Observation of distinct spatial distributions of the zero- and non-zero energy vortex modes in $(Li_{0.84}Fe_{0.16})OHFeSe$

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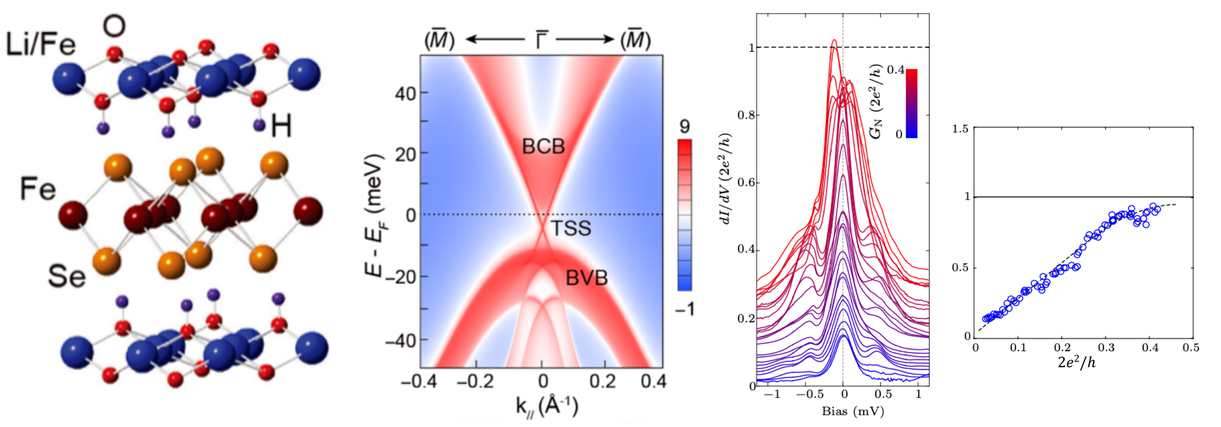
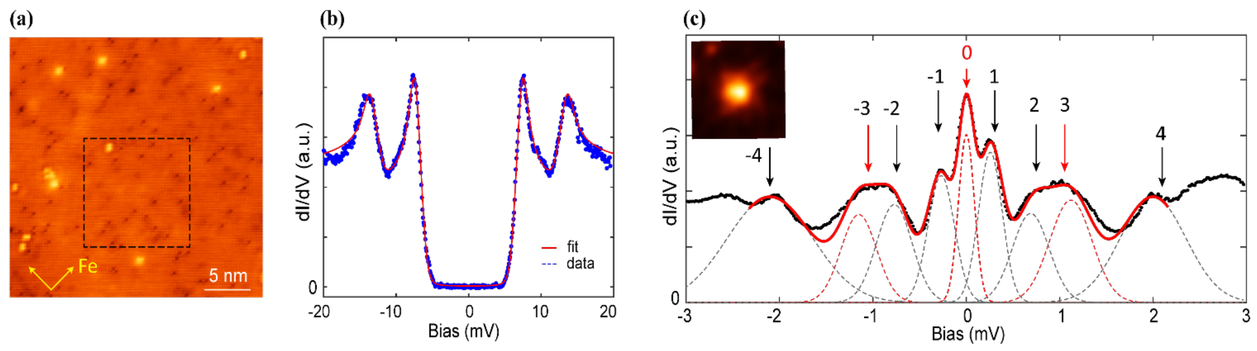
Introduction



