Open Problems in Strongly Correlated Electron Systems

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Open Problems in Strongly Correlated Electron Systems

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Preface

In the last decade it has become increasingly evident that strong correlations between electrons are an essential and unifying factor in such diverse phenomena within solid state physics as high-temperature superconductivity, colossal magnetoresistance, the quantum Hall effect, heavy-fermion metals and Coulomb blockade in single-electron transistors. A new paradigm of non-Fermi Liquid behaviour is also emerging and, in a number of systems, replacing the Fermi liquid, which has been the cornerstone of the physics of metals and superconductors for the past decades.

In spite of major achievements, the theoretical studies and understanding of strongly-correlated electrons seems to be still in its infancy. Anomalous electron properties have been studied in some generic models of correlated electrons, such as the Hubbard and t - J models, the Anderson and Kondo impurity models, and their lattice equivalents. New insights into the behaviour of these, and related models is emerging from the introduction of powerful numerical methods to study such many-body models, including approximate techniques of many-body theory and exact results in low- and high-dimensional systems. These all show convincing evidence for breakdown of the Fermi liquid concept.

The Bled workshop focused on several major open questions in the theory of anomalous metals with correlated electrons. These theoretical advances were complemented by the latest experimental results in related materials, presented by leading experimentalists in the field. The main emphasis was on the following topics:

- physics of cuprates and high-temperature superconductors,
- charge- and spin-ordering and fluctuations,
- manganites and colossal magnetoresistance,
- low-dimensional systems and transport,
- Mott-Hubbard transition and infinite dimensional systems,
- quantum Hall effect.

The major funding of the Workshop was from the NATO grant, with further substantial Slovenian support from the Ministries of Defense, Science and Technology, and Foreign Affairs, the Institute Jožef Stefan, and the Faculty of Mathematics and Physics, University of Ljubljana. The organizers particularly acknowledge the personal support of the Slovenian Minister of Defense Dr. Franci Demšar, who gave the Workshop opening address.

The organizers also wish to acknowledge T.M. Rice for his encouragement and valuable advice concerning the program. Finally, we express our gratitude to colleagues, in particular to I. Sega for financial management, T. Rejec, D. Veberič and K. Haule for help and technical assistance before and during the Workshop, and M. Budiša for the work done on the final version of the book.

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Ljubljana, November 2000