DOUBLE-WELL STATES OF *UNGERADE* SYMMETRY IN H_2: FIRST OBSERVATION AND COMPARISON WITH *AB INITIO* CALCULATIONS.

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The observation of a new class of long-lived outer well states of $ungerade$ symmetry ($B''\,\bar{B}\,^1\Sigma_u^+$) in molecular hydrogen, lying above the ionization threshold, is reported. Rovibrational levels within a potential extended over internuclear separations of $R = 7 - 25$ a.u. are experimentally investigated in a triple resonance scheme involving a tunable extreme ultra violet (XUV) laser, two tunable infrared lasers, and a fourth laser for ionization. Good agreement (< 0.5 cm^{-1}) with updated $ab\ initio$ calculations is found for vibrational levels up to $v = 26$, demonstrating that such calculations can now be extended to this energetic range above ionization, as long as interaction with the Rydberg manifolds is shielded by a barrier. The dynamical behaviour (pre-dissociation and auto-ionization) of this class of 'u' symmetry states is remarkably different from similar outer well states of 'g' symmetry; this phenomenon can be understood from the structure of doubly-excited electronic states.