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Ultracold Neutron Transport and Density Monitoring in the UCNτ Experiment A.T. HOLLEY, Tennessee Technological University, FOR THE UCNτ COLLABORATION — The UCNτ experiment is designed to help resolve the current tension between in-beam and bottle measurements of the free neutron lifetime $\tau_{\rm n}$. This is an important goal since a high-precision value of $\tau_{\rm n}$ will shed light on the implications of other free neutron decay measurements for beyond the Standard Model physics and because of the critical role that $\tau_{\rm n}$ plays in Big Bang Nucleosynthesis. Our focus is on providing a bottle measurement of $\tau_{\rm n}$ to better than one second ($< 0.1\%$) by reducing the systematic effects generally associated with storage techniques. Our strategy uses ultracold neutrons (UCN) confined in a magneto-gravitational trap and detected both traditionally and using a novel *in situ* approach. The full potential of our technique is best realized when we are able to maximize the density of polarized, trappable UCN in our $\sim$670 L storage volume while simultaneously monitoring that density during filling with $< 0.1\%$ precision. We will report on measurements conducted during the 2013 run cycle at the Los Alamos Neutron Science Center designed to optimize the transport of polarized UCN into our trap and to investigate strategies for monitoring the resulting density with high precision.

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