Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Power-law-like correlation between condensation energy and superconducting transition temperatures in iron pnictide/chalcogenide superconductors: Beyond the BCS understanding JIE XING, SHENG LI, Center for Superconducting Physics and Materials, National Laboratory of Solid State Microstructures and Department of Physics, Nanjing University, BIN ZENG, GANG MU, BING SHEN, National Laboratory for Superconductivity, Institute of Physics and National Laboratory for Condensed Matter Physics, Chinese Academy of Sciences, J. SCHNEELOCH, R.D. ZHONG, T.S. LIU, G.D. GU, Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, HAI-HU WEN, Center for Superconducting Physics and Materials, National Laboratory of Solid State Microstructures and Department of Physics, Nanjing University — Superconducting condensation energy U_0^{int} has been determined by integrating the electronic entropy in various iron pnictide/chalcogenide superconducting systems. It is found that $U_0^{int} \propto T_c^n$ with $n = 3$ to 4, which is in sharp contrast to the simple BCS prediction $U_0^{BCS} = 1/2N_F\Delta_s^2$, with N_F the quasiparticle density of states at the Fermi energy and Δ_s the superconducting gap. A similar correlation holds if we compute the condensation energy through $U_0^{cal} = 3\gamma_n^{eff}\Delta_s^2/4\pi^2k_B^2$, with γ_n^{eff} the effective normal state electronic specific heat coefficient. This indicates a general relationship $\gamma_n^{eff} \propto T_c^m$ with $m = 1$ to 2, which is not predicted by the BCS scheme. A picture based on quantum criticality is proposed to explain this phenomenon.

Center for Superconducting Physics and Materials, National Laboratory of Solid State Microstructures and Dep

Date submitted: 07 Jan 2015 Electronic form version 1.4