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Observation of strong electron pairing on band without Fermi surfaces in LiFe1-xCoxAs HU MIAO, TIAN QIAN, XUN SHI, PIERRE RICHARD, Institute of Physics, Chinese Academy of Sciences, T. KIM, M. HOESCH, Diamond Light Source, LINGYI XING, XIANGCHENG WANG, CHANGQING JIN, JINAGPING HU, HONG DING, Institute of Physics, Chinese Academy of Sciences — In conventional BCS superconductors, the quantum condensation of superconducting electron pairs is understood as a Fermi surface instability, in which the low-energy electrons are paired by attractive interactions. Whether this explanation is still valid in high-Tc superconductors such as cuprates and iron-based superconductors remains an open question. In particular, a fundamentally different picture of the electron pairs, which are believed to be formed locally by repulsive interactions, may prevail. Here we report a high-resolution angle-resolved photoemission spectroscopy study on LiFe1-xCoxAs. We reveal a large and robust superconducting gap on a band sinking below the Fermi energy upon Co substitution. The observed Fermi surface free superconducting order is also the largest over the momentum space, which rules out a proximity effect origin and indicates that the superconducting order parameter is not tied to the Fermi surface as a result of a Fermi surface instability.

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