Probing unconventional superconductivity in LiFeAs by quasiparticle interference

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A crucial step in revealing the nature of unconventional superconductivity is to investigate the symmetry of the superconducting order parameter. Scanning tunneling spectroscopy has proven a powerful technique to probe this symmetry by measuring the quasiparticle interference (QPI) which sensitively depends on the superconducting pairing mechanism. A particularly well suited material to apply this technique is the stoichiometric superconductor LiFeAs as it features clean, charge neutral cleaved surfaces without surface states and a relatively high T_c~18K. Our data reveal that in LiFeAs the quasiparticle scattering is governed by a van-Hove singularity at the center of the Brillouin zone which is in stark contrast with other pnictide superconductors where nesting is crucial for both scattering and s_{+-}-superconductivity. Indeed, within a minimal model and using the most elementary order parameters, calculations of the QPI suggest a dominating role of the hole-like bands for the quasiparticle scattering. Our theoretical findings do not support the elementary singlet pairing symmetries s_{++}, s_{+-}, and d-wave. This brings to mind that the superconducting pairing mechanism in LiFeAs is based on an unusual pairing symmetry such as an elementary p-wave (which provides optimal agreement between the experimental data and QPI simulations) or a more complex order parameter (e.g. s+id-wave symmetry). The evolution of the superconducting properties as a function of various doping schemes is discussed.