**Exploring Novel Electronic Structures of Topological Quantum Matter**

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The discovery of new materials with novel properties is one of the most fascinating aspects of physics. Such findings will not only create new research fields in science, but also open the door for exciting future technologies that impact the human life. A very recent example of conceptually new materials is the topological quantum matter (e.g. topological insulators, topological semimetals and topological superconductors). On the face of it, these are well-known, off-the-shelf materials, but they have previously overlooked properties which distinguish them from all other previously known quantum states.

Within the last few years, topological quantum matter has grown as one of the most intensely studied fields in condensed matter physics due to their scientific significance and technological potentials. In our group, we study the electronic structure of novel quantum materials by the angle resolved photoemission spectroscopy (ARPES)1-16 – which can directly visualized the electronic band structures in the momentum space. We were one of the first groups in the world that realized the 3D topological insulators and 3D topological Dirac semimetals, and are keeping working hard to push the frontier of this research fields.

We are looking for 2 summer students who will be interested in doing the research in our group during the summer of 2015. Both students will work with senior Ph.D students and under my supervision.

**Position 1: Experiment assistant**

Description: Help set up and run our ARPES spectrometer in our Oxford lab, and assist in the experiments in our lab and at synchrotron radiation lab nearby and aboard.

Prerequisite:

1) Courses: The candidate should have completed the courses of quantum mechanics and solid state physics. Ideally, he/she has also taken the course of modern physics lab, Vacuum technology and/or practical training in the mechanical workshop.

2) Skills: Strong hand-on capability and intuition to relate our goal of the project to the outcome of the experiment. The candidate should also have the ability to solve simple problems (e.g. mechanical, electrical, etc.) during the experiments, and conduct measurements under supervision.

**Position 2: Assistant on data analysis**

Description: Assemble and analyze the data from ARPES experiments, and visualize the final results.

Prerequisite:

1) Courses: The candidate should have completed the courses of quantum mechanics and solid state physics. Ideally, he/she has also taken the course of numerical methods and a course of programming language.

2) Skills: Intuition to correlate physics concepts to mathematical expressions. Strong skill in programing (the language we mainly use is Matlab and/or C), data analysis and data visualization, as well as user interface designing.

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| **1** | Discovery of a Three-dimensional Topological Dirac Semimetal, Na3Bi  **Science, 343, 864 (2014)** |
| **2** | Experimental Realization of a Three Dimensional Topological Insulator, Bi2Te3  **Science, 325, 178 (2009)** |
| **3** | Massive Dirac Fermion on the Surface of a magnetically doped Topological Insulator  **Science, 329, 659 (2010)** |
| **4** | Evolution of the Fermi surface of Weyl semimetals in the transition metal pnictide family  **Nature Materials, 15, 27 (2016)** |
| **5** | Weyl Semimetal Phase in non-Centrosymmetric Compound TaAs  **Nature Physics, 11, 728 (2015)** |
| **6** | A Stable Three-dimensional Topological Dirac Semimetal Cd3As2  **Nature Materials, 13, 677 (2014)** |
| **7** | Discovery of a single topological Dirac fermion in the strong inversion asymmetric compound BiTeCl  **Nature Physics, 9, 704 (2013)** |
| **8** | Selective-area van der Waals epitaxy of topological insulator grid nanostructures for broadband transparent flexible electrodes  **Advanced Materials, 25, 5959 (2013)** |
| **9** | Single Dirac Cone Topological Surface State and Unusual Thermoelectric Property of Compounds from a New Topological Insulator Family **Phys. Rev. Lett., 105, 266401 (2010)** |
| **10** | Ambipolar field effect in the ternary topological insulator (BixSb1-x)2Te3 by composition tuning  **Nature Nanotechnology, 6, 705 (2011)** |
| **11** | Studies on the Electronic Structures of Three-dimensional Topological Insulators by Angle Resolved Photoemission Spectroscopy **Frontiers of Physics, 7, 175 (2012)** |
| **12** | STM Imaging of electronic waves on the surface of Bi2Te3  **Phys. Rev. Lett. 104,016401 (2010)** |
| **13** | Aharonov-Bohm interference in topological insulator nanoribbons  **Nature Materials, 9, 225 (2010)** |
| **14** | Topological insulator nanostructures for transparent flexible electrodes  **Nature Chemistry, 4, 281 (2012)** |
| **15** | Ultrafast optical excitation of a persistent surface-state population in the Bi2Se3 topological insulator **Phys. Rev. Lett., 108, 117403 (2012)** |
| **16** | Controlled synthesis of topological insulator nanoplate arrays on mica  **J. Am. Chem. Soc., 134, 6132 (2012)** |

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