Magnetic Excitations of LaFeAsO0.89F0.11

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This project was originally planned to study the dynamical magnetic properties of honeycomb systems of Na3Cu2SbO6and Na2Co2TeO6 to investigate in detail the unusual behavior such as the spin gap phenomena found in the former one. However, the machine time was used to measure the magnetic excitation spectra of newly found superconducting system LaFeAsO1-xFx1) to quickly obtain information on its electronic state useful to investigate the superconducting mechanism.

In LaFeAsO1-xFx, the superconducting phase is derived by the F-doping to the magnetically ordered phase, and the highest transition temperature Tc is ˜ 28 K at x˜0.11. Because the magnetic fluctuation is considered to play a possible role in realizing the superconductivity, to study the magnetic excitation spectra of the system one of the most important things for the study of the superconducting mechanism.

The measurements were carried out for a powder sample of LaFeAsO1-xFx (x˜0.11) with the incident (Ei) or scattered (Ef) neutron energy being fixed at 30.5meV. In the measurements, the horizontal collimations were 40 ’-40 ’-80 ’-80 ’. Scanning the absolute scattering vector Q at various fixed transfer energies E, we found a peak at Q ˜1.1 -1 corresponding to (?, 0) point in the reciprocal space. Because the peak gets sharper with decreasing T, they are considered to be magnetic. The integrated intensities Iint of the peaks have been estimated, and in the figure, Iint/(n+1) (n: Bose factor) are shown against E at T = 3.5 K (< Tc) and 40 K (> Tc).These results should be compared with the so-called resonance peak, the existence of which is discussed by Maier and Scalapino for the s? symmetry of the superconducting order parameter ?.2) Because the expected resonance peak is expected to be very sharp, if it exists, the widths of the peaks of the ? ” (Q,?)-? curve obtained with constant Ei, for which the energy resolution widths are ?3.3 meV, should be sharper than those obtained with constant Ef (the resolution widths ?5.2 meV. As can be found in the figure, we do not see appreciable change of the curves with changing the experimental resolution, which suggests that the resonance peak does not exist. Recently, the neutron scattering measurements on aligned crystals of BaFe1.84Co0.14As23) and BaFe1.9Ni0.1As24) were reported. The present data seems to be very similar to that of BaFe1.9Ni0.1As2. Here, we note that our data are consistent with the fact that the Co doping effect on Tc of LaFeAsO1-xFx (x˜0.11) is much weaker than expected for the s? symmetry first reported by us.5)

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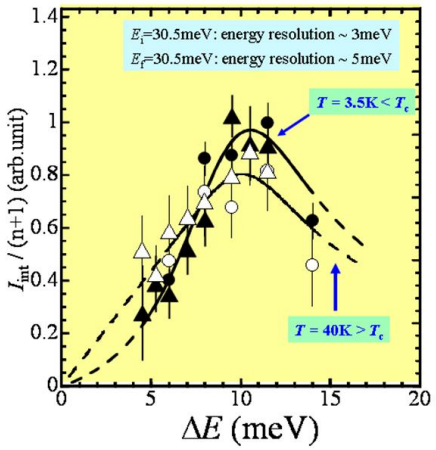
E_i=30.5meV: energy resolution ~ 3meV
E_f=30.5meV: energy resolution ~ 5meV
T = 3.5K < T_c
T = 40K > T_c
I_{int} / (n+1) (arb.unit)
ΔE (meV)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
5
10
15
20

Fig. 1.