Double photoemission on correlated electron pairs in metals

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The interaction between electrons in solids plays a central role in magnetism, superconductivity as well as metal-insulator transitions [1]. In double photoemission (DPE) experiments, a pair of interacting electrons can be excited by one single photon and analyzed spectroscopically. Therefore, DPE may allow a direct access to probe the strength of electron correlation [2,3]. In contrast to the well-established angle-resolved photoelectron spectroscopy on individual electrons, DPE experiments have been developed progressively over the last decade. In this contribution we will present new DPE experiments using a laboratory high-order harmonic light source in combination with two time-of-flight electron spectrometers [4,5]. With this setup we explore the energy distribution of electron pairs on the Ag(001) and Cu(111) surfaces and discover signatures of electron correlation between the *sp* and *d* valence electrons [6].

The DPE experiments were performed using photon energies of 25 and 32 eV. In the two dimensional energy distribution of electron pairs from the Ag(001) surface, we observed step-like features located at well-defined sum energies of electron pairs. These features can be explained according to the multiples of the minimal binding energy of Ag 4*d* electrons of around 4 eV. Consequently, the photoelectron pairs can be assigned as pairs of *sp* and *d* electrons (*sp*-*d*) as well as pairs of two *d* electrons (*d*-*d*) [6]. In addition, we observed indications of excitation processes with three *d* electrons (*d*-*d*-*d**) including one neutral excitation from the *d* bands to the Fermi level (*d**). These results will be discussed in terms of electron correlation and compared with the DPE spectra on Cu(111) as well as the strongly correlated electron system NiO.

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