



## Direct spectroscopic evidence for phase competition between the pseudogap and superconductivity

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In the high-temperature ( $T_c$ ) cuprate superconductors, increasing evidence suggests that the pseudogap phase, existing below the pseudogap temperature  $T^*$ , is characterized by some broken electronic symmetries distinct from those of superconductivity. Particularly, recent scattering experiments have suggested that charge ordering competes with superconductivity. However, no direct link of the interplay between the two phases has been identified from the important low-energy excitations. In this talk, we present an antagonistic singularity at  $T_c$  in the spectral weight of  $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$  as compelling evidence for phase competition, which has not been clearly identified in the spectral line shape. Comparison with theoretical calculations confirms that the singularity is a signature of competition between the order parameters for the pseudogap and superconductivity. Further, it shows how the pseudogap, superconductivity, and bosonic mode coupling contribute to the antinodal spectral lineshape that shows complex doping and temperature evolution. The competition at finite temperature, observed as the spectral weight singularity, persists up to a high hole concentration  $p \sim 0.22$ , provides new insights into the nature of the competitive interplay between the two intertwined orders and the complex phase diagram near the pseudogap critical point.

Reference: M. Hashimoto *et al.*, to appear in *Nature Materials* (arXiv:1405.5199)