**A strongly inhomogeneous superfluid in an iron-based superconductor**

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Although the possibility of spatial variations in the superfluid of unconventional, strongly correlated superconductors has been suggested, it is not known whether such inhomogeneities—if they exist—are driven by disorder, strong scattering or other factors. In this seminar, I will present our recent atomic-resolution Josephson scanning tunneling microscopy (JSTM) study that reveal a strongly inhomogeneous superfluid in an iron-based superconductor. By simultaneously measuring the topographic and electronic properties, we find that the inhomogeneity in the order parameter is not caused by structural disorder or strong inter-pocket scattering, and does not correlate with variations in the energy of the Cooper pair-breaking gap. Instead, we see a clear spatial correlation between the order parameter and the quasiparticle strength, defined as the height of the coherence peak, on a local scale. his result places iron-based superconductors on equal footing with copper oxide superconductors, where a similar relation has been observed on the macroscopic scale. When repeated at different temperatures, our technique could further help elucidate what local and global mechanisms limit the critical temperature in unconventional superconductors. Time permitting, I will further discuss our recent studies of atomic scale noise in conventional and unconventional superconductors [2,3].

[1] D Cho, KM Bastiaans, D Chatzopoulos, et al., *Nature* 571, 545 (2019)

[2] KM Bastiaans et al., *PRB* 100, 104506 (2019)

[3] KM Bastiaans et al., *Nature Physics* 14, 1183 (2018)