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Enhanced superconductivity accompanying a Lifshitz transition in electron-doped FeSe monolayer XUN SHI, PIERRE RICHARD, ZHIQING HAN, XILIANG PENG, TIAN QIAN, XIANXIN WU, MINGWEI QIU, Chinese Academy of Sciences (CAS), SHANCAI WANG, Renmin University of China, JIANGPING HU, YUJIE SUN, HONG DING, Chinese Academy of Sciences (CAS)
— The origin of enhanced superconductivity over 50 K in the recently discovered FeSe monolayer films grown on $SrTiO_3$ (STO), as compared to 8 K in bulk FeSe, is intensely debated. As with the ferrochalcogenides $A_xFe_{2-y}Se_2$ and potassium doped FeSe, which also have a relatively high superconducting critical temperature (T_c), the Fermi surface (FS) of the FeSe/STO monolayer films is free of hole-like FS, suggesting that a Lifshitz transition by which these hole FSs vanish may help increasing T_c. However, the fundamental reasons explaining this increase of T_c remain unclear. Here we report a 15 K jump of T_c accompanying a second Lifshitz transition characterized by the emergence of an electron pocket at the Brillouin zone (BZ) centre, which is triggered by high electron doping following *in-situ* deposition of potassium on FeSe/STO monolayer films. Our results suggest that the pairing interactions are orbital-dependent with the d_{xy} orbital playing a determining role in generating enhanced superconductivity in FeSe.

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