

Development of a Polarized ^{139}La Target for the NOPTREX Experiment

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“The NOPTREX collaboration is planning to explore time-reversal invariance violation (T-violation) in neutron compound nuclear resonances using a polarized ^{139}La target. For this purpose, we are developing a polarized target system based on dynamic nuclear polarization (DNP), in which a single crystal of LaAlO_3 doped with a small amount of Nd^{3+} ions is used as a target material.

The NOPTREX project is proceeding in two steps: a preparatory Phase I and a full-scale Phase II. As a preparation for the Phase I, we tested a 15 mm cubic LaAlO_3 single crystal doped with 0.03 mol\% of Nd, which was grown by a company. Using the DNP method, we achieved the polarization of 36% in ^{27}La and the relaxation time of 60 minutes at 1.3 K and 2.335 T. These results show this crystal is practically available for Phase I since the target material will be cooled down at 0.1 K, where the relaxation time is expected to be longer.

In parallel, to study the effect of Nd concentration on the DNP performance, we are growing LaAlO_3 crystals by the floating zone (FZ) method at Tohoku University. The DNP experiment with the 0.01 mol\% crystal at Yamagata University showed the relaxation time of 375 minutes in ^{27}Al under the same environment, which means that the longest relaxation time observed so far and the crystal is more suitable to the target material. The remaining problem is the crystal size, which is currently limited to, which is actually about 5 mm in diameter. Therefore, we are planning to use an assembled target with multiple crystals in Phase I or Phase II or producing a larger bulk crystal with the CZ method.

In this presentation, we report the current status of polarized ^{139}La target development, the recent DNP results, and future plans.”

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