A 18: Highly charged ions and their applications

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

A 18.1 Tue 16:30 Empore Lichthof

APPA R&D — Verbundforschung bei FAIR — •Stefan Schippers[1], Thomas Stöhlker[2,3] und für die APPA-Kollaborationen[4] — [1]I. Physikalisches Institut, Justus-Liebig-Universität Gießen — [2]GSI-Helmholtzzentrum für Schwerionenforschung, Darmstadt — [3]Helmholtzinstitut Jena, Jena — [4]

Der vom BMBF im Rahmen der Verbundforschung geförderte Forschungsverbund APPA R&D umfasst die deutschen Universitätsgruppen, die sich im Rahmen des internationalen APPA-Verbunds für die Forschung an der zukünftigen internationalen Beschleunigeranlage FAIR engagieren, die derzeit auf dem GSI Gelände in Darmstadt errichtet wird. APPA („Atomic, Plasma Physics and Applications") ist eine der vier Forschungssäulen von FAIR. Die unter dem gemeinsamen Dach von APPA agierenden internationalen Forschungskollaborationen BIOMAT, FLAIR, HEDgeHOB, SPARC und WDM, konzentrieren sich auf die Erforschung der Bausteine und Phänomene der Materie unter extremen Bedingungen (hohe Felder, Dichten, Drücke und Temperaturen). Gegenstand des Forschungsverbunds APPA R&D sind thematisch abgestimmte Forschungsprojekte im Bereich beschleunigergestützter Experimente mit schweren Ionen an der zukünftigen FAIR-Anlage. Zentrale Punkte dabei sind: 1) Fortentwicklung der Großgeräteinfrastruktur, vor allem Forschung und Entwicklung zur Steigerung der wissenschaftlichen Leistungsfähigkeit vorhandener Anlagen sowie zukünftiger Beschleuniger- und Detektorsysteme einschließlich der entsprechenden Basistechnologien und 2) Aufbau der APPA-Experimente bei FAIR.

A 18.2 Tue 16:30 Empore Lichthof

A new electron beam ion source as charge breeder for rare isotope beams — •Michael A. Blessenohl[1], Stepan Dobrodey[1], Zachary Hockenbery[1], Renate Hubele[1], Thomas Baumann[2], José R. Crespo López-Urrutia[1], and Jens Dilling[3] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]European XFEL, Hamburg, Germany — [3]TRIUMF, Vancouver, Canada

TRIUMF is the Canadian national nuclear research facility. Its key equipment is the largest cyclotron in the world, which accelerates protons to 500 MeV. These hit a target composed of heavy elements to produce heavy isotopes, which are then studied in two post-accelerators: ISAC (Isotope Separator and ACcelerator) I and ISAC II.

Currently, the TRIUMF facility is upgraded with ARIEL (Advanced Rare IsotopE Laboratory), which will include a new EBIS (Electron Beam Ion Source) for charge breeding these rare isotopes. Highly charged ions of heavy elements are used to keep the charge-to-mass ratio A/Q low, which is required by ISAC I and II. Because the isotopes of interest have short half-lives in the millisecond range and also low abundancies, the whole process of injection, charge breeding and extraction has to be very efficient. The repetition rate of 100 Hz requires fast high voltage control and switching. The goal is to achieve a charge breeding efficiency of at least 20 % in one single charge state. In this work the latest design is presented, including finite element and Monte Carlo simulation results, concepts for the on-line diagnostics and a fast control system.

A 18.3 Tue 16:30 Empore Lichthof

EBIT spectroscopy of $Sn^{8+\cdots14+}$ in the optical and extreme ultraviolet range — •Alexander Windberger[1], Francesco Torretti[1], Hendrik Bekker[2], Anastasia Borschevsky[3], Stepan Dobrodey[2], Wim Ubachs[1,4], Ronnie A. Hoekstra[1,5], José R. Crespo López-Urrutia[2], and Oscar O. Versolato[1] — [1]Advanced Research Center for Nanolithography, Amsterdam, The Netherlands — [2]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [4]Department of Physics and Astronomy, VU Amsterdam, The Netherlands — [5]Zernike Institute for Advanced Materials, University of Groningen, The Netherlands

The charge state resolved fluorescence of $Sn^{8+\cdots14+}$ ions was simultaneously detected in the optical and extreme ultra-violet region using the electron beam ion traps (EBIT) at the Max-Planck-Institute for Nuclear Physics. Spectra were obtained while gradually increasing the electron beam energy, thus enabling us to assign the measured spectral lines to their respective charge states. A comparison with theory and complementary data leads to tentative identifications of several transitions. Our measurements contribute to an analytical understanding of atomic processes and new diagnostic tools for EUV light sources.

A 18.4 Tue 16:30 Empore Lichthof

Resonant excitation of highly charged ions at ultrabrilliant light sources — •Sven Bernitt[1,2], René Steinbrügge[1], Stepan Dobrodey[1], Jan K. Rudolph[1,3], Sascha W. Epp[4], and José R. Crespo López-Urrutia[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]IOQ, Friedrich-Schiller-Universität, Jena, Germany — [3]IAMP, Justus-Liebig-Universität. Gießen, Germany — [4]Max-Planck-Institut für Struktur und Dynamik der Materie, Hamburg, Germany

The transportable electron beam ion trap FLASH-EBIT was used to provide targets of trapped highly charged ions for VUV and X-ray radiation from the free-electron lasers FLASH and LCLS, as well as the synchrotron light sources BESSY II and PETRA III. By observing resonantly excited fluorescence we were able to measure transition energies and natural line widths. By simultaneously detecting changes of ion charge states we were able to deduce branching ratios and absolute radiative and Auger decay rates.

Our measurements provide valuable data for the interpretation of spectra from astrophysical and laboratory plasmas, and by studying high-Z few-electron systems, we can provide tests of atomic theory on the level of QED contributions.

A 18.5 Tue 16:30 Empore Lichthof

Geometrical and statistical simulations of the CANREB Electron Beam Ion Source for charging rare isotope beams — •Zachary Hockenbery[1], Michael A. Blessenohl[1], Stepan Dobrodey[1], Renate Hubele[1], Thomas Baumann[2], Jens Dilling[3], and José R. Crespo López-Urrutia[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]European XFEL, Hamburg, Germany — [3]TRIUMF, Vancouver, Canada

The Canadian rare-isotope facility with electron beam ion source (CANREB) will be used for charge breeding and mass separation of rare isotope beams for experiments at TRIUMF, the Canadian National Laboratory for Particle and Nuclear Physics. The CANREB Electron Beam Ion Source (EBIS) will consist of a trapping region, electron gun, and collector, and will accept pulsed bunches of isotopes for charge breeding towards mass-to-charge ratios < 7. A software library to accurately simulate the dynamics of the injection, charge breeding, and extraction processes is being developed as a tool for engineering design and future diagnostics of the experiments. The software utilizes finite element methods to prescribe geometrical constraints, solve electrostatic and magnetostatic equations, and for self-consistent trajectory calculations of particles. Furthermore, it includes semi-empirical calculations and Monte Carlo probability to track the charge state evolution of the injected isotopes in combination with electronic structure cross-section calculations. This poster will focus on the methods employed in the software libraries and the accuracy of the calculations.