SYMMETRY AND HETEROGENEITY IN HIGH TEMPERATURE SUPERCONDUCTORS

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edited by

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Acknowledgements

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Preface

This book is a collection of the papers presented at the workshop on "Symmetry and Heterogeneity in High Tc Superconductors" directed by Antonio Bianconi and Alexander F. Andreev in collaboration with K. Alex Müller and Giorgio Benedek. Philip B. Allen, Neil W. Ashcroft, Alan R. Bishop, J. C. Séamus Davis, Takeshi Egami, Francesco Iachello, David Pines, Shin-ichi Uchida, Subodh R. Shenoy, chaired hot sessione contributing to the success of the workshop.

The object of the workshop was the quantum mechanism that allows the macroscopic quantum coherence of a superconducting condensate to resist to the attacks of high temperature. Solution to this problem of fundamental physics is needed for the design of room temperature superconductors, for controlling the decoherence effects in the quantum computers and for the understanding of a possible role of quantum coherence in living matter that is debated today in quantum biophysics.

The discussions in the informal and friendly atmosphere of Erice was on new experimental data showing that high T_c in doped cuprate perovskites is related with the nanoscale phase separation and the two component scenario, the two-band superconductivity in magnesium diboride and the lower symmetry in the superconducting elements at high pressure.

There has been a large interest in the superconductivity of MgB_2. This system provides the simplest system for testing the high T_c theories, and plays the same role as atomic hydrogen for the development of the quantum mechanics in the twenties. Clear experimental evidence in this system shows that multiband superconductivity enhances the critical temperature from the low T_c range $T_c < 19K$, to the high temperature range, $T_c = 40K$. The heterogeneous structure, the superlattice of superconducting layers, determines the disparity and different spatial location of the Bloch wave functions of electrons at the Fermi level that provides in superconductivity the clean limit. The chemical potential can be tuned by atomic substitutions without increasing inelastic single electron interband scattering. The

Feshbach shape resonance in the exchange-like off-diagonal interband pairing term, as predicted since 1993, appears to be the mechanism for evading temperature decoherence effects and enhancing the critical temperature.

The picture below shows some of the participants at the Erice workshop: 1. Samia Charfi-Kaddour, 2. Cinzia Metallo 3. Laura Simonelli, 4. Sergei Kruchinin , 5. Fedor Kusmartsev, 6. Naurang L. Saini , 7. Alexander Agafonov, 8. Victor Kabanov, 9. Boris Kochelaev , 10. Josef Ashkenazi, 11. Massimo Inguscio , 12. Giorgio Benedek , 13. Francesco Iachello , 14. Karl Alex Muller , 15. Neil W. Ashcroft , 16. David Pines, 17. Antonio Bianconi , 18. Hiroyuki Oyanagi , 19. Nikolay Kristoffel , 20. Takeshi Egami, 21. Sadamichi Maekawa , 22. Anna Maria Cucolo , 23. Kazumi Maki , 24. Georgios Varelogiannis , 25. Shin-ichi Uchida, 26. Annette Bussmann Holder, 27. Roman Micnas , 28. Matteo Filippi, 29. Hidenori Takagi, 30. Fabrizio Bobba , 31. Hugo Keller, 32. John D. Dow, 33. Oystein Fischer, 34. Philip B. Allen , 35. Yuri Latyshev , 37. Sang. W. Cheong, 38. Lev S. Mazov , 39. Christophe Salomon, 40. Nejat Bulut, 41. J.C. Seamus Davis , 42. Toni Schneider , 43. Davor Pavuna , 44. Tomislav Vuletic, 45. Carmine Antonio Perroni, 46. Alan R. Bishop, 47. Efthymios Liarokapis, 48. Subodh R. Shenoy, 49. Pavol Banacky, 50. Jorgen Haase