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

**Yulin Chen**

*Department of Physics, University of Oxford, Parks Road Oxford, OX1 3PU*

*Website:* [*www.arpes.org.uk*](http://www.arpes.org.uk)

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 insulator. 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. In its pure form, a topological insulator has a full energy gap in the bulk; while on the surface, it has massless and gapless metallic states formed by an odd number of relativistic (massless) Dirac fermions with well-defined (helical) spin texture.

Within the last few years, topological insulators have 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 (see our website: [www.arpes.org.uk](http://www.arpes.org.uk) for a full description and publication list) – 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 are keeping working hard to push the frontier of this research fields.

Our ongoing projects include:

1) Improve the native properties of currently known topological insulators.

2) Search for new topological insulators with better chemical, physical and electrical properties.

3) Study low dimension (nano-scale) topological insulators.

4) Search for better 3D topological Dirac semi-metals.

5) Search for topological crystalline insulators.

6) Study the candidate materials for topological superconductor.

We are looking for 2 summer students who will be interested in doing the research in our group during the summer of 2013. Bothe 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 the Diamond synchrotron radiation lab nearby.

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**

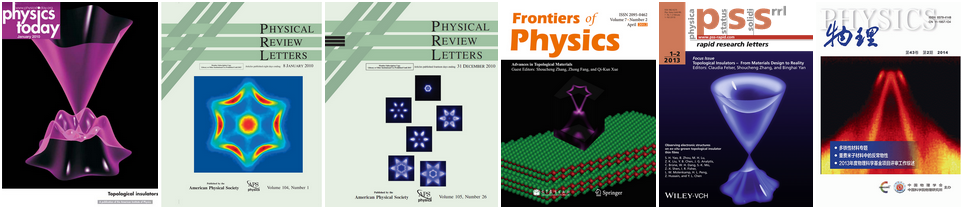
Description: Assemble and analyze the data from ARPES experiments, and visualize the final results.

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 main language we use is Matlab and/or C), data analysis and data visualization, as well as user interface designing.

**Magazine covers from our work:**

****