

Neutron and γ -Ray Spectroscopy on Condensed Matters

Prof. **Kazuyoshi Yamada** (2003.4~)

【Staff Members】

Prof. Kazuyoshi Yamada, Assoc. Prof. Kenji Ohoyama, Res. Assoc. Masaki Fujita,
Res. Assoc. Haruhiro Hiraka (Supporting Staff : 2)

【Research Activities】

- (1) We have succeeded in observing the high-energy spin excitations in hole-doped superconductor $\text{La}_{2-x}\text{Ba}_x\text{CuO}_4$ ($x=1/8$). Our results showed a similarity dispersive excitation in YBCO system, suggesting a potential role of magnetism in the high- T_c mechanism.
- (2) Effects of magnetic fields on static spin correlation were studied for the electron-doped superconductors $\text{Pr}_{1-x}\text{LaCe}_x\text{CuO}_4$. Results showed a weak coupling between the antiferromagnetic ordering and superconductivity.
- (3) Impurity effects on spin correlations were studied for the electron-doped $\text{Pr}_{1-x}\text{LaCe}_x\text{CuO}_4$ in a wide Ce concentration range. We found that a static magnetic order is revealed to degrade upon Zn-doping, unlike the results of the hole-doped systems.
- (4) We investigated static and dynamic lattice properties of lead-oxide-type relaxors, which show characteristic dielectric properties. With aid of neutron scattering experiments, it has been clarified that polar nano-regions play an important role in such the specific features in these relaxors.
- (5) Magnetic excitations in the spin-density-wave state of Cr was studied by neutron scattering experiments. We found an unusual magnetic dispersion at low energy regions, which implies a different mechanism of the magnetic excitations from spin waves.
- (6) We determined the crystal structures in the complex hydrides Li-N-H , which are promising hydrogen storage materials, by the neutron diffraction technique, and found that hydrogen atoms in the materials have a characteristic cage type structure.
- (7) We studied the development of magnetic correlations in rare earth compounds RB_2C_2 , which exhibit characteristic and complicated magnetic and quadrupolar orderings.

1. Magnetic field effect on the static antiferromagnetism of the electron-doped superconductor $\text{Pr}_{1-x}\text{LaCe}_x\text{CuO}_4$ ($x=0.11$ and 0.15)
M. Fujita, M. Matsuda, S. Katano, K. Yamada
Phys. Rev. Lett. 93, (2004) 147003/1-147003/4
2. Quantum Magnetic Excitations from Stripes in Copper-Oxide Superconductors
J. M. Tranquada, H. Woo, T. G. Perring, H. Goka, G. D. Gu, G. Xu, M. Fujita, K. Yamada
Nature 429, (2004) 534 - 538
3. Revised crystal structure model of Li_2NH by neutron powder diffraction
K. Ohoyama, Y. Nakamori, S. Orimo and K. Yamada

J. Phys. Soc. Jpn. 74,(2005) 483-487.

4. Xu, GY; Zhong, Z; Hiraka, H; Shirane, G
Three-dimensional mapping of diffuse scattering in $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{O}_{3-x}\text{PbTiO}_3$
Rev. B, 70, (2004) 174109
5. Hiraka, H; Boni, P; Yamada, K; Park, S; Lee, SH; Shirane, G
Characterization of low-energy magnetic excitations in chromium
Phys. Rev. B,70, (2004) 144413

【Plan】

- (1) Measurement of an overall spin excitations in electron-doped superconductors in order to reveal universal role of magnetism in the mechanism of high- T_c superconductivity.
- (2) Clarification of the close connection between magnetism and superconductivity by measuring spin dynamics in the magnetic-impurity-doped cuprate superconductors $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$.
- (3) Study of competition between antiferromagnetic and antiferroquadrupolar interactions by observing spin and lattice dynamics.
- (4) Structural study of complex hydrides and dielectric materials
- (5) The reconstruction of the Kinken-neutron-spectroemter (AKANE) since 2003 will be completed by June 2005.
- (6) Development of new experimental techniques of neutron scattering: beam focusing by supermirrors, high magnetic field by pulse magnets, 2D detector system.