THE GERADE RYDBERG STATES OF MOLECULAR HYDROGEN

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High-resolution spectroscopic investigations of molecular Rydberg states at different values of the principal quantum number n enable one to study the interaction between the Rydberg electron and the molecular ion core. With increasing n values, the electron motion gradually decouples from the motion of the molecular ion core. The decoupling is accompanied by very characteristic perturbations of the spectral patterns and by spin-rovibronic channel interactions which provide extremely detailed information on the electron-ion system.

We present the results of a combined experimental and theoretical investigation of the s, p, d, and f Rydberg states of molecular hydrogen. Experimentally, high-resolution laser and millimeter-wave spectra of Rydberg states with principal quantum numbers between 30 and 60 have been recorded with a precision of better than 100 kHz. Theoretically, multichannel quantum defect theory has been employed to analyze the spectra: first, eigenquantum defect functions were determined *ab initio* in R-matrix calculations; second, the eigenquantum defect functions were refined until agreement with the experimental data was reached. The s and d Rydberg states of ortho-H_2 are particularly interesting because pronounced, but also subtle, effects caused by the hyperfine structure and by doubly excited states can be studied in considerable detail. The talk will present several examples of interesting and so far unobserved types of perturbations and uncoupling phenomena.