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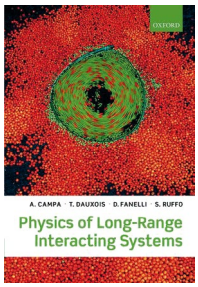

A. Campa, T. Dauxois, D. Fanelli and S. Ruffo
Physics of Long-Range Interacting Systems
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It is natural to think that the total energy of an ensemble of many interacting sub-systems is not the sum of the individual sub-system internal energies, due to the additional interaction energy. Also in thermodynamics it was fairly early recognized that, as a consequence of the fact that fundamental forces in nature such as gravity and electromagnetism are long-range, the total thermodynamic state functions of a large system are not extensive, in that they are not the sum of the corresponding functions of its parts. Many consequences of the classical thermodynamics of ideal gases or weakly interacting systems with short-range interactions like van der Waals forces, including the irreversible growth of entropy and the expected thermal death of the universe, which caused harsh discussions at Boltzmann's time, are actually hampered by the long-range character of natural forces acting from the atomic level onward. Magnetic dipolar systems, plasmas and self-gravitating ensenbles are examples spanning the range from atomic to astronomical scales. Current manifestations in condensed matter of non-additivity of statistical state functions are, *e.g.*, negative specific heats, negative susceptibility, and non-ergodicity. While the problem is well formulated, various possible wayouts have been questioned in the past, and are still matter of intense discussions and controversy, more or less as in the old times of the H-theorem, despite the apparent success of various applications to complex systems.

All that considered, the publication of this book by Alessandro Campa, Thierry Dauxois, Duccio Fanelli, and Stefano Ruffo by the Oxford University Press is an important event in the field, because it collects in a clear and tutorial style, suitable to young researchers and graduate students entering the field as well as to experienced scientists in adjacent areas, what is well-established in the broad field of long-range interacting systems. After providing the basic concepts of statistical mechanics of short-range interacting systems, the first part of the book introduces the problem of non-additivity in equilibrium statistical mechanics with long-range potentials, and discusses methods and solutions within and beyond various mean-field models. A chapter is devoted to quantum long-range systems. The second part of the book deals with the dynamical properties, *i.e.* the kinetic theories of long-range systems, the dynamics and slow relaxation under out-of-equilibrium conditions. The third and most substantial part of the book covers the applications: the gravitational systems; the two-dimensional fluid dynamics, also with reference to problems of geophysical interest; cold Coulomb systems such as strongly coupled plasmas and Wigner crystals; hot plasmas; wave-particle interactions as occurring, *e.g.*, in free-electron lasers; and dipolar systems, also with reference to experimental studies on spin-ice sustems, two-dimensional optical lattices and Bose-Einstein condensates. The book is completed by an illuminating Foreword by David Mukamel, several useful appendices, a vast literature of almost 400 references, and a rather complete suject index. Altogether an excellent book.

G. Benedek
Università di Milano Bicocca