Preface

The effective field approach to a phase transition, used by Pierre Weiss at the beginning of this century to describe theoretically ferromagnetic transitions in iron, nickel, and cobalt, is the second oldest (surpassed in this respect only by Van der Waals theory of liquid–vapor transitions) and certainly the simplest approach to investigate cooperative phenomena of this kind. Early in the effort to describe satisfactorily the rich variety of physical phenomena accompanying a phase transition, it was realized that the role of fluctuations, introduced by Einstein in 1905 (the same year in which he introduced special relativity and the first successful explanation of the photoelectric effect), was crucial to investigate the subtleties of the behavior of systems undergoing phase changes at temperatures very close to the transition temperature. Of course, the concept of effective field, being an average or mean field, leaves out completely thermodynamic fluctuations. Nevertheless, the effective field approach gives in most cases a good qualitative description of the cooperative phenomena, and in some cases, ferroelectric transitions being an outstanding example, it even gives a fairly good quantitative description. It took some time for prominent theorists to realize that deviations of "classical" (effective field) behavior in ferroelectrics and dipolar ferromagnets should show up in the form of logarithmic corrections, which are very hard to detect experimentally.

This work, which could as well be entitled "Pedestrian approach to Phase Transitions," obviously does not aim at a comprehensive discussion of the effective field approach to phase transitions in general and less so at a discussion that goes deeply beyond this approach to such a broad and active field of contemporary research. It attempts at a simple presentation of the approach, at a very elementary level in most cases, to a number of interesting phase transitions, mostly solid-state transitions, with special attention,

in the second half of the book, to some work in ferroelectric systems inflecting, unavoidably, the research interest of the author. This material formed the basis for a short graduate course on "Phase Transitions" imparted by the author at the Universidad Autonoma de Madrid, in 1989.

I would like to thank Professor J. Palacios and Professor S. Velayos, former teachers of mine at the University of Madrid, who introduced me to this field; Drs. B.C. Frazer, K. Okada, M. Ray, and G. Shirane, from whom I learned much on ferroelectrics and phase transitions at Brookhaven National Laboratory and at Puerto Rico Nuclear Center; I. Lefkowitz and K.A. Müller to whom I am also indebted; and many of my former graduate students from whom I have also learned a good deal.

Madrid, January 15, 1990

Julio A. Gonzalo

Preface to the Second Edition

This second edition of *Effective Field Approach to Phase Transitions* includes additional sections, Parts III–IV, in which additional papers involving the effecitve field approach to Ferroelectric Transitions published in the period 1991–2005 are included.

It is for me a pleasure to give proper credit to the various main authors of these papers: to my younger Spanish colleagues R. Ramirez, G. Lifante, M. de la Pascua, B. Noheda, T. Iglesias, J.R. Fernadez del Castillo, N. Duan, C. Arago, M.I. Marqués, and J. García, some of them at UAM or other Universities in Madrid; and to my long time friends and colleagues from abroad, including G. Shirane (BNL, recently deceased), D. Cox (BNL), C.W. Garland (MIT), J.O. Tocho (La Plata), W. Windsch (Leipzig), M. Koralewski (Poznan), Y.L. Wuag (Shanghai), B. Mroz (Poznan), L. Cross (Penn State), R. Guo (Penn State), and C.L. Wang (Sandong).

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Julio A. Gonzalo