MS 5: Posters I

Time: Tuesday 16:30–19:00 Location: Empore Lichthof

MS 5.1 Tue 16:30 Empore Lichthof

Isobar-free High Resolution On-Line Spectroscopy: New Features for the Laser Ion Source & Trap (LIST) at ISOLDE/CERN — •Carsten Weichhold[1], Valentin Fedosseev[4], Reinhard Heinke[1], Tobias Kron[1], Bruce Marsh[4], Sebastian Raeder[2], Tobias Reich[3], Sven Richter[1], Sebastian Rothe[4], Pascal Schönberg[3], Marcel Trümper[1], and Klaus Wendt[1] — [1]Institute of Physics, Mainz University — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [3]Institute of Nuclear Chemistry, Mainz University — [4]CERN, Switzerland

Highly selective and efficient ion sources are of fundamental importance in the research field of nuclear properties at the edges of the chart of nuclei, where production yields at isotope generators such as ISOLDE at CERN are low and any background is overwhelming. To address this, the LIST combines the highly element-selective laser resonance ionization technique with suppression of isobaric contaminants inside a radiofrequency quadrupole structure. Today, the LIST is integrated as a routine-operational ion source at ISOLDE and has allowed investigations of previously not accessible isotopes.

In order to achieve higher resolution and to pave the way for isomer-selective ionization, a crossed laser/atom beam geometry inside the LIST quadrupole structure has been developed, reducing the spectral linewidth from a few GHz down to around 100 MHz. First off-line tests at the Mainz RISIKO mass separator, advantages, constraints as well as required refinements of this new PI(Perpendicular Illuminated)-LIST design are presented.

MS 5.2 Tue 16:30 Empore Lichthof

Design of a grating Ti:Sapphire laser with computer controlled wavelength tuning and intra-cavity second harmonic generation for resonant ionization — Vincent Degner[1,2], •Pascal Naubereit[2], Daiki Matsui[1], Takahide Takamatsu[1], Atsushi Nakamura[1], Kousuke Saito[1], Ryohei Ohtake[1], Volker Sonnenschein[1], Tomita Hideki[1], Tetsuo Iguchi[1], and Klaus Wendt[2] — [1]Department of Quantum Engineering, Nagoya University, Japan — [2]Institut für Physik, University of Mainz, Germany

Tunable lasers with spectrally well controlled, high power output are desirable for inducing a variety of resonant atom-photon interactions. A specific technique serving a broad range of applications is multi-step Resonance Ionization Mass Spectrometry (RIMS). In this field, pulsed high repetition rate Ti:Sapphire (Ti:Sa) lasers are used due to their reliable long term operation and large tuning range from 680 to 1000 nm. Conventional wavelength selection based on birefringent filters and etalons does not allow for wide range mode-hop free tuning as needed for atomic spectroscopy. Therefore, a motorized grating Ti:Sa laser with computer controlled wavelength tuning and synchronized tracking of intra-cavity second harmonic generation (ic-SHG) is currently being developed. Merits of ic-SHG are wide coverage of the blue spectral range and high conversion efficiency combined with a compact setup. Application of this laser design in RIMS will simplify the search for new ionization schemes and enable fast exchange between different ionization schemes for multi-elemental analysis. Both the development and the first characterization of this laser system is discussed.

MS 5.3 Tue 16:30 Empore Lichthof

Spectroscopy and Laser-SNMS on stable and radioactive Strontium — •Hauke Bosco[1], Michael Franzmann[1,2], Tobias Kron[2], Clemens Walther[1], and Klaus Wendt[2] — [1]Institut für Radioökologie und Strahlenschutz, Leibniz Universität Hannover — [2]Institut für Physik, Johannes Gutenberg Universität Mainz

Nuclear accidents as experienced e.g. in Chernobyl or Fukushima and nuclear weapon tests released considerable activity levels and a variety of medium to long-lived radionuclides into the environment. Strontium-90 appears as a significant share of the fission products in spent nuclear fuel and correspondingly in any possible release. Due to its chemical properties it is subject to long range transport through the environment and can cause considerable dose to man when entering the food chain. Correspondingly, the investigation of speciation and migration channels is of major relevance. A radioanalytical approach is severely hampered by the low beta energy of the strontium-90 decay and the need to separate strontium-90 from the secular equilibrated daughter yttrium-90. Hence, application of a mass spectrometric method without chemical separation of the elements is a promising alternative for low-level investigation of strontium-90. Application of the new Laser-SNMS system at IRS Hannover could well suit those needs. It applies three Ti:Sa lasers for resonant ionization of neutral atoms produced by primary ion sputtering in a SIMS together with a time-of-flight mass analysis which provides high spatial resolution. The analytical measurements are preceded by spectroscopic studies on the level structure of strontium to develop a most efficient ionization scheme.

