**Topological Spintronics**

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Recent years have seen an explosion in the interest in materials where a large spin-orbit interaction can lead to a non-trivial topological order of the band structure.

Through their crystal structure and peculiar band-structure lead to symmetry protected surface states. Of particular interest is the study of proximity effects between topological insulator materials and ferromagnets and superconductors both from the point of view of fundamental physics and potential applications in spintronics and ultimately quantum computing.

In this project we will be focusing on a class of materials known as Heusler and half Heusler alloys – a rich family of ternary alloys with a generic structure X2YZ and XYZ respectively. By choosing the correct elements for X, Y and Z it is possible to produce ferromagnetic materials, superconducting materials and, for with comparatively heavy metals, potential candidates as topological materials. In this project you will prepare Heusler and half Heusler alloy materials in thin film form. To grow the materials we will use an existing ultra-high vacuum chamber that has been designed to be able to co-deposit the ternary alloy by dc magnetron sputtering onto heated substrates, allowing a full control over the material composition and growth process. Initial characterisation will be by our extensive facilities in Leeds, such as electron microscopy, X-ray diffraction, magnetometry and electron transport measurements, although eventually, successful materials will need to be measured at central facilities such as the new angle-resolved photon emission spectroscopy (ARPES) beamline at the Diamond light source. The goal of the project is to build multi-layer materials combining ferromagnetic, superconducting and topologically insulating phases to study the proximity effects at the interfaces between the materials.