

Study of Nuclear Spin Ordering

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1990 Fiscal Year Final Research Report Summary

Study of Nuclear Spin Ordering

Research Project

Project/Area Number

01540259

Research Category

Grant-in-Aid for General Scientific Research (C)

Allocation Type

Single-year Grants

Research Field

固体物性

Research Institution

Kanazawa University (1990)
Tohoku University (1989)

Principal Investigator

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Project Period (FY)

1989 – 1990

Keywords

Nuclear Magnetism / Nuclear Cooling / Adiabatic Demagnetized Cooling / Ultra Low Temperature / Spin Glass

Research Abstract

Among a large number of pure metals, only in Cu the nuclear spins have been cooled down below their spontaneous ordering temperature. Though great efforts have been devoted to achieve the nuclear spin order, the clear evidence of ordering has not yet been observed in other metals so far. We are interested in the nuclear spin ordering in Sc metal which is known as the highly exchange enhanced Pauli paramagnetic metals. In order to achieve the nuclear spin ordering in Sc metal, we constructed two stage demagnetization cryostat. Before doing the two stage demagnetized cooling experiment, we measured a temperature dependence of the magnetic susceptibility of Sc metal above 0.25 mK by the one stage demagnetized cooling. Result can be understood by the spin glass phenomenon of iron impurity in Sc metal. Then we performed the two stage demagnetized experiment. By a first stage demagnetization cooling, we cooled down the Sc metal to 0.25 mK. From this temperature and 7 T initial magnetic field, nuclear spins in Sc metal were cooled down below 50 nK by the demagnetization. The warming up behaviour of the ac magnetic susceptibility has been measured following demagnetization.

cooling of Sc specimen itself. Antiferromagnetic-like maximum of the magnetic susceptibility was observed. Nuclear spins stayed in the ordered state about 45 minutes. This is the second observation of the nuclear spin ordering in metal elements. But we have not yet determined the ordering temperature T_N . We are going to make further experiment to clear the properties of the nuclear magnetism of Sc metal.

Research Products (12 results)

AllOther

AllPublications (12 results)

[Publications] 増田 由美子: "Hyperfine Enhanced Nuclear Magnetism of Cs₂NaHoCl₆" J.Low Temp.Phys.75. 159-186 (1989) ▼

[Publications] 鈴木 治彦: "Antiferromagnetic Resonance of Hyperfine Enhanced Nuclear Antiferromagnet HoVO₄" Proc.of Symposium on Quantum Fluids and Solids—1989,Ed.by Ihas & Takano. 328-329 (1989) ▼

[Publications] 鈴木 治彦: "Experiment on Nuclear Spin Ordering in Sc Metal" Physica. B165 & 166. 795-796 (1990) ▼

[Publications] 鈴木 治彦: "Antiferromagnetic Resonance of Hyperfine Enhanced Nuclear Spins of Ho in HoVO₄" Physica. B165 & 166. 787-788 (1990) ▼

[Publications] 水谷 直樹: "Kapitza Resistance Between Enhanced Nuclear Spin System and Liquid ³He" Physica. B165 & 166. 523-524 (1990) ▼

[Publications] 中島 哲夫: "An Evident Change of the Structure Transformation at 150mK in Ho—Elpasolite observed By SR—X—Ray Topography" Physica. B165 & 166. 328-329 (1990) ▼

[Publications] H. Suzuki, T. Sakon and N. Mizutani: "Experiment on nuclear spin ordering in Sc metal" Physica. B165 & 166. 795-796 (1990) ▼

[Publications] H. Suzuki and M. Ono: "Antiferromagnetic resonance of hyperfine enhanced nuclear spin of Ho in HoVO₄." Physica. B165 & 166. 787-788 (1990) ▼

[Publications] N. Mizutani, H. Suzuki and M. Ono: "Magnetic Kapitza resistance between enhanced nuclear spin system and liquid ³He." Physica. B165 & 166. 523-524 (1990) ▼

[Publications] Nakajima, H. Suzuki and T. Tsutsumi: "Evidence of the structure transformation at 150 mK in Ho-elpasolite observed by X-ray topography." Physica. B165 & 166. 915-916 (1990) ▼

[Publications] H. Suzuki, M. Ono and N. Mizutani: "Antiferromagnetic resonance of hyperfine enhanced nuclear antiferromagnet HoVO₄." Proc. of Symposium on Quantum Fluids and Solids—1989. 328-329 (1989) ▼

[Publications] Y. Masuda and H. Suzuki: "Hyperfine enhanced nuclear magnetism of Cs₂NaHoCl₆." J. Low Temp. Phys.75. 159-186 (1989) ▼

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