MS 5.4 Tue 16:30 Empore Lichthof

Ein Multireflektions-Flugzeitmassenspektrometer zur Untersuchung von atomaren Clustern — Paul Fischer[1], Gerrit Marx[1], Madlen Müller[1], Marco Rosenbusch[1], •Birgit Schabinger[1], Lutz Schweikhard[1] und Robert Wolf[2] — [1]Institut für Physik, Universität Greifswald, Felix-Hausdorff-Str. 6, 17489 Greifswald — [2]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

Ein Greifswalder Multireflektions-Flugzeitmassenspektrometer (MR-ToF MS) wird seit ein paar Jahren erfolgreich bei ISOLTRAP zur Massenseparation und -spektrometrie exotischer Radionuklide in der experimentellen Kernphysik angewendet [1−4].Darauf aufbauend wurde kürzlich ein weiteres MR-ToF-Gerät konstruiert, das zur Untersuchung von atomaren Clustern zum Einsatz kommen soll. Aufgrund des hohen Massenauflösungsvermögens kann die Zusammensetzung auch großer Cluster bestimmt werden. Für Experimente zu Cluster-Laser-Wechselwirkungen, wie der Photofragmentation oder der Photoelektronenspektroskopie, sollen einzelne Clustergrößen mit dem MR-ToF isoliert werden. Erste Ergebnisse werden vorgestellt.

[1] R. Wolf et. al, Phys. Rev. Lett. 110 (2013) 041101
[2] F. Wienholtz et. al, Nature 498 (2013) 346
[3] M. Rosenbusch et. al, Phys. Rev. Lett. 114 (2015) 202501
[4] D. Atanasov et al., Phys. Rev. Lett., in print

MS 5.5 Tue 16:30 Empore Lichthof

Ion source area of the Cryogenic Storage Ring — •Jonas Karthein[1], Klaus Blaum[1], Christian Breitenfeldt[1,2], Sebastian George[1], Jürgen Göck[1], Manfred Grieser[1], Thomas Kolling[3], Holger Kreckel[1], Christian Meyer[1], Preeti Manjari Mishra[1], Jennifer Mohrbach[3], Gereon Niedner-Schatteburg[3], Roland Repnow[1], Lutz Schweikhard[2], Sunil Kumar Sudhakaran[1], Robert von Hahn[1], and Andreas Wolf[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Institut für Physik, Ernst-Moritz-Arndt Universität, Felix-Hausdorff-Str. 6, 17487 Greifswald, Germany — [3]Fachbereich Chemie, Universität Kaiserslautern, 67663 Kaiserslautern, Germany

The new electrostatic Cryogenic Storage Ring at the Max-Planck-Institut für Kernphysik in Heidelberg - operated at cryogenic temperatures below 10 K and thus at background pressures of below 10^{-13} mbar room temperature equivalent - is designed to perform background-free laser spectroscopy and collision experiments on cold molecular and cluster ions. Ion beam storage times of hours have been demonstrated. Thus, it is ideally suited for studies in astro-, molecular- and cluster physics. To cover this wide range of applications many different ionic systems have to be produced at nA to μA currents. A 5 m × 5 m high-voltage platform of up to 300 kV is available for the ion sources, which include a cesium sputter ion source, an electrospray ion source and a buffer-gas cooled laser-vaporization ion source in combination with a radio-frequency quadrupole ion trap for cooling and accumulation. The layout of the area as well as first ion source tests will be presented.

MS 5.6 Tue 16:30 Empore Lichthof

Laser-induced delayed electron emission of small copper cluster anions — •Christian Breitenfeldt[1,2], Klaus Blaum[2], Sebastian George[2], Jürgen Göck[2], Jonas Karthein[2], Michael Lange[2], Sebastian Menk[2], Christian Meyer[2], Lutz Schweikhard[1], and Andreas Wolf[2] — [1]Institut für Physik, Ernst-Moritz-Arndt Universität, Felix-Hausdorff-Str. 6, 17487 Greifswald, Germany — [2]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

The Cryogenic Trap for Fast ion beams (CTF) is an electrostatic ion beam trap located at the Max-Planck-Institute for nuclear physics in Heidelberg and designed to investigate fundamental properties of charged particles in the gas phase. Here it is employed to study thermionic and laser-induced electron emission of cluster anions with complex multi-body structure. In recent measurements the cooling of small copper cluster anions was investigated both at room temperature as well as under cryogenic conditions of about 15 K. The cluster ions were produced in a caesium sputter ion source, known to produce poly-atomic ions in highly excited ro-vibrational states. For probing the evolution of the internal energy as a function of the storage time the clusters have been irradiated with nanosecond laser pulses at 1064 nm, and the delayed electron emission has been recorded. Results for copper clusters with cluster sizes ranging from 4 to 7 will be presented.