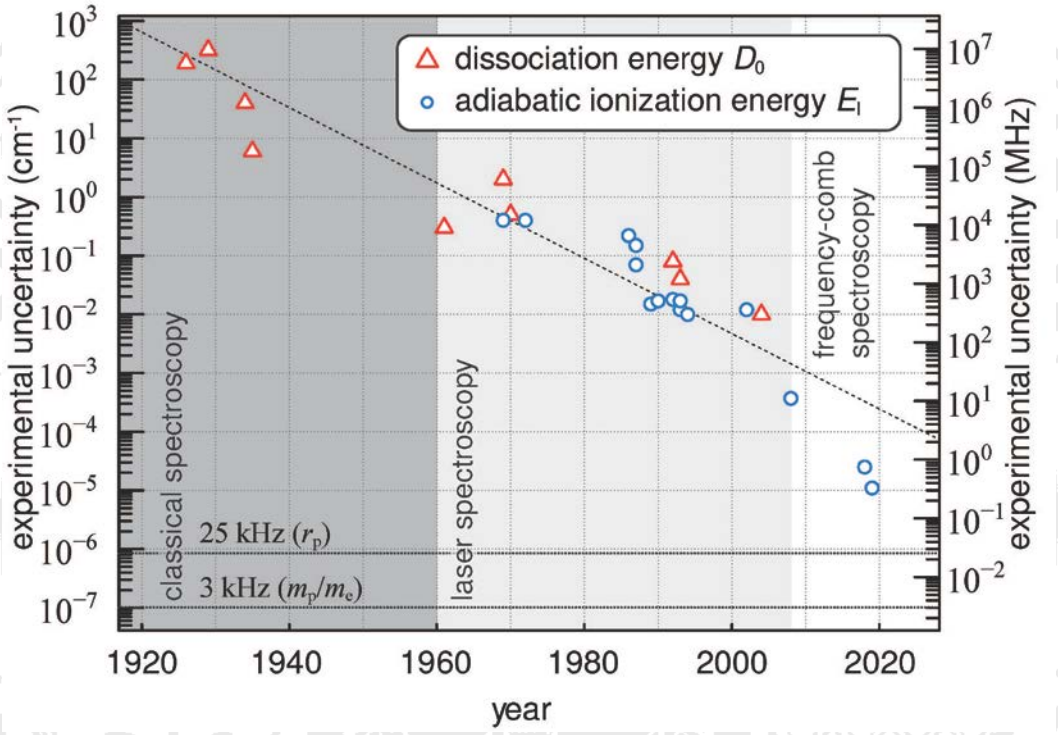
PHYSIKALISCHES KOLLOQUIUM

AM 1. JULI 2019 UM 17 UHR C.T.

IM GROßEN HÖRSAAL



IMPROVEMEMT IN THE UNCERTAINTY OF MEASUREMENTS OF THE DISSOCIATION AND IONIZATION ENERGIES OF THE HYDROGEN MOLECULE OVER THE PAST 100 YEARS

PRECISION SPECTROSCOPY IN FEW-ELECTRON MOLECULES

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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. 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 and metastable He_2. In the case of H_2, we determine the ionization energy with a precision ($\Delta\nu/\nu$) of 10^{-10} from high-resolution Rydberg spectra 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. In the case of He_2, we use multistage Zeeman deceleration to prepare slow, cold metastable molecules in selected spin-rotational components of the metastable *a* state. We exploit the long transit times of these molecules through microwave and laser fields to measure fine-structure intervals in the *a* state, the Rydberg spectrum of He_2, and the energy-level structure of He_2^+.