MO 1: Quantum-Control

Time: Monday 10:30–11:30 Location: MO-H5

MO 1.1 Mon 10:30 MO-H5

Coherent control of molecular nitrogen ionization — •Aaron Ngai[1], Matteo Bonanomi[2,3], Lukas Bruder[1], David Busto[1,4], Carlo Callegari[5], Paolo Carpeggiani[6], Giovanni De Ninno[5,7], Michele Devetta[2], Michele Di Fraia[5], Katrin Dulitz[1], David Facciala[2], Luca Giannessi[5,8], Alexei Grum-Grzhimailo[9], Elena Gryzlova[9], Kenichi L. Ishikawa[10,11], Ioannis Makos[1], Praveen K. Maroju[1], Tommaso Mazza[12], Michael Meyer[12], Paolo Piseri[3], Oksana Plekan[5], Kevin C. Prince[5,13], Giuseppe Sansone[1], Simone Spampinati[5], Frank Stienkemeier[1], Kiyoshi Ueda[14], and Caterina Vozzi[2] — [1]Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Germany — [2]Istituto di Fotonica e Nanotecnologie, CNR, Milano, Italy, — [3]Dipartimento di Fisica and CIMaINa, Universitá degli Studi di Milano, Italy — [4]Department of Physics, Lund University, Sweden — [5]Elettra - Sincrotrone Trieste S.C.p.A., Basovizza, Trieste, Italy — [6]Institut für Photonik, Technische Universität Wien, Austria — [7]Laboratory of Quantum Optics, University of Nova Gorica, Slovenia — [8]Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali di Frascati, Italy — [9]Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Russia — [10]Graduate School of Engineering, The University of Tokyo, Japan — [11]Research Institute for Photon Science and Laser Technology, The University of Tokyo, Japan — [12]European XFEL, Schenefeld, Germany — [13]Department of Chemistry and Biotechnology, School of Science, Swinburne University of Technology, Australia — [14]Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, Japan

We investigated the coherent control of molecular photoionization by using phase-locked first and second harmonic radiation from the Free-Electron Laser FERMI. As in the case of atomic coherent control [1, 2], interference between single-photon and two-photon ionization of the valence electrons was observed, and was manifested as asymmetry in the photoelectron angular distributions. Oscillations of this asymmetry were observed as a function of the relative phase difference between the two wavelengths. In our recent experimental campaign, we used a gas mixture of molecular nitrogen and atomic neon, with the neon serving as a reference target. We impulsively aligned the nitrogen molecules in the cold molecular beam using infrared pulses, and measured the photoelectron angular distributions using a Velocity Map Imaging spectrometer. Here we present preliminary experimental results as well as preliminary results from theoretical calculations.

[1] K. C. Prince *et al. Nat. Photonics* **10**, 176 (2016).
[2] D. You *et al. Phys. Rev. X* **10**, 031070 (2020).

MO 1.2 Mon 10:45 MO-H5

Channel- and Full Angle-Resolved Strong-Field Ionization and Electron Rescattering Probabilities in the Molecular Frame — •Federico Branchi[1], Felix Schell[1], Tilmann Ehrlich[1], Mark Mero[1], Horst Rottke[1], Varun Makhija[2], Serguei Patchkovskii[1], Marc J. J. Vrakking[1], and Jochen Mikosch[1] — [1]Max-Born-Institut, Berlin, Germany — [2]Univ. of Mary Washington, Fredericksburg, USA

By analyzing lab frame coherent rotational wavepacket evolution in a reaction microscope experiment [1] we measure the angle- and channel-resolved ionization and electron rescattering probabilities in the asymmetric-top molecule 1,3-butadiene. With this approach we achieve both polar and azimuthal angle-resolved molecular frame information, in contrast to previous works [2,3].

Our results indicate that the nodal structure of the ionizing orbitals is more strongly reflected in the electron rescattering probability rather than in the ionization probability. The molecular frame electron rescattering probability is significantly influenced by structured, channel-specific continuum electron wavepackets. Experimental results are compared with results from a TD-RIS [4] ab-initio simulation.

[1] Wang et al., Phys. Rev. A 96, 023424 (2017)
[2] Mikosch et al., Phys. Rev. Lett. 110, 023004 (2013)
[3] Schell et al., Sc. Adv. 4, 5 aap8148 (2018)
[4] Spanner and Patchkovskii, Phys. Rev. A 80, 063411 (2009)

MO 1.3 Mon 11:00 MO-H5

quantum state control of chiral molecules — •juhyeon lee[1], johannes bischoff[1], alicia o. hernandez-castillo[1], boris sartakov[1,2], gerard meijer[1], and sandra eibenberger-arias[1] — [1]Fritz-Haber-Institut der Max-Planck-Gesellschaft, Department of Molecular Physics, Faradayweg 4-6, D-14195 Berlin — [2]Prokhorov General Physics Institute, Russian Academy of Science, Vavilovstreet 38, 119991, Moscow, Russia

Recently, the enantiomer-specific state transfer (ESST) method [1] was demonstrated using tailored microwave fields. This method allows to populate or depopulate a rotational state of a chosen enantiomer, providing a way of quantum-controlled chiral separation. Thus far, the transfer efficiency of ESST has been limited by thermal population of the energy levels participating in ESST [1,2] and by spatial degeneracy [3]. To address these prior limitations, we developed a new experimental scheme which increases the efficiency of ESST by over a factor of ten compared to previously reported values [4]. This scheme enables a quantitative comparison between experiment and theory for the transfer efficiency in the simplest ESST triangle which includes the absolute ground state level. Details of this scheme and experimental results will be discussed in the presentation.

[1] S. Eibenberger, et al., Phys. Rev. Lett. 118, 123002 (2017)
[2] P. Cristóbal, et al., Angew. Chem. Int. Ed. 56, 12512 (2017)
[3] M. Leibscher, et al., arXiv:2010.09296 (2020)
[4] J. H. Lee, et al., arXiv:2112.09058 (2021)

MO 1.4 Mon 11:15 MO-H5

Atom-molecule and molecule-molecule collisions in ultracold quantum gas mixtures of 39K atoms and rovibronic 23Na39K ground-state molecules — •Philipp Gersema[1], Mara Meyer zum Alten Borgloh[1], Kai Konrad Voges[1], Torsten Hartmann[1], Leon Karpa[1], Alessandro Zenesini[2], and Silke Ospelkaus[1] — [1]Leibniz Universität Hannover, Institut für Quantenoptik — [2]Universita di Trento, Dipartimento di Fisica

Ultracold heteronuclear molecules enable the study of fascinating new physical phenomena in the quantum realm. These arise from the degrees of freedom of vibration and rotation and the large permanent dipole moment of heteronuclear molecules. However, especially for the investigation of novel phenomena in quantum many-body physics, a precise understanding of the collision properties of heteronuclear polar molecules is mandatory. Here we report on our experiments on collisions in pure quantum gases of bosonic NaK molecules and atom-molecule mixtures. We discuss photoinduced collisional processes and hyperfine dependent atom-molecule scattering and report on our progress towards photoassociation of weakly bound triatomic NaK2 molecules.