Transcript of Interview with the *Molecular Physics* Longuet-Higgins Young Author's Prize Winner – 15th August 2013

Agnes Chu: I have the pleasure of speaking to this year's *Molecular Physics* Longuet-Higgins Young Author's Prize winner, Dr Alex Wiederkehr, who is currently based at ETH Zürich in Switzerland. His winning paper, as chosen by the Editors, is *"Velocity-tunable slow beams of cold O_2 in a single spin-rovibronic state with full angular-momentum orientation by multistage Zeeman deceleration".*

Alex, thank you for taking time out to speak to me. How would you summarise your paper for an undergraduate?

Alex Wiederkehr: In our experiment we decelerated a supersonic beam of paramagnetic, ground-state oxygen molecules by employing the interaction with strong inhomogeneous magnetic fields (>2T) in a process we call multistage Zeeman deceleration. The cold (<1K), velocity-adjustable samples of oxygen molecules produced after more than 90 stages of deceleration were investigated by laser spectroscopy. This method enabled us to investigate the quantum state selectivity of the deceleration process and, in addition, we verified the production of a gas-phase sample of molecular oxygen in a single spin-rovibronic state with full angular-momentum orientation. Such a sample has similar symmetry properties to a right-handed corkscrew or a beam of circularly polarized radiation.

Agnes Chu: What are the practical implications of the research described in your paper?

Alex Wiederkehr: A highly state-selected sample of molecular oxygen can be of direct use for spectroscopic investigations of the molecules because it enables to circumvent the spectral congestions resulting from closely spaced spin-rotational components that are populated in thermal samples.
Furthermore, slow beams of fully polarized oxygen molecules could be used in collision experiments with chiral molecules to investigate whether collisions with two enantiomeric forms have different cross sections.

Agnes Chu: How do you see your research area developing in the future?

Alex Wiederkehr: Multistage Zeeman deceleration and its proven ability to produce cold, state-selected samples of atoms and molecules has to be seen on in the context of a variety of new approaches developed during the last decade to facilitate the production of molecular samples at very low temperatures. These efforts have been driven by a broad range of applications in physics as well as in chemistry, examples being high-resolution spectroscopy, reaction dynamics, but also quantum-information science.
Besides improving the efficiency of the methods, the future focus of the science will shift towards applications, for example, employing the tailor made samples to study processes with a degree of precision and selectivity not accessible previously and exploiting new regimes of interactions within such samples.

Agnes Chu: Who or what inspired you to get involved in this research?

Alex Wiederkehr: I got first exposed to the field of cold atoms and molecules during my diploma thesis, which I did in the group of Professor Esslinger. Fascinated by this growing field I decided to get further involved and I got the great opportunity to do my PhD in the Group of Professor Merkt. There I could work on multistage Zeeman deceleration, a method that has just been experimentally realized for the first time in this group. Inspiration for my research I got mainly through the

stimulating environment in the research group and the various discussions with the people involved in the experiment.

Agnes Chu: Finally, how did you feel winning the Prize and what does this mean to you?

Alex Wiederkehr: For me it's a great honour that I've been awarded the Longuet-Higgins Young Author's Prize. This prize honours an experiment which was both extremely challenging and a true highlight of my PhD thesis. This experiment and with it my PhD thesis, however, would have never been possible without the continuous support of my supervisor Professor Frédéric Merkt and my co-workers Stephen Hogan and Michael Motsch, as well as a lot of technical support from the electronics side, from Hansjürg Schmutz, Markus Andrist, as well as from the mechanical workshops of Josef Agner and Bruno Lambillotte.

Agnes Chu: The winning article was published in *Molecular Physics* Volume 110, issues 15-16. Alex, thank you and all the best with your future endeavours.