XXIX International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC2015) IOP Publishing
Journal of Physics: Conference Series **635** (2015) 112019 doi:10.1088/1742-6596/635/11/112019

H_n^+ Ejection from Aligned CH_3Cl Molecules in Intense *fs* Laser Fields

Sizuo Luo[1*], Lanhai He[*], Xiaokai Li[*], Wenhui Hu[*], Pan Ma[*], Chuncheng Wang* and Dajun Ding[2*]

[*] *Institute of Atomic and Molecular Physics, Jilin University, Changchun 130012, P R China*

Synopsis We report experimental results on strong-field laser interact with aligned CH_3Cl molecules, the ejection of fragments H_n^+ dependent on alignment of CH_3Cl molecules has been studied. The mechanism of fragmentation builds on the alignment sensitive ionization and dissociation from inner and outer valence orbitals or the excitation process of molecular have been discussed.

The study on the ejection of H_n^+ from Hydrocarbon molecules is very important which is related to many photophysical processes such as proton migration, deformation, and other ultrafast processes [1]. This phenomenon has been studied for different molecules in intense laser fields, such as CH_3OH, C_mH_n, and CH_3Cl [2].For further understanding of the underlying mechanism, a deep investigation with elaborated measurement is required.

We have studied the different fragment ejections, using CH_3Cl as an example, and focus on the effect of orbitals or the excitation process on the fragment ejection of polyatomic molecules in intense laser initiate dynamics. We performed the experiment for field-free aligned CH_3Cl molecules from *fs* laser impulsive interaction. We align the rotation state selected CH_3Cl from a hexapole Stark selector by using a linearly polarized laser, with a stretched pulse of 300 *fs*, at the intensity of 3×10^{12} W/cm^2. The aligned molecules were ionized or dissociated by a 50 *fs* laser as a probe in the intensity range from 1×10^{13}- 4×10^{14} W/cm^2, and the alignment dependence of strong field ionization and dissociation yields were measured, as shown in Figure 1.

The alignment dependence of fragment ions Cl^{2+}, H_n^+ (n=1,2,3) are given in Fig. 1 (a)-(d), respectively. It is interesting to notice that H^+ and H_2^+ show the same alignment dependence as the case of Cl^{2+}, giving a larger yield in the direction of the probe laser polarization parallel to the molecular axis. But H_3^+ gives a prefer yield in the direction of the probe laser polarization perpendicular to the molecular axis, just like the parent ion. The ion yields H_n^+ of alignment and anti-alignment as a function of the laser intensity were also measured and the results are given in Figure 1(e)-(g). For H^+ and H_2^+, the ion yield for the aligned molecules is larger than that for anti-aligned molecules almost for the whole laser intensity region. The signal of H_3^+ is almost the same when laser intensity below 1.6×10^{14} TW, and as increasing the laser intensity the signal is stronger when probe laser is perpendicular than parallel to the molecular axis. Futhermore, H_n^+ ejection was controlled by manipulating the molecular alignment. The same dependence of the ejected H_3^+ and CH_3Cl^+ on the alignment observed indicates that H_3^+ is ejected from CH_3Cl^{2+}, produced by sequence double ionization.

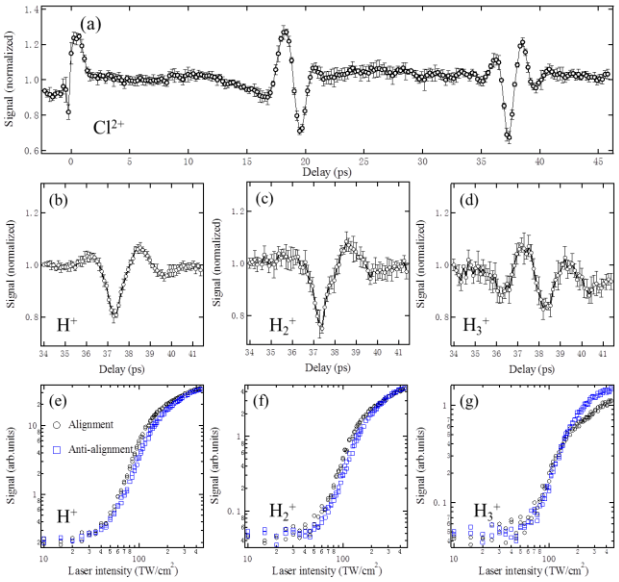

Figure 1. The delay dependent of the yields of signal produced from different fragmentation channels Cl^{2+}, H_n^+ (n=1,2,3) (a)-(d). (e)-(g) is ion intensities of H_n^+ (n=1,2,3) dissociated from aligned and anti-aligned molecules as a function of laser intensity.

References

[1] Y. H. Jiang *et al* 2010 *Phys. Rev. Lett.* 105 263002.

[2] E. Wells *et al* 2013*Nat. Comms* 4 2895.

[1]E-mail: luosz12@mails.jlu.edu.cn

[2]E-mail: dajund@jlu.edu.cn