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Precision measurements in molecular hydrogen

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Few-electron molecules are attractive systems for precision spectroscopy because their properties can be calculated with high accuracy by quantum-chemical methods.[1,2,3] The measurements serve to test theoretical predictions, ideally at the level where their accuracy is limited by the uncertainties of the fundamental constants or by unrecognized physical effects. I will report on precision measurements of energy intervals in cold samples of H_2. In particular, we determine the ionization energy with a precision ($\Delta\nu/\nu$) of 10^{-10} from high-resolution Rydberg spectra[4,5,6] and derive the dissociation energy with an accuracy of 350 kHz, approaching the level where the size of the proton and the uncertainty in the proton-to-electron mass ratio would limit the accuracy of otherwise exact calculations. Comparison will be made to recent theoretical results in the context of a more-than-100-year-long series of experimental and theoretical determinations of the dissociation energy of H_2. I will also discuss the determination of an upper bound for a hypothetical global shift of the energy level structure of ortho-H_2 with respect to that of para-H_2.

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Author: MERKT, Frédéric (ETH Zurich, Laboratory of Physical Chemistry)

Presenter: MERKT, Frédéric (ETH Zurich, Laboratory of Physical Chemistry)

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