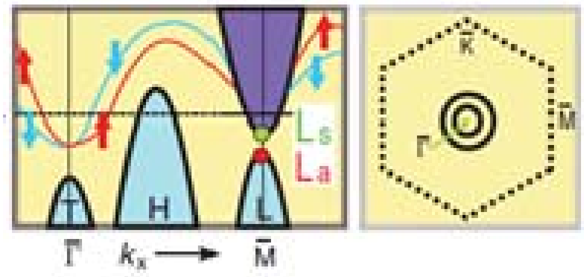

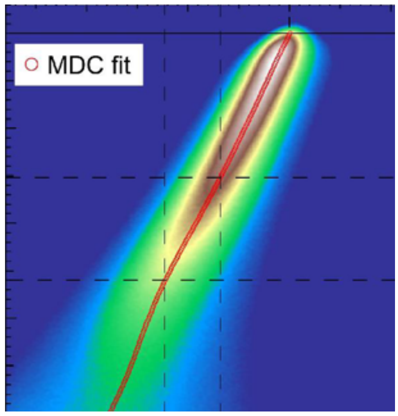

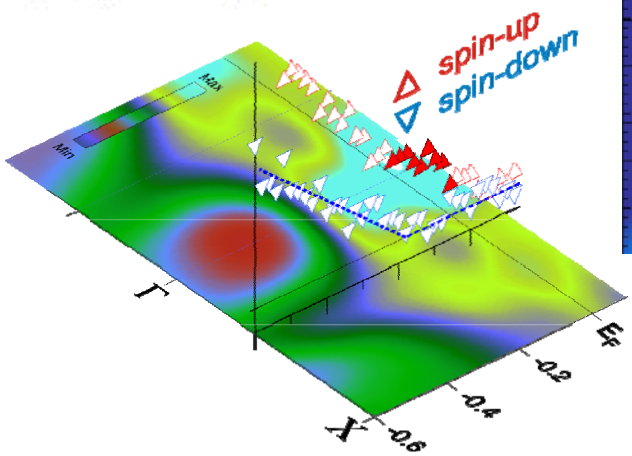

SLS Symposium on

Spin Effects at Surfaces

Tuesday, June 1, 2010

10:00 to 12:00, WBGB/019

10:00 High energy kinks due to spin-excitations in metals
X.Y. Cui, A. Hofmann, J. Schaefer, K. Shimada, R. Claessen and L. Patthey

10:30 Spin and angle-resolved photoemission from $La_{0.7}Sr_{0.3}MnO_3$ surfaces
J. Krempaský, L. Patthey, V.N. Strocov, M. Shi, M. Falub, M. Radović, M. Hoesch, K. Hricovini

11:00 Coffee

11:15–12:00 An experimentalist introduction to topological insulators: the next surface science revival
H. Dil

High energy kink due to spin-excitations in metals

X.Y. Cui[1], A.Hofmann[2], J.Schaefer[2], K.Shimada[3], R. Claessen[2] and L.Patthey[1]

