Description of many-body effects in quasiparticle interference on noble-metal surfaces

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One of the applications of scanning tunneling microscopy (STM) is the study the electronic density of states is based on a simple approximation that the STM tunneling current is determined by the local density of states of the sample [1,2]. Recently, to take advantages offered by the Fourier transform (FT) of the quasiparticle interference (QPI) imaging in the STM experiments, the experimental and theoretical studies to probe the electron self-energy have appeared [3-5]. It was shown that, in principle, the self-energy can be extracted by examining the properties of the peak attributed to the quasiparticle excitations.

However, the self-energy effects are generally not reduced to a quasiparticle picture, since the many-body spectral function can have other features with lower intensities. Recently, by analyzing the images of the energy dependent standing-wave patterns at Cu, Ag, and Au (111) surfaces, we demonstrated that additionally to the surface-state quasiparticle peak a satellite with certain dispersion emerges [6]. We relay the appearance of this satellite in the STM measurements to the existence of the acoustic surface plasmon on these surfaces [7-12]. Within a proposed approach based on the GW approximation for the self-energy, we describe how the additional plasmon-related peak appears in the FT-QPI. We believe that our approach can be useful in expanding the capabilities of the FT-QPI imaging as an experimental technique to study many-body effects in condensed matter physics.

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