A 13: Posters: Photoionization and atomic systems in external fields

Zeit: Dienstag 16:30–18:30 Raum: Poster C3

A 13.1 Di 16:30 Poster C3

Photoionization of highly charged ions — •Martin C. Simon, Sascha W. Epp, Thomas M. Baumann, José R. Crespo López-Urrutia, and Joachim Ullrich — Max-Planck Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg, Germany

Photoionization counts to the essential processes of light-matter interaction. For such experiments sufficiently high photon flux and target densities have to be provided. While cross-sections for atoms were already measured during the middle of the last century, the first measurements on singly charged ions started only about two decades ago. There are a few results on multiply chared ions but so far HCIs (highly charged ions) could not be studied. In principle an EBIT (electron beam ion trap) can provide a sufficiently high HCI density but the required photon energies increase strongly with the charge state of the ion. Combined with the demand of high flux this type of experiments are restricted to modern light sources like fourth-generation synchrotrons and soft X-ray FELs (free electron lasers). With a transportable cryogenic EBIT it was recently possible for the first time to perform resonant laser spectroscopy on highly charged iron ions at the FEL in Hamburg (S. W. Epp et al. PRL 98). This EBIT is now equipped with an extraction system in order to measure photoionization by the detection of extracted ions. First tests will be performed at the FEL in Hamburg in March 2008 and further studies will take place at the Berliner electron storage ring synchrotron BESSY in June 2008.

A 13.2 Di 16:30 Poster C3

An approximate quantum number in doubly excited helium — •Ralph Püttner[1], Jiang Yuhai[1,2], Dominique Delande[3], Michael Martins[4], and Günter Kaindl[1] — [1]Institut für Experimentalphysik, Freie Universität Berlin, Arnimallee 14,14195 Berlin, Germany — [2]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [3]Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — [4]Laboratoire Kastler-Brossel, Université Pierre et Marie Curie-Paris 6, ENS, CNRS; 4 Place Jussieu, F-75005 Paris, France

Helium close to the double ionization threshold is a prototypical system for studying quantum chaos. In this contribution experimental and theoretical total photoionization cross sections of doubly excited He up to the single ionization threshold I_{15} of He^+ are presented, revealing excellent agreement. All spectra are dominated by principal Rydberg series, what is explained by the observation that the quantity $F = N - K$ is approximately a good quantum number for a large fraction of states. The statistical distributions of nearest-neighbor energy spacings between resonances of Rydberg series with small F approach a Wigner distribution. The results show no indication for a transition to full chaos – i.e. a loss of all approximate quantum numbers – in He. From these results we derive a lower limit for the appearance of Eriscon fluctuations, which are also expected directly below the double ionization threshold.

A 13.3 Di 16:30 Poster C3

Enhanced Four-Wave Mixing in mercury isotopes, prepared by Stark-chirped rapid adiabatic passage — •martin oberst, jens klein, and thomas halfmann — TU darmstadt, starße xy 204777777

We demonstrate significant enhancement of four-wave mixing (FWM)in coherently driven mercury isotopes to generate vacuum-ultraviolet radiation at 125 nm. The enhancement is accomplished by preparation of the mercury atoms in a state of maximum coherence, i.e. maximum nonlinear-optical polarization, driven by Stark-chirped rapid adiabatic passage (SCRAP). In this technique a pump laser at 313 nm excites the two-photon transition between the ground state $6s^2\ ^1S_0$ and the target state $7s\ ^1S_0$ in mercury. A strong, off-resonant radiation field at 1064 nm generates dynamic Stark shifts. These Stark shifts induce a rapid adiabatic passage process on the two-photon transition. The maximum nonlinear-optical polarization induced by SCRAP permits efficient FWM of the pump laser and an additional probe laser at 626 nm. The efficiency is further enhanced, as the SCRAP process stimulates the *complete* set of different mercury isotopes to participate in the FWM-process. This enlarges the effective atomic density of the medium. Thus, we observe the generation of radiation at 125 nm enhanced by more than one order of magnitude with respect to conventional frequency conversion. Parallel to the FWM-process, we monitored the evolution of the population in the medium by laser-induced fluorescence. These data demonstrate efficient coherent population transfer by SCRAP.

A 13.4 Di 16:30 Poster C3

Visible spectra of highly charged ions: g-factor and hyperfine splitting — •José R. Crespo López-Urrutia, Monika Binder, Lodewijk Arntzen, Volkhard Mäckel, and Joachim Ullrich — Max-Planck-Institut für Kernphysik, 69117 Heidelberg

The lines present in the visible spectra of highly charged ions (HCI) can display large hyperfine splittings due to the large overlap between the wave functions of the optical electron and of the nucleus. The strong magnetic field present in an electron beam ion trap allows to investigate and compare the simultaneous effects of the internal (nuclear magnetic moment) and external field. A high resolution optical spectrometer is used to register the emission spectra of highly charged Bi and Xe ions having non-zero nuclear spins. By evaporatively cooling the trapped ions, the Zeeman and hyperfine components of M1 transitions within the ground state configuration of Ti-like ions can be resolved.

