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**Quantum Spin Excitations through the metal-to-insulator crossover in $YBa_2Cu_3O_{6+y}$** SHILIANG LI, University of Tennessee, ZAHRA YAMANI, Chalk River Laboratories, Canada, HYE-JUNG KANG, NIST and University of Maryland, KOUJI SEGAWA, YOICHI ANDO, Osaka University, Japan, XIN YAO, Shanghai Jiaotong University, China, H.A. MOOK, ORNL, PENGCHENG DAI, University of Tennessee and ORNL — We use inelastic neutron scattering to study the temperature dependence of the spin excitations of a detwinned superconducting $YBa_2Cu_3O_{6.45}$ ($T_c$ = 48 K). In contrast to earlier work on $YBa_2Cu_3O_{6.5}$ ($T_c$ = 58 K), where the prominent features in the magnetic spectra consist of a sharp collective magnetic excitation termed "resonance" and a large ($\hbar\omega \approx 15$ meV) superconducting spin gap, we find that the spin excitations in $YBa_2Cu_3O_{6.45}$ are gapless and have a much broader resonance. Our detailed mapping of the spin excitations along the $a^*$- axis direction reveals a dispersion consistent with the "hourglass" like dispersion near the resonance, but the spin excitations are isotropic at lower energies. Since a fundamental change in the low-temperature normal state of $YBa_2Cu_3O_{6+y}$ when superconductivity is suppressed takes place at $y \sim 0.5$ with a metal-to-insulator crossover (MIC), where the ground state transforms from a metallic to an insulating-like phase, our results suggest a clear connection between the large change in spin excitations and the MIC.

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