UCLA Department of Physics & Astronomy

COLLOQUIUM

Thursday, June 1 at 4 p.m.
1-434 PAB

Visualizing Helical Tunneling of Dirac Fermions

Vidya Madhavan
(UIUC)

Incorporating relativistic physics into quantum tunneling can lead to exotic behavior such as perfect transmission via Klein tunneling, or apparent faster than light travel. The realization of massless Dirac Fermions in topological materials has provided a new avenue to explore their properties. In this talk I will describe an experiment that demonstrates another property of Dirac electrons i.e. `helical tunneling', a process where spin-polarized electrons can be transmitted in a nominally time-reversal invariant fashion. I will describe our experiments where we use nanowires of the topological Kondo insulator, SmB_6 to generate and measure spin-polarized currents of Dirac surface states. Using nanofabrication techniques, we attach SmB_6 nanowires to the end of scanning tunneling microscope (STM) tips, effectively making a functional probe with atomic resolution. The tips are used to image the canonical spin density wave material, $Fe_{1+x}Te$. STM images show a superstructure with the periodicity of the antiferromagnetic order, indicating spin-selective tunneling from the nanowire. We further confirm a smoking gun signature of Helical tunneling by imaging the contrast reversal of the antiferromagnetic order at opposite bias voltages. Our experiment demonstrates a new technique to probe spin properties of materials using the special tunneling properties of relativistic fermions and opens the door to the development of other nanowire based probes.

Refreshments at 3:30 p.m. on the PAB Patio. Undergraduates Welcome!