

CMP Seminar Michigan State University

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Interplay between magnetism and superconductivity in iron chalcogenides

The interplay between magnetism and superconductivity in Fe-based superconductor systems is currently a subject of intense studies. The iron chalcogenide $\text{Fe}_{1+y}(\text{Te}_{1-x}\text{Se}_x)$ is of particular interest due to its unique magnetic properties. While the parent compound Fe_{1+y}Te shows antiferromagnetism with $(\pi,0)$ in-plane magnetic wave vector [1], the optimally doped sample displays superconductivity with (π,π) spin resonance [2]. This contrasts with iron pnictides in which both the parent compound's antiferromagnetism [3-4] and the doped samples' superconducting (SC) spin resonance [5-7] are characterized by the in-plane Fermi surface nesting wave vector $Q_n = (\pi,\pi)$. The evolution from $(\pi,0)$ magnetism to superconductivity with (π,π) spin resonance in iron chalcogenides is associated with coexistence of magnetic correlations at $(\pi,0)$ and (π,π) [8]. The other remarkable difference between iron chalcogenide and iron pnictide superconductors is their phase diagrams. In iron pnictides, bulk superconductivity either emerges immediately following suppression of long-range (π,π) antiferromagnetic (AFM) order [9-10], or coexists with it in a particular composition range [11-14]. In contrast, in iron chalcogenides, bulk superconductivity does not appear immediately following the suppression of long-range $(\pi,0)$ AFM order. Instead, an intermediate phase with weak charge carrier localization appears between AFM order and bulk superconductivity for $0.09 < x < 0.3$ [8]. In this talk, I will first present an overview on the results summarized above and then introduce our recent studies on the coupling between electronic and magnetic properties in this system [8,15]. I will show the doping dependences of Sommerfeld coefficient γ , Hall coefficient R_H and Hall angle as well as their relations with superconductivity [15]. The origin of superconductivity suppression and charge carrier localization in the underdoped region will be discussed in terms of these experimental results.

References:

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Prof. David Tomanek - Host