Topological 2DEG at the 111 surface of KTaO3

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Abstract:
Two-dimensional electron gases (2DEGs) at surfaces or interfaces of transition-metal oxides can show stunning properties, such as superconductivity magnetism and large magnetoresistance, paving the way for the development of an oxide-based electronics. Angle-resolved photoemission spectroscopy (ARPES) reveals that the 2DEG at the surface of KTaO3 (KTO), a wide-gap insulator with a strong spin-orbit coupling (SOC) of about 0.47 eV, is a genuinely new physical state with respect to the bulk: the orbital symmetries of its subbands are entirely reconstructed and their masses are renormalized. This occurs because the values of the SOC, the Fermi energy and the subband splittings become comparable in the 2DEG. Tight-binding based numerical approaches and analytical computations give access to key band structure quantities. In particular, we establish that the 2DEG which is revealed in ARPES at the (111) KTO surface is a Z2 topological metal. We propose ways to experimentally reveal this phase.