A 35: Precision Spectroscopy of Atoms and Ions VI

Zeit: Freitag 10:30–12:30 Raum: VMP 6 HS-B

Fachvortrag A 35.1 Fr 10:30 VMP 6 HS-B

Precision Measurement of the K-Shell Spectrum from Highly Charged Xenon With a Quantum Microcalorimeter — •Daniel B. Thorn[1,2], F. Scott Porter[4], Ming F. Gu[3], Gregory V. Brown[3], Peter Beiersdorfer[3], Caroline A. Kilbourne[4], and Richard L. Kelley[4] — [1]ExterMe Matter Institute EMMI, 64291 Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — [3]Lawrence Livermore National Laboratory, Livermore, CA 94550, USA — [4]Goddard Space Flight Center, NASA, MD 20771, USA

We present a measurement of the K-shell spectrum from highly charged xenon ions recorded with a high-energy microcalorimeter array that can distinguish between various theories for the atomic structure of the two electron system. The array was designed to provide high quantum efficiency in the 10-60 keV x-ray range. A resolution of 34 eV at 31 keV is achieved, which is an order of magnitude better than previous measurements. This allows for a ≤ 2 eV measurement of the Xe^{52+} and Xe^{53+} K-shell transitions without the uncertainty of unresolved blends that afflicted previous measurements. This work was performed under the auspices of the U. S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-C52-07NA27344 and was supported by NASA grants to LLNL and GSFC.

Fachvortrag A 35.2 Fr 11:00 VMP 6 HS-B

Design einer asymmetrischen zylindrischen Penningfalle für *g*-Faktor-Messungen mit hochgeladenen Ionen — Nicolaas P. M. Brantjes[1], •David von Lindenfels[2], Wolfgang Quint[1] und Manuel Vogel[1] — [1]GSI Darmstadt, Deutschland — [2]Universität Heidelberg, Deutschland

Die präzise Bestimmung von g-Faktoren gebundener Elektronen in schweren hochgeladenen Ionen ermöglicht einen genauen Test der QED gebundener Teilchen in starken Feldern. Für die Laser-Mikrowellen Doppelresonanztechnik wird eine halboffene zylindrische Penningfalle benötigt. Simulationen dienen der Optimierung des elektrostatischen Speicherpotentials in einer solchen Falle. Dazu gehen wir von einer geschlossenen, elektrisch kompensierten Falle aus. Dann ersetzen wir eine der Endkappen durch weitere röhrenförmige Elektroden.

A 35.3 Fr 11:30 VMP 6 HS-B

Decoherence and losses by collisions in ^{88}Sr lattice clocks — •Joseph Sundar Raaj Vellore Winfred, Christian Lisdat, Thomas Middelmann, Fritz Riehle, and Uwe Sterr — Physikalisch-Technische Bundesanstalt and Centre for Quantum Engineering and Space-Time Research QUEST,Bundesallee 100, 38116 Braunschweig,Germany.

Recent advancement in optical frequency metrology has enabled optical lattice clocks with neutral atoms to surpass Cesium fountain clock's stability and accuracy. Such precise measurement of time is very important in technological and scientific endeavors. High atom number induces collisional effects in neutral atom clocks. In case of the ^{87}Sr fermionic isotope, collision induced frequency shift is suppressed while in ^{88}Sr bosonic isotope the shift is present due to s-wave collisions. Due to its higher natural abundance, a ^{88}Sr optical clock can offer better signal-to-noise ratio and therefore higher stability. We report our study of collision induced losses in a ^{88}Sr optical lattice clock. Around 1×10^6 ^{88}Sr atoms are loaded into a 1-D optical lattice operated at the magic wavelength. The atoms are interrogated on the doubly forbidden $^1S_0$-$^3P_0$ transition which is made possible by applying static magnetic field that mixes the $^3P_1$ state to $^3P_0$ state. The investigations of density dependent losses and of line broadening give estimates for the loss coefficients which would determine the operational parameters of an ^{88}Sr optical lattice clock.