A 13.5 Di 16:30 Poster C3

EBIS test ion source for HITRAP and charge breeding — Sabrina Geyer[1], Oliver Kester[1], Jochen Pfister[2], Alexey Sokolov[1], Thomas Stoehlker[1,3], and •Gleb Vorobjev[1] — [1]Gesellschaft für Schwerionenforschung — [2]Universität Frankfurt, Institut für Angewandte Physik — [3]Universität Heidelberg, Fakultät für Physik und Astronomie

The electron beam ion source MAXEBIS from Frankfurt University has been installed in a test beam setup at GSI to deliver highly charged ions for HITRAP and to serve for charge state breeding experiments. Recent experiments were dedicated to evaluate the parameters of the ion beam line, i.e. emittance, dependence of the charge state distribution on the confinement time in the electron beam and the resolution of multi passage spectrometer (MPS). Simulations of the beam-line using SIMION 7.0 were performed add additional elements were installed in order to improve the beam current for more efficient ion transfer. To simplify downstream focusing the setup has been equipped with new diagnostics and beam optics devices. Due to the complicate running procedure of the cryogenic MAXEBIS a next generation compact Dresden electron beam ion trap (EBIT) has been purchased and installed at GSI and will be used for the routine operation. The EBIT will continue the experiments done so far with the MAXEBIS and is dedicated as SPARC test ion source. For ion - neutral atom collision experiments a Magnesium jet target will be mounted. X-ray spectroscopy will allow the investigation of processes of the slow ions - fast electrons interaction in the ionization chamber.

A 13.6 Di 16:30 Poster C3

Resonant strong field ionization of atomic hydrogen — •Mircea G. Girju, Kiril Hristov, Oleg Kidun, and Dieter Bauer — Max Planck Institute for Nuclear Physics, Heidelberg, Germany

In H(1s) close to resonance with the 2p state Autler-Townes duplets are known to appear in the photoelectron spectra [1]. In the case of sufficiently weak laser fields the two peaks of each Autler-Townes pair are separated by $\Omega = \sqrt{\Omega_R^2 + \Delta^2}$ with Ω_R the Rabi-frequency and Δ the detuning. However, our numerical *ab initio* solutions of the time-dependent Schrödinger (TDSE) equation show that already at $10^{14}\,\mathrm{Wcm}^{-2}$ the true peak separation deviates from the naively expected gap according to the above formula. The reasons for this failure are the use of the rotating wave approximation and the neglect of ionization, AC Stark effect, and other excited states.

A strong field approximation (SFA) is developed for an initially bound electron interacting with a resonant high-frequency pulse causing both Rabi-floppings and ionization. Taking the pure Rabi-flopping as the zeroth-order approximation in a straightforward two bound state-SFA turns out to yield inaccurate Autler-Townes peak strengths, the more so the larger the detuning $|\Delta|$ is [2].

[1] K.J. LaGattuta, Phys. Rev. A **47**, 1560 (1993).

[2] M.G. Girju, K. Hristov, O. Kidun, and D. Bauer, J. Phys. B: At. Mol. Opt. Phys. **40**, 4165 (2007).

A 13.7 Di 16:30 Poster C3

Entwicklung einer Pepperpot-Emittanzmessanlage und Messungen zur Inbetriebnahme des HITRAP Linearbeschleunigers — •Jochen Pfister[1,2], Oliver Kester[2] und Ulrich Ratzinger[1] für die HITRAP-Kollaboration — [1]Universität Frankfurt, Institut für Angewandte Physik, Max-von-Laue-Str. 1, 60438 Frankfurt — [2]Gesellschaft für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt

Die erste Stufe des HITRAP-Beschleunigers, die Resonatoren des Double-Drift-Bunchers, wurden in zwei Strahlzeiten im Mai und August 2007 in Betrieb genommen. Dabei gehörten u.a. die Emittanzmessungen zum angestrebten Messprogramm.

Eine Repetitionsrate von einem Ionenbunch in einer Minute aus dem ESR schloss die Schlitz-Gitter-Methode zur Bestimmung der Emittanz aus. Daher wurden Messungen mit einer Pepperpot-Anlage sowie die Berechnung der Emittanz aus Strahlprofilmessungen durchgeführt.

Es werden die Messmethoden und Auswertealgorithmen sowie die Ergebnisse aus beiden Strahlzeiten dargestellt und mit den Designwerten verglichen. Außerdem wird die Entwicklung einer Pepperpot-Emittanzmessanlage auf der Basis eines Micro-Channel-Plates vorgestellt.

A 13.8 Di 16:30 Poster C3

Calculation of Berry phases emerging in atomic beam spin echo experiments — •Martin-Isbjörn Trappe, Thomas Gasenzer, and Otto Nachtmann — Institut für Theoretische Physik, Philosophenweg 16, 69120 Heidelberg

We consider the derivation of geometrical phase factors in longitudinal atomic beam spin echo (lABSE) experiments. The propagation of hydrogen like atoms in stationary electric and magnetic fields leads to geometrical phases in addition to the common dynamical phase factors. We provide numerical calculations of parity conserving as well as parity violating contributions to the geometrical phases depending on the electromagnetic field configuration and the initial superposition of the atomic eigenstates. The conditions for suitable configurations of lABSE experiments for measuring Berry phases in hydrogen are investigated.