SPIN PLASMONS AT SURFACES WITH STRONG SPIN-ORBIT COUPLING

Jon Lafuente-Bartolome
Idoia G. Gurtubay
Asier Eiguren

Condensed Matter Physics Department, University of the Basque Country (UPV-EHU), 644 Postakutxatila, 48080 Bilbao, Spain

Donostia International Physics Center (DIPC), Paseo Manuel de Lardizabal 4, 20018 Donostia, Spain

jon.lafuente@ehu.eus

Understanding the role of the spin in the dynamics of many-electron systems has become a topic of major interest during the last few years, with the advent of several fascinating phenomena such as the Spin-Hall effect, the Edelstein effect, or the recently discovered topological phases of matter [1]. All these effects rest on the profound connection that the relativistic spin-orbit coupling imposes between the electronic charge and spin degrees of freedom.

More specifically, surfaces and interfaces with strong relativistic effects show a sizeable spin-splitting of its electronic surface states, leading to complex and well-defined spin textures even in nominally non-magnetic systems [2].

In this oral communication, I will present the impact that spin-orbit coupling may cause on the plasmonic properties of such surfaces. For that purpose, we generalize the linear response formalism in order to include the full spinor nature of the electronic wave functions, and perform first-principles calculations within the TDDFT framework. We show, using the Tl/Si(111) surface as an example, that the spin-texture of the conduction electrons give rise to a novel coupled spin-charge plasmon mode, which is composed of a strong spin-density oscillation together with the usual charge-density oscillation, and which is localized at the first few atomic layers of the system [3].

References

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[2] G. Bihlmayer, O. Rader and R. Winkler, New Journal of Physics 17 (2015), 050202.
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Figures

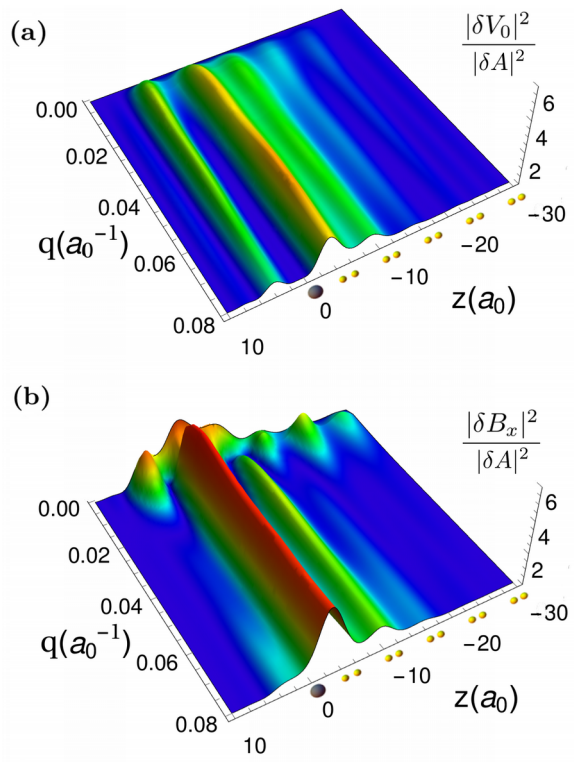

Figure 1: Real-space structure and momentum (q) dependence of the coupled spin-charge plasmon. The normalized charge and transversal-spin components of the self-sustained oscillation are shown with respect to the z coordinate, the direction perpendicular to the surface. Negative values of z correspond to penetration into the bulk, and orientative positions of the first thallium and silicon atomic layers are represented by big gray and small yellow spheres, respectively.