

Internal Energy and Alignment of Dissociation Products after the Resonant Auger Decay of HCl

M. Meyer^{1,2}, S. Aloise^{1,2} and A.N. Grum-Grzhimailo^{1,3}

¹*L.U.R.E., Centre Universitaire Paris-Sud, Bâtiment 209D, F-91898 ORSAY Cedex, FRANCE*

²*CEA/DRECAM/SPAM, CEN Saclay, F-91105 Gif-sur-Yvette, FRANCE*

³*Institute of Nuclear Physics, Moscow State University, Moscow 119899, RUSSIA*

Dispersed fluorescence spectroscopy in the Visible-UV wavelength regime has been used to determine the internal energy of the dissociation products produced upon resonant Cl 2p photoexcitation of HCl molecules. Similar to earlier studies on innershell excited N₂ and N₂O molecules [1, 2], the spectra are characterized by intense emissions from neutral and singly charged atomic fragments. The high spectral resolution in the fluorescence analysis allows us to assign unambiguously the observed lines to transitions of the type Cl⁺ 3p³4p → 3p³4s, 3d and Cl 3p⁴4d,4p → Cl 3p⁴4p, 4s. Excited hydrogen atoms H* (n=3) give rise to strong Balmer H_α-fluorescence at 656nm, which dominates the spectrum recorded upon excitation of the HCl 2p⁻¹3d Rydberg state. The internal energies of the fragments can be directly related to highly excited molecular ions, which are produced after the resonant Auger decay with binding energies of more than 29.5eV. The fluorescence analysis, in particular the observed variation of the relative intensities of lines upon excitation of different Rydberg resonances, provides therefore, compared to the well-established results of Auger electron spectroscopy [3], additional information on the symmetry of the dissociating ionic states. Furthermore, we have analyzed the degree of linear polarization of the fluorescence allowing to deduce the alignment of the emitting species [4]. A strong polarization was observed for transitions from excited hydrogen atoms. After excitation with linearly polarized synchrotron radiation from the SU7 undulator beamline at SuperACO, the initial alignment of the neutral molecule is transferred to the molecular ion and finally to the dissociation products. The measurement of polarization enables us to follow the alignment transfer in the electronic relaxation and in the subsequent dissociation process and offers thereby a sensitive tool to study in a detailed manner molecular dissociation dynamics. A theoretical treatment of the underlying processes is presently under progress.

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