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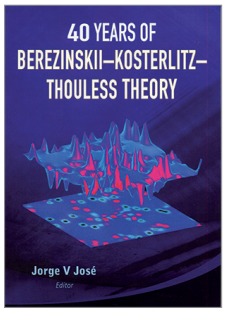

J. V. José (Editor)
40 Years of Berezinskii-Kosterlitz-Thouless Theory
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In the early seventies Vadim Berezinskii at the Landau Institute, and Michael Kosterlitz and David Thouless in the US approached independently the problem of phase transitions in two-dimensional systems. An explanation was sought of how a two-dimensional Bose liquid, *e.g.*, a thin film of ^{4}He, can become superfluid at finite temperature, at odds with the original prediction of Rudolf Peierls and the rigorous proof by Mermin and Wagner that no long-range order associated with Bose-Einstein condensation can occur in two dimensions. The pioneering studies collected under the name of BKT theory, have offered a remedy to that apparent inconsistency by showing that a phase transition is possible from a disordered phase, with an exponentially decaying correlation, to a quasi-long-range order with a power-law correlation decay. BKT theory introduced the important concept of topological phase transition and a corresponding critical temperature, above which bound opposite vortex pairs (having zero circulation) unbind, leading to a gas of topological defects formed by single quantized vortices. BKT theory provided a powerful tool for the analysis of phase transitions in a wide range of quasi–two–dimensional systems, including superfluid films, cuprates and other more recent high-temperature exotic superconductors, Josephson junction arrays, ultra-cold atomic gases in light traps, quantum-Hall bilayers, certain classes of ferroelectrics, etc.
The editor Jorge V. José has made an excellent job in bringing together ten articles exhaustively covering the most paradigmatic examples. All articles have the appropriate extension so as to offer a comprehensive tutorial basis to each argument. The subject is introduced by a delightful tale, written by Kosterlitz and Thouless themselves, on the motivations and the uneasy path which led to their great discovery. Their illustration of the early work on defect-driven phase transitions, besides its great scientific and historical value, offers a lesson of intellectual integrity when the authors carefully expose their progress as well as their mistakes, all being basic ingredients of any scientific enterprise.
In the second chapter Jorge José illustrates the role that duality transformations for 2D models with compact gauge symmetries, introduced by the author in a seminal work with Kadanoff, Nelson and Kirkpatrich, played, in conjunction with Wilson's renormalization group, for the development of BKT theory.
The important features of duality are exposed in the third chapter by G. Ortiz, E. Cobanera and Z. Nussinov. The BKT transition in (quasi) two-dimensional superconductors is discussed in two chapters by A. M. Goldman and by L. Benfatto, C. Castellani and T. Giamarchi, the latter presenting a thorough analysis of the BKT transition within the Sine-Gordon model.
The following chapters by Steve Teitel and by Rosario Fazio and Gerd Schön deal with the Josephson junction arrays in the light of BKT theory. Valerii Vinokur and Tatyana Baturina introduce, as a consequence of the uncertainty principle, the novel concept of superinsulator as the dual counterpart of a 2D superconductor. The emergence of DKT physics from the experimental investigation and theoretical analysis of ultracold trapped atomic gases in reduced dimensionality is discussed by Zoran Hadzibabic and Jean Dalibard. The last chapter by Herbert Fertig and Ganpathy Murthy opens a window on quantum-Hall bilayer systems and exciton condensation in 2D semiconductor structures. Quantum-Hall bilayers with unit total filling factor are shown to have a close analogy with superfluid films, the main difference being that the former host charged vortices, called merons. The book is completed by a very informative introduction by the editor and a useful subject index.
The evergreen interest in two-dimensional physics has been amplified in recent years by the discoveries of the quantum spin-Hall effect, the surface conducting states of topological insulators, the evidence of Majorana fermions in condensed matter, graphene, silicene, and various classes of exotic quasi-2D superconductors, including the persistent superconductivity in thin Pb films down to one single layer. All this proves how timely and well done was the initiative of celebrating the first forty years of BKT theory. No need to wait for the fiftieth anniversary, for which this collection, despite the further rapid progress expected in the field, promises to remain a reference textbook.

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