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Anomalous correlation effects and unique phase diagram of electron-doped FeSe revealed by photoemission spectroscopy CHENHAOPING WEN, HAICHAO XU, CHEN CHEN, ZICAN HUANG, XIA LOU, YUJIA PU, QI SONG, BINPING XIE, Fudan Univ., MAHMOUD ABDEL-HAFIEZ, Institute of Physics, Geothe University Frankfurt, Germany, D. A. CHAREEV, Institute of Experimental Mineralogy, Russian Academy of Sciences, A. N. VASILIEV, Low Temperature Physics and Superconductivity Department, M.V. Lomonosov Moscow State University, RUI PENG, DONGLAI FENG, Fudan Univ. — FeSe layer-based superconductors exhibit exotic and distinctive properties. The undoped FeSe shows nematicity and superconductivity, while the heavily electron-doped $K_xFe_{2-y}Se_2$ and single-layer $FeSe/SrTiO_3$ possess high superconducting transition temperatures. However, a comprehensive study on the doping dependence of an FeSe layer-based superconductor is still lacking. Through angle-resolved photoemission spectroscopy studies on K-dosed thick FeSe ?lms and $FeSe_{0.93}S_{0.07}$ bulk crystals, here we reveal the internal connections between these two types of FeSe-based superconductors, and obtain superconductivity below ˜46 K in an FeSe layer under electron doping without interfacial effects. Moreover, we discover an exotic phase diagram of FeSe with electron doping, including a nematic phase, a superconducting dome, a correlation-driven insulating phase and a metallic phase. Such an anomalous phase diagram unveils the remarkable complexity, and highlights the importance of correlations in FeSe layer-based superconductors.

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