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Spectroscopic evidence for negative electronic compressibility in a quasi-three-dimensional spin-orbit correlated metal JUNFENG HE, T. HOGAN, THOMAS MION, Boston College, H. HAFIZ, Northeastern University, Y. HE, Stanford, J.D. DENLINGER, S.-K. MO, ALS, C. DHITAL, X. CHEN, QISEN LIN, Boston College, Y. ZHANG, Peking University, M. HASHIMOTO, SSRL, H. PAN, Boston College, D.H. LU, SSRL, M. ARITA, K. SHIMADA, HISOR, R.S. MARKIEWICZ, Northeastern University, Z. WANG, K. KEMPA, M.J. NAUGHTON, Boston College, A. BANSIL, Northeastern University, S.D. WILSON, RUI-HUA HE, Boston College — In quantum materials consisting of multiple mutually-coupled subsystems, the effective compressibility of one subsystem can be negative when it is countered by the positive compressibility of other subsystems. Manifestations of such negative compressibility in quantum materials have so far been limited to low-dimensional dilute electron systems. Their origins have been commonly attributed to a dominance of the exchange energy over kinetic energy of electrons. Here we present evidence from ARPES for negative electronic compressibility in a quasi 3D spin-orbit correlated metal, $(Sr_{1-x}La_x)_3Ir_2O_7$, which is driven by a dominance of the correlation energy of electrons at a relatively high density. Increased electron filling results in both an expansion of the electron Fermi pockets and an anomalous decrease of the chemical potential. This anomaly, suggestive of negative electronic compressibility, is made possible by a concomitant rapid lowering in energy of the correlated conduction band on which the chemical potential is defined, unveiling a new band picture of doping Mott insulators.

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