Investigation of the magnetic excitations in high-T_C

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The interplay between antiferromagnetic (AF) spin fluctuations and superconductivity is the central issue in the physics of high-transition temperature superconductivity because of the persistent AF fluctuations in the superconducting phase. Recently, a characteristic hourglass magnetic excitation have been reported from two families of high-Tc materials, LBCO and YBCO. If spin fluctuations are important for the mechanism of high-T_c superconductivity, they should be universal for all copper-oxide systems, however, it is still not clear. To resolve this issue, we explored another high-T_c system, optimmaly doped $Bi_{2.1}Sr_{1.9}CaCu_2O_{8+\delta}$ (Bi2212). Single crystals of Bi2212 were grown using travelling-solvent-floatingzone method. Neutron scattering experiments were performed on the triple-axis spectrometer PONTA installed at the JRR-3 Reactor of the JAEA. We have aligned 9 single crystals on Al plates. The total mass of aligned crystals is 6.4g (0.98cc), which is 16 times as large as the crystal used in the previous report[1].

Constant-Q spectrum taken in 2007 August show three peaks at 22, 36, and 46 meV (Fig.1a). We found 22- and 46 meV-peaks are spurious peaks arising from incoherent scattering of analyzer. Therefore, we improved 5G analyzer to reduce the incoherent scattering and the spurious peaks disapper for the 2007 Dec. spectrum (Fig.1a). Thus, the scattering around 34 meV comes from sample, in addition, it increases below T_c as previous works.[1, 2] (Fig.1b) Constant-E scan along the [110] direction at $E = 34$ meV shows a peak at (π,π) which is slightly enhanced below T_c (Fig.1c). One shoud note that large peak at (π,π) and $E = 34$ meV remains even at $T = 100$ K ($> T_c$). This suggests that strong spin fluctuations exist in the normal state, which has been neglected in the study of magnetic excitations in Bi2212.

References

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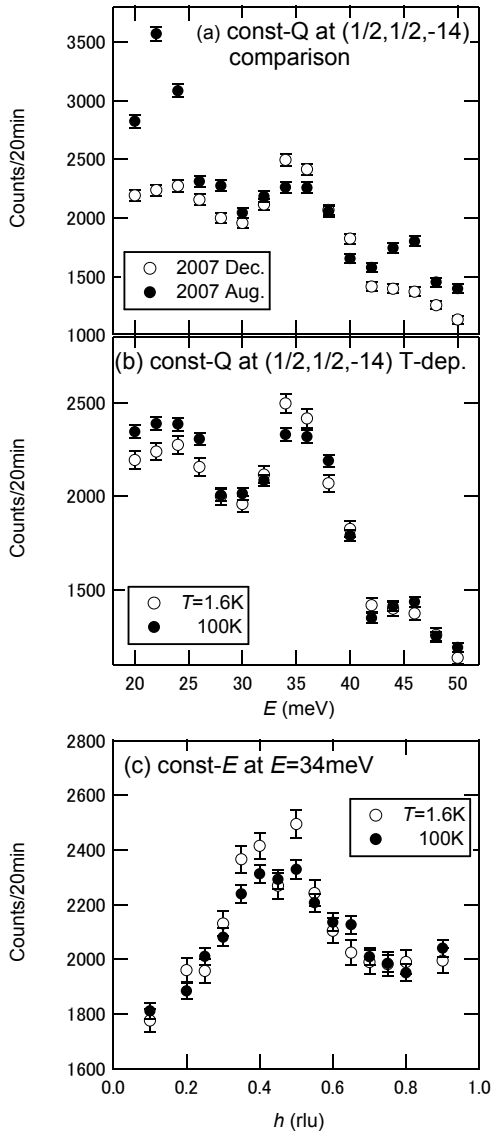

Fig. 1. Const-Q spectra at (1/2 1/2 -14) and $T = 1.2$ K ($T < T_c$) and 100 K ($T > T_c$). b) Constant-Energy profiles at $\hbar\omega = 34$ meV with (hh-14).