UCLA College | Physical Sciences Physics & Astronomy

Time-domain pulsed tunneling spectroscopy of a two-dimensional electronic system

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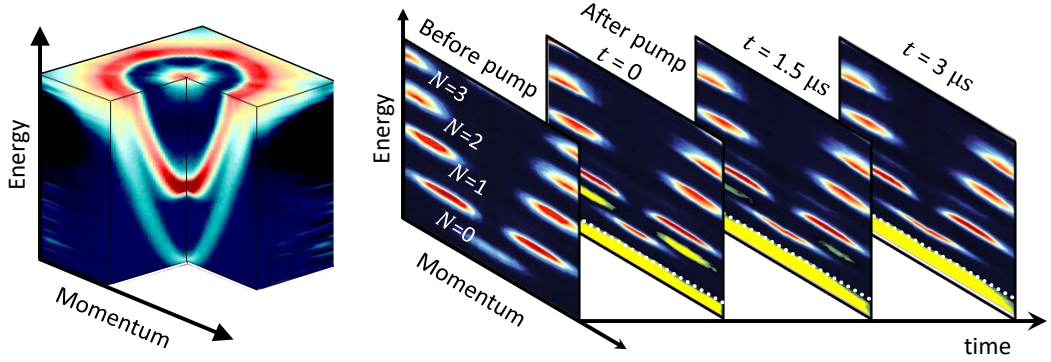

Two-dimensional (2D) electronic systems host a plethora of remarkable phenomena, including the integer and fractional quantum Hall effects, and have stimulated a wide range of fundamental science and engineering research. Yet, many of the important phenomena that emerge from the collective behavior of 2D electrons remain poorly understood as there have been substantial experimental challenges in probing the electronic structures and interactions in these systems. In this talk, I will introduce a time-domain pulsed tunneling technique that can visualize the energy, momentum, spin, and time resolved electronic structures of a 2D electronic system. Unlike the conventional tunneling method that requires the in-plane conductivity of the system, our pulsed tunneling technique functions on strongly insulating systems at low temperatures or in large applied magnetic fields. Furthermore, through the use of pulses that drive tunneling in extremely short time intervals, the technique eliminates perturbations such as heating. Using the pulsed tunneling technique, we visualized Landau quantization in energy-momentum space. We also performed spin-resolved pulsed tunneling experiments and measured the magnetization of a 2D electronic system over a wide range of applied magnetic fields and electron densities. Moreover, we pumped a 2D electronic system using an additional electrical pulse and imaged time-resolved tunneling spectra of the system driven out of equilibrium. These results illustrate the potentially broad applicability of our time-domain pulsed tunneling technique to studying correlated electron phenomena in a wide variety of two-dimensional materials.