Kink far below the Fermi level reveals new electron-magnon scattering channel in Fe

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The appearance of electron dispersion anomalies, such as kinks, provides clues on the physics of electron-boson interactions. The kinks are expected to occur on the scale of the boson energy (typically up to few a hundred meV).

In this work [1], we have used momentum microscopy operated using the synchrotron light to map the electronic band structure of Fe(001) grown on Au(001). We have used linearly polarized photons with energy of 70 eV to access the electronic states close to the bulk Γ point of bcc Fe. We have measured k-space maps with spin resolution and analyzed the dipole selection rules to unambiguously identify orbital and spin character of the experimentally observed electronic states. We have observed strong spin dependence of the electron-electron correlation effects, with the majority states affected much more than the minority states.

Importantly, we have experimentally observed a peculiar kink in the electronic dispersion of the minority Δ_2 state, located at the binding energy as high as E_B=1.5 eV. Such high binding energy is much higher than expected for electron-phonon or electron-magnon scattering [2][3].

We compare the experimentally measured signatures with the results of many body perturbation theory calculations performed using the newly-developed *GT* self-energy approximation, where *G* stands for the Green function and *T* is the effective magnon propagator. The *GT* result reflects the spin asymmetry of the electron-electron correlation effects, and reproduces the high-energy kink in the minority channel at E_B=1.5 eV.

We interpret the observed kink as a signature of the many-body state that includes a photohole bound to a coherent superposition of Stoner-type spin-flip excitations renormalized by magnons. The existence of such a state sheds new light on the physics of the electron-magnon interaction.

References

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