

Report of RCNP International Joint Usage/Joint Research Project (Cat. I)			
KKProject 003		PI: IINUMA Masataka	
1	Title of reserch		Development of various polarized nuclear targets with dynamic and static nuclear polarizations
2	List of collaborators		Masaki FUJITA, Takahiro IWATA, Yoshiyuki MIYACHI, Tomohiro UESAKA, Kenichiro TATEISHI, Takeshi OHTA, Hiroyuki FUJIOKA, Hirohiko SHIMIZU, Masaaki KITAGUCHI, Takuya OKUDAIRA, Yoshiro TAKAHASHI, Masaru YOSOI, Tatsushi SHIMA, Hiroki KANDA, Hideki KOHRI, Manabu ABE, Shin-ichi WADA, Kouichi HAGINO, Satoshi SAKAGUCHI
3	Period of research		one and half of year (untill 31/Mar/2024)
	Publication list	Talks	Ikuo IDE, "Development of a polarized La target for the T-violation search with slow neutrons (NOPTREX)" , in RCNP workshop "Fundamental Physics Using Neutrons and Atoms", 12/Aug/2022-13/Aug/2022, RCNP Masataka IINUMA, "NOPREX project" Ikuo IDE, "Present status of development of a polarized La target in the T-violation search with a slow neutron", in 19th workshop on high energy QCD, 2/Sep, Yamagata Univ. Yuki Ito, et. al., "Present status of development of nuclear polarized La targets for the experiments of T-violation searches", in JPS 2022 Autumn Meeting, The Physical Society of Japan, 06/Sep/2022-08/Sep/2022, Okayama University of Science Ikuo IDE, et. al., "Present status of development of a polarized La target in the T-violation search with a slow neutron" in 2022 international workshop on Polarized Sources, Targets, and Polarimetry, 26/Sep/2022-30/Sep/2022, Mainz, Germany Yuki Ito, et. al., "Present status of development of nuclear polarized La targets for the experiments of T-violation searches" in JPS 2023 Spring Meeting, The Physical Society of Japan, 22/Mar/2023-25/Mar/2023, Online
		Theses	Yuki Ito, "Development of LaAlO ₃ polarized target for NOPTREX experiments and evaluation of Nd concentration dependence of properties on nuclear polarization", Master thesis in Nagoya University, Mar/2023
5	Description of the results and outputs		Following our previous project research, we are continuing the development of polarized solid lanthetrium(La) targets by using a single crystal of LaAlO₃ doped with Neodymium(Nd) ions. Our previous study has implied that the spin-lattice relaxation time(T₁) of the crystals with 0.03 mol% Nd concentration is not sufficiently long under practical conditions, so that fine optimization of the Nd concentration is absolutely necessary. Hence, we have grown some crystals with various Nd concentrations and selected highly crystalline samples through DNP tests in Yamagata Univ. The other issue is to construct a DNP apparatus with cryogenics equipped in RCNP for taking enough time for the experiments. The DNP tests in this year have confirmed that the 0.01 mol% crystal can give the unsaturated polarization of 20.7 %+-2.3% and the T₁ longer than 2 hours in 2.3 T and 1.3 K, which is maximum and longest, each, in past experiments under the same conditions. This clearly shows that the 0.01 mol% crystal grown by ourselves is the best so far. In parallel to the crystal selection, the construction of the DNP apparatus for 5 T is ongoing, which allows us to keep the samples cooled for a long time. Specifically, we have improved some cryogenic components, such as a needle valve, a level gauge for liquid helium, etc. The microwave components, 144GHz waveguide, a sample box, EIT source, have been also tested and mounted to the DNP apparatus. We have almost achieved the feasible stage of the first DNP experiments in RCNP. The remaining issue is to prepare the NMR system for the usage in 5 T.
6	Requests or comments for improvement of the RCNP KK Project *For Internal Use only		The simple format of the report is very helpful for us. I wish that the budget for the project would become large even if a little because the increase of the budget accelerates the proceed of the project.