus	127
Forced, unbounded shear flows	
F. K. Browand, C.-M. Ho	139
Evolution of coherent structures in shear flows: a phase dynamics approach	
P. Huerre	159
Fluid mixing and dynamical systems	
A. Leonard, V. Rom-Kedar, S. Wiggins	179
Catastrophe theory	
R. Gilmore	191

The quest for quantum chaos in the stadium E. J. Heller, P. W. O'Connor	201
Electrical resistivity as quantum chaos R. B. Laughlin	213
Chaos and the dynamics of biological populations R. M. May	225
From temporal chaos towards spatial effects P. Bergé	247
Theory of dendrite dynamics P. Pelcé, D. Bensimon	259
Dispersion in the presence of recirculation zones E. Guyon, Y. Pomeau, J. P. Hulin, C. Faudet	271
Basin boundary metamorphoses: changes in accessible boundary orbits C. Grebogi, E. Ott, J. A. Yorke Physica 24 D (1987) 243	281
Role of fluctuations in fluid mechanics and dendritic solidification H. E. Stanley	301
Large scale spatial structures and temporal chaos in Rayleigh-Bénard convection S. Ciliberto	327
Dynamics of two coupled oscillators near the critical line in Rayleigh-Bénard convection M. Dubois	339
Fully developed turbulence via Feigenbaum's period-doubling bifurcations M. Duong-van	353
Phase portraits from a time series: a singular system approach G. P. King, R. Jones, D. S. Broomhead	379
Chaotic behavior in the solar system J. Wisdom	391
<b>Chapter 3 Mathematical methods</b>	
Renormalization group and local order in strong turbulence V. Yakhot, S. A. Orszag	417
A study of chaos and mixing in Rayleigh-Taylor and Richtmyer-Meshkov unstable interfaces C. L. Gardner, J. Glimm, J. Grove, O. McBryan, R. Menikoff, D. H. Sharp, Q. Zhang	441
Large scale spatial structures in two-dimensional turbulent flows B. Nichols	453

## Chapter 4 Thermodynamics and phase transition of strange sets

### Editor's note

- Multifractal scaling structure at the onset of chaos: theory and experiment  
M. H. Jensen 487
- Time ordering and the thermodynamics of strange sets: theory and experimental tests  
M. J. Feigenbaum, M. H. Jensen, I. Procaccia 497  
Phys. Rev. Lett. 57 (1986) 1503
- Fractal measures and their singularities: the characterization of strange sets  
T. C. Halsey, M. H. Jensen, L. P. Kadanoff, I. Procaccia, B. I. Shraiman 501  
Phys. Rev. A33 (1986) 1141
- Global universality at the onset of chaos: results of a forced Rayleigh-Bénard experiment  
M. H. Jensen, L. P. Kadanoff, A. Libchaber, I. Procaccia, J. Stavans 513  
Phys. Rev. Lett. 55 (1985) 2798
- Phase transitions in the thermodynamic formalism of multifractals  
D. Katzen, I. Procaccia 517  
Phys. Rev. Lett. 58 (1987) 1169
- Phase transition of multifractals  
M. Duong-van 521
- Exploring deterministic chaos via unstable periodic orbits  
I. Procaccia 527
- Conclusion**
- Chaos: Chto Delat?  
D. K. Campbell 541
- EXTENDED ABSTRACTS**
- Experiment: fluids, instabilities, and chaos**
- Chaos and instabilities in multimode CW dye lasers  
H. Atmanspacher, H. Scheingraber 565
- Solidification in a capillary tube  
J. Bechhoefer, H. Guido, A. Libchaber 566
- The dynamics of sidebranching in dendritic crystal growth  
A. Dougherty, J. P. Gollub, P. D. Kaplan 567
- Chaotic behavior of nonlinear resonant circuits at subharmonic frequencies  
D. H. Douglass, M. F. Bocko, J. H. Baxter, M. Fischer 568

