



Münchner Physik- Kolloquium

at home!
Winter
2021/22

Goldilocks and the three bears or: How we made the most precise neutron lifetime measurement and why

Prof. Dr. Chen-Yu Liu, *Indiana University Bloomington, USA*

Monday, 6 December 2021, 17:15 h

<https://tum-conf.zoom.us/j/93234766313> Meeting-ID: 932 3476 6313 Password: Kolloquium

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Neutrons are stable inside atomic nuclei. Outside the confines of the nucleus, they decay into a proton, electron, and antineutrino, with a lifetime of 880 s . The rate of decay can be precisely calculated, using the theory of electroweak interactions, with an uncertainty on the order of 10^{-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 colloquium, I will discuss the challenges of precision measurement of the neutron lifetime, illustrating the UCN τ 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, $877.75 \pm 0.28\text{ (stat)} + 0.22/ - 0.16\text{ (sys)}\text{ s}$ [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 V_{ud} , independent of nuclear decays, and address the recent tension in the test of CKM unitarity.

