Progress in High Temperature Superconductivity — Vol. 14

Proceedings of the Adriatico Research Conference and Workshop on

TOWARDS THE THEORETICAL UNDERSTANDING OF HIGH T_c SUPERCONDUCTORS

ICTP, Trieste, Italy 20 June — 29 July 1988

Editors

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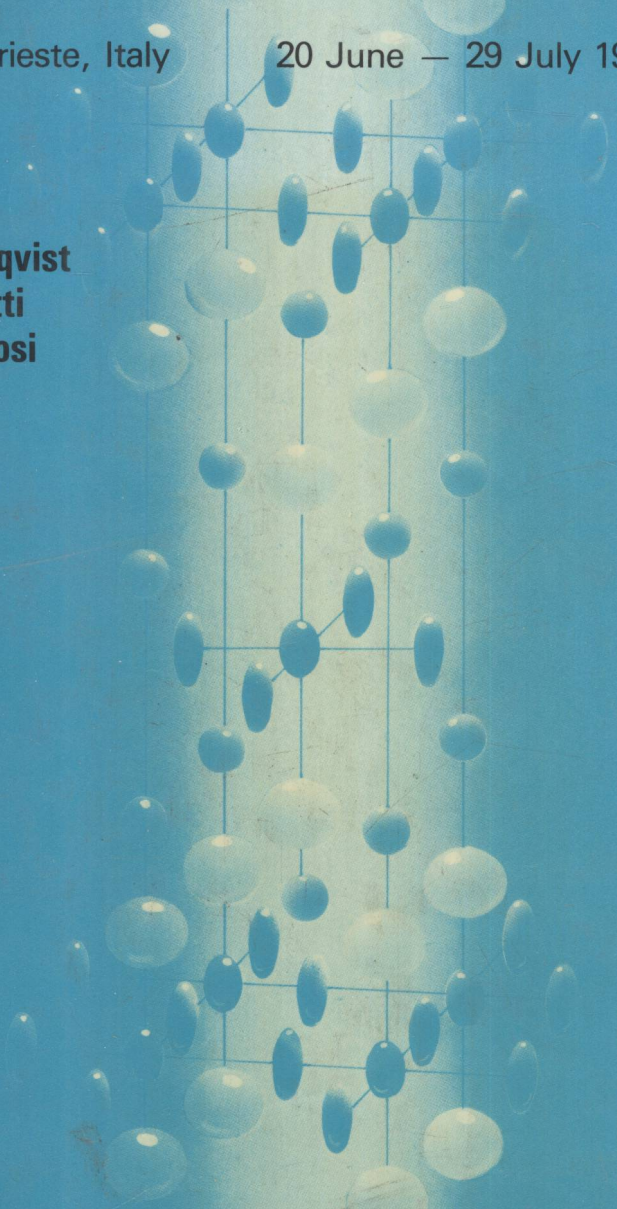

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TOWARDS THE THEORETICAL UNDERSTANDING OF HIGH T_c SUPERCONDUCTORS

SERIES ON PROGRESS IN HIGH TEMPERATURE SUPERCONDUCTIVITY

Editors-in-charge

Published

Vol. 1 — Proceedings of the Adriatico Research Conference on High Temperature Superconductors (*eds. S. Lundqvist, E. Tosatti, M. Tosi and Yu Lu*)

Vol. 2 — Proceedings of the Beijing International Workshop on High Temperature Superconductivity (*eds. Z. Z. Gan, G. J. Cui, G. Z. Yang and Q. S. Yang*)

Vol. 3 — Proceedings of the Drexel International Conference on High Temperature Superconductivity (*eds. S. M. Bose and S. D. Tyagi*)

Vol. 4 — Proceedings of the 2nd Soviet-Italian Symposium on Weak Superconductivity (*eds. A. Barone and A. Larkin*)

Vol. 5 — Proceedings of the IX Winter Meeting on Low Temperature Physics — High Temperature Superconductors (*eds. J. Heiras, R. A. Barrio, T. Akachi and J. Taguena*)

Vol. 7 — Chemical and Structural Aspects of High Temperature Superconductors (*ed. C. N. R. Rao*)

Vol. 8 — World Congress on Superconductivity (*eds. C. G. Burnham and R. O. Kane*)

FOREWORD

A Workshop on Mechanisms for High Temperature Superconductivity was held at the International Centre for Theoretical Physics in Trieste from June 20 to July 29, 1988. An Adriatico Research Conference on "Towards the Theoretical Understanding of High T_c Superconductors" provided a climax during the last week of the Workshop. The papers collected in this volume summarize some (though by no means all) of the most meaningful contributions presented during these two events. A list of lectures delivered has been included to provide a more complete picture. The effort has been mostly theoretical, as witnessed by the subject of the papers themselves, but the rather comprehensive overviews of the latest experimental results presented by the leading experts at the Conference would serve a guideline towards a deeper theoretical understanding of the mechanism for superconductivity.

