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Development of a Cryogenic insert for polarized nuclear target for NOPTREX Phase-1 Experiment

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The NOPTREX collaboration aims to search for time-reversal symmetry violation (T-violation) beyond the Standard Model using compound nuclear reactions. For a high-sensitivity T-violation search, the spins of polarized neutrons and polarized nuclear targets must be aligned perpendicularly. However, transporting neutron spin orientation is technically challenging. As a Phase-1 experiment, we plan to perform measurements with a configuration that allows easier neutron spin transport, albeit with reduced sensitivity: the spins of the neutrons and target nuclei are parallel, and the neutron spins are rotated by a fixed angle relative to the neutron momentum. To realize this, we require a superconducting magnet that can generate a magnetic field parallel to the neutron momentum and a cryogenic system that can operate in conjunction with it. We are currently designing and developing a dilution refrigerator insert capable of reaching temperatures below 0.1 K. In this presentation, we will report on the current preparation status for the Phase-1 experiment at J-PARC MLF ANNRI (BL04), focusing on the design and development of the cryogenic insert for the polarized nuclear target system.

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