A 12: Interaction of matter with ions I

Time: Tuesday 14:00–15:30 Location: BAR 106

Invited Talk A 12.1 Tue 14:00 BAR 106

Dissociative charge transfer into molecular ions — •Lothar Ph. H. Schmidt, Reinhard Dörner, and Horst Schmidt-Böcking — Institut für Kernphysik, Goethe-Universität Frankfurt am Main

The dissociative electron transfer from He into slow hydrogen molecular ions was measured in a kinematically complete experiment by using cold target recoil ion momentum spectroscopy (COLTRIMS) in combination with a molecular fragment imaging technique. Neutral molecules produced by electron capture into an excited electronic state dissociate in a second step of the reaction.

We were able to determine the initial vibration energy from the measured momenta. The vibrationally excited states yield a multi peak structure in the measured kinetic energy releases (KER) distribution. We used several models as the reflection approximation to reconstruct the square of the initial nuclear wave functions.

In case of close collisions between the molecule and the helium atom we find a striking two center interference pattern in the He transverse momentum distribution. From that - just as for the case of an optical double slit experiment - we can infer the distance between the scattering centers. We observed a correlation between the interference pattern and the selected KER as expected from the reflection approximation.

Using HD^+ labels the molecular scattering centers by the isotope mass. This does not lead to a loss of interference fringe contrast, but modifies the interference pattern which can be explained by a breakdown of the axial recoil approximation.

A 12.2 Tue 14:30 BAR 106

Manipulating Atomic Fragmentation Processes by Controlling the Projectile Coherence — Kisra Egodapitiya[1,2], •Aaron LaForge[1,2], Sachin Sharma[1], Ahmad Hasan[3], Robert Moshammer[2], Daniel Fischer[2], Don Madison[1], and Michael Schulz[1] — [1]Dept. of Physics, Missouri University of Science & Technology , Rolla, USA — [2]Max Planck Institut für Kernphysik, Heidelberg, DE — [3]Dept of Physics, United Arab Emirates University, Abu Dhabi, UAE

We have performed an atomic collision version of Young*s double slit experiment. The scattering angle dependence of double differential cross sections for ionization of H2 by 75 keV proton impact for a fixed projectile energy loss was studied. Depending on the coherence of the projectile beam, an interference due to indistinguishable diffraction of the projectile from the two atomic centers was either present or absent in the data. The results have far-reaching implications on several decades of atomic scattering theory.

A 12.3 Tue 14:45 BAR 106

Das PRIOC-Experiment: Präzisionsexperimente in Atom-Ionen-Stössen — •Renate Hubele, Dominik Globig, Aditya Kelkar, Aaron LaForge, Katharina Schneider, Martin Sell, Xincheng Wang und Daniel Fischer — Max-Planck Institut für Kernphysik, Heidelberg

Zur detaillierten Untersuchung der korrelierten Mehrteilchendynamik in Ion-Atom-Stössen wird am MPIK gerade ein Experiment entwickelt, bei welchem erstmals drei unterschiedliche Techniken kombiniert werden sollen. Diese Kombination aus einem elektronengekühlten Ionenstrahl in einem Speicherring, einem Reaktionsmikroskop zur kinematisch vollständigen Untersuchung von Fragmentationsprozessen und dem ultrakalten Lithium-Target einer magneto-optischen Falle wird es in Zukunft ermöglichen, die Dynamik z.B. in Ionisationsprozessen mit einer bisher unerreichten Auflösung zu untersuchen. Die experimentelle Herausforderung bei MOT-REMI-Experimenten - also der Verbindung aus einem Reaktionsmikroskop mit einer Magneto-Optischen Atomfalle - besteht insbesondere bei der Detektion niederenergetischer Elektronen darin, dass das magnetische Quadrupolfeldes der MOT mit dem homogenen Magnetfeld des Reaktionsmikroskopes nicht vereinbar ist, bzw. dass diese Felder daher äusserst schnell geschaltet werden müssen. Der Aufbau und erste Testmessungen mit dem neuen Spektrometer werden vorgestellt.

A 12.4 Tue 15:00 BAR 106

Two-electron transfer in collisions of highly charged ions with ultracold Na atoms — •Ina Blank[1], Corine Meinema[1], Ronnie Hoekstra[1], Simone Götz[2], Bastian Höltkemeier[2], and Matthias Weidemüller[2] — [1]KVI, Atomic and Molecular Physics, Zernikelaan 25, NL-9747 AA Groningen, the Netherlands — [2]Physikalisches Institut, Universität Heidelberg, Philosophenweg 12, D-69120 Heidelberg, Germany

The process of two-electron transfer in collisions of ions with atoms is an example of many-particle dynamics of a Coulomb system. We have investigated two-electron transfer in collisions of O^{6+} with Na(3s). The electron transfer is studied by precisely measuring the momentum of the recoils ions. The target is provided by a magneto-optical trap. Two different reaction mechanisms are observed: Final states O^{4+}(3ln'l') with n'≥5 are created by sequential electron transfer, while the two electrons captured into the O^{4+}(3l3l') states are transferred simultaneously. Energy dependent measurements reveal an increase of the simultaneous electron transfer with decreasing energy.

A 12.5 Tue 15:15 BAR 106

Energy loss and charge-transfer of heavy ions in laser-generated plasma — Alexander Frank[1], A. Blazevic[2], M. Basko[3], P. L. Grande[4], •M. Börner[1], W. Cayzac[1], T. Hessling[2], G Schiwietz[5], D. Schumacher[1], An. Tauschwitz[6], and M. Roth[1] — [1]TU Darmstadt — [2]GSI Darmstadt — [3]ITEP, Moscow — [4]Universidade Federal do Rio Grande do Sul, Brazil — [5]Helmholtz-Zentrum Berlin — [6]Universität Frankfurt

At GSI the plasma physics group is investigating the differences in the interaction processes of swift heavy ions penetrating either cold matter or hot and dense laser-generated plasma. The plasma target is created by direct laser irradiation of a target foil. This scheme produces high temperatures and hence high ionization degrees. A new spectrometer based on CVD diamond was developed for measuring the projectile charge state distribution exiting the target and energy loss at the same time. The experiments carried out on very thin carbon foils resulted in cross sections for the charge transfer processes. These cross sections were recalculated for plasma conditions. The combination of the projectile charge states in plasma and the corresponding stopping power calculated by a modified version of the CasP code allows to reproduce the measured energy losses and charge distributions and consequently to explain the differences between hot and cold matter. A special focus in the theoretical description is laid upon modeling the relevant charge transfer and energy loss processes and not relying on an effective charge description which will be presented in this talk.