SYPS 1: Velocity map imaging - focusing on intra- and interatomic dynamics 1

Time: Thursday 14:00–15:55 Location: Audimax

Welcome and introduction

Invited Talk SYPS 1.1 Thu 14:10 Audimax

Oxygen and imaging, a perfect match — •David Parker — Radboud University, Department of Physics, FNWI-IMM-MLF, NIjmegen, The Netherlands

Molecular oxygen, O_2, is fascinating molecule. Despite this, a full understanding of the photodynamics of molecular oxygen is lacking due to the complex electronic structure and the forbidden nature of almost all optical transitions of O_2. Over the past decade our group has been able to reveal many new aspects of O_2 photodynamics due in part to the development and application of the velocity map imaging technique. In this talk I will highlight our past work on the photodissociation of: O_2 super-excited states , the Herzberg continuum6 of O_2, singlet oxygen b-state, the Schumann-Runge continuum, and O_2-isoprene clusters. I will mainly describe new work on the photodissociation of the singlet oxygen a $^1\Delta_g$ -state. Velocity map imaging will be shown to be particularly well-matched to the study of O_2 photodynamics.

Invited Talk SYPS 1.2 Thu 14:40 Audimax

Attosecond imaging — •Marc Vrakking — Max Born Institute (MBI), Berlin

The natural timescale for electron dynamics reaches down to the attosecond domain. Following the discovery of attosecond laser pulses, about a decade ago, attosecond science has developed into a vibrant, new research field, where the motion of single or multiple electrons and, in molecules, the coupling of electronic and nuclear motion, can be investigated, on attosecond to few-femtosecond timescales. Attosecond experiments require suitable observables. In my talk I will describe how "attosecond imaging", basing itself on kinetic energy and angle-resolved detection of photoelectrons and fragment ions using a velocity map imaging (VMI) spectrometer, has been exploited in a number of pump-probe experiments. The use of a VMI spectrometer in attosecond experiments has allowed the characterization of attosecond pulse trains and isolated attosecond pulses, the elucidation of continuum electron dynamics and wave packet interferometry in atomic photoionization and the observation of electron localization in dissociative molecular photoionization.

SYPS 1.3 Thu 15:10 Audimax

Insight in chemical dynamics by three-dimensional momentum imaging — •Robert Siemering[1], Eric Wells[2], Itzik Ben-Itzhak[3], Matthias Kling[4], and Regina de Vivie-Riedle[1] — [1]Ludwig-Maximilians-Universität, München, Germany — [2]Augustana College, Sioux Falls, USA — [3]Kansas State University, Manhattan, USA — [4]Max Planck Institute of Quantum Optics, Garching, Germany

The description of laser pulse interaction with molecules have different constrains for theory and experiment. While adaptive feedback in experiments can manipulate dynamics in molecular systems, the finding of the underlying mechanism or the forming of an appropriate theoretical model is difficult. This is especially the case when the feedback is limited to a single observable. By rapidly inverting velocity map images of ions to recover the three-dimensional photofragment momentum distribution and incorporating that feedback into the control loop, the specificity of the control objective is dramatically increased. As an example in the isomerization of acetylene ($C_2H_2^{2+} \rightarrow CH_2^+ + C^+$) the angle-resolved ratio of CH^+/CH_2^+ was controlled in the experiment[1]. With the experimentally obtained pulses on-the-fly-trajectories were performed to unveils the underlying barrier suppression mechanism. The theoretical model can explain the observed shift to lower kinetic energy release values for the CH_2^+ fragments.

[1] Wells, E., *et al.*, Adaptive Strong-field Control of Chemical Dynamics Guided by Three-dimensional Momentum Imaging, *Nature Communications*, DOI:10.1038/ncomms3895

Invited Talk SYPS 1.4 Thu 15:25 Audimax

Applications of the fast imaging Pixel Imaging Mass Spectrometry camera — •Mark Brouard — Department of Chemistry, University of Oxford

Recent work on the development of a fast imaging camera, known as the Pixel Imaging Mass Spectrometer (or PImMS) camera will be described [1,2]. The talk will focus on example applications of the PImMS camera. These range from studies of molecular photofragmentation [3] using correlation imaging techniques, progress towards three-dimensional velocity map ion imaging, through to imaging mass spectrometry of surfaces [4]. Future potential developments and applications will also be discussed.

[1] A. Nomerotski, M. Brouard, E. Campbell, A. Clark, J. Crooks, J. Fopma, J.J. John, A.J. Johnsen, C.S. Slater, R. Turchetta, C. Vallance, E. Wilman and W.H. Yuen, JINST 5, C07007, (2010). [2] J J John, M Brouard, A Clark, J Crooks, E Halford, L Hill, J W L Lee, A Nomerotski, R Pisarczyk, I Sedgwick, C S Slater, R Turchetta, C Vallance, E Wilman, B Winter and W H Yuen, JINST 7, C08001, (2012). [3] A. T. Clark, J. P. Crooks, I. Sedgwick, R. Turchetta, J. W. L. Lee, J. J. John, E. S. Wilman, L. Hill, E. Halford, C. S. Slater, B. Winter, W.H. Yuen, S. H. Gardiner, M. L. Lipciuc, M. Brouard, A. Nomerotski, and C. Vallance, J. Phys. Chem. A 116, 10897, (2012). [4] M. Brouard, E. Halford, A. Lauer, C. S. Slater, B. Winter, W. H. Yuen, J. J. John, L. Hill, A. Nomerotski, A. Clark, J. Crooks, I. Sedgwick, R. Turchetta, J. W. L. Lee, C. Vallance, and E. Wilman, Rev. Sci. Instrum. 83, 114101, (2012).