Elettra + BaD ElPh

Quasiparticles at the Mott transition in V_2O_3 studied by bulk-sensitive VUV angle-resolved photoemission spectroscopy

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Understanding the electronic properties of quasiparticles in strongly correlated materials is the key to answer many important open questions in condensed matter physics. Angle resolved photoemission spectroscopy (ARPES) is one of the main experimental techniques to study this problem, but its intrinsic surface sensitivity often turns out to be a problem for the fermiology of coherent electronic states.

The BaD ElPh beamline at the Elettra synchrotron light source was constructed to perform ARPES at low photon energy, thus in a more bulk sensitive way, in conditions of high flux and high energy resolution [1]. These characteristics were exploited to explore the electronic properties of the prototype Mott compound V_2O_3.

We found that spectral features corresponding to the quasiparticle peak in the metallic phase present a marked wave vector dependence, with a stronger intensity along the ΓZ direction. The analysis of their intensity for different probing depths shows the existence of a characteristic length scale for the attenuation of coherent electronic excitations at the surface. This length scale, which is larger than the thickness of the surface region as normally defined for noncorrelated electronic states, is found to increase when approaching the Mott transition [2]. These results are in agreement with the behavior of quasiparticles at surfaces as predicted by a very recent theoretical work [3], and appear to be of general interest also for other strongly correlated materials [4].

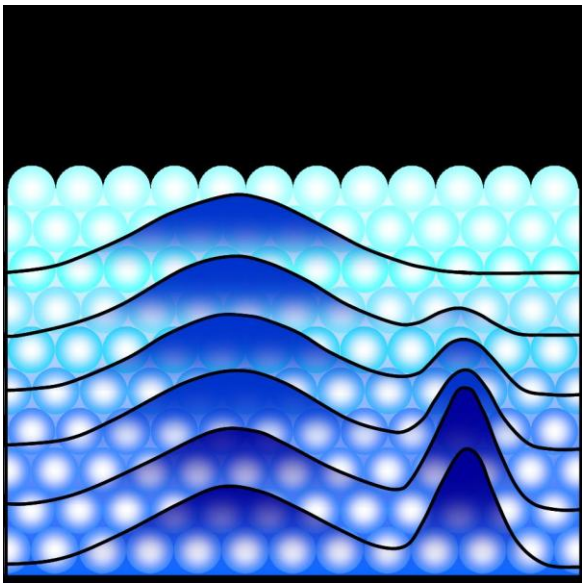

Fig. 1. In the V_2O_3 prototype Mott compound an insulating layer is present in a region near the surface even when the bulk is still a metal [4].

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[2] F. Rodolakis, B. Mansart, E. Papalazarou, S. Gorovikov, P. Vilmercati, L. Petaccia, A. Goldoni, J. P. Rueff, S. Lupi, P. Metcalf and M. Marsi, Phys. Rev. Lett. **102** (2009) 066805.

[3] G. Borghi, M. Fabrizio and E. Tosatti, Phys. Rev. Lett. **102** (2009) 066806.

[4] Synopsis in "Physics": http://physics.aps.org/synopsis-for/10.1103/PhysRevLett.102.066805