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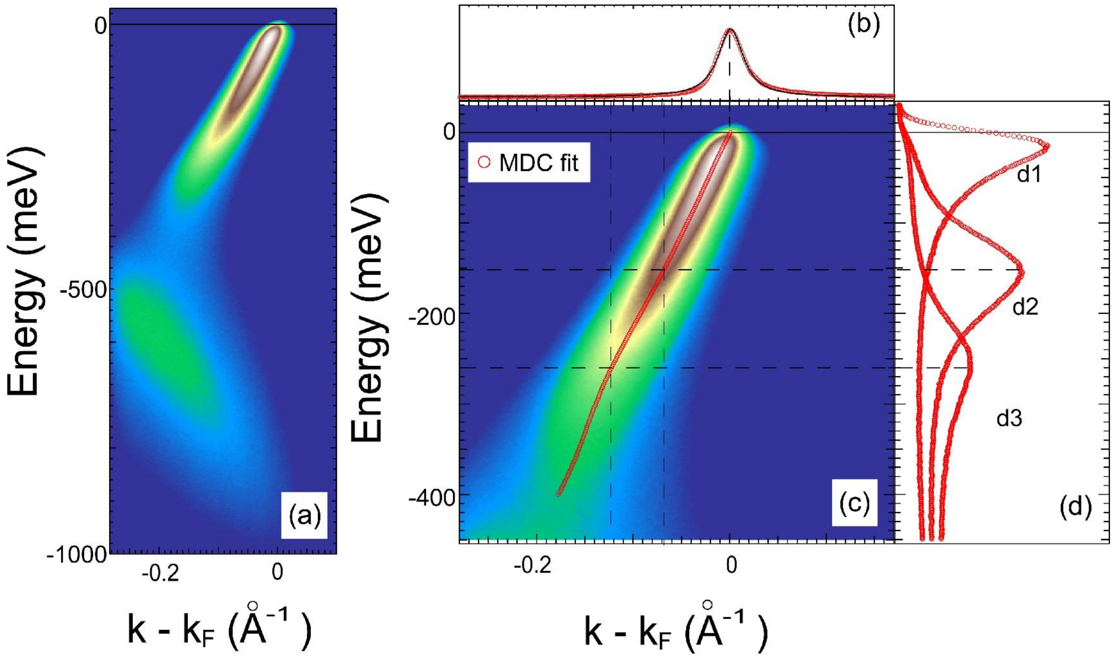
High-resolution angle-resolved photoelectron spectroscopy (ARPES) in the VUV and soft x-ray range enables us to elucidate bulk- and surface-derived energy-band dispersions and Fermi surfaces in detail.

In this presentation, we report high-resolution ARPES study of metals and clarify magnitudes of the electron-magnon and electron-phonon interactions on the quasi-particles near the Fermi level.

The quasiparticle dynamics of electrons in a magnetically ordered state is investigated by ARPES of Ni(110) and Fe(110) at 10 K. The self-energy is extracted for high binding energies reaching up to several hundred meV, using a Gutzwiller calculation as a reference frame for correlated quasiparticles. Significant deviations exist in the 300 meV range, as identified on magnetic bulk bands for the first time. The discrepancy is strikingly well described by a self-energy model assuming interactions with spin excitations. Implications relating to different electron-electron correlation regimes are discussed.



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[1] A. Hofmann, **X. Y. Cui**, J. Schaefer, S. Meyer, P. Hoepfner, C. Blumenstein, M. Paul, L. Patthey, E. Rotenberg, J. Buenemann, F. Gebhard, T. Ohm, W. Weber, and R. Claessen, Phys. Rev. Lett. **102**, 187204 (2009).

[2] **X. Y. Cui**, K. Shimada, Y. Sakisaka, H. Kato, M. Hoesch, T. Oguchi, Y. Aiura, H. Namatame, M. Taniguchi, submitted to PRB; **X. Y. Cui**, E. E. Krasovskii, V. N. Strocov, A. Hofmann, J. Schaefer, R. Claessen, L. Patthey, submitted to PRB

Spin and Angle Resolved Photoemission from $La_{0.7}Sr_{0.3}MnO_3$ Surfaces.

