Intra-band Quasiparticle Interference and Direct Determination of the Anisotropic Superconducting Energy-Gap Structure in LiFeAs

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Cooper pairing in iron-based high temperature superconductors is often conjectured to occur via exchange of antiferromagnetic spin-fluctuations. These models generally lead to two characteristics that should be, in principle, accessible to experiments. The first is $s_{\pm}$ symmetry of the order-parameter. The second is that the momentum-space structure of the gap $\Delta_i(\mathbf{k})$ should be markedly anisotropic. While there is growing evidence for $s_{\pm}$ symmetry, direct in plane high-precision spectroscopy of $\Delta_i(\mathbf{k})$ has not been achieved. Here we report temperature dependent intra-band Bogoliubov quasiparticle scattering interference (QPI) in the iron-based superconductor LiFeAs, and we measure directly the strong anisotropy of the gap $\Delta_i(\mathbf{k})$ on the hole-like band. This opens a direct high precision approach to understanding the anisotropic momentum-space structure $\Delta_i(\mathbf{k})$, and to testing spin-fluctuation exchange pairing theories, in iron-based superconductors.