Quantum confinement of strongly correlated electrons in oxide artificial structure

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The quantum confinement of strongly correlated electrons in artificial structures provides an ideal platform for studying the behavior of correlated Fermi-liquid states in reduced dimensions, as well as for controlling the extraordinary physical properties of layered complex oxides, such as high-temperature superconductivity in cuprates, triplet superconductivity in ruthenates, and colossal magnetoresistance in manganites. In this talk, we report the creation and control of two-dimensional electron-liquid states in ultrathin films of $SrVO_3$ epitaxially grown on Nb:$SrTiO_3$ substrates, which are artificial oxide structures that can be varied in thickness by single monolayers. Angle-resolved photoemission from the $SrVO_3$/Nb:$SrTiO_3$ samples shows metallic quantum well states that are adequately described by the well-known phase-shift quantization rule, confirming the quantum confinement of strongly correlated electrons in the oxide artificial structures. The observed quantum well states in $SrVO_3$ ultrathin films exhibit distinctive features, such as orbital-selective quantization originating from the anisotropic orbital character of the V 3*d* states and unusual band renormalization of the subbands near the Fermi level, that reflect complex interactions in the quantum well. The successful fabrication of a metallic quantum well structure based on a strongly correlated oxide promises to provide a setting in which to explore the fundamental physics and extraordinary functionalities of strongly correlated oxides.

[1] K. Yoshimatsu e*t al.* Science **333,** 319 (2011).