J. Krempaský[1], L. Patthey[1], V.N. Strocov[1], M. Shi[1], M. Falub[1], [1,4]M. Radović, M.Hoesch[2], K. Hricovini[3]

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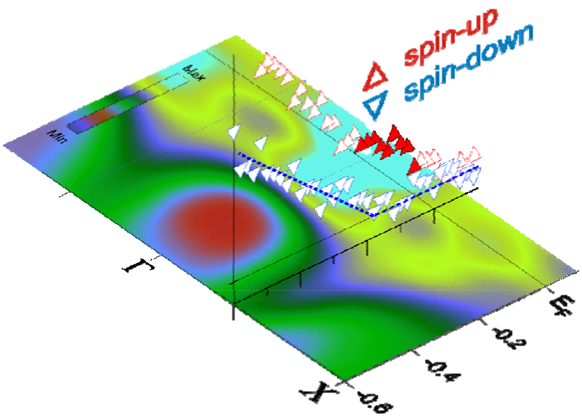
We characterize the $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) electronic properties with Spin- and Angle-Resolved Photoemission Spectroscopy (SARPES). Since photoemission from three-dimensional LSMO is known to be difficult to measure and even more difficult to interpret, I briefly discuss some experimental data treatment which help reveal signatures of Mn-*d* shell bands in ARPES, their orbital character, spin, and even some evidence on the polaron formation. The experimentally characterized orbital character of the valence band occupied states challenge the common believe that strained LSMO/STO thin films lift the degeneracy of the $3z^2$-r^2 and x^2-y^2 e_g states [1] and seems to be related with the polaron formation of the e_g states observed in our experimental data. In the first place, however, we give answers as to whether LSMO is half-metallic system with 100% spin-polarized electrons at the Fermi surface [2] and what is the energy separation between the spin-up and spin-down bands. In order to ensure that the experimental data account on bulk LSMO properties, we compare the experimental data to simulations of the photoemission spectra from GGA+U band structure calculations and disentangle the LSMO surface-reconstruction effects from LSMO bulk properties on the experimental side [3].

Finally I present spin-integrated and spin-resolved data from the LSMO valence band measured with photon energies below and near the Mn*3p*→Mn*3d* resonant photoemission edge. In resonant conditions the footprints of the e_g and t_{2g} Mn-states become "magically" enhanced in the photoemission final states [4]. This allows us to compare the LSMO ground state from theory with ARPES in great detail.



Off-normal emission spin-resolved spectrum cutting the $La_{0.7}Sr_{0.3}MnO_3$ Brillouine zone for $k_{//}$ ~0.4 π/a in the (100) mirror plane, overlaid with spin-integrated ARPES data. The energy separation between the spin-up (majority) and spin-down (minority) e_g bands is distorted due to intrinsic broadening effects in a photoemission process and due to a polaron formation of the Mn e_g states close to the Fermi level. In spin-resolved experiment the polaron formation of the half-metallic Mn e_g bands is marked with solid triangles.

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An experimentalist introduction to topological insulators: the next surface science revival

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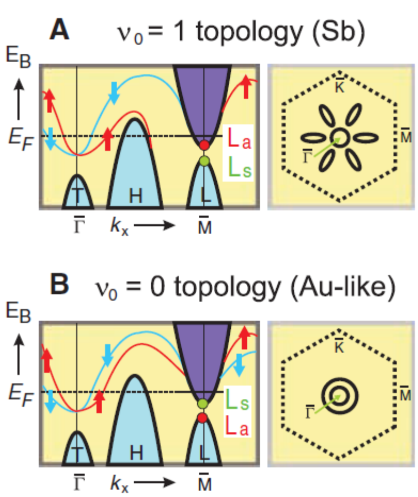
The quantum Hall effect (QHE) is a prime example of a physical effect that is not as much based on symmetry breaking, but rather on the topological order of the system. Where for the quantum Hall effect the time reversal symmetry still needs to be broken, this is no longer the case for the recently discovered quantum spin Hall effect (QSHE). In the QSHE the spin-orbit coupling takes the role of the magnetic field in the integer QHE.

Theory suggests that the QSHE can be observed for a novel class of materials termed topological insulators[1]. A topological insulator can be described as a band gap insulator, which at the surface supports one or more metallic spin-polarized surface states with a non-trivial topology. Verification of whether a system has a non-trivial ν_0=1 topology (see figure) is based on counting the number of Fermi level crossings between two time-reversal invariant momenta (mostly Γ-M). For a non-trivial system the number of spin-polarized crossings will always be odd. Therefore, the best technique to directly probe the topology is spin and angle-resolved photoemission spectroscopy (SARPES)[2]. In this presentation we will discuss some results we obtained for topological insulators and their parent compounds [3,4,5].



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