τSPECT- towards a new measurement of the free neutron lifetime in a full-3D magnetic trap

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The high-precision determination of the free neutron lifetime τ_n remains at the forefront of low-energy particle physics. Neutron physics can provide a cornerstone ingredient for a high-precision test of the Cabibbo-Kobayashi-Maskawa (CKM) matrix unitarity without nuclear structure corrections. The matrix element V_{ud} can be extracted from the combination of an accurate, high-precision determination of λ, the ratio of axial-vector and vector coupling strength of the weak interaction, a commensurate theoretical description of neutron beta decay, and a high-precision determination of τ_n. The τSPECT experiment has been in operation at the ultracold neutron (UCN) source of the Paul Scherrer Institute since 2023. Confining UCNs for thousands of seconds in a full 3D magnetic gradient field trap, τSPECT can extract τ_n by counting the surviving UCN. In a first step, τSPECT aims to determine τ_n with an uncertainty of $< 0.3\,\mathrm{s}$ to contribute to the resolution of the neutron lifetime puzzle, a significant disagreement of τ_n measurements using complementary methods. With the next generation instrument τSPECT aims at an uncertainty of $< 0.1\,\mathrm{s}$, which opens the avenue for a CKM unitarity test at the 10^{-4} level. I will present the relevant concepts, τSPECT's performance in its commissioning phase during 2023, and share a peek at the first blinded science data run in 2024.