Cross sections for the formation of H(2p) atom via doubly excited states in photoexcitation of para-H$_2$

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1 Introduction

Formation and decay of doubly excited states of H$_2$ has been theoretically and experimentally investigated [1,2]. Recently, it was found that the non-adiabatic transition would play a role in the dissociation of the Q$_2^+\Pi_u$ doubly excited states of H$_2$ and D$_2$ [3,4]. In the present study, we measured cross sections for the formation of H(2p) atom in photoexcitation of para-H$_2$ in the lowest rotational level, $J' = 0$, for obtaining detailed information against the non-adiabatic transition. Only the $3\Sigma_u^+$ states as well as the $1\Sigma_u^+$ states can be populated in photoexcitation from the $J' = 0$ rotational level, while all the dipole allowed states ($2\Pi_u^+$ and $3\Sigma_u^+$) can be formed in photoexcitation of ordinary-H$_2$ at room temperature. It is thus expected that the cross section for the rotationally cold H$_2$ could be different from those for ordinary-H$_2$ since the $3\Pi_u^+$ states interact with the $3\Sigma_u^+$ states differently due to the Kronig’s selection rule [5].

2 Experiment

Linearly polarized light from BL20A beam line was introduced into the gas cell filled with H$_2$. A gas of H$_2$ in the lowest rotational level was obtained by a cryogenic ortho-para hydrogen converter. The gas cell was kept at approximately -186°C by using liquid-N$_2$ during the measurement. The rotational distribution in the sample was checked through measuring high-resolution photoion yield spectra. The Lyman-α photon emitted from the H(2p) atom produced through photoexcitation of H$_2$ were detected.

3 Results and Discussion

Figure 1 shows the cross sections for the formation of H(2p) atom for para-H$_2$ in the lowest rotational level, $J' = 0$. The shape of the cross section curve agrees with that for ordinary-H$_2$ at room temperature within the statistical uncertainty.

References


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