sively on Japanese observations. Though Mogi includes chapters on the physical basis, methods, and strategy of earthquake prediction, coverage of these topics is neither systematic nor complete. Although few seismologists reading this book can fail to be offended by at least one cutting omission or idiosyncratic interpretation, the work has a clear value in a developing field where no consensus has yet emerged. It should be of interest to all specialists wishing to learn about Japanese seismology and that country's progress in the field of earthquake prediction.

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Heavy-Ion Collisions

Frontiers in Nuclear Dynamics. R. A. BROGLIA and C. H. DASSO, Eds. Plenum, New York, 1985. xii, 402 pp., illus. $69.50. Ettore Majorana International Science Series, Physical Sciences, vol. 25. From a symposium, Erice, Sicily, July 1984.

A major theme of modern nuclear research is the study of nuclear matter under extremes of temperature, density, and spin. These studies bear on the nature of the fundamental strong interaction, on the physics of quantal many-body systems, and on the properties of neutron stars and supernovae. Much recent progress can be attributed to experiments that make use of accelerated beams of large nuclei. In constrast to the gentler interactions associated with "light ions," collisions with a "heavy ion" projectile can severely stress a target nucleus. Analysis of the debris, in combination with models of the collision process, offers an otherwise unattainable glimpse of the nuclear material. *Frontiers in Nuclear Dynamics* surveys the diverse and evolving field of heavy-ion physics through a set of lecture notes prepared for an international school.

The large nuclear fragments emerging from a heavy-ion collision can be spinning rapidly, often enough to cause dramatic changes in their internal structure. The study of such "high spin" states through the energies and angular distributions of the many photons emitted during their de-excitation has been very fruitful, and numerous connections to nuclear structure under more prosaic circumstances have been made as a result of such studies. Lectures by D. Schwalm *et al.* and by F. Stephens summarize what can be learned with large arrays of photon detectors that surround the collision, with much welcome detail on design and data analysis. The story is one in which steady improvements in instrumentation are constantly refining the physics, and the next generation of experiments should significantly advance our understanding of how nuclei respond to rotation.

The nature of the collision process itself can be more elusive. Lectures by A. Winther and W. von Oertzen review grazing collisions, from which the nuclei emerge relatively intact. These interactions are understood in terms of the quantal properties of the target and projectile and a semiclassical analysis of their relative motion. However, more central collisions require consideration of the dynamical properties of the nuclear material, as is discussed in lectures by C. Ngô and G. Bertsch. Bertsch presents the formalism and results of the time-dependent mean-field method appropriate to low-energy collisions, as well as a very promising approach to intermediate energies, simulation of the Uehling-Uhlenbeck equation.

Measurement of the nuclear equation of state and the detection of new phases of nuclear matter, two of the field's holy grails, are discussed in D. Scott's lectures. Prerequisites are the attainment of approximate equilibrium in the small systems (less than about 100 nucleons) occurring in the collision and a demonstrated sensitivity of experimental observables to the equation of state. Though there is some circumstantial evidence that the former takes place, the jury is certainly not in yet, and the complexity of the latter makes firm statements about it difficult. However, there has been progress in these matters since Scott's lectures, and there is now considerable optimism about ultimately deducing an equation of state from the data.

Heavy-ion collisions at ultrarelativistic energies are perhaps foremost among the "frontiers" that will be explored in the coming years. This regime offers the possibility of "melting" the nucleons and creating a novel plasma of quarks and gluons. The present book is deficient only in not containing an exposition of this subject of a quality commensurate with its other coverage.

The 11 lecturers, all experts in their fields, have generally taken their pedagogy seriously. The resultant material exemplifies the diversity of heavy-ion phenomena and the arsenal of experimental and theoretical tools used to understand them. The lectures will serve well either to introduce a graduate student to the field or to provide more experienced scientists with useful reviews.

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(Continued on page 411)