

Search for magnetic scattering in Fe and Pb co-doped Bi2201

H. Hiraka and K. Yamada
IMR, Tohoku University

There is no conclusion yet about the origin of attractive force that creates Cooper pairs and eventually high- T_c superconductivity. Recent inelastic neutron scattering studies revealed that the so-called "hourglass-like" magnetic dispersion relation commonly exists in La214 [1], Y123 [2], and Bi2212 [3] systems, thus indicating the magnetic interaction as a prime candidate of pairing mechanism. However, no magnetic cross section has been experimentally reported yet in one of the most typical cuprate superconductors, $\text{Bi}_2\text{Sr}_2\text{CuO}_{6+\delta}$ (Bi2201). So, we tried to find magnetic signals from this CuO_2 mono-layer system to establish universal features among high- T_c superconductors. Because Cu-site substitution enhances elastic and low-energy neutron magnetic scattering in La214 system [4, 5], we doped Fe atoms in this study by expecting a substantial impact on magnetic correlations due to its large magnetic moment. In addition, Bi atoms were partially substituted by Pb atoms, so that large single crystals (\sim cm-size in length) could be easily grown by TSFZ techniques.

Neutron scattering experiments were carried out on triple-axis spectrometers AKANE and TOPAN using as-grown single crystals of $\text{Bi}_{1.74}\text{Pb}_{0.38}\text{Sr}_{1.88}\text{Cu}_{1-y}\text{Fe}_y\text{O}_{6+\delta}$ ($y = 0, 0.01, 0.03, \text{ and } 0.05$). Figure 1 shows a contour map of intensity difference of elastic scattering between 3 K and 300 K, measured on AKANE under the triple-axis mode using 3%-Fe doped sample around $(1, 0, 0)_{\text{ortho}}$, or (π, π) . A pair of broad peaks is clearly seen at $(0.8, \pm 0.2, 0)_{\text{ortho}}$, in addition to the nuclear peak at $(1, 0, 0)_{\text{ortho}}$. Later on, another pair was confirmed at $(1.2, \pm 0.2, 0)_{\text{ortho}}$, and the same four-fold structure was observed in $(3, 0, 0)_{\text{ortho}}$ zone with weak intensity. The onset temperature of this diffuse scattering (~ 30 K)

is comparable to that in spin-glasses of La214 [6]. These facts strongly support that this symmetric cross section has the magnetic origin. (Indeed, we confirmed it by polarized neutron experiments.) This magnetic scattering is incommensurate and similar to that in La214 system, except the large incommensurability ($\delta \sim 0.20$). We conjecture that Fe spins may reflect underlying magnetic modulations in pure Bi2201 system. Search for the dynamical magnetic component is now in progress.

References

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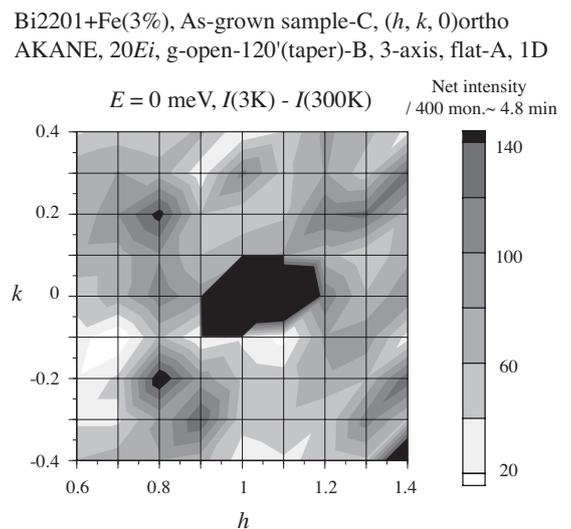


Fig. 1. Contour map of intensity difference of elastic scattering between 3 K and 300 K.