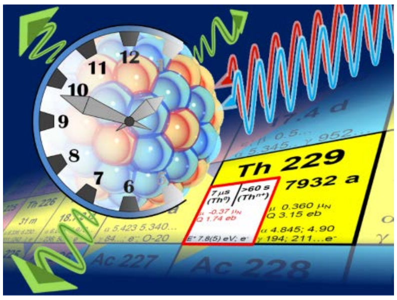
[Oscillations in the atomic nucleus of thorium-229 to be used as pulse generator for future nuclear clocks]

Precise time measurements play a vital role in our daily life. They allow reliable navigation and accurate experimenting and provide a basis for world-wide synchronized exchange of data. A team of researchers of PTB Braunschweig, Ludwig-Maximilians-Universität München (LMU), Johannes Gutenberg University Mainz (JGU), the Helmholtz Institute Mainz (HIM), and GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt now reports on a decisive step toward the potential development of a nuclear clock, which bears the potential to significantly outperform the best current atomic clocks. The only known excited state of an atomic nucleus that is located at a suitably low excitation energy to be accessible by optical techniques, as they are in use in current atomic clocks, exists in thorium-229. Fundamental properties of thorium-229 in this state have now been determined, the researchers report in the current issue of the journal *Nature*. More information is available here.

Pictures:



Graphical representation of a nuclear clock based on a transition in the atomic nucleus of thorium-229 (left). In such a clock, the nucleus will be excited with laser light. In the present experiment, laser excitation of the electron shell allowed measurements of relevant properties of the excited, isomeric nucleus. The corresponding cut-out from the chart of nuclei, which tabulates all known atomic nuclei, is visible in the background. The thorium-229 ground state is listed with its half-life of 7,932 years. The half-life of the isomeric state is only 7 µs in the neutral atom, but >60 s for the ion, as this cannot emit a loosely-bound electron. The determined nuclear properties µ and Q indicative of the charge distribution and shape are indicated as well.
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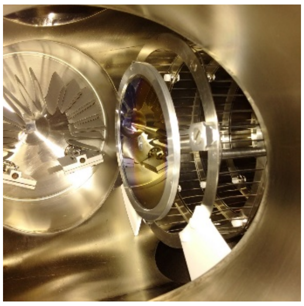

The uranium-233 source (large disk in center of image) produced at the Johannes Gutenberg University Mainz, Germany, mounted inside the experimental apparatus at the Ludwigs-Maximilian-University Munich, Germany. Components of the setup are reflected in the surface of the source.
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