A 46: Atomic collisions and ultracold plasmas

Time: Thursday 16:30–18:00 Location: BEBEL E34

A 46.1 Thu 16:30 BEBEL E34

Electron spectroscopy at the high-energy endpoint of electron-nucleus bremsstrahlung — •Pierre-Michel Hillenbrand[1,2], Siegbert Hagmann[1,3], Dariusz Banas[4], Carsten Brandau[5,2], Reinhard Dörner[3], Enrico De Filippo[8], Alexandre Gumberidze[5], Dalong Guo[9,10], Doris Jakubassa-Amundsen[11], Michael Lestinsky[1], Yuri Litvinov[1,12], Alfred Müller[2], Hermann Rothard[13], Stefan Schippers[2], Uwe Spillmann[1], Andrey Surzhykov[6], Sergey Trotsenko[1,6], Alexander Voitkiv[14], Vladimir Yerokhin[15], and Thomas Stöhlker[1,6,7] — [1]GSI Darmstadt — [2]Univ. Giessen — [3]Univ. Frankfurt — [4]Univ. Kielce, Poland — [5]Extreme Matter Institute Darmstadt — [6]Helmholtz-Institut Jena — [7]Univ. Jena — [8]INFN Catania, Italy — [9]IMP Lanzhou, China — [10]Univ. Beijing, China — [11]Univ. München — [12]Univ. Heidelberg — [13]CIRIL GANIL Caen, France — [14]MPI-K Heidelberg — [15]Petersburg State Univ., Russia

The high-energy endpoint of electron-nucleus bremsstrahlung has been studied in inverse kinematics: For collisions $U^{88+} + N_2 \rightarrow U^{88+} + [N_2^+]^* + e^- + \gamma$ the energy distribution of electrons scattered under $\vartheta_e^{lab} = 0°$ with $v_e \approx v_{proj}$ was measured coincident with the bremsstrahlung photons emitted under various angles ϑ_γ^{lab}. The triple-differential cross sections provide a stringent test for the fully relativistic theory of electron-nucleus bremsstrahlung. Furthermore the studied process, also termed radiative electron capture to continuum RECC, was compared to the competing processes of non-radiative electron capture to continuum ECC and the electron loss to continuum ELC.

A 46.2 Thu 16:45 BEBEL E34

Röntgenpolarimetrie angewandt zur Untersuchung der Wechselwirkung von energiereichen Teilchen- und Photonenstrahlen mit Materie — •Renate Märtin[1,2], Karl-Heinz Blumenhagen[1,3], Sebastian Hess[2], Max Schwemlein[2,4], Uwe Spillmann[2], Günter Weber[1,2] und Thomas Stöhlker[1,2,3] — [1]HI-Jena, Jena — [2]GSI, Darmstadt — [3]IOQ, Universität Jena — [4]EMMI, Darmstadt

Die Messung der linearen Polarisation von harter Röntgenstrahlung, die in Stößen von energiereichen Teilchen und Photonen mit Materie entsteht, ermöglicht Einblick sowohl in die Dynamik der Wechselwirkung als auch in die Struktur von atomaren hochgeladenen Systemen. Darüber hinaus kann die Polarisationsmessung der Röntgenstrahlung in Stoßprozessen zur Diagnose der Spinpolarisation von Elektronen- und Ionenstrahlen dienen. Frühere Messungen der linearen Polarisation waren aufgrund des Fehlens effizienter Polarisationsdetektoren fast ausschließlich auf die Messung der Spektral- und Winkelverteilung beschränkt. Durch die Entwicklung von orts-, zeit- und energieempfindliche Röntgendetektoren, die als Compton-Polarimeter eingesetzt werden können, besteht seit einiger Zeit die Möglichkeit die lineare Polarisation von Photonen im Energiebereich von ca. 60 keV bis einige hundert keV effizient zu untersuchen. Wir präsentieren verschiedene Experimente zur Studie der linearen Polarisation, die an den unterschiedlichsten Strahlplätzen durchgeführt wurden. Dazu gehören Messungen am ESR-Speicherring, der polarisierten Elektronenquelle SPIN in Darmstadt und der PETRAIII-Synchrotronanlage in Hamburg.

