ARPES and experimental electronic structure of correlated materials

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Abstract. Angle-resolved photoemission spectroscopy (ARPES) is a powerful technique to study the microscopic properties of solids. ARPES gives direct access to the band structure of a material, and provides valuable information about the many-body interactions affecting such band structure. This lecture will introduce the basic aspects of ARPES, from a synopsis of currently used instrumentation to its application in the study of correlated-electron systems. Time permitting, topics to be discussed include: (*i*) Basic aspects of ARPES: theoretical concepts and instrumentation; (*ii*) Brief overview of many-body effects and how to study them using ARPES; (*iii*) Electron-phonon coupling (and similar electron-boson couplings); (*iv*) Quasi-1D systems; (*v*) Low- and high-T_C superconductors; (*vi*) Effects of spin-orbit coupling on the electronic structure; (*vii*) 2D electron gases at oxide surfaces and interfaces; (*viii*) Kondo resonance and periodic Anderson lattice; (*ix*) Heavy fermions and exotic phase transitions. Furthermore, as a practical training, we will perform some simple simulations of the spectral function and electronic structure of a few basic systems of importance in correlated-electron physics, such as the Fermi liquid, the Einstein electron-phonon coupling, or the «Marginal Fermi liquid».

Suggested introductory readings (textbook, review or articles)

1. S. Hüfner. *Photoelectron Spectroscopy – Principles and Applications*. Third edition, Springer (Berlin), 2003.
2. S. Hüfner (Editor). *Very High Resolution Photoelectron Spectroscopy*. Lecture Notes in Physics **715**, Springer (Berlin), 2007.
3. F. Reinert and S. Hüfner, New Journal of Physics **7**, 97 (2005).
4. A. Damascelli, Z.-X. Shen, S. Hussain, Rev. Mod. Phys. **75**, 473 (2003).
5. J. C. Campuzano, M. R. Norman, M. Randeria, cond-mat/0209476.
6. J. Braun. *The theory of angle-resolved ultraviolet photoemission and its application to ordered materials*. Rep. Prog. Phys. **59**, 1267-1338 (1996).