



Beitrag ID: 49

Typ: Talk

HITHOR: Laser Spectroscopy of $^{229}\text{Th}^{89+}$ at ESR

Dienstag, 16. September 2025 10:15 (25 Minuten)

The low-lying isomeric state of the ^{229}Th nucleus has been intensively discussed as a candidate for nuclear clocks. Different approaches are pursued worldwide, either based on Th-doped crystals or lowly charged Th ions. The HITHOR project follows a different approach by utilizing nuclear hyperfine mixing (NHM) in highly-charged hydrogen-like $^{229}\text{Th}^{89+}$. GSI offers the unique possibility to produce Th in this charge state and it is planned to conduct a series of successive experiments at the ESR storage ring, the SPECTRAP Penning trap, and the quantum logic spectroscopy setup, which is currently build behind the HITRAP deceleration facility. The aim is to successively reduce the uncertainty of the nuclear transition, with the ultimate goal of establishing a new time standard based on a ^{229}Th nuclear clock.

The first step of this endeavor is the demonstration of NHM at the ESR by means of collinear laser spectroscopy. Due to hyperfine quenching of states with the same total angular momentum, the transition probability is significantly enhanced, making the transitions within the hyperfine structure of $^{229}\text{Th}^{89+}$ accessible to conventional laser spectroscopy. The production of ^{229}Th from a ^{229}U primary beam, as well as the preparation of an electron-cooled bunched ^{229}Th beam, has already been successfully demonstrated. Initial laser spectroscopy attempts were carried out at a beam energy of 189 MeV/u, which Doppler-shifts the 8.34 eV transition into the visible regime.

In this talk, I will present the current status of the experiment as well as the associated experimental challenges.

Autor: MOHR, Konstantin (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Co-Autoren: BANAS, Dariusz (Jan Kochanowski University); BRANDAU, Carsten (GSI Helmholtzzentrum für Schwerionenforschung GmbH); CHEN, Rui Jiu (GSI Helmholtzzentrum für Schwerionenforschung GmbH); GLORIUS, Jan (GSI Helmholtzzentrum für Schwerionenforschung GmbH); GUMBERIDZE, Alexandre (GSI Helmholtzzentrum für Schwerionenforschung GmbH); SÁNCHEZ, Rodolfo (GSI Helmholtzzentrum für Schwerionenforschung GmbH); HILLENBRAND, Pierre-Michel (GSI Helmholtzzentrum für Schwerionenforschung GmbH); HANNEN, Volker (Westfälische Wilhelms-Universität Münster); HESS, Regina (GSI Helmholtzzentrum für Schwerionenforschung GmbH); HEYL, Christoph (Helmholtz-Institut Jena); INDELICATO, Paul (Lab. Kastler Brossel); KLAMMES, Sebastian (GSI Helmholtzzentrum für Schwerionenforschung GmbH); KOZHUHAROV, Christoph (GSI Helmholtzzentrum für Schwerionenforschung GmbH); KÖNIG, Kristian (TU Darmstadt); LESTINSKY, Michael (GSI Helmholtzzentrum für Schwerionenforschung GmbH); LITVINOV, Sergey (GSI Helmholtzzentrum für Schwerionenforschung GmbH); LITVINOC, Yuri (GSI Helmholtzzentrum für Schwerionenforschung GmbH); LORENTZ, Bernd (GSI Helmholtzzentrum für Schwerionenforschung GmbH); NÖRTERSHÄUSER, Wilfried (TU Darmstadt); PFÜTZNER, Marek (University of Warsaw); PODOLYAK, Zsolt (University of Surrey); QUINT, Wolfgang (GSI Helmholtzzentrum für Schwerionenforschung GmbH); RÖHLSBERGER, Ralf (Helmholtz-Institut Jena); MICKE, Peter (GSI Helmholtzzentrum für Schwerionenforschung GmbH); SANJARI, Shahab (GSI Helmholtzzentrum für Schwerionenforschung GmbH); SCHIPPERS, Stefan (Justus-Liebig-Universität Gießen); SCHÜSSLER, Rima (GSI Helmholtzzentrum für Schwerionenforschung GmbH); SIDHU, Ragandeep Singh (University of Edinburgh); SPILLMANN, Uwe (GSI Helmholtzzentrum für Schwerionenforschung GmbH); STALLKAMP, Nils (GSI Helmholtzzentrum für Schwerionenforschung GmbH); STECK, Markus (GSI Helmholtzzentrum für Schwerionenforschung GmbH); STÖH-

LKER, Thomas (GSI Helmholtzzentrum für Schwerionenforschung GmbH); THIROLF, Peter (Ludwig-Maximilians-Universität München); TRASSINELLI, Martino (Sorbonne Université); TROTSENKO, Sergiy (GSI Helmholtzzentrum für Schwerionenforschung GmbH); VOGEL, Manuel (GSI Helmholtzzentrum für Schwerionenforschung GmbH); WINTERS, Danyal (GSI Helmholtzzentrum für Schwerionenforschung GmbH)

Vortragende(r): MOHR, Konstantin (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session 3