The discussions at the Workshop and Conference were very stimulating, and the depth reached by some of the theories is genuinely stunning. Of course, there is as yet no consensus as to what theory explains High T_c superconductivity. But the feeling at this moment is that whatever the right mechanism might be, it will have an overlap with one or more among those presented, described, and elaborated during these two events.

The Workshop and Conference have provided an ideal melting pot for very old and very new ideas, and also for very diverse scientific communities from the West, the South, and the East. Each participant brought in his own contribution and, if in the end we haven't solved the full problem, we are all certainly left with the feeling that our entire community is now moving in a more unified fashion towards this electrifying goal.

The number of papers included in this volume is very large, so some grouping has been necessary. The grouping of papers we have done here is certainly subjective and may not be the optimal one, but we do hope that it will facilitate the reader.

We owe all participants and lecturers our heartfelt thanks for providing such excitement. Dr. G. Baskaran from Madras, Dr. A.R. Bishop from Los Alamos, and Prof. N. Kumar from Bangalore have been instrumental in arranging a good part of the programme. Both meetings have benefited from the sponsorship of the International School for Advanced Studies (SISSA), Trieste and the Italian Research Council (CNR). IBM Italy has very generously provided support for a number of invited speakers and offered an excellent dinner for speakers of the Adriatico Research Conference. Finally, we express our gratitude to our kind secretaries, Ms. Deisa Buranello, Ms. Milena Poropat, and Ms. Stanka Tanoskovic whose industrious and excellent work has helped to make the Workshop and Conference a success.

The organizers

MINIWORKSHOP ON
MECHANISMS FOR HIGH TEMPERATURE SUPERCONDUCTIVITY

20 June - 29 July 1988

SEMINARS PRESENTED (in chronological order)

G. KOTLIAR (Cambridge)	"The slave boson approach to the extended models of high temperature superconductivity"
S. TRUGMAN (Los Alamos)	"Hole correlations in the Hubbard model"
S. DONIACH (Stanford)	"Antiferromagnetism and superconductivity"
I.O. KULIK (Kharkov)	"Electronic transfer of local pairs and superconductivity in metal oxide compounds"
M. NOGA (Bratislava)	"Superconductivity in chain-like structures"
P. FAZEKAS (Budapest)	"On possible extensions of the Gutzwiller Ansatz"
A.M. OLES (Cracow)	"Electron correlation and antiferromagnetism in high T_c superconductors"
V. ZLATIC (Zagreb)	"Perturbative treatment of local correlations in Cu-O planes for high T_c superconductors"
P. HORSCH (Stuttgart)	"Spin correlations, excitations of spin-1/2 Heisenberg antiferromagnet on square lattice"
P. PRELOVSEK (Ljubljana)	"Spin-hole models for CuO_2 layers in superconducting oxides"

F. WOYNAROVICH (Budapest)	"Exact excitation spectrum of 1-D Hubbard model"
R. JOYNT (Madison)	"Phase diagram of d-wave superconductors in magnetic fields"
I. MORGENSTERN (Rüschlikon)	"Numerical simulation of high T_c superconductivity"
G. BASKARAN (Madras)	"Resonating valence bond picture of high T_c superconductors"
D. ROKHSAR (Yorktown Heights)	"The short-range RVB superconductor"
D.H. LEE (Yorktown Heights)	"Connection of RVB with QHE"
B. DOUCOT (Princeton)	"Numerical simulations of RVB"
A. RUCKENSTEIN (La Jolla)	"Approach to strongly correlated systems with and without slave Bosons"
T.M. RICE (Zürich)	"What do high T_c experiments tell theoreticians"
D. POILBLANC (Zürich)	"Exact states and variational states of a periodic two-dimensional cluster of the Heisenberg model"
F. MILA (Zürich)	"Parameters of a Hubbard Hamiltonian to describe superconducting Cu oxides"
S. SORELLA (Trieste) and others	*Informal discussion on numerical simulations*
A.R. BISHOP (Los Alamos)	"Charge fluctuation pairing in the extended Hubbard model"
J.C. FUGGLE (Nijmegen)	"High energy spectroscopies of High T_c Superconductors"
R. SHANKAR (Yale) and others	*Informal discussion on topological term in the Heisenberg model and gauge field theory of RVB*
V.L. POKROVSKY (Moscow)	"Two or three dimensionality of high T_c superconductors"

SHORT COMMUNICATIONS (in chronological order)

