SCIENCE
PASSION
TECHNOLOGY

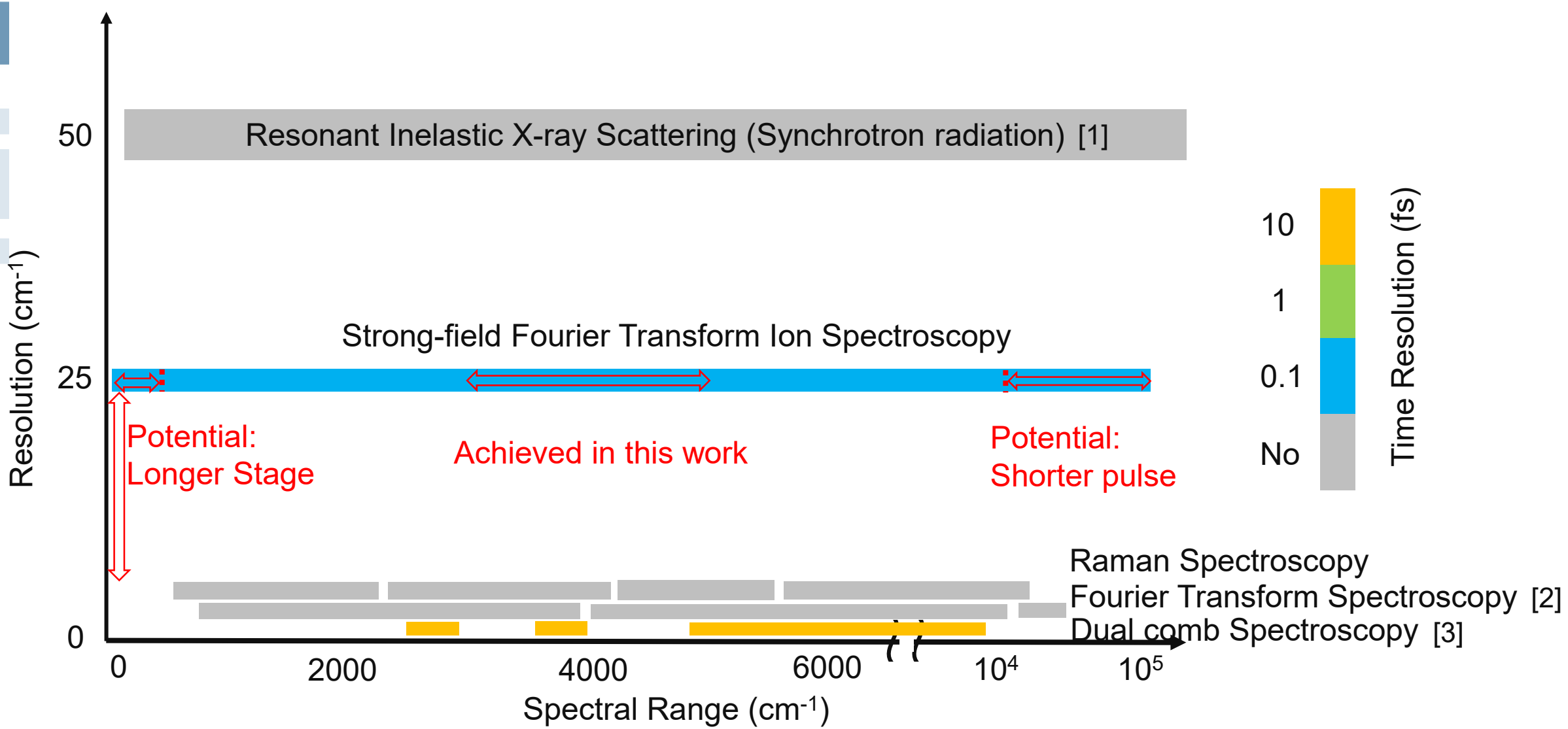
Strong-field Fourier-Transform Ion Spectroscopy

