UC MULTICAMPUS NATIONAL LAB COLLABORATIVE RESEARCH AND TRAINING AWARDS
2025 Awards

TOPOLOGICAL ANTIFERROMAGNETS FOR ENERGY EFFICIENT MEMORY AND COMPUTING

Lead Principal Investigator: Eric Fullerton, Ph.D., UC San Diego
— *Collaborating Sites:* Irvine, Santa Cruz, Los Alamos, Lawrence Berkeley

Project Abstract:

We propose a materials-centered multidisciplinary research program to exploit the unique properties of antiferromagnetic (AF) materials to address fundamental challenges to the microelectronic industries by creating new spintronic devices for next-generation low-power computing that supports and grows our current data-centered society. The discovery of new AF materials with novel functionality will occur by accelerating basic research discoveries. We will use state-of-the-art computational tools and material informatics-based theoretical approaches to predict materials with enhanced properties followed by experimental validation. The most promising materials will be integrated into functioning devices and their performance bench marked to current technologies. The team combines researchers at three UC campuses (two of which are Minority Serving Institutions) and two national laboratories with extensive and complementary experience. The transformative goal is to address the need for future low-power, high-performance, and sustainable microelectronics to advance information technologies and produce a new generation of researchers and creative innovators who excel in a globally competitive economy.

ANTIFERROMAGNETIC SPINTRONICS FOR ADVANCED MEMORY AND COMPUTING

Lead Principal Investigator: Jing Shi, Ph.D., UC Riverside
— *Collaborating Sites:* Davis, Los Angeles, San Diego, Lawrence Livermore

Project Abstract:

This project explores a groundbreaking approach to microelectronics: antiferromagnetic (AFM) spintronics. AFM materials hold immense promise for creating devices significantly faster, denser, and more energy-efficient than current ferromagnet (FM)-based information technology. Their unique properties, including ultrafast spin dynamics and immunity to magnetic fields, make them ideal for next-generation non-volatile memory and neuromorphic computing applications. Our multidisciplinary team, comprised of leading researchers from four UC campuses (UCD, UCLA, UCR, and UCSD) across academic ranks and Lawrence Livermore National Lab (LLNL), will leverage unique collaboration opportunities to unlock the full potential of AFM spintronics. We will tackle the following critical challenges: (1) designing and controlling the magnetic anisotropy energy landscape; (2) efficiently detecting and manipulating the AFM order parameter (Néel vector); (3) wafer-scale heterostructure synthesis. This project fosters a collaborative environment where senior researchers with world-class expertise in spintronics and magnetic materials will mentor early career scientists, trainees, and students from Physics, Materials Science & Engineering (MSE), Electrical & Computer Engineering (ECE), and Quantum Simulations. It will ensure the next generation of leaders is equipped to advance this transformative field. This research holds the promise of significant scientific discoveries in AFM spintronics, solidifying UC's global leadership in AFM spintronics. This will open new avenues for multidisciplinary, multi-institutional collaborations, enabling us to compete for extramural funding opportunities aligned with national priorities outlined by the CHIPS Act, such as DOE Energy Frontier Research Centers (EFRC) and DoD Multidisciplinary Research Initiative (MURI).