MAR13-2012-020059

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Shallow pockets and very strong coupling superconductivity in $FeSe_xTe_{1-x}$

AMIT KANIGEL, Physics Department, Technion-Israel Institute of Technology, Haifa 32000, Israel

The celebrated BCS theory has been successful in explaining metallic superconductors, yet many believe that it must be modified to deal with the newer high temperature superconductors. A possible extension is provided by the BCS-BEC theory, describing a smooth evolution from a system of weakly-interacting pairs to a BEC of molecules of strongly-bounded fermions. Despite its appeal, spectroscopic evidence for the BCS-BEC crossover was never observed in solids. Here we report electronic structure measurements in $FeSe_xTe_{1-x}$ showing that these materials are in the BCS-BEC crossover regime. Above T_c we find multiple bands with remarkably small values for the Fermi energy ε_F. Yet, in the superconducting state, the gap Δ is comparable to ε_F. The ratio $\Delta/\varepsilon_F \approx 0.5$ is much larger than found in any previously studied superconductor, resulting in an anomalous dispersion of the coherence peak very similar to that found in cold Fermi gas experiments, in agreement with the predictions of the BCS-BEC crossover theory.