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# The Neutron Lifetime puzzle and the Latest Results of the UCNtau Experiment

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The rate of neutron decay can be precisely calculated, using the theory of electroweak interactions, with an uncertainty on the order of 1e-4. Recent measurements using bottled neutrons have achieved uncertainties below 1 s (0.1 %), but other measurements observing neutron decay in flight disagree by 10 s. Attempts to resolve this discrepancy have spawned much experimental effort as well as exotic theoretical conjectures, thus far without a clear conclusion. In this talk, I will discuss the challenges of precision measurement of the neutron lifetime, illustrating the UCNtau experiment. It eliminates the dominant loss mechanisms present in previous bottle experiments by levitating polarized ultracold neutrons above the surface of a large magnetic trap. Using this approach, a new result, 877.75 ± 0.28 (stat) +0.22/-0.16 (sys) s [PRL 127, 162501 (2021)], is the most precise measurement of the lifetime. This result, together with improved measurements of the axial coupling constant, will provide a determination of the CKM matrix element Vud, independent of nuclear decays, and address the recent tension in the test of CKM unitarity.

**Primary author:** Prof. LIU, Chen-Yu (Indiana University, Bloomington)

**Presenter:** Prof. LIU, Chen-Yu (Indiana University, Bloomington)

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