# An energy scale directly related to superconductivity in the high-$T_c$ cuprate superconductors: Universality from the Fermi arc picture

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In the normal state of cuprate high-temperature superconductors (HTSCs), a pseudogap exists on part of the Fermi surface (FS) away from the $d$-wave superconducting (SC) gap node, and the FS is truncated into gapless regions called "Fermi arcs". We have performed a temperature dependent angle-resolved photoemission spectroscopy (ARPES) study of the tri-layer HTSC $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$ (Bi2223), and have shown that the "effective"SC gap $\Delta_{sc}$ defined at the end point of the Fermi arc and the $T_c$ (= 110 K) approximately satisfies the weak-coupling BCS-relationship $2\Delta_{sc} = 4.3k_BT_c$. Combining this result with previous ARPES results on single- and double-layer cuprates, we show that the relationship between $2\Delta_{sc} = 4.3k_BT_c$ holds for various HTSCs. Furthermore, at $T \sim T_c$, the quasi-patricle width at the end point of the Fermi arc is found to coincide with $\Delta_{sc}$, consistent with the context of Planckian dissipation.