Q. Liu*, C. Chen*, et al, Phys. Rev. X 8, 041056 (2018).

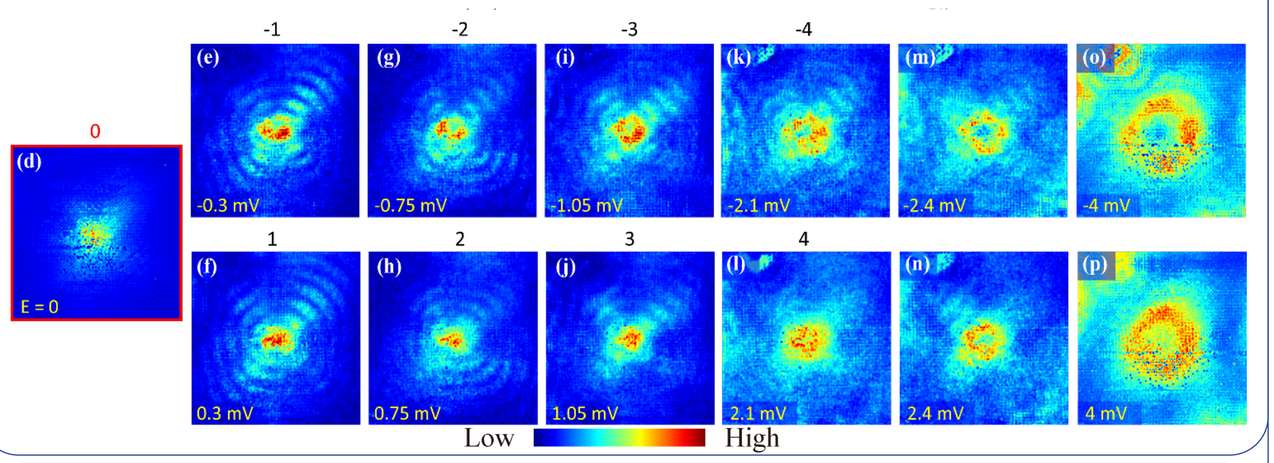
C. Chen*, Q. Liu*, et al, Chin. Phys. Lett 36(5), 057403 (2019)

Discrete CdGM states and zero-energy mode in a free vortex

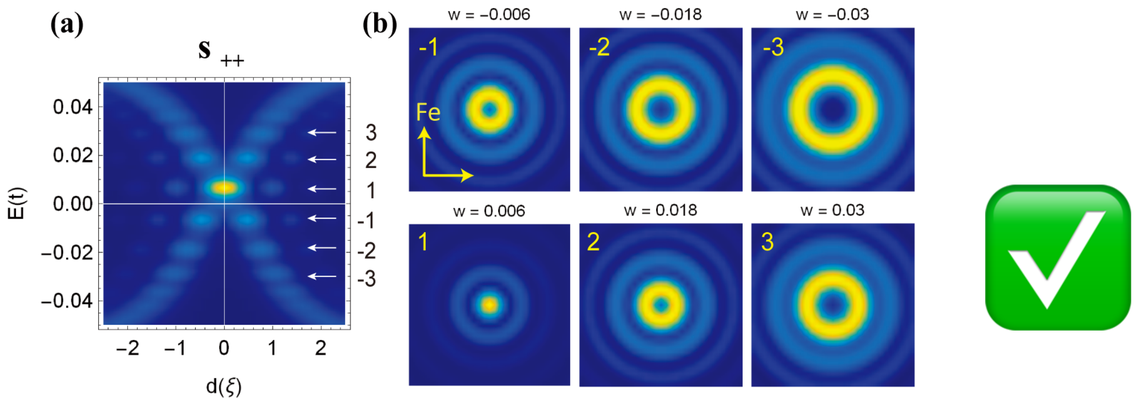


$E = \mu\Delta^2/E_F$, where μ=0,$\pm\frac{1}{2}$,$\pm\frac{3}{2}$,$\pm\frac{5}{2}$...

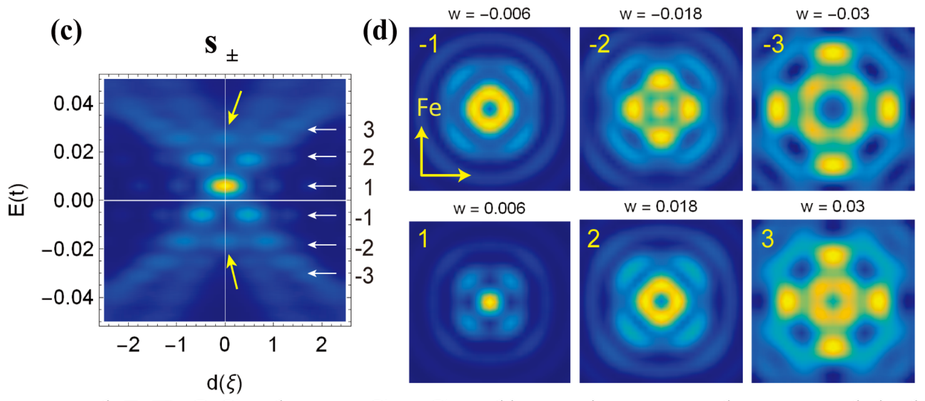
Spatial distribution of CdGM states and zero-energy mode



