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A Mott insulator continuously connected to iron pnictide superconductors YU SONG, Rice University, ZAHRA YAMANI, Canadian Neutron Beam Centre, CHONGDE CAO, YU LI, CHENGLIN ZHANG, JUSTIN CHEN, Rice University, QINGZHEN HUANG, HUI WU, NIST Center for Neutron Research, JING TAO, YIMEI ZHU, Brookhaven National National Laboratory, WEI TIAN, SONGXUE CHI, HUIBO CAO, Oak Ridge National Laboratory, YAOBO HUANG, MARCUS DANTZ, THORSTEN SCHMITT, Paul Scherrer Institut, RONG YU, Renmin University of China, A. H. NEVIDOMSKYY, EMILIA MOROSAN, QIMIAO SI, PENGCHENG DAI, Rice University — Whether an actual Mott insulator can be realized in the phase diagram of the iron pnictides remains an open question. Here we use transport, transmission electron microscopy, X-ray absorption spectroscopy, and neutron scattering to demonstrate that $NaFe_{1-x}Cu_xAs$ near $x \approx 0.5$ exhibits real space Fe and Cu ordering, and are antiferromagnetic insulators with the insulating behavior persisting above the Néel temperature, indicative of a Mott insulator. Upon decreasing x from 0.5, the antiferromagnetic ordered moment continuously decreases, yielding to superconductivity around $x = 0.05$. Our discovery of a Mott insulating state in $NaFe_{1-x}Cu_xAs$ thus makes it the only known Fe-based material in which superconductivity can be smoothly connected to the Mott insulating state, highlighting the important role of electron correlations in the high-T_c superconductivity.

Yu Song
Rice University

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