A 35.4 Fr 11:45 VMP 6 HS-B

Messung der Vibrationsamplituden von Pulsrohrkühlerstufen und deren Effekt auf die Zyklotronfrequenz eines Protons in der Penning-Falle — •Christian Mrozik[1], Klaus Blaum[2], Holger Kracke[1], Susanne Kreim[1], Andreas Mooser[1], Wolfgang Quint[3,4], Cricia de Carvalho Rodegheri[1], Stefan Stahl[5], Stefan Ulmer[1,2,3,4] und Jochen Walz[1] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz, 55099 Mainz — [2]MPI für Kernphysik, 69117 Heidelberg — [3]GSI, 64291 Darmstadt — [4]Ruprecht-Karls-Universität, 69047 Heidelberg, — [5]Stahl-Electronics, 67582 Mettenheim

Das neue Mainzer Experiment zur Bestimmung des $g-$Faktors des freien Protons wird mit Hilfe eines zweistufigen Pulsrohrkühlers auf die erforderliche Temperatur von etwa 4 K gebracht. Als nachteilig erweist sich hierbei die Tatsache, dass sich die Stufen des Kühlers mit jedem Pulszyklus bewegen. Diese Vibrationen können auf die Falle übertragen werden. Wir haben bei der reduzierten Zyklotronfrequenz ν_+ eines Protons in der vibrierenden Falle Schwankungen beobachtet, die mit den Kühlervibrationen korreliert sind. Diese Schwankungen begrenzen derzeit die relative Genauigkeit für die Bestimmung von ν_+ auf 10^{-6}. Die Vibrationsamplituden der Kühlerstufen sind daraufhin unabhängig mit Hilfe einer positionssensitiven Photodiode in allen drei Raumrichtungen gemessen worden. Eine Dämpfung der Fallenvibrationen kann über eine Modifikation der Kopplung zwischen Kühler und Falle erreicht werden.

A 35.5 Fr 12:00 VMP 6 HS-B

Development of improved detection electronics for the g-factor experiment on highly-charged ions — •Sven Sturm[1], Klaus Blaum[2], Wolfgang Quint[3], Birgit Schabinger[1], and Anke Wagner[2] — [1]Institut für Physik, Johannes Gutenberg-Universität, 55099 Mainz, Germany — [2]Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany — [3]GSI Darmstadt, 64291 Darmstadt, Germany

For the high-precision measurement of the magnetic moment of the electron bound in highly-charged calcium ions [1] extremely sensitive detection electronics are needed. The cryogenic amplifier systems used in former experiments [2] was shown to limit the accessible measurement accuracy for the g-factor by raising the necessity to increase the ion temperature to $\sim$ 200 K. Therefore, a novel cryogenic ultra low noise amplifier was developed, realizing previously unmatched noise performance and detection sensitivity for the axial motion of medium-heavy ions in Penning traps. The noise performance especially in the interesting range from 100 kHz - 1 MHz and the negligible feedback even on tank circuits with very high quality factors will allow for a considerably decreased axial ion temperature and thus for an improved measurement accuracy. Exploiting the extremely low noise temperature (<1K) of the amplifier, ion temperatures far below the trap ambient temperature of 4.2 K might become accessible. The design and setup of the amplifier system will be presented and first results will be shown.

[1] M. Vogel *et al.*, Nucl. Inst. Meth. B **235**, 7 (2005)
[2] G. Werth *et al.*, Int. J. Mass Spec. **251**, 152 (2006)

A 35.6 Fr 12:15 VMP 6 HS-B

Relativistic theory of trielectronic recombination with K-shell excitation — •Octavian Postavaru, Christian Beilmann, Christoph H. Keitel, Joachim Ullrich, José R. Crespo López-Urrutia, and Zoltan Harman — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

In the dielectronic recombination (DR) process involving two interacting electrons, the kinetic energy of the recombined electron is transferred to a single bound electron by excitation to an intermediate autoionizing state. Beyond the simple DR, resonant recombination processes involving higher-order correlations may also occur. Two bound electrons can be simultaneously excited in trielectronic recombination (TR). We performed calculations of cross sections for TR with excitation of a K-shell electron in the framework of the multiconfiguration Dirac-Fock (MCDF) method. Our theoretical predictions have been verified by recent high-resolution emission spectroscopy experiments at the Heidelberg electron beam ion trap [1]. For Kr^{30+}, TR contributions of nearly 6% to the total resonant photorecombination rate were found. This effect has to be considered in the quantitative modelling of fusion and other hot, e. g., astrophysical plasmas.

[1] C. Beilmann, O. Postavaru, R. Ginzel, et al., submitted (2008)