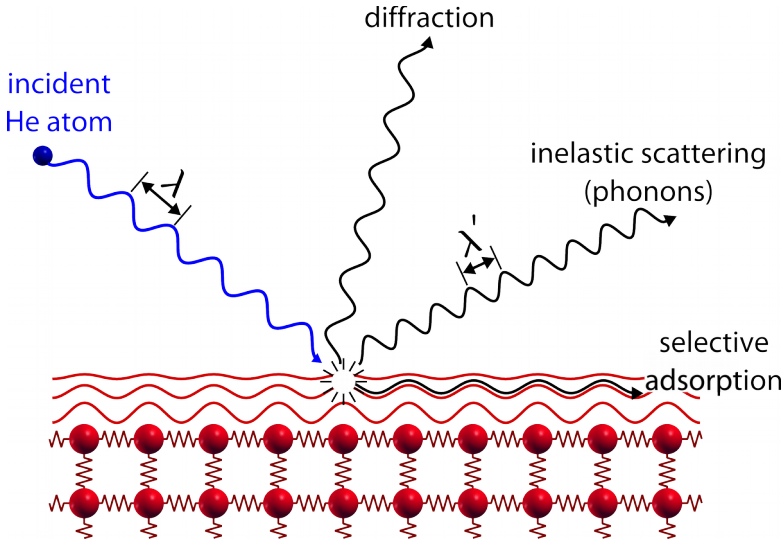
Master thesis

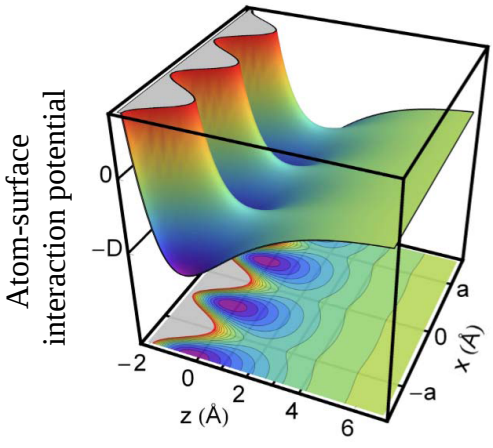
Probing Topological Materials with Atom-Surface Scattering

Description:

Our group is currently studying surfaces of the material classes of semimetals and the so-called topological insulators which are promising candidates for potential applications in spintronics and quantum computation. For example the surfaces of topological insulators (TI) exhibit good metallic character while the bulk remains insulating. A further topological material class of interest pose the Weyl-semimetals (WS), which show many similarities to TI surfaces while possessing an even more interesting electronic structure.



Our goal is, to advance the fundamental understanding of these materials using helium atom scattering (short: HAS). HAS provides surface-specific information by scattering a nearly monoenergetic helium beam from the electron density at the surface. Measuring the angular and energetic distribution of the scattered helium atoms, the static and vibrational properties of the surface under investigation can be deduced, while leaving even the most fragile surface structures unchanged. Furthermore, since the scattering signal from lattice vibrations is always mediated by the electrons of the material, HAS is the first method able to measure the mode-specific electron-phonon interaction of a material.



Aims:

Acquiring new experimental data using helium atom scattering from a topological insulator surface and depending on the progress also from the surface of a Weyl semimetal. Based on the individual interests of the student the focus of this project can either be on the experimental side with some first analysis of the data or using a more theoretical approach involving the comparison of experimental measurements with simulated data.

The project will help the student do develop several experimental skills such as the work with ultra-high-vacuum systems and surface analysis techniques (helium scattering, Auger spectroscopy, electron scattering, …) as well as analytical thinking and computational skills.

For more information or if you are interested in visiting the lab:

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