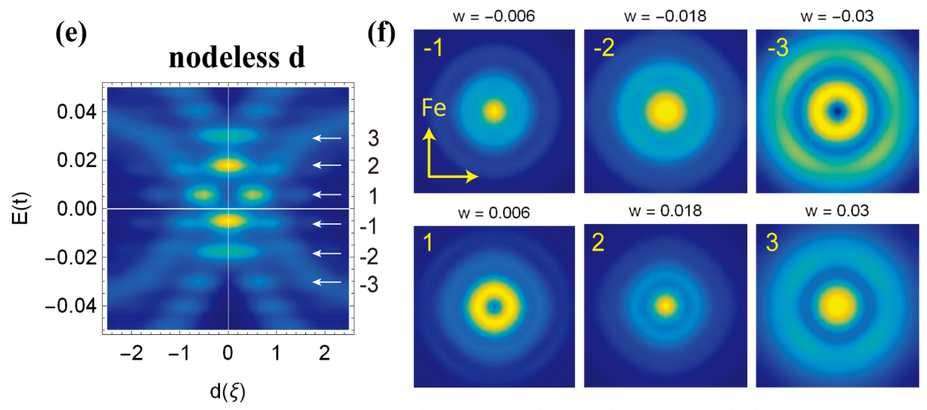
Simulated vortex state distribution of three pairing symmetries.



Two lowest level states are out of phase, and only the positive one has local maximum at the core center.

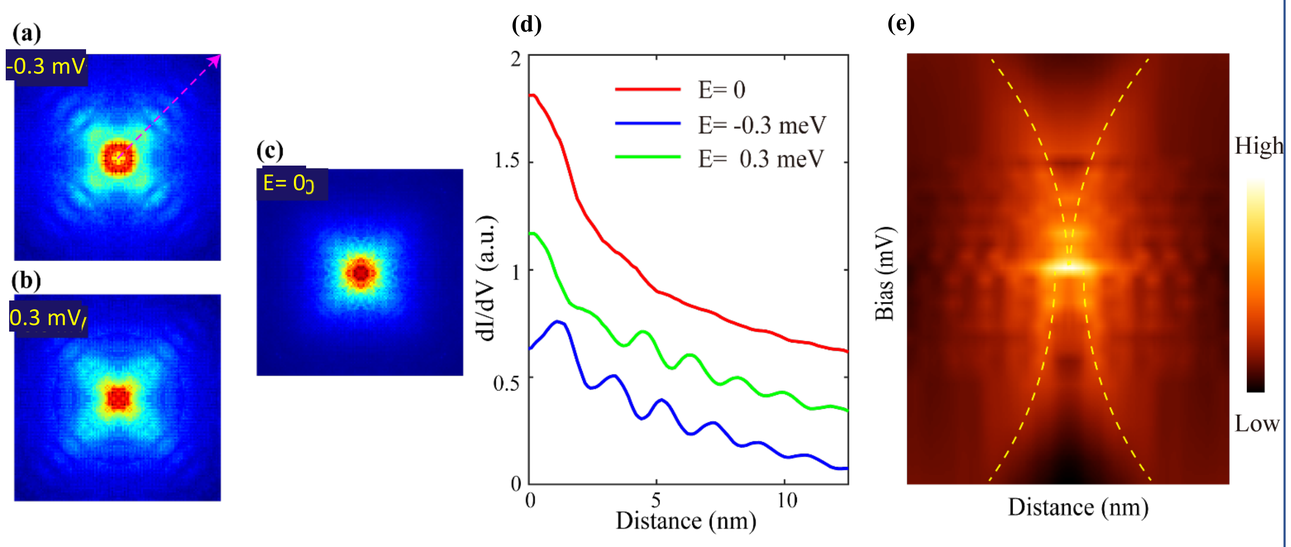


Enhanced LDOS along Se-Se direction, and some high level vortex states have local maximum at d = 0.



Inversed phase of the spatial oscillations with our experimental observation.

Decay and Friedel-like osscilations along the Fe-Fe direction



Zero-energy state shows no clear osscilation.

Non-zero energy states display clear oscillations with a wavelength of 1.6 nm which is corresponding to *bulk* band(λ_F~3nm).
Positive and negative energy states are out-of-phase.
Positive energy state(E=0.3mV) has maximum intensity at the core center.

Conclusion

Finite energy states display clear spatial oscillations with a period corresponding to bulk Fermi wavelength; while the zero-energy mode doesn't show such oscillation, which suggests their **distinct electronic origin.**
Based on two-band model calculations, we show that our observation is mostly consistent with **s_{++} wave pairing**.