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Book Review: *Chaotic Behavior in Quantum Systems*

Chaotic Behavior in Quantum Systems G. Casati, ed., Plenum Press, New York, 1985.

The concept of chaos, as its use has evolved in the theory of dynamic systems, has crept ever closer to that of random or stochastic. Among the general characteristics associated with chaos have been the sensitive dependence on initial conditions and the loss of predictability. Chaos is a phenomenon that appears in both conservative nonintegrable Hamiltonian systems (KAM theory, tori breakdown, etc.) and nonconservative dissipative systems (strange attractors, noninvertible maps, etc.). The richness of the structures generated by nonlinear interactions in classical systems has led a number of scientists to inquire how these phenomena are instantiated in the quantum domain. Surely the nonlinear interaction term in a classically nonintegrable Hamiltonian system should manifest new behavior in its quantum counterpart; at least an ever-growing segment of the scientific community believes this to be the case.

The spectrum of presentations at the conference was quite broad, ranging from the limitations of perturbation theory, where the small divisor problem plagued astronomers and may also lead to strong energy resonances to produce quantum tunneling, to torus quantization, to Anderson localization, to the fluctuations in nuclear spectra. Although not of uniform mathematical difficulty, there was a sufficient breadth of mathematical topics in the lectures to challenge the background of most mathemtical physicists. The fundamenal physical problem was to find criteria to characterize quantum chaos and the range of suggested criteria highlighted the conjectural aspect of much of the research being described. This state of affairs could cause one to scoff at what is presently understood about quantum chaos or in constrast to stimulate one to investigate this unsettled field still further, depending on one's ability to deal with ambiguity and uncertainty. If numbers are any indication, it would seem that studies into the foundations of quantum mechanics are undergoing a rebirth.

I recommend these lectures to anyone who has ever wondered what

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would happen to the fabric of quantum mechanics if resonances were the rule rather than the exception and if the present quantum theory were truly not adequate to describe the physical world.

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Book Review: *Memory Function Approaches to Stochastic Problems in Condensed Matter*

Memory Function Approaches to Stochastic Problems in Condensed Matter. M. W. Evans, P. Grigolini, and G. Pastori Parravicini, eds. Volume 62 of *Advances in Chemical Physics*, I. Prigogine and S. A. Rice, eds., Interscience, New York, 1985.

This is an interesting volume which is useful for research workers in the field of nonequilibrium statistical mechanics and less so to students of this subject. The book consists of a number of chapters written by a number of different authors.

The first three chapters discuss the projection operator techniques devised by Mori and Zwanzig, which are used to eliminate fast variables—the basic problem of statistical mechanics. These chapters are extremely formal and most of the applications are to phenomenological equations rather than to the dynamical equations of physical systems. There are some nice chapters on molecular dynamics simulations and some chapters describing the applications of the general techniques to solid state physics, the liquid state, EPR spectra, chemical reaction rates, multiplicative noise in electric circuits, population genetics, and astrophysics.

There is essentially no discussion of mode-coupling techniques and only lip service paid to the appropriate Langevin-like equations for nonlinear systems. It would have been helpful to have more examples in which one starts with the Hamiltonian of a many-body physical system and uses the techniques to obtain reduced descriptions in terms of Langevin-like dynamical equations or Fokker–Planck equations for reduced distribution functions.

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