A 16: Atomic Clusters I (joint session A/MO)

Time: Monday 16:15–17:45 Location: K 2.016

Invited Talk A 16.1 Mon 16:15 K 2.016

Halo states in helium dimers/trimers — •Reinhard Doerner[1], Maksim Kunitski[1], Stefan Zeller[1], Lothar Schmidt[1], Till Jahnke[1], Markus Schöffler[1], Dörte Blume[2], Jörg Voitsberger[1], Florian Trinter[1], and Anton Kalinin[1] — [1]Goethe Universität Frankfurt Germany — [2]Washington State University USA

We will show experimental imaging the Helium dimer, trimer and the Efimov state of He3. We will also show movies of the rotational response of halo states to a nonresonant short laser pulse.

A 16.2 Mon 16:45 K 2.016

Rotating rotationless: nonadiabatic alignment of the helium dimer — •Maksim Kunitski[1], Qingze Guan[2], Stefan Zeller[1], Dörte Blume[2], and Reinhard Dörner[1] — [1]Institut für Kernphysik, Goethe-Universität Frankfurt am Main — [2]Department of Physics and Astronomy, University of Oklahoma

Quantum mechanically rotational and vibrational dynamics in molecules is time evolution of corresponding wave packets. Such dynamics can be periodic, as well-known rotational and vibrational revivals with wave packets consisting of many coherently prepared bound states. How the rotational and vibrational dynamics would look like in a molecular system with a single bound state? One of such extreme quantum system is the helium dimer, where the two-body potential supports only one state.

We applied the nonadiabatic "kick" to the helium dimer by a femtosecond laser pulse (pump) and watched evolution of the system by Coulomb explosion imaging, which was initiated by the second much more intense delayed probe pulse. The observed time-dependent alignment of the helium dimer, as well as time evolution of the rovibronic wave packet, is going to be discussed.

A 16.3 Mon 17:00 K 2.016

Evidence of angulon quasiparticles formation in superfluid ^{4}He nanodroplets — •Igor Cherepanov, Giacomo Bighin, and Mikhail Lemeshko — IST Austria (Institute of Science and Technology Austria), Am Campus 1, 3400, Klosterneuburg, Austria

Quasiparticles are a core concept in many-body physics widely used for solving quantum impurity problems [1]. Models based on quasiparticles serve as an alternative to theories implying extensive numerical calculations. Moreover, they provide a more straightforward and intuitive understanding of complex phenomena taking place in many-body systems. Here we present the evidence for the formation of angulon quasiparticles [2] in experiments on trapping molecules in superfluid ^{4}He nanodroplets. The angulon consists of a rotating impurity (such as a molecule) dressed by a field of surrounding bath excitations (phonons, rotons etc.). Anisotropic interactions of the impurity with helium give rise to a number of many-body effects, such as angulon instabilities – resonant transfer of a small amount of angular momentum from the molecule to the superfluid. We demonstrate that broadening and splitting of spectral lines as well as a violation of rotational selection rules can be explained by means of angulon instabilities [3]. Furthermore, the dynamical emergence of angulon instabilities affects the time evolution of a rotational wavepacket and therefore may be detected in experiments on impulsive molecular alignment in ^{4}He droplets.

[1] M. Lemeshko, Phys. Rev. Lett. **118**, 095301 (2017)
[2] R. Schmidt, M. Lemeshko, Phys. Rev. Lett. **114**, 203001 (2015)
[3] I. Cherepanov, M. Lemeshko, Phys, Rev. Materials **1**, 035602 (2017)

A 16.4 Mon 17:15 K 2.016

Decoherence in the dissociation of the alkali-helium droplet system — •Marcel Binz, Lukas Bruder, Ulrich Bangert, Daniel Uhl, and Frank Stienkemeier — Institute of Physics, University of Freiburg, Germany

The intriguing properties of the alkali (Ak)-helium droplet system have been extensively studied in the past by several groups. The broadened Ak absorption lines were successfully explained by a pseudo-diatomic molecule model, and the dissociation of this pseudo molecular system was studied in detail with fs pump probe experiments. As an intriguing aspect of the dissociation, we have in a recent study investigated the temporal evolution of an electronic coherence induced in the parent system and follow this evolution in the desorbing Ak atom. For this purpose, we have applied coherent nonlinear spectroscopy to our helium droplet machine. Our scheme is particularly sensitive to the time evolution of coherences and allows us to follow the dissociation with high spectro-temporal resolution.

A 16.5 Mon 17:30 K 2.016

Resonante Ionisation dotierter Heliumtropfen — •Michael Kelbg[1], Lev Kazak[1], Michael Zabel[1], Andreas Heidenreich[2], Josef Tiggesbäumker[1] und Karl-Heinz Meiwes-Broer[1] — [1]Universität Rostock, Inst. f. Physik, Rostock, Germany — [2]Ikerbasque, Basque Foundation for Science, Bilbao, Spain

Heliumtropfen sind für NIR-Laserpulse transparent und können erst bei hohen Intensitäten durch Feldionisation ionisiert werden. Durch eine Dotierung des Tropfens mit Metallen oder anderen Edelgasen als Ionisationskeim ist es jedoch bereits für deutlich niedrigere Intensitäten möglich den gesamten Heliumtropfen lawinenartig zu ionisieren. Besonders effektiv wird dieser Prozess durch Anregung mittels zwei getrennter Pulse, wobei der erste Puls ein Plasma erzeugt, und der zweite Puls dann durch Erreichen der Bedingungen für die Mie-Resosanz einen optimalen Energietransfer ermöglicht.

Eine Dotierung mit Xenon führt zu einem leicht zu ionisierendem Cluster im Zentrum des Heliumtropfens. Die Effektivität einer resonanten Anregung äußert sich hier durch die Erzeugung von sehr hohen Ladungszuständen des Xenons bis zu Xe23+. Ein völlig anderes Bild zeigt sich bei Dotierung mit Magnesium. Dieses bildet zunächst einen sogenannten Magnesiumschaum, bei dem die einzelnen Magnesiumatome im Abstand von 10 Å voneinander in einem metastabilen Zustand verharren. Durch Anregung des Magnesiums unterhalb der Ionisationsenergie lässt sich ein Kollaps des Magsiumschaums induzieren.

Zuletzt wird die Elektronenemission aus dem Tropfen bei unterschiedlicher Dotierung und Anregung untersucht.