

TEMPERATURE DEPENDENCE OF THE “FERMI ARCS” LENGTH IN Bi-2212

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The origin of the pseudogap (PG) in the high temperature superconductors (HTSC) is a matter of strong debate, where the main question is whether the pseudogap is a precursor of superconductivity, or a result of a competing order parameter [d-density wave, stripes, etc].

Measuring the momentum dependence of the gap might help answer this question. In early studies, Ding *et al.* [1] argued that the PG has the same d-wave anisotropy as the SC gap. This was taken as evidence of the relationship between the PG and superconductivity.

Later on, Norman *et al.* [2], revealed that in the PG state only part of the Fermi surface is gapped, and there are Fermi "arcs" around the nodal points. This arc was seen to expand with increasing temperature, up to a temperature T^* , where the full Fermi surface is recovered.

A very important question that remains open is what is the real ground-state momentum dependence of the gap?

Here we use angle-resolved photoemission spectroscopy (ARPES) to carefully reexamine the momentum dependence of the PG, with the intent of further clarifying its connection, or lack thereof, to the superconducting gap.

We find the surprising result that there is a sudden onset of the PG as a function of momentum around the Fermi surface, for temperatures close to T^* . Upon decreasing the temperature towards T_c , the transition from the PG to the arcs becomes smoother.

Moreover, this angular dependence of the PG is independent of temperature and doping -- it scales -- provided the sample temperature is scaled by $1/T^*$. The arcs length is found to depend linearly on the effective temperature $t=T/T^*$, extrapolating to $T=0$ reveals the arcs become the zero-length nodes.

References:

[1] H. Ding *et al.*, Nature (London), **382**, 51 (1996).

[2] M. R. Norman *et al.*, Nature (London), **392**, 157 (1998).

