Postdoctoral Position

In the ERC Synergy Grant Project "ThoriumNuclearClock" at LMU Munich/Germany

ThoriumNuclearClock is an ERC Synergy Grant project that started in 2020, for a duration of 6 years. 4 international research teams (3 experimental: LMU Munich/Germany, PI: P.G. Thirolf, TU Vienna/Austria, PI: T. Schumm, PTB Braunschweig/Germany, PI: E. Peik; 1 theoretical: U Delaware/USA, PI: M. Safronova) join forces to build world's first optical nuclear clock and apply it to fundamental physics studies.

Project background:

Today's most precise time and frequency measurements are performed with optical atomic clocks. However, it has been proposed that they could potentially be outperformed by a nuclear clock, which employs a nuclear transition instead of an atomic shell transition. There is only one known nuclear state that could serve as a nuclear clock, namely, the isomeric first excited state of ^{229}Th. Evidence for its existence until recently could only be inferred from indirect measurements, suggesting since 2009 an excitation energy of 7.8(5) eV. Thus the first excited state in ^{229}Th represents the lowest nuclear excitation so far reported in the whole landscape of known isotopes. In 2016, the first direct detection of this nuclear state could be realized via its internal conversion decay branch, laying the foundation for precise studies of its decay parameters [1]. Subsequently, a measurement of the half-life of the neutral isomer was achieved, confirming the expected reduction of 9 orders of magnitude compared to the one of charged ^{229m}Th [2]. Recently, collinear laser spectroscopy was applied to resolve the hyperfine structure of the electronic states of the thorium isomer, providing information on nuclear moments and the charge radius [3]. Most recently, also the cornerstone on the road towards the nuclear clock, i.e. a more precise and direct determination of the excitation energy of the isomer, could be achieved [4,5]. Thus major progress on the properties of this elusive nuclear state could be achieved in recent years, opening the door towards an all-optical control and thus the development of an ultra-precise nuclear clock. Such a nuclear clock promises intriguing applications in applied as well as fundamental physics, ranging from geodesy and seismology to the investigation of possible time variations of fundamental constants or the search for Dark Matter [6].

[1] L. v.d. Wense et al., Nature 533, 47-51 (2016).
[2] B. Seiferle, L. v.d. Wense, P.G. Thirolf, Phys. Rev. Lett. 118, 042501 (2017).
[3] J. Thielking et al., Nature 556, 321 (2018).
[4] B. Seiferle, L. v.d. Wense, P.G. Thirolf, Eur. Phys. Jour. A 53, 108, (2017).
[5] B. Seiferle et al., Nature 573, 243 (2019).
[6] E. Peik et al., Quantum Science and Technology 6, 034002 (2021).

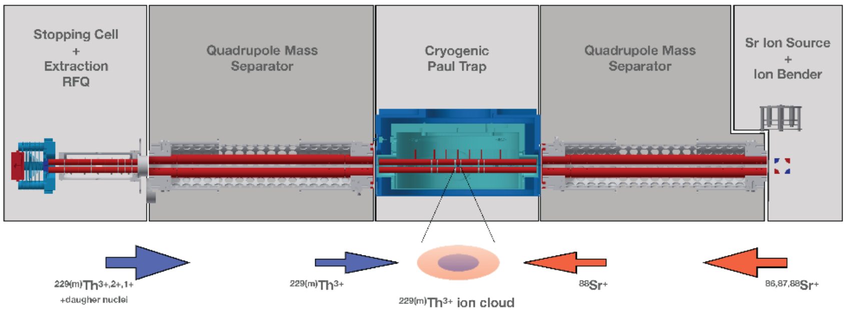
To strengthen our LMU team for upcoming ground-breaking experiments, we search for a highly motivated and experienced Postdoctoral Fellow with specific expertise on ion trapping and related techniques. The position will be initially for 2 years, with an optional 1 year extension.

Project description:

Operation of a cryogenic Paul trap and experiments with laser-cooled $^{229m}Th^{3+}$ ions

Our experimental goals:

With our unique ‘thorium isomer generator’ setup we work towards a series of ‘world’s first’ experiments:
- determination of the radiative lifetime of $^{229m}Th^{3+}$
- sympathetic laser cooling of $^{229m}Th^{3+}$ with $^{88}Sr^{+}$
- laser excitation of the thorium isomer
- realization of a nuclear clock



Our experimental setup:

- buffer-gas stopping cell (housing a ^{233}U source) with RF-DC funnel
- RFQ ion guide, quadrupole mass separators
- cryogenic Paul trap : coupled to $^{88}Sr^{+}$ laser cooling and $^{229m}Th^{3+}$ hyperfine spectroscopy setup
- ion and fluorescence detection devices

Your tasks:

- operation and further development of the experimental devices
- experiments with stored and cooled $^{229m}Th^{3+}$ ions
- participation in collaborative activities of ThoriumNuclearClock consortium
- support of students’ thesis projects

Your profile:

- experience with ion trapping techniques, specifically Paul traps
- familiar with ion optics & manipulation of ions using electromagnetic fields
- experience with ion and photon detection techniques
- experience with optical (laser-) techniques is beneficial, yet not mandatory

If you are highly motivated to work at the forefront of physics and technology in a dynamic and internationally highly visible project and in close collaboration with other leading experimentalists and theorists, then you are encouraged to apply to join our team for the described Postdoctoral Fellow position.

The position is immediately available, initially for a period of 2 years, with an optional 1 year extension.

Applications including a list of professional experience and educational history, transcripts of grades, publication list and 2 letters of recommendation should be sent to:

Contact:

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