Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Imaging the coexistence of superconductivity and antiferromagnetism in $Fe_{1+y}Te_{1-x}Se_x$ (x=0.1) using spin-polarized scanning tunneling microscopy HAIBIAO ZHOU, RAMAKRISHNA ALURU, University of St Andrews, VLADIMIR TSURKAN, ALOIS LOIDL, JOACHIM DEISENHOFER, University of Augsburg, PETER WAHL, University of St Andrews — Magnetism has been widely thought to play an important role in unconventional superconductivity. In iron chalcogenide $Fe_{1+y}Te$, the bicollinear antiferromagnetim (AFM) can be suppressed by Se doping, and consequently superconductivity appears. Though a competition between the two orders is expected, their relation has never been shown in details. Here, using spin-polarized scanning tunneling microscopy, we explore their relation at the atomic scale in an $Fe_{1+y}Te_{1-x}Se_x$ (x=0.1) single crystal with T_C = 10 K, in a regime of the phase diagram where a spin-glass phase has been detected. We clearly observe the short-range AFM order with domains of a lateral size of $\sim$ 10 nm embedded in a non-magnetic matrix. In addition we observe a superconducting gap with prominent coherent peaks in differential conductance spectroscopy with a gap size $2\Delta \sim 4$ mV. Surprisingly, no correlation between the superconducting properties (gap size and zero bias conductance) and the local AFM order is observed, while the coherence peaks are weakened by the existence of excess iron atoms. Our observations put constraints on theories that are aimed at explaining the relation between magnetism and unconventional superconductivity.

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Date submitted: 10 Nov 2016 Electronic form version 1.4