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Phase diagram of $Fe_{1+y}(Te_{1-x}Se_x)$: evolution from antiferromagnetism to superconductivity

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Iron chalcogenide $Fe_{1+y}(Te_{1-x}Se_x)$ is the simplified version of Fe-based superconductors [1,2] and has a unique antiferromagnetic (AFM) structure in the parent compound $Fe_{1+y}Te$ [3,4]. In iron pnictide superconductor parent compounds, the AFM wavevector Q_{AF} is along the FS nesting direction [5-7], while in $Fe_{1+y}Te$, Q_{AF} is rotated 45° from the FS nesting direction. Understanding the magnetic and superconducting properties of this system is considered critical [8]. In this talk I will discuss the phase diagram of $Fe_{1+y}(Te_{1-x}Se_x)$ that we recently established. We found that long-range AFM order is gradually suppressed by Se substitution, disappearing near 9% Se, above which short-range AFM order coexists with non-bulk superconductivity (NBSC). Bulk superconductivity (BSC) does not appear until the Se content is greater than ~30%. The normal state exhibits distinct properties between the NBSC and BSC regions: metallic behavior is observed above T_c for the BSC region, while the NBSC region exhibits weak localization behavior above T_c. These observations, together with our results of neutron scattering studies, suggest that the short-range magnetic order near Q_{AF} leads to weak charge carrier localization, and is thus unfavorable to superconducting pairing.

[1] F.C. Hsu *et al.*, Proc. Natl. Acad. Sci. USA. **105**, 14262 (2008).
[2] M.H. Fang *et al.*, Phys. Rev. B **78**, 224503 (2008).
[3] W. Bao *et al.*, Phys. Rev. Lett. **102**, 247001 (2009).
[4] S.L. Li *et al.*, Phys. Rev. B **79**, 054503 (2009).
[5] C. Cruz *et al.*, Nature **453**, 899 (2008).
[6] Q. Huang *et al.*, Phys. Rev. Lett **101**, 257003 (2008).
[7] J. Zhao *et al.*, Phys. Rev. Lett. **101**, 167203 (2008).
[8] A.V. Balatsky and D. Parker, Viewpoint, Physics **2**, 59 (2009).