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Controlling Electronic Band Structure and Correlations by Dimensional Confinement and Epitaxial Strain in Complex Oxide Thin Films

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Our ability to control the electronic structure of materials, for instance at semiconductor interfaces, has had enormous scientific and technological implications. Recently, this concept has been extended to materials which possess inherently strong quantum many-body interactions which can harbor novel electronic or magnetic properties. Here, we demonstrate the ability to control the band structure and effective strength of correlations through dimensional confinement or epitaxial strain in complex oxide thin films. We employ epitaxial strain to drive a Lifshitz transition in thin films of Sr_2RuO_4, and also utilize dimensional confinement to achieve large mass enhancements over the bulk in atomically thin iridate thin films (IrO_2). We also use dimensional confinement and epitaxial strain to drive metal-insulator transitions and modify the magnetic ground states in atomically thin films of perovskite ruthenates ($BaRuO_3$ and Ca_2RuO_4).