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Spin-orbit coupling and its influence on superconductivity in iron-based superconductors

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In this talk, I will present our inelastic neutron scattering efforts to determine low-energy spin excitations in a variety of iron-based superconductors, in which spin-orbit coupling leads to anisotropic response in spin space. To prepare the scientific context I will first introduce our earlier works on BaFe₂As₂ and FeSe_{1-x}S_x, where regardless of whether long-range magnetic order is present, we show that the magnetic excitations at low temperatures are preferentially polarized along the *c*-axis [1,2]. In our most recent work on the tetragonal and *c*-axis oriented magnetic phase of Sr_{1-x}Na_xFe₂As₂, we find the first spectroscopic evidence that the itinerant charge carriers actually "prefer" to be assisted by *c*-axis polarized magnetic excitations in their formation of superconducting Cooper pairs [3], namely, only the weak *c*-axis response exhibits a spin resonant mode in the superconducting state. Our results naturally explains why the superconductivity competes strongly with the tetragonal magnetic phase in Sr_{1-x}Na_xFe₂As₂, and provide a fresh view on how to make a good superconductor out of a magnetic "Hund's metal".

References

- [1] C. Wang *et al.*, *Phys. Rev. X* **3**, 041036 (2013).
- [2] M. Ma *et al.*, *Phys. Rev. X* **7**, 021025 (2017).
- [3] J. Guo *et al.*, *Phys. Rev. Lett.* **122**, 017001 (2019).

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