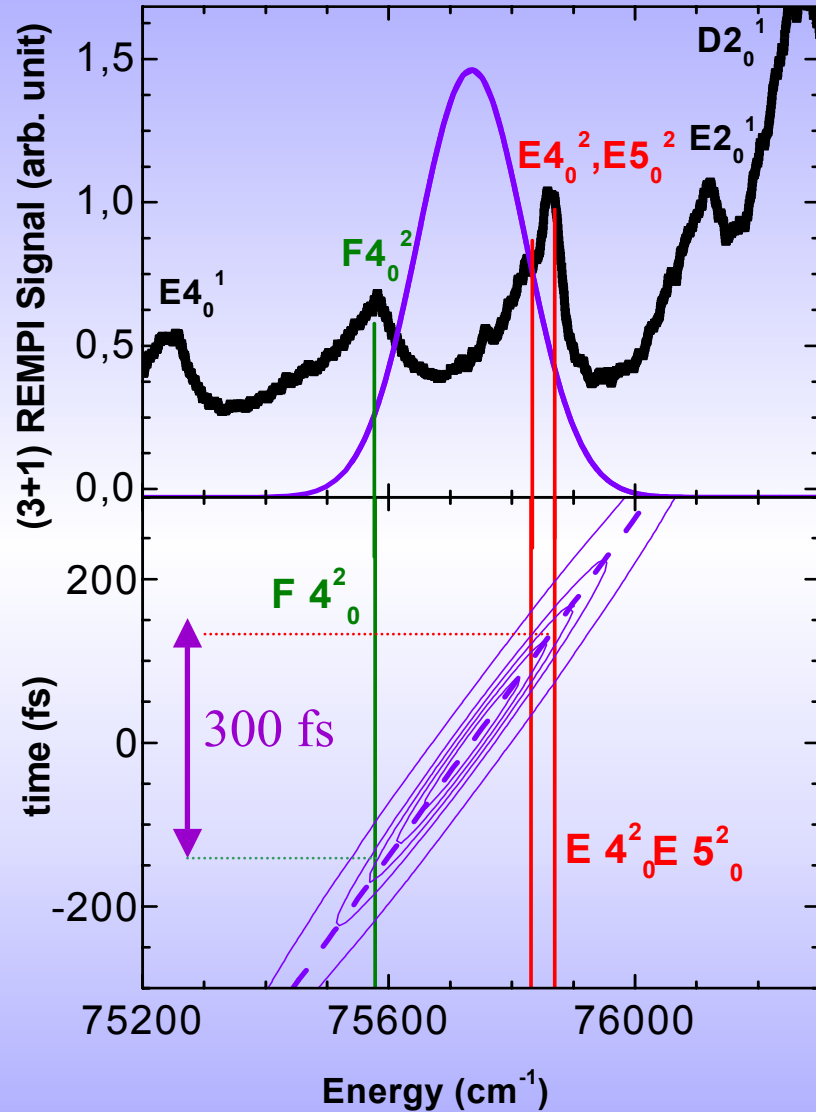


# Time resolved dynamics in polyatomic molecules with VUV pulses

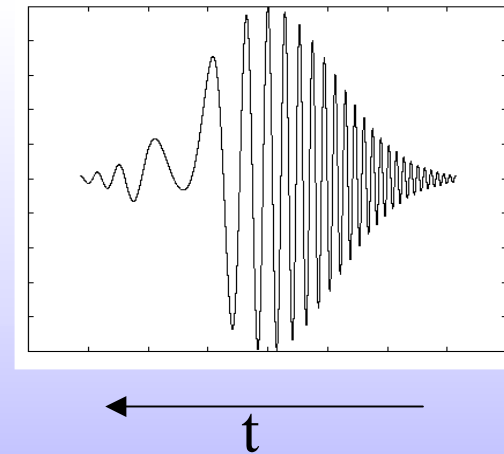
- VUV pump pulse :
  - predissociation of Acetylen
- VUV probe pulse :
  - photoionisation of photofragment
  - coincidence - vector correlations
  - Vibrational dynamics in ground electronic state (pump-dump-VUV probe)



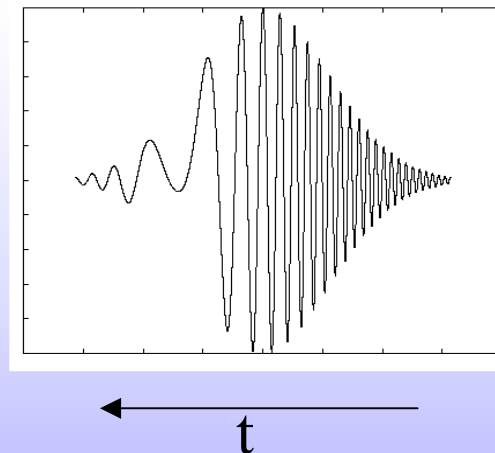
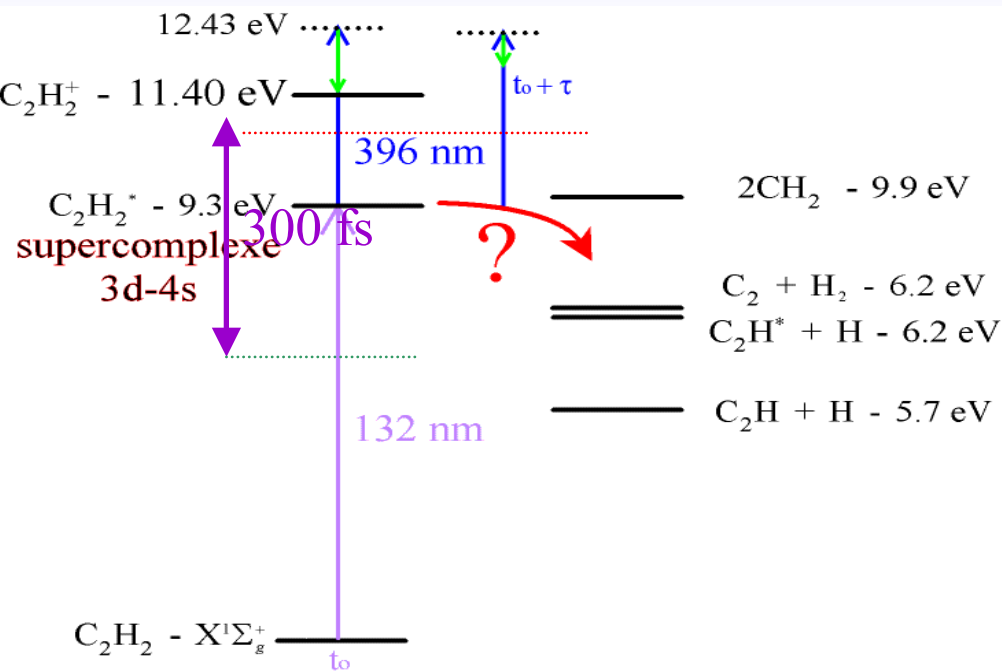
