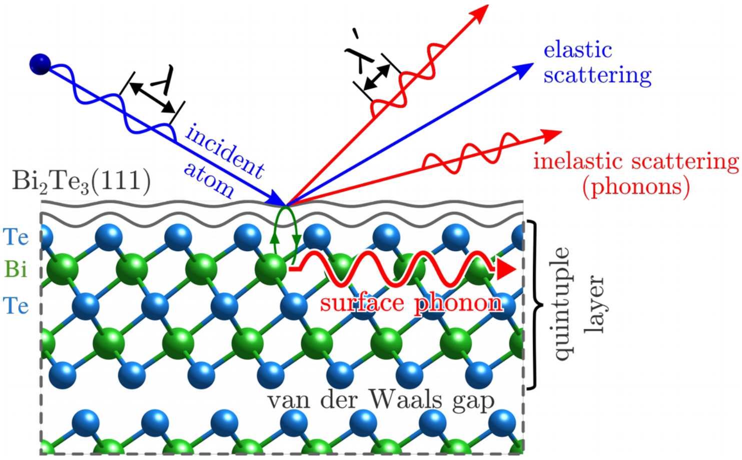
PhD project:
Probing Dirac Materials with Atom-Surface Scattering

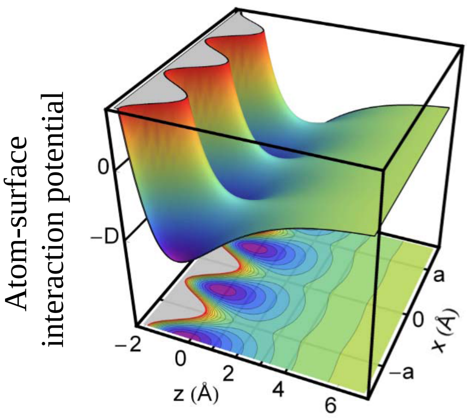
Description:



Our group is currently studying various promising material surfaces, so-called **Dirac materials**, which are promising candidates for potential applications in spintronics and quantum computation.

The unifying framework of the class of Dirac materials is an electronic surface state with a linear energy-momentum relationship, a so-called Dirac cone. Among Dirac materials are the so-called **topological insulators** (TIs) such as Bi_2Te_3 (see figure), which exhibit an insulating gap in the bulk while the surface is electrically conducting.

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 topological insulator surfaces and layered Dirac materials such as TaS_2. Based on the individual interests of the student the focus of 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 to 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.

If the student is interested in spending some time abroad the group my also be able to organise either a research stay at the University of Cambridge (experimental measurements) or at the Donostia International Physics Centre (theoretical calculations).
We are also performing neutron scattering measurements at a regular basis (about 1-2 weeks per year at the Institut Laue-Langevin in Grenoble) where the student can be involved if interested.

Compensation: € 2071 per month (30 hours per week, FWF funded)

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

Toni Tamtögl Petersgasse 16, PH EG 114, tamtoegl@tugraz.at
Adrian Ruckhofer Petersgasse 16, PH EG 114, adrian.ruckhofer@student.tugraz.at