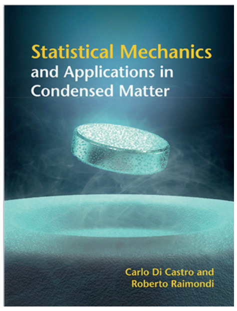
# RECENSIONI

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## Statistical Mechanics and Applications in Condensed Matter

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A basic feature of academy is the inseparable link between research and teaching. Good teaching is much more than just conveying good notions in the classroom. It is rather seeding and growing up a new generation of able and open-minded scientists. The present textbook is the natural output of the virtuous circle between teaching and research: it collects the materials and the wisdom that have nurtured the highly renown theoretical group in condensed matter statistical physics in Rome.

Statistical mechanics, started with the ground-breaking work of Daniel Bernoulli and greatly expanded in the 19th century with Laplace, Maxwell, Clausius, Boltzmann, etc. , provided a first unification of two apparently different and self-standing fields of physics, the Newtonian classical mechanics and thermodynamics, about the same time when Maxwell realized the other great unification, that between electricity and magnetism.
It is a statistical-mechanical problem, that of black-body radiation, which led to quantum mechanics, followed by quantum statistics and modern many-body field theories. Not just that: the methods and paradigms of statistical mechanics rapidly extended to all domains of science, like biology and medicine, geophysics and metereology, particle physics and cosmology, information, economy and sociology, etc. Statistical mechanics have more credentials to qualify as a "theory of everything"; in fact statististical mechanics far from equilibrium also lead to the concepts of emergent properties, self-organization and irreducible laws which define complex systems and confute reductionism. In this respect statistical mechanics holds a central position in scientific education.

Necessarily a textbook of statistical mechanics aiming to accompany the young researcher from the undergraduate through the graduate and post-doc levels needs to be focussed on a specific domain. The sub-title of this remarkable textbook suggesting condensed matter as a domain of application sounds as a slight understatement. Condensed matter physics is a major domain, because concepts currently used in condensed matter physics like symmetry breaking, phase transitions, renormalization, Bose-Einstein condensation and BCS theory have gained universality for being borrowed by other fields like nuclear and particle physics, astrophysics, etc. Nevertheless the amount of information and notions involved in this domain, while conveniently collected in a single textbook, largely exceeds the content of a single course. A special merit of this book is the possibility of using it as a modular text, suitable to a variety of monographic courses, from the undergraduate to the post-graduate level. The authors suggest six different sequences of chapters for:
(1) an introductory (undergraduate) module on statistical mechanics, preceded by a brief overview on thermodynamics; (2) a module on mean-field theory and critical phenomena providing, in combination with (1), the basis for a one-year graduate course; (3) a graduate/post-graduate module on mean-field theory for quantum systems and a unified theory for superfluids and superconductivity; (4) a module on dissipative phenomena in classical and quantum physics, suitable to a graduate one-semester course. The modern trends in quantum-statistical mechanics, organized in module (5), can provide in combination with (3) and (4) a one-year course either at the graduate or post-graduate level. The advanced topics and techniques in quantum-statistical mechanics like the thermal Green's function, the microscopic foundations of Fermi liquids, the Luttinger liquid and quantum interference in disordered systems, constitute, with the addition of an introductory chapter on linear response, the last module (6) suitable to a post-graduate course. In addition the authors indicate a few classical textbooks which have been found useful in the preparation of the various chapters of the book. This is good, although the absolute clarity and thouroughness of the tutorial sections, as well as of the most advanced chapters, suggest that the students and young researcher using this textbook will hardly need to consult the previous classics. The same holds for the experienced condensed matter theorist, who eventually grew up with those classics: he will find in the present book, exposed in a clear and coherent way, the theoretical concepts and models which determined the great advances in the field during the last decades.

Altogether the twenty-one chapters of this beautiful book, integrated by fourteen essential appendices, several problems with their solutions, and a rich bibliography constitute the ideal companion to the student who undertakes, soon after the basic undergraduate courses in quantum mechanics and mathematical methods, a curriculum in condensed matter theory, and aims high in the exciting universe of statistical physics.

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