Similarities between cavitation experiments and electrical breakdown R. Germer, K.-H. Schoenbach	569
Dynamics of two dimensional soap froths J. A. Glazier, S. P. Gross, J. Stavans	570
Experimental tests of universality at the transition from quasiperiodicity to chaos in semiconductor transport E. G. Gwinn, R. M. Westervelt	571
Traveling waves and spatial variation in the convection of a binary mixture R. Heinrichs, G. Ahlers, D. S. Cannell	572
A turbulent, buoyant plume in a stratified environment N. D. Kazarinoff, M. Mostagir	573
Chaos in glycolysis M. Markus, S. C. Müller, B. Hess	574
Competition between static and dynamic instabilities in cholesteric liquid crystals H. Pleiner, H. R. Brand	575
Special pattern formation in activator inhibitor reaction diffusion systems H.-G. Purwins, J. Berkemeier, C. Radehaus	576
Rayleigh numbers ramps cause moving convection patterns I. Rehberg, F. H. Busse	577
Chaotic ionization of highly excited hydrogen atoms M. M. Sanders, R. V. Jensen, P. M. Koch, K. A. H. van Leeuwen	578
Measuring basins of attraction and complex transients in a hydrodynamic system F. Simonelli, J. P. Gollub	580
Diffusive transport and chaotic advection in two-dimensional Rayleigh-Bénard convection T. H. Solomon, J. P. Gollub	581
Lyapunov exponents and dimensions determined from experimental time series R. Stoop, P. F. Meier	582
Flow structure and heat transfer phenomena associated with mixed turbulent convection in vertical ducts L. W. Swanson, J. M. McDonough, I. Catton	583
The 'periodal index,' a quantitative measure of chaos for experimental data and observation of Arnold Tongues in YIG M. Warden	584
<b>Theory: fluids, instabilities, and chaos</b>	
On the limitations of the Birkhoff-Gustavson normal form approach M. K. Ali, W. R. Wood	587

Three-frequency quasiperiodicity and chaos on a torus P. Battelino, C. Grebogi, E. Ott, J. Yorke	588
Irregular variability of stars J. R. Buchler	589
Spatial stochastic instability in nonlinear optical media E. Caglioti, S. Trillo, S. Wabnitz	590
Origins and measures of turbulence in open-flow systems R. J. Deissler	591
A coupled-lattice model of dendritic crystal growth and complexity M. Duong-van, P. R. Keller	592
Semiclassical ergodic quantum mechanics M. Feingold	596
Chaos theory and $1/f$ noise in HgCdTe photodiodes A. Fote, J. McDonough, R. Egler	597
Mutual information for noisy measurements of shift maps A. M. Fraser	598
Numerically induced stochasticity A. Friedman	599
Do numerical trajectories represent true trajectories? S. M. Hammel, J. A. Yorke, C. Grebogi	601
A three-dimensional dissipative map with three routes to chaos D. L. Hitzl, F. Zele	602
Patterns from models of dissipative systems P. Keller, M. Duong-van	603
Direct simulation of antiparallel vortex stretching and helicity R. M. Kerr, A. Pumir	605
Dimension estimates from time series E. Kostelich, H. L. Swinney	606
Breakdown of a quasi-invariant through quantum resonance overlap W. A. Lin, L. E. Reichl	607
Higher-order bifurcation phenomena in premixed combustion S. B. Margolis	608
Phase-pulling and breather instability in an AC driven-damped one-dimensional sine-Gordon system A. Mazor (Ben-Mizrachi), A. R. Bishop	609
Nonlinear evolution of surface wave patterns E. Meron	610

On the quantification of chaos and predictability J. M. Nese, J. A. Dutton, R. Wells	611
Explicit anisotropic solutions to the nonlinear Klein-Gordon equation in 3+1 dimensions M. Otwinowski, R. Paul, J. A. Tuszynski	612
Disorder-induced localized states in quasiequivalent protein assemblies C. J. Ritz-Gold	613
Modeling of chaos in semiconductors E. Schöll	614
Cellular device machines: an approach to mathematical modeling of infectious diseases H. B. Sieburg, C. E. Müller-Sieburg	615
Bistability transition in the self-trapping indiscrete lattice P. X. Tran	616
Spectrum of scaling-indices in two-dimensional maps K. Y. Tsang	617
Biological membranes as dissipative structures J. A. Tuszynski	618
Statistics of the time-evolution operator or one-dimensional systems with periodic time-dependent Hamiltonians W. M. Visscher	619
Representation of chaos using stabilization principle M. Zak	620
List of Participants	621
Author Index	629