	A multicomponent plasma model"
A.N. DAS (Calcutta)	"Superconductivity in the nearly half-filled Hubbard model with strong on-site correlation"
A. ROBLEDO (Mexico)	"Simple spin hole model for magnetic correlations in copper oxide superconductors"
R. MEDINA (Roma)	"Microscopic origin of effective attractive interaction in a Hubbard type Hamiltonian for the Cu-O plane"
M.D. NUNEZ-REGUEIRO (Bariloche)	"Common excitonic mechanism for CuO_2 and BiO_3 based perovskites"
M. GRILLI (Roma)	"Possible occurrence of band interplay in high T_c superconductors"
Z. GULACSI (Cluj-Napoca)	"Superconductivity and impurities in layered systems"

Adriatico Research Conference on:

Towards the Theoretical Understanding of High T_c Superconductors

(26 - 29 July 1988)

LECTURES PRESENTED (in chronological order)

K.A. Müller (Zürich)	**Recent Progress in High T_c Superconductors**
D.C. Johnston (Ames)	**Superconductivity and Magnetism in High T_c Oxides**
P. Fulde (Stuttgart)	**Treatment of Strong Electron Correlations in High T_c Materials**
H.R. Ott (Zürich)	**Anomalous Electronic Properties of High T_c Superconductors**
P.M. Horn (Yorktown Heights)	**Experimental Insights into the Mechanism of High T_c Superconductivity**
C.M. Varma (Murray Hill)	**ODLRO in Various Proposed Models of High T_c Superconductors**
P. Prelovsek (Ljubljana)	**Binding of Holes within the Effective Single Band Hamiltonian for CuO_2 Layers**
H. Kamimura (Tokyo)	**Spin Polaron Pairings and High T_c Superconductivity**

M. Gunn (Didcot)	**Spin Waves and Superconductivity**
V. Galaiko (Kharkov)	**A Two-Band Superconductor with a Narrow Band Near the Fermi Level**
T.M. Rice (Zürich)	**Electronic Properties of Strongly Correlated Systems**
G. Baskaran (Madras)	**RVB Theory : An Overview**
D. Rokhsar (Yorktown Heights)	**RVB vs BCS**
H. Fukuyama (Tokyo)	**Mean Field Theory of RVB**
D.H. Lee (Yorktown Heights)	**RVB: A New State for Mixed Valence Systems?**
B. Alascio (Bariloche)	**Holes in Cu-O Planes: Exact Diagonalization and Renormalization Group Results**
G.A. Sawatzky (Groningen)	**The Electronic Structure of High T_c Materials**
A. Kapitulnik (Stanford)	**Electronic Properties and the Nature of the Superconductivity State in the High T_c Materials**
P. Chaudhari (Yorktown Heights)	**Critical Currents in High T_c Superconductors**
A. Balzarotti (Roma)	**Charge Fluctuations in $YBa_2Cu_3O_7$ from XPS and Auger Spectroscopies**
A. Bianconi (Roma)	**Symmetry of the $3d^9$ Ligand Hole Induced by Doping in $YBa_2Cu_3O_{7-d}$**
G. Ruani (Bologna)	**Photo-induced Infrared Absorption in 1-2-3 System**
Y. Endoh (Sendai)	**Spin Correlations in Superconducting $La_{2-x}Sr_xCuO_4$**

M. Kastner (Cambridge)	**Spin Correlations and their Interaction with Charge Carriers in $La_{2-x}Sr_xCuO_4$**
T. Penney (Yorktown Heights)	**Comparison of Hall Number, Hole Concentration and T_c in Nd and Zn Substituted $YBa_2Cu_3O_y$ Superconductors**
H.Takagi (Tokyo)	**Transport and Magnetic Properties of $(La_{1-x}Sr_x)_2CuO_4$ Systems**
L. Mihaly (Budapest)	**NMR Studies of High T_c Superconductors**
R. Cantelli (Roma)	**Elastic Modulus, Internal Friction and Oxygen Ordering in Y-Ba-Cu-O**
K. Fossheim (Trondheim)	**Elastic Properties of High T_c Materials; C_p (spec.heat) Near T_c**
S. Sorella (Trieste)	**Fermi Liquid Behavior and Its Breakdown in the 2-Dimensional Hubbard Model**
M. Imada (Urawa City)	**Magnetic Mechanism of Superconductivity**
I. Morgenstern (Zürich)	**Numerical Simulations of High T_c Superconductivity**
P. Horsch (Stuttgart)	**Hole Attraction in Multi-Band Extended Hubbard Model**
B. Doucot (Princeton)	**Antiferromagnetism and RVB in the 2-Dimensional Heisenberg Model**
K.A. Chao (Linköping)	**Pairing-Bag in Superconducting Oxides**
A. Aharony (Tel-Aviv)	**Magnetic Frustration Model for Superconducting Oxides**
A. Bishop (Los Alamos)	**Charge Fluctuation Pairing in the Extended Hubbard Model**
C. Di Castro (Roma)	**Kondo Lattice Hamiltonian for High T_c Superconductors**

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