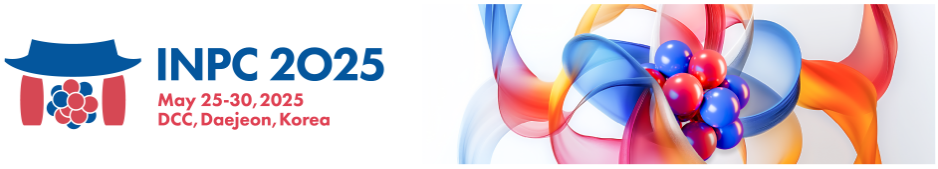

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Excitation of Thorium-229 doped in crystals using a pulsed laser toward nuclear clocks

Tuesday, 27 May 2025 11:25 (15 minutes)

^{229}Th has the uniquely low nuclear first excited state (^{229m}Th) with the excitation energy of 8.356 eV.
This allows excitation using vacuum ultraviolet lasers, which opens up the possibility of realizing a clock based on nuclear energy levels, called nuclear clocks.
It has long been known that ^{229}Th has a first excited state with low excitation energy, but laser excitation has been difficult to achieve.
However, in 2024, the world's first laser excitation of ^{229}Th was finally achieved using ^{229}Th-doped CaF_2 [1].
Following this, two other groups also reported laser excitations, leading to rapid advances in research on ^{229}Th [2][3].

Our group has conducted experiments using the high-intensity synchrotron radiation facility, SPring-8, in Japan, to excite ^{229}Th to ^{229m}Th via its second excited state and observe the de-excitation light from ^{229m}Th using ^{229}Th-doped CaF_2[4].
For this experiment, we have developed a detector system that can efficiently reduce background events and that can also be used for laser excitation experiments [5].
Recently, we have developed a vacuum ultraviolet pulsed laser in our laboratory and have initiated laser excitation experiments.
In this presentation, we will introduce an overview of our laser and detection systems and the status of our laser excitation experiments.

[1] J. Tiedau et al., Phys. Rev. Lett. 132, 182501 (2024)
[2] R. Elwell et al., Phys. Rev. Lett. 133, 013201 (2024)
[3] C. Zhang et al., Nature 633, 63 (2024)
[4] T. Hiraki et al., Nat. Commun. 15, 5536 (2024)
[5] T. Hiraki et al., hyperfine interactions, 245, 14 (2024)

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