TOWARDS MORE ACCURATE MEASUREMENTS OF THE IONIZATION ENERGY OF MOLECULAR HYDROGEN

D. SPRECHER, M. BEYER, J. LIU, and F. MERKT, *ETH Zürich, Laboratorium für Physikalische Chemie, Wolfgang-Pauli-Strasse 10, 8093 Zürich, Switzerland*; E. SALUMBIDES, K. S. E. EIKEMA, W. UBACHS, *Department of Physics and Astronomy, Laser Centre, Vrije Universiteit, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands*; CH. JUNGEN, *Laboratoire Aimé Cotton, CNRS II, Bâtiment 505, Campus d'Orsay, 91405 Orsay Cedex, France*.

With two electrons and two protons, molecular hydrogen is the simplest molecule displaying all features of a chemical bond. H_2 is therefore a fundamental system for testing molecular quantum mechanics and quantum electrodynamics in molecules. The test can be performed by comparing measured and calculated intervals between different rovibronic states of H_2 [a].

Two further quantities that can be used for this test are the dissociation and ionization energies of H_2, and considerable efforts have been invested over more than 80 years to improve the precision and accuracy of experimental and theoretical determination of these two quantities. The current status of the comparison is that the theoretical [b] and experimental [c] values of the ionization and dissociation energies of H_2 agree within the combined uncertainty of 30 MHz (see also [d]).

The factors currently limiting the precision of the experimental determination will be discussed and the strategies that are being implemented towards overcoming these limitations will be presented. A long-term goal is to achieve a precision of better than 15 kHz, which is the ultimate limit imposed on the accuracy of the theoretical determination by the current uncertainty of the proton-to-electron mass ratio.

[a] E. J. Salumbides, G. D. Dickenson, T. I. Ivanov and W. Ubachs, *Phys. Rev. Lett.* **107** (4), 043005 (2011).

[b] K. Piszczatowski, G. Łach, M. Przybytek, J. Komasa, K. Pachuckiand and B. Jeziorski, *J. Chem. Theory Comput.* **5** (11), 3039 (2009).

[c] J. Liu, E. J. Salumbides, U. Hollenstein, J. C. J. Koelemeij, K. S. E. Eikema, W. Ubachs and F. Merkt, *J. Chem. Phys.* **130** (17), 174306 (2009).

[d] D. Sprecher, Ch. Jungen, W. Ubachs and F. Merkt, *Faraday Discuss.* **150**, 51 (2011).