Low energy electron attachment at sub-meV resolution

A. KORTYNA, Colby College, P.-T. HOWE, M. DARRACH, A. CHUTJIAN, Jet Propulsion Laboratory, California Institute of Technology — Single-photon ionization of rare-gas atoms is used to produce low energy electrons for the study of electron attachment to SF₆. Vacuum ultraviolet laser radiation (λ ≈ 92 nm), produced by nonlinear up-conversion techniques, is tunable in the vicinity of the 2P⁰/₂ ionization threshold of xenon. A beam of xenon atoms thus yields photoelectrons that then scattering from SF₆ target molecules admixed into the xenon beam. The photoelectron energy, $e$, is scanned over the range 0 ≤ $e$ ≤ 84 meV. A Monti Carlo model of the attachment signal, when compared to data, clearly shows that the electron energy distribution is well characterized by a Gaussian width < 100 μeV and that the electron attachment cross section obeys the $e^{-1/2}$ energy dependence expected for s-wave scattering below 5 meV without need for the modification of the Wigner threshold law. At higher energies ($e = 45 ± 1$ meV) resonant structure in the attachment cross section reveals the opening of an inelastic attachment channel associated with one quanta of the $ω₆$ vibrational mode of SF₆ whose excitation energy has been measured previously to be 44.0 ± 0.2 meV. Further investigations into the threshold behavior of the electron attachment cross section are underway.

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