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| **Summer Placement Project Proposal** |
| Supervisor(s): Dr Thorsten Hesjedal  Nominees in case of absence: Dr Yulin Chen, Mr Liam J Collins-McIntyre  Duration of Placement: 12 weeks  Date restrictions: none |
| **Section 1: Project description:**  Project title: **Studying the temperature-dependent electronic properties of topological insulators**  This project aims to study the electronic properties of topological insulator (TI) thin films for a wide range of temperatures. This project is a key part of a large TI research effort at Oxford and the student will join a dynamic team involved with the synthesis and characterization of TIs.  Topological insulators are a new class of quantum materials that are insulating in their bulk, with protected spin-polarized conducting channels on the surface. The exotic metallic surface state is topologically protected by time-reversal symmetry against scattering from non-magnetic impurities. As a result, the novel phases of matter that have been known since the discovery of the fractional quantum Hall effect seem now to be in reach for room-temperature spintronic and quantum computing device applications.  Thin film TI samples are grown by molecular beam epitaxy (MBE). MBE is a superior tool for the precise engineering of quantum materials – in the form of thin films, nanowires, or self-assembled quantum dots. MBE is at the root of many discoveries and developments in physics such as the fractional quantum Hall effect, semiconductor lasers, or high electron mobility transistors. The electrical transport studies will be carried out using the 4-point probe technique, which is commonly used to measure the resistivity of semiconductor materials. Results from electrical transport will be used to further refine the material growth procedures.  This exploratory materials synthesis project uses a cutting-edge MBE system and the student will assist with its operation. The electrical transport studies will be carried out both *in-situ* in the machine, as well as in external cryostats. The films will also be characterized by x-ray diffraction and scanning probe microscopy (the student will receive training in all of these techniques). The work will be carried out in Oxford’s Thin Film Quantum Materials Laboratory in the RCaH (http://www.rc-harwell.ac.uk/) at the Rutherford Appleton Laboratory. |
| **Section 4: Special requirements (skills and experience required):**  Required skills: practical lab experience (hands-on approach), concept and ideally practical experience in 4-point probing; electrical transport/electronics  Desired skills: ultra-high vacuum technology, thin films and thin film growth, programming (e.g. Python, LabView) advantageous |