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A Precision Magnetic Mapper for the UCNτ Effort KEEGAN HOFFMAN, MATT ADAMS, ADAM HOLLEY, Tennessee Technological University — The free neutron lifetime τ_n is a physical constant that is associated with a variety of experimental tests for new physics. For example, it is used in calculations of expected light element abundances in the universe, which can be compared with observational data. The UCNτ collaboration has the ultimate goal of measuring the free neutron lifetime to within 0.01%, or to an error of about $\pm$0.1 s. A trap composed of a bowl-shaped Halbach array of permanent magnets inside of a vacuum jacket that is wrapped by field coils is used to contain polarized, ultracold neutrons (UCN), which are allowed to decay inside the trap. The magnetic array, in conjunction with gravity, keeps the UCN from escaping while the field coils prevent the UCN from depolarizing. However, there will be a systematic error if UCN leave the trap for a reason other than decay. For example, if UCN become depolarized by interacting with magnetic field zeroes or if some surface region of the array has a magnetic field insufficient to repel trapped UCN. We have constructed a robotic arm to move a three-axis Hall probe through the entire volume of the trap with $\sim$1 mm precision to check for low-field regions. We will describe the design and control software for this magnetic mapping system.

Keegan Hoffman
Tennessee Technological University

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