PHOTOLYSIS PRODUCTION AND PRECISION MEASUREMENT OF THE HIGHEST VIBRATIONAL STATES ($v = 14$) AND QUASI-BOUND RESONANCES IN $X^1\Sigma_g^+$ H_2

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Highly excited rovibrational states of H_2 in the $X\ ^1\Sigma_g^+$ electronic ground state are prepared by two-photon photolysis of H_2S [1]. The highest vibrational levels $v = 14, J = 0 - 4$, with a dissociation energy of less than 100 cm^{-1}, and some long-lived quasi-bound resonances (v, J) = (7,21), (8,19), (9,17), and (10,15) are probed through Doppler-free two-photon spectroscopy of $F\ ^1\Sigma_g^+$ - $X\ ^1\Sigma_g^+$ transitions. By compensating AC-Stark shifts, absolute transition frequencies were determined with an accuracy on the order of 90 MHz. From combination differences of the F-X transitions the energy level splittings in the electronic ground state are determined and compared with *ab initio* calculations, including relativistic and QED effects. This study extends precision test of QED theory for the electronic ground state of the hydrogen molecule to the very highest bound level, and into the quasi-bound region.

[1] K.-F. Lai, M. Beyer, E.J.Salumbides, W. Ubachs, Photolysis production and spectroscopic investigation of the highest vibrational states in H2 ($X^1\Sigma_g^+$ $v = 13, 14$), J. Phys. Chem. A 125, 1221-1228 (2021)