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Progress of the LMU ^{229m}Th^{3+} Trapped-Ion Nuclear Clock Project

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The ^{229}Th nucleus assumes a unique role in the nuclear landscape for its low-lying isomeric first excited state ^{229m}Th with an excitation energy of 8.338 ± 0.024 eV [1], accessible with modern VUV-laser systems. A nuclear clock based on this thorium isomer holds promise not only to push the limits of high-precision metrology with a fractional uncertainty expected in the range of 10^{-19} [2], but also to contribute to dark matter and other fundamental physics research as a novel quantum sensor.
It will also be able to contribute to the search for theoretically expected temporal fluctuations of fundamental constants like the fine-structure constant α [3].

The cryogenic Paul-trap experiment currently operated at the LMU Munich is primarily designed for long ion-storage times, allowing for the measurement of the still unknown ionic lifetime of the isomer. The lifetime is expected to be several thousands of seconds and its determination is essential for the realization of a nuclear frequency standard. In a second step, the setup will be a platform for VUV-comb spectroscopy of the ^{229}Th nuclear transition, paving the way towards a first nuclear clock prototype.

In this poster, the building blocks of the experimental setup for trapping and sympathetic laser cooling of ^{229m}Th^{3+} by ^{88}Sr^{+} are presented and the status of first measurements, such as trapping, storage, and Doppler-laser cooling of ^{88}Sr^{+}, are discussed.

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