

Physical Phenomena at High Magnetic Fields Proceedings

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FOREWORD

This book is based on the proceedings of the conference on "*Physical Phenomena at High Magnetic Fields*" held in Tallahassee during May 15-18, 1991. This conference was to celebrate the award of the National High Magnetic Field Laboratory (NHMFL) to Florida State University, University of Florida and Los Alamos National Laboratory. One of the purposes of this conference was to identify the most important topics in Material Science at the extreme of parameter space (i.e., magnetic field, pressure, temperature, etc.) and set the scientific background for future experimental and theoretical developments at the new NHMFL.

High magnetic fields probe and reveal properties of various forms of organic or inorganic matter which in many cases can be the key to their puzzling behavior. High magnetic fields can also induce new physical phenomena by entering a regime of the parameter space where qualitatively new behavior emerges.

This book includes contributions presented at the conference from a wide spectrum of areas in condensed matter physics, structured in six main parts according to the topics covered: *Quantum Hall Effect*, *Heavy Fermions*, *Superconductivity and Superfluidity*, *Molecular and Biological Systems*, *Itinerant and Spin Magnetism* and status reports from the present High Field Facilities in the World. Each Part contains Chapters with invited talks which give a broad overview of each sub-field followed by one Chapter containing shorter contributed papers.

When the magnetic field is high, the temperature sufficiently low and the parameters describing electronic systems (such as electronic density, effective masses and interaction strengths) are suitable, the system can demonstrate interesting physical properties. Several new phenomena, predicted or discovered upon application of high magnetic fields, are included in this volume. The first Part of the book deals with electron systems in the so called extreme quantum limit which exhibit the *Quantum Hall Effect* and related properties. During the last decade an intense theoretical and experimental effort went into the understanding of the so called *Heavy Fermion* materials which are rare-earth or actinide intermetallic compounds. The second Part of this book is devoted to these materials. The third Part contains macroscopic quantum phenomena, such as *Superfluidity* of liquid ^4He or ^3He and of mixtures of these two elements, as well as *Superconductivity* in cuprate oxides and related systems. These materials as well as the heavy fermion materials are strongly correlated systems and it is believed that their magnetic properties are intimately coupled to their transport properties. *Molecular* and, in particular, *Biological* systems can be probed very effectively by strong magnetic fields and in certain cases biological processes can be altered by an external field (Part 4). Systems demonstrating *Itinerant Magnetism* or magnetic behavior due to *localized atomic moments* are outlined in Part 5. Part 6, presents the most sophisticated *High Field Facilities* in the World and reports some of the most recent discoveries in these laboratories. Finally, the conference is summarized by E. Abrahams in Part 7.

To publish this book in a record time (less than five months from the time of the conference), we relied on the invaluable support from the staff of the Center for Materials Research and Technology, and the Department of Physics of The Florida

State University, and the support staff of the NHMFL. In particular, we would like to thank Heather Allen and Jane Jimeian, who have done an outstanding job in assisting us with the preparation of the book from the author-submitted papers to a camera-ready form which meets the high-standard specifications of Addison-Wesley. We would also like to thank Walter W. Thorner for his artistic design of the book cover and Ken Ford for taking the photograph of the Conference participants. In this effort we have received considerable assistance from our fellow editors, Dr. K. Bedell, Dr. P. Kumar and Dr. F. M. Mueller. In addition, the help of Barbara Holland and Pam Suwinsky of Addison-Wesley was very valuable. This conference was also supported in part by the Center for Material Science of Los Alamos National Laboratory and in part by Digital Computer Corporation. We are also indebted to the Supercomputer Computations Research Institute of The Florida State University and to those who helped us with the logistics of the Conference. Finally, we would like to thank the contributors to this volume and the conference participants for the lively discussions which made the conference a success.

Efstratios Manousakis
Pedro Schlottmann

Tallahassee, FL
August 1, 1991

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