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NQR study of the impurity effect on the superconductivity of $Pr(Os_{1-x}Ru_x)_4Sb_{12}$

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Pr-based heavy fermion superconductor $PrOs_4Sb_{12}$ was recently discovered, and this compound has been paid many attentions, because it has a nonmagnetic ground state. In recent NQR experiments, neither coherence peak nor the T^3-like power law behavior have been observed and existence of the large isotropic gap is suggested [1]. In the thermal transport measurements under the external magnetic field, it was found that the gap functions have a point node [2], and now we are interested in the SC gap symmetry.

We performed NQR experiments using the sample $Pr(Os_{1-x}Ru_x)_4Sb_{12}$ $[x = 0.1, 0.2]$, in order to reveal the gap symmetry by using impurity effects. The NQR spectrum have been observed at 4.2 K and the relaxation rate $1/T_1$ have been measured from 0.09 K to 30 K. The temperature dependence of the relaxation rate shows $T_1T=$ constant in the low temperature region ($T<T_c$) due to the impurity effects. The theoretical curves, calculated by K. Miyake for the case of the gap functions having the node, are shown by the solid and dashed lines in Fig. 1. The calculated values agree well with the experimental values, and this result suggests the existence of node in the gap functions.
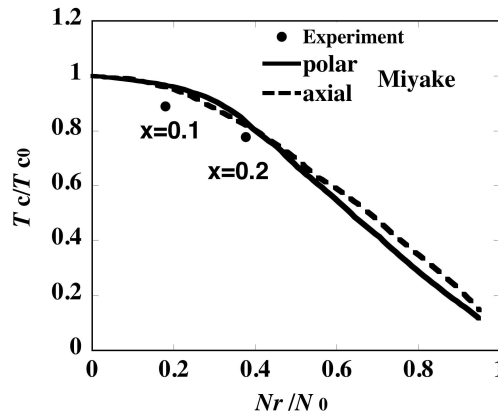

Figure 1: Relation between superconducting transition tempeture T_c and residual state density Nr. Solid and dotted lines are theoretical curve calculated by K. Miyake.

[1] H. Kotegawa, *et al.*, PRL**90**, 027001 (2003)

[2] K. Izawa, *et al.*, PRL **90**, 0117001 (2003)