A 46.3 Thu 17:00 BEBEL E34

Observation of the Double resonant coherent excitation of highly charged ions crystals — •Alena Ananyeva[1,2], Toshiyuki Azuma[3,4], Harald Bräuning[2], Angela Bräuning-Demian[2], Yasuyuki Kanai[4], Yuji Nakano[3,4], and Yasunori Yamazaki[4,5] — [1]Goethe-Universität, Frankfurt-am-Main, Germany — [2]GSI, Darmstadt, Germany — [3]Tokyo Metropolitan University, Japan — [4]RIKEN, Tokyo, Japan — [5]University of Tokyo, Japan

An ion passing through a crystal feels the periodic Coulomb potential of the target like a fast oscillating electromagnetic field with frequencies in the x-ray range. If the field frequency matches the energy difference between two electronic states a resonant excitation of the ion became possible. The onset of the process can be steered by tuning the relative orientation of the incoming ion velocity and the crystallographic orientation. If the crystal orientation permits simultaneously the frequencies for two different electronic transitions, a double resonant excitation process became possible. This contribution present experimental evidence of the double excitation process in relativistic H-like and He-like Ar ions observed by means of resonance coherent excitation in a Si target. The experiment was performed by using beams of Ar ions at few hundreds MeV/u and a 1 μm thick crystal. The double resonance was detected by measuring the charge state distribution of the ions after the interaction with the crystal and the yield of the x-rays emitted during the decay of the excited states as function of the relative orientation of the target to the beam direction. Resonance spectra for transitions from n=1 to n=3,4,5 levels were obtained.

A 46.4 Thu 17:15 BEBEL E34

Switching exciton pulses through conical intersections — •Karsten Leonhardt, Sebastian Wüster, and Jan Michael Rost — Max Planck Institute for the Physics of Complex Systems

Exciton pulses transport excitation and entanglement adiabatically through Rydberg aggregates [1], assemblies of highly excited light atoms, which are set into directed motion by resonant dipole-dipole interaction [1-4]. Here, we demonstrate the coherent splitting of such pulses as well as the spatial segregation of electronic excitation and atomic motion [5]. Both mechanisms exploit local non-adiabatic effects at a conical intersection, turning them from a decoherence source into an asset. The intersection provides a sensitive knob controlling the propagation direction and coherence properties of exciton pulses.

References

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A 46.5 Thu 17:30 BEBEL E34

Cooling Relativistic Ion Beams of initially large Momentum Spread with a fast scanning cw Laser System — •Michael Bussmann[1], Danyal Winters[2], Weiqiang Wen[3], Christina Dimopoulou[2], Tino Giacomini[2], Christophor Kozhuharov[2], Thomas Kühl[2,4,5], Yuri Litvinov[2], Matthias Lochmann[2,4], Wilfried Nörtershäuser[2,6], Fritz Nolden[2], Rodolfo Sánchez[2,6], Shahab Sanjari[2], Markus Steck[2], Thomas Stöhlker[2,5,7], Johannes Ullmann[2,6], Tobias Beck[6], Gerhard Birkl[6], Benjamin Rein[6], Sascha Tichelmann[6], Thomas Walther[6], Xinwen Ma[3], Dacheng Zhang[3], Markus Löser[1], Michael Seltmann[1], Matthias Siebold[1], and Ulrich Schramm[1,8] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]GSI Darmstadt — [3]Institute of Modern Physics, Chinese Academy of Science, Lanzhou — [4]Uni Mainz — [5]HI Jena — [6]TU Darmstadt — [7]Uni Jena — [8]TU Dresden

We present new results from a recent experiment on laser cooling of relativistic bunched ion beams at the Experimental Storage Ring at GSI. Our results show laser cooling with a single solid-state cw laser system with a laser frequency scanning range larger than the bucket acceptance. This technique is of great importance for future storage ring facilities such as FAIR and HIAF, as it allows for all-optical beam cooling of initially hot ion beams without the need for pre-electron cooling or stochastic cooling.

A 46.6 Thu 17:45 BEBEL E34

Quantum phases of quadrupolar Fermi gases on a quasi one-dimensional system — •Wen-Min Huang[1,2], Martin Lahrz[1], and Ludwig Mathey[1,2] — [1]Center for Optical Quantum Technologies and Institute for Laser Physics University of Hamburg, 22761 Hamburg, Germany — [2]Hamburg Centre for Ultrafast Imaging, Luruper Chaussee 149, Hamburg 22761, Germany

In this work, we study quantum phases diagrams of polar fermions with a pure interquadrapolar interaction on two one-dimensional tubes. In the framework of Tomonaga-Luttinger-liquid theory, we map out the phases diagrams with reasonable experimental parameters versus the distance of two tubes and the angle between the direction of the tubes and quadrupolar moments. The latter can be controlled by an exter-

nal field in experiments. We show that there are two magic angles from 0 to $\pi/2$, where intratube quadrupolar interactions vanish and change signs. Between two magic angles, a two gapless Tomonaga-Luttinger liquids exhibit under a dominated intratube attraction. By further computing various correlation functions, we show that a polarized triplet superfluid and a planer (pseudo-)spin-density wave compete each other. Outside of the regime, both intratube and intertube interactions are repulsive. Under the renormalization-group transformation in weak couplings, a flow to strong coupling of the backward scattering between two tubes lead to a pseudo-spin-gapped state with an axial-(pseudo-)spin-density-wave correlation in low-energy limit.