



Contribution ID: 177 Contribution code: **FRAI02**

Type: **Invited Oral Presentation**

X-ray FEL lays the groundwork for Scandium-45 nuclear clock

Friday 23 August 2024 09:20 (35 minutes)

Precise timekeeping is indispensable in everyday life, science, and technology. It relies on reference oscillators with stable frequencies. Atomic clocks – the most precise time-measurement devices at present – use spectrally very narrow resonant transitions between electronic states in atoms as their reference oscillators. With the advent of hard x-ray FELs, the use of extremely narrow resonant transitions in atomic nuclei as reference oscillators for ultra-high-precision clocks is now within reach. Nuclear oscillators are naturally more stable and more resilient to external perturbations than their atomic counterparts. Resonant excitation of an ultra-narrow transition in Scandium-45 nuclear isomer with hard x-rays became recently possible [1] due to the high spectral photon flux delivered by the European XFEL in self-seeded high-repetition-rate mode. In this talk, the results of this experiment will be presented along with discussion of further developments of hard X-ray FELs required for ultra-high precision nuclear clocks.

[1] Shvyd'ko, Yu. et al. *Resonant x-ray excitation of the nuclear clock isomer ^{45}Sc* . Nature **622** (2023) 471.

Footnotes

Funding Agency

Work at Argonne National Laboratory (ANL) was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under contract DE-AC02-06CH11357.

Primary author: SHVYD'KO, Yuri (Argonne National Laboratory)

Presenter: SHVYD'KO, Yuri (Argonne National Laboratory)

Session Classification: Advanced FEL modes and science applications

Track Classification: Advanced FEL modes and science applications