Surfaces – Condensed Matter Physics in Accessible Systems

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Low-dimensional electron systems are at the heart of some of the most exciting discoveries in condensed matter research. Quantized Hall effects in semiconductor quantum wells, graphene, and magnetic topological insulators, and unconventional superconductivity in cuprates and iron pnictides are transformational discoveries that define the frontiers of condensed matter science. The emergence of these phenomena arises from the competition between the charge, lattice, and spin degrees of freedom such that small changes in external parameters can alter the qualitative features of the many-body system. Surfaces and interfaces are ideal platforms for studying these interactions because the atomic and electronic structure can be studied in both real and reciprocal space with atomic resolution. In this talk, I will describe some of our past and current work using surface science approaches to study emergent phases on silicon surfaces. Our discussion will run the gamut from magnetic order in surface Si orbitals, to the emergence of a doping-induced surface phase transition, and the observation of quasiparticle peaks in a doped triangular Mott-Hubbard insulator built upon a Si surface.