Speaker: Zhenhao Wang, MSc BSc

Supervisor: Martin Schultze, Dr.rer.nat.habil

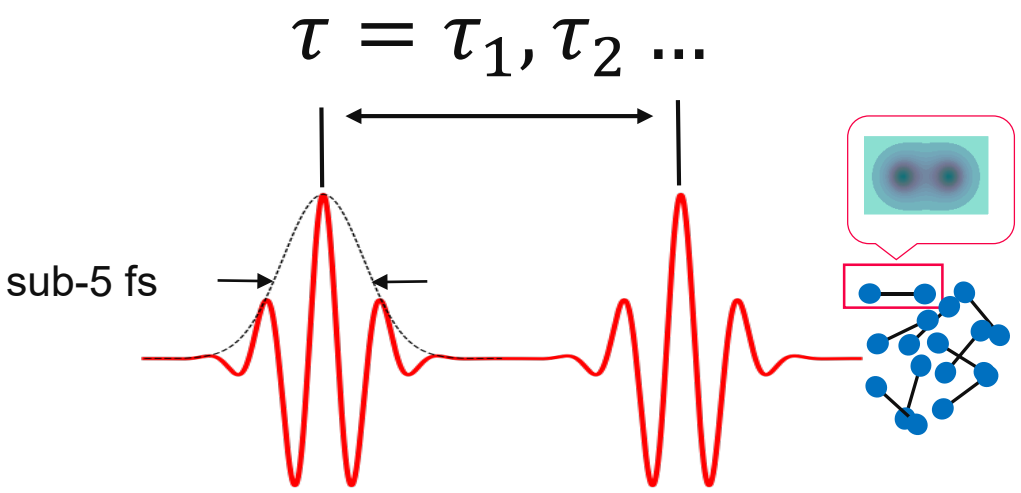
Institute of Experimental Physics

Spectral range of several kinds of spectroscopy



Reference: [1] F. Hennies *et al.*, *Phys. Rev. Lett.*, vol. 104, no. 19, p. 193002, May 2010.
[2] A. Thorne, *Phys. Scr.*, vol. 1996, no. T65, p. 31, Jan. 1996.
[3] I. Coddington, N. Newbury, and W. Swann, *Optica, OPTICA*, vol. 3, no. 4, pp. 414–426, Apr. 2016.

Principle of the experiment

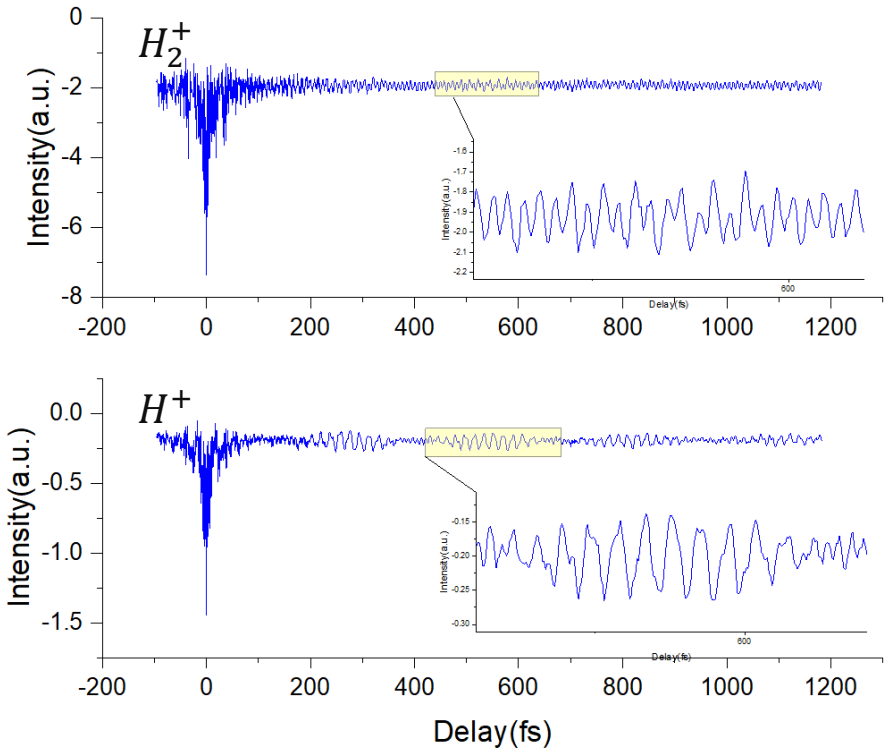


Maximum intensity: 9E14 W/cm^2

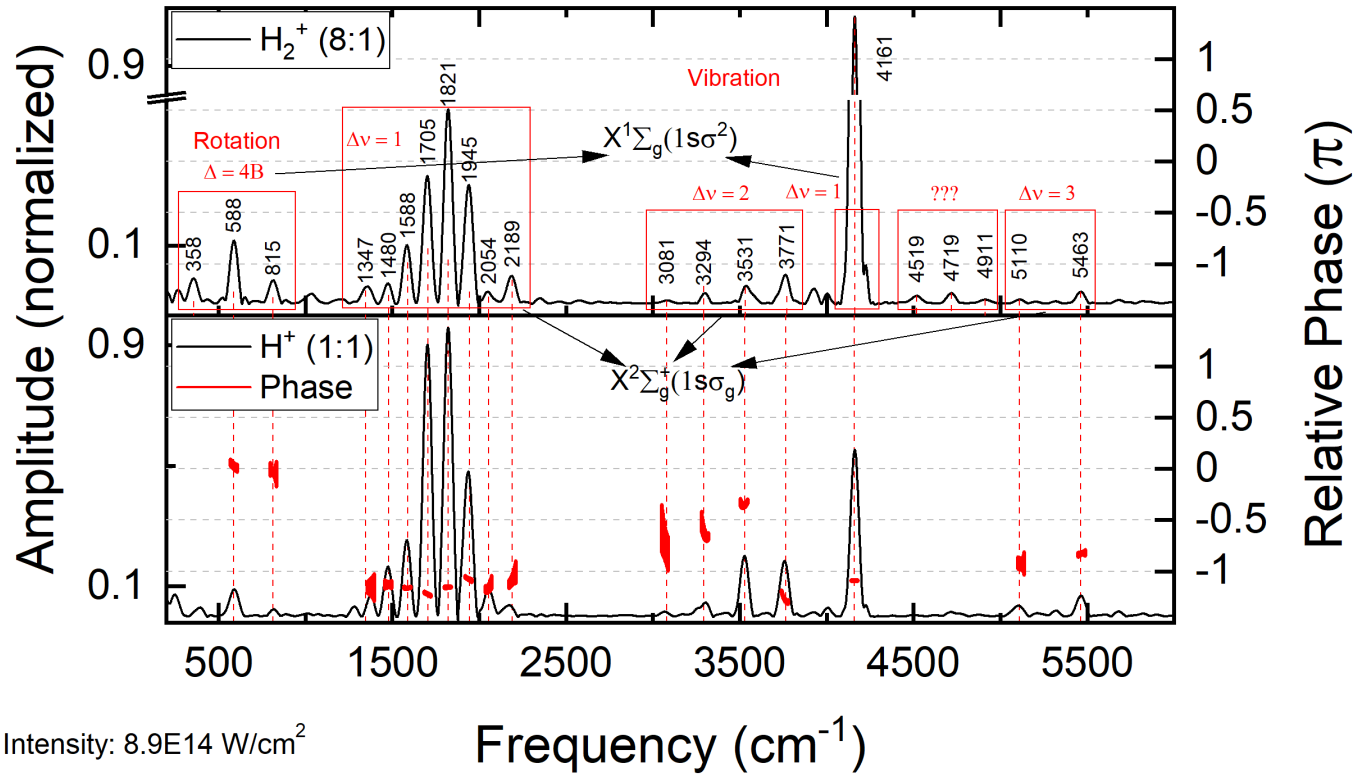
Ion detection

Yield of H^+, H_2^+
@ $\tau = \tau_1, \tau_2 \ldots$

Ion yield at various time delay



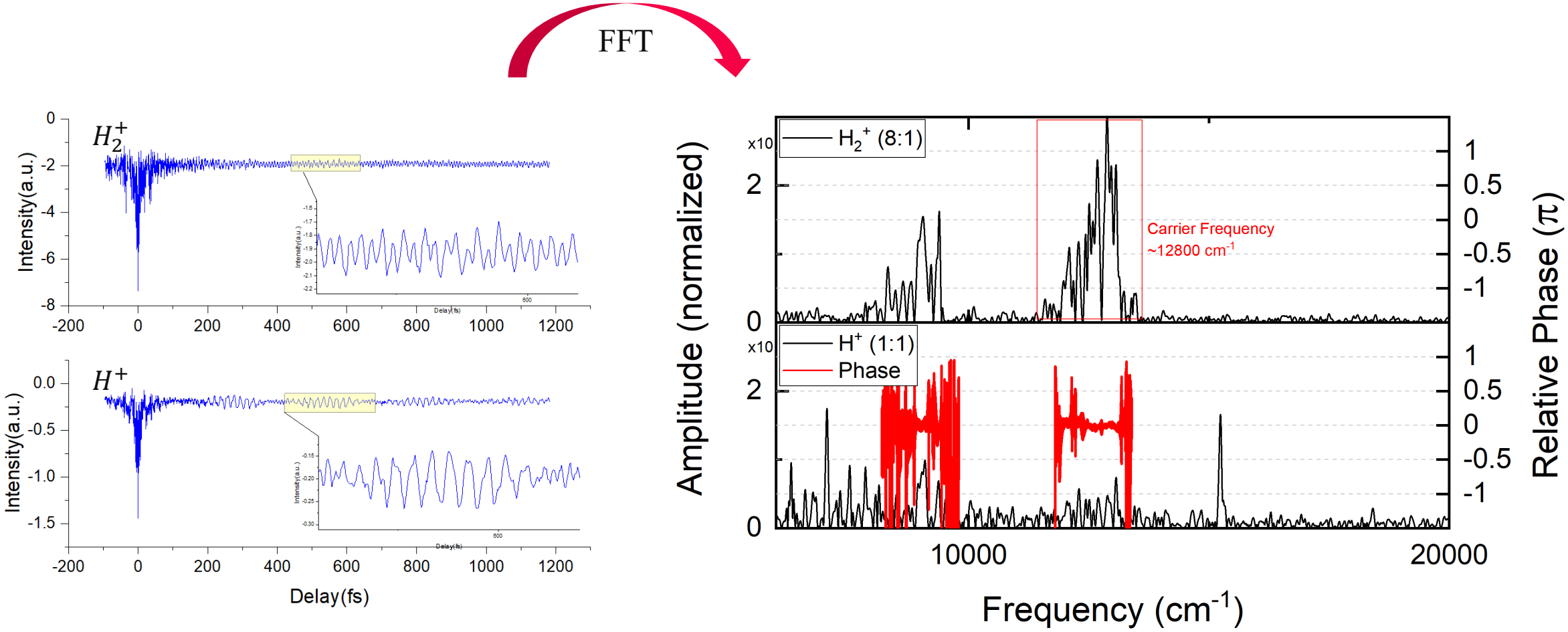
FFT



Intensity: 8.9E14 W/cm^2

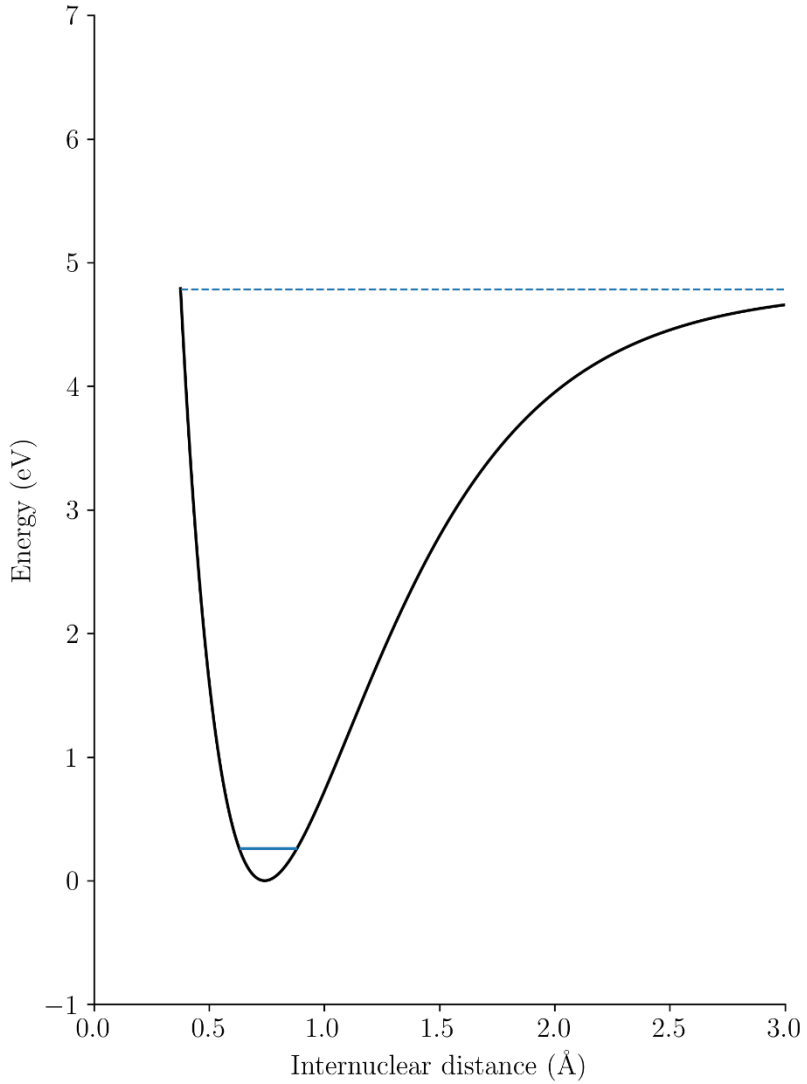
Reference: Y. Mi *et al.*, *Phys. Rev. Lett.*, vol. 125, no. 17, p. 173201, Oct. 2020; L. Wolniewicz, *Journal of Molecular Spectroscopy*, vol. 63, no. 3, pp. 537–546, Dec. 1976; NIST Chemistry WebBook, SRD 69

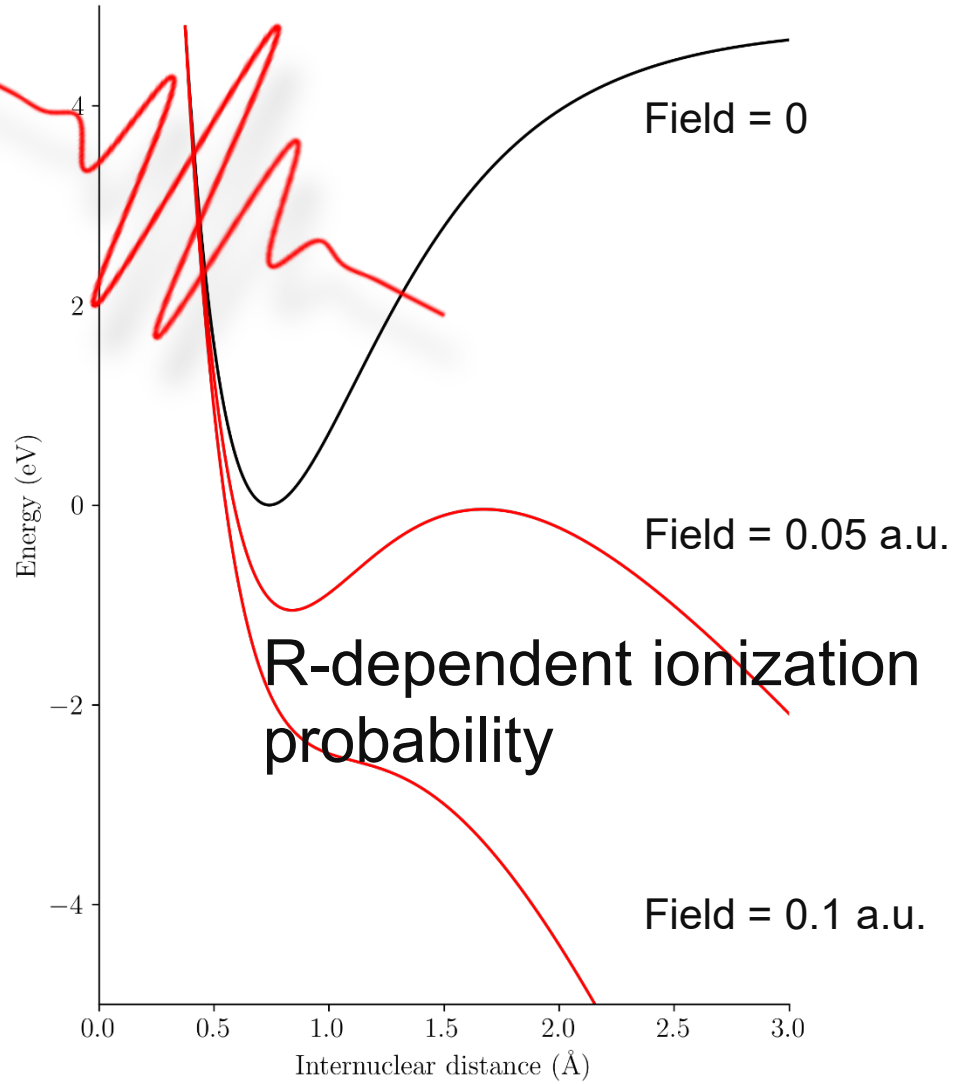
Ion yield at various time delay



Reference: Y. Mi *et al.*, *Phys. Rev. Lett.*, vol. 125, no. 17, p. 173201, Oct. 2020; L. Wolniewicz, *Journal of Molecular Spectroscopy*, vol. 63, no. 3, pp. 537–546, Dec. 1976; NIST Chemistry WebBook, SRD 69

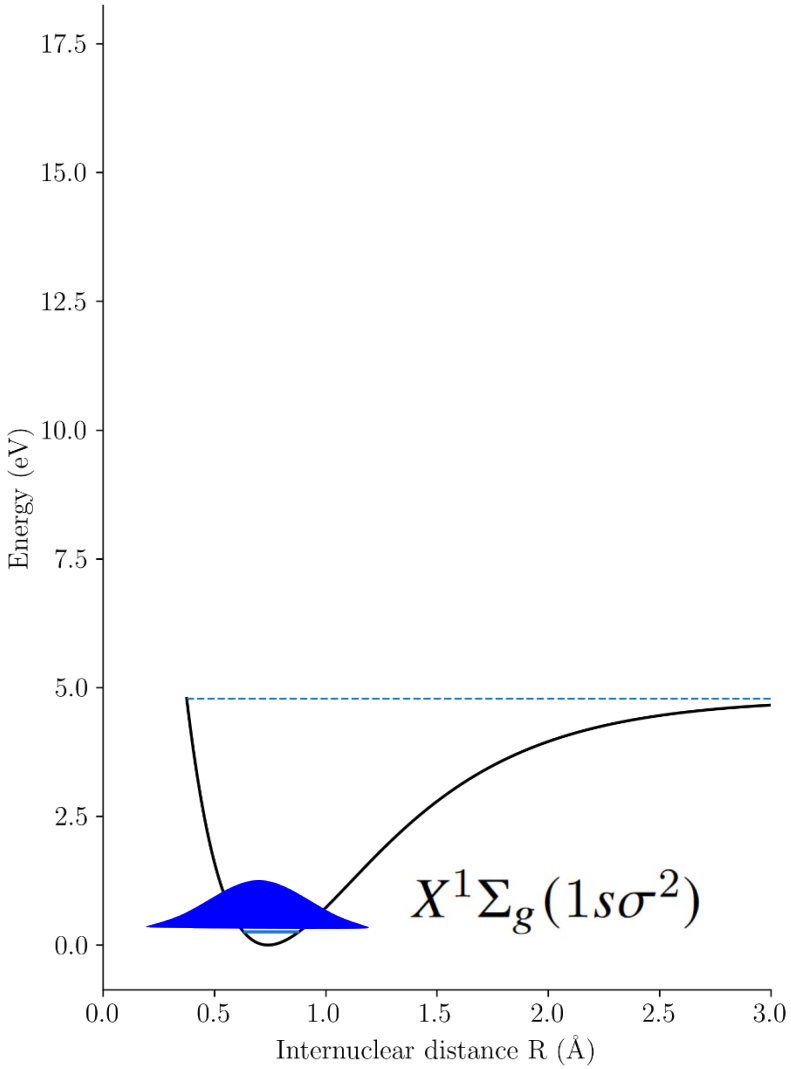
Ionization in intense laser field





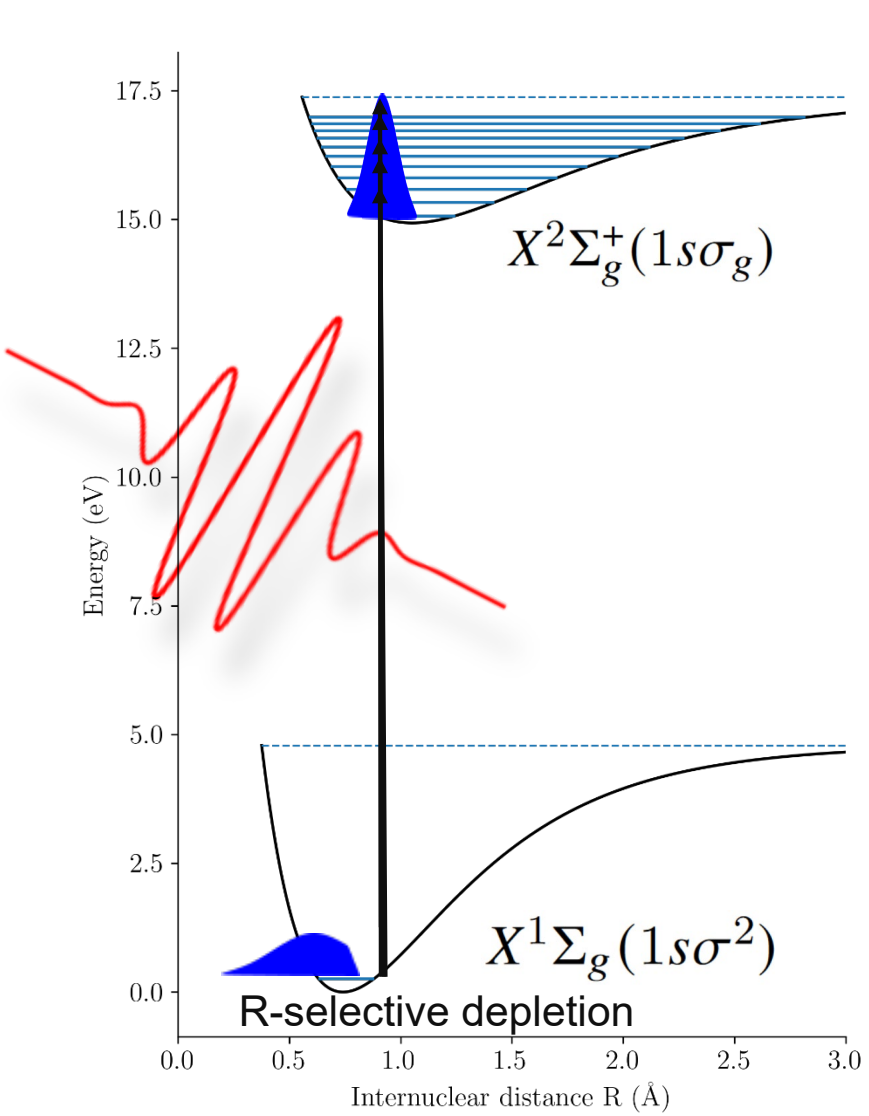
Reference: E. Goll, G. Wunner, and A. Saenz, *Phys. Rev. Lett.*, vol. 97, no. 10, p. 103003, Sep. 2006 ; Th. Ergler *et al.*, *Phys. Rev. Lett.*, vol. 97, no. 10, p. 103004, Sep. 2006 ; H. Zimmermann and U. Eichmann, *Phys. Scr.*, vol. 91, no. 10, p. 104002, Sep. 2016

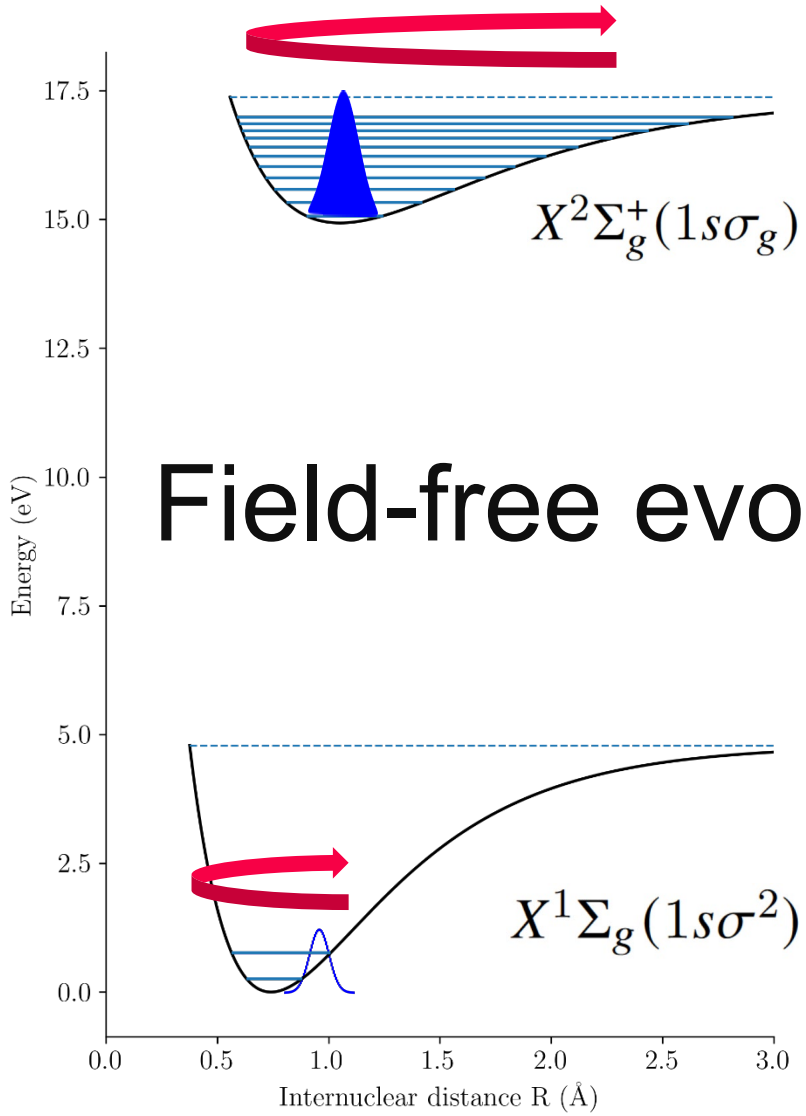
Wavepacket creation



Reference: E. Goll, G. Wunner, and A. Saenz, *Phys. Rev. Lett.*, vol. 97, no. 10, p. 103003, Sep. 2006 ; Th. Ergler *et al.*, *Phys. Rev. Lett.*, vol. 97, no. 10, p. 103004, Sep. 2006 ; H. Zimmermann and U. Eichmann, *Phys. Scr.*, vol. 91, no. 10, p. 104002, Sep. 2016

Wavepacket creation

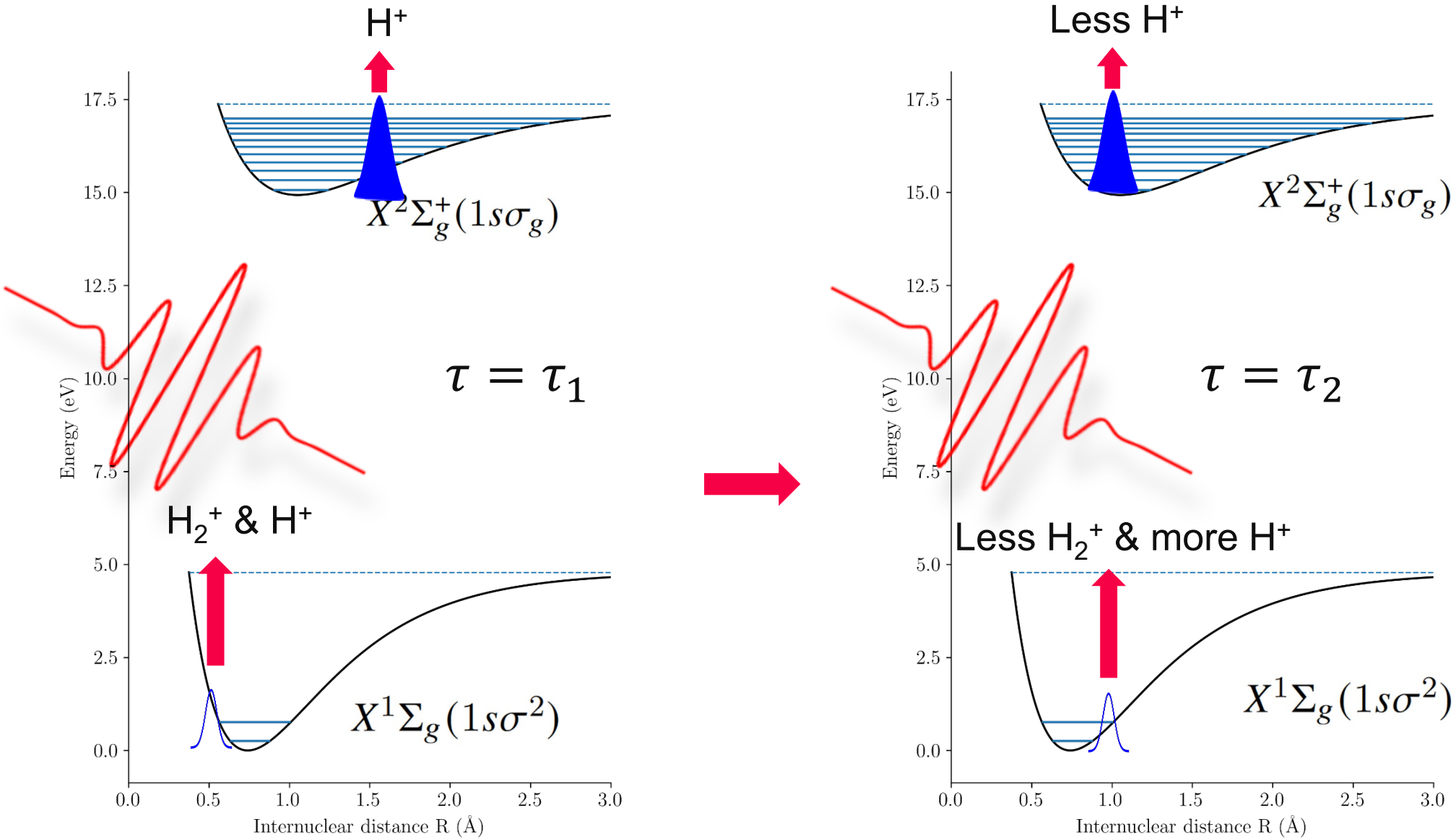




Field-free evolution

Reference: E. Goll, G. Wunner, and A. Saenz, *Phys. Rev. Lett.*, vol. 97, no. 10, p. 103003, Sep. 2006 ; Th. Ergler *et al.*, *Phys. Rev. Lett.*, vol. 97, no. 10, p. 103004, Sep. 2006 ; H. Zimmermann and U. Eichmann, *Phys. Scr.*, vol. 91, no. 10, p. 104002, Sep. 2016

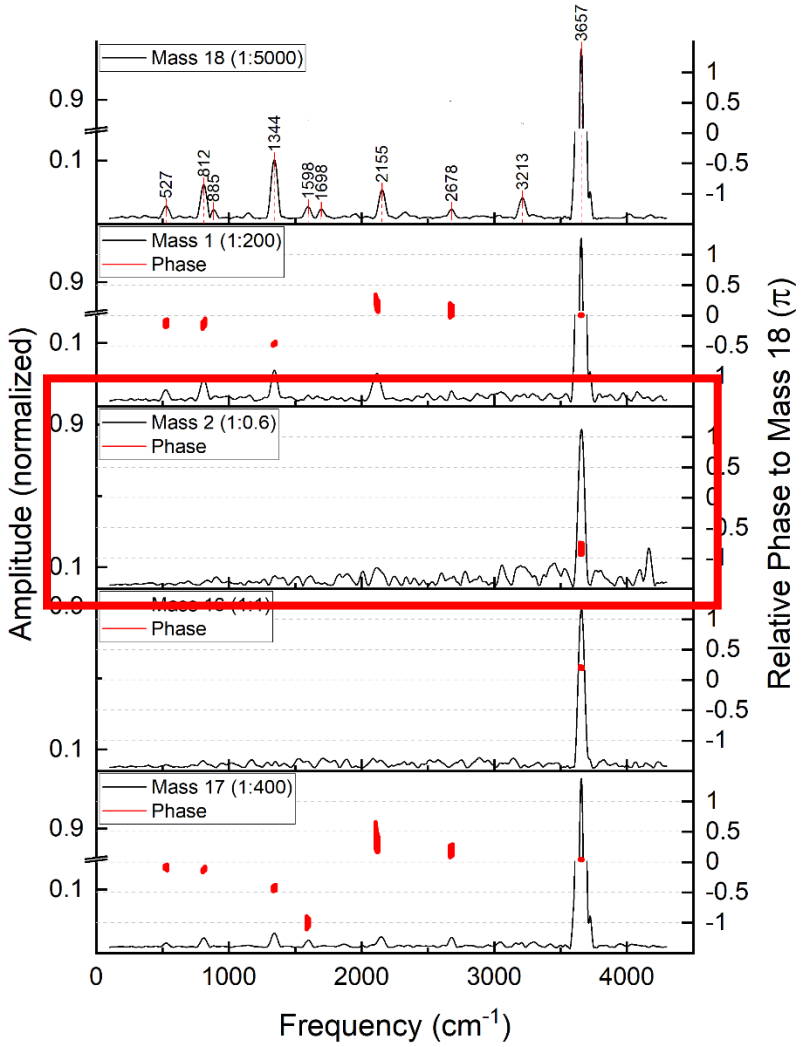
Wavepacket detection



What can we learn from this experiment?

✓ Dissociation channels	→	Which fragments?
✓ The probability of each channel	→	Relative ion yields
✓ Evolution of wavepackets	→	Phase and amplitude of FFT

Experiment result of gas-phase H_2O molecule



Interesting phenomenon: Hydrogen generation from H_2O

Pure Green Hydrogen!

Thank you for listening!