Preface

A rich variety of real-life physical problems which are still poorly understood are of a nonlinear nature. Examples include turbulence, weather forecasting, granular flows, detonations and flame propagation, fracture dynamics, and a wealth of new biological and chemical phenomena which are being discovered. On these problems, there has been significant historical interest, as well as a considerable amount of experimental data and research into industrial applications during the last 20 years. However, the essentials of many underlying physical mechanisms remain unexplained despite the high potential interest from the theoretical and applied points of view and the considerable progress achieved during recent years. The current theoretical understanding of these subjects is based on similar techniques and approaches. This allows for a common language and the existence of a unifying background for the manifold phenomena arising from nonlinearities.

Most interesting among the manifestations of nonlinearity are coherent structures. In turbulence, numerical evidence of high-vorticity small-size filaments in simulations of the full Navier–Stokes equations has given great theoretical and experimental impetus to this field and many new ideas about the role of coherent structures are now the subject of intense scrutiny. In practical applications, such as internal combustion engines, it is of fundamental importance to know how the speed of propagation of a flame front is affected by the turbulence intensity. There are diverse regimes controlled by the ratio of the Kolmogorov scale of the turbulent flow to the flame width. At the relatively well-understood limit of large values of this ratio, the phenomenon of turbulent flame wrinkling appears. In the other limit (of much greater practical importance), flame extinction, saturation of the flame velocity with turbulence intensity and other interesting phenomena may appear. Theoretical understanding of these phenomena is still poor and strong controversy has arisen. The formation of structures is also particularly important in gaseous detonations, where much discussion has followed new theoretical advances in understanding the interplay between fluid dynamics, chemistry and heat release in a detonation wave, in both one-dimensional and multidimensional cases. Pattern formation and spatio-temporal structures are also prominent in fluid flow, dendritic growth, and chemical and biological phenomena. Lastly, granular flow and fracture dynamics are developing fields posing very challenging problems with important nonlinear and statistical aspects which will no doubt be the object of a great deal of attention and work in coming years.

Motivated by these considerations, we gathered several leading experts for the XVII Sitges Conference. This book contains a number of reviews and contributions reporting on the state of the art as it concerns the role of coherent structures and patterns in the above-listed problems of nonlinear science.

The conference was the second of a series of two Euroconferences focusing on the topic *Nonlinear Phenomena in Classical and Quantum Systems*. It was sponsored by the UE (Euroconference) and by institutions which generously provided financial support: DGES of the Spanish Government, CIRIT of the Generalitat of Catalonia, Universitat de Barcelona and Universidad Carlos III de Madrid. The city of Sitges allowed us, as usual, to use the Palau Maricel as the lecture hall.

Finally, we are also very grateful to all those who collaborated in the organization of the event, Prof. C. Dopazo, Drs. A. Pérez-Madrid and T. Alarcón, and M. González, I. Santamaría-Holek, I. Pérez-Castillo, and O. Sánchez.

Barcelona, November 2000 *The Editors*

Springer

http://www.springer.com/978-3-540-41705-7

Coherent Structures in Complex Systems
Selected Papers of the XVII Sitges Conference on Statistical Mechanics Held at Sitges, Barcelona, Spain, 5–9 June 2000. Preliminary Version
Reguera, D.; Bonilla, L.L.; Rubi, J.M. (Eds.)
2001, IX, 465 p., Hardcover
ISBN: 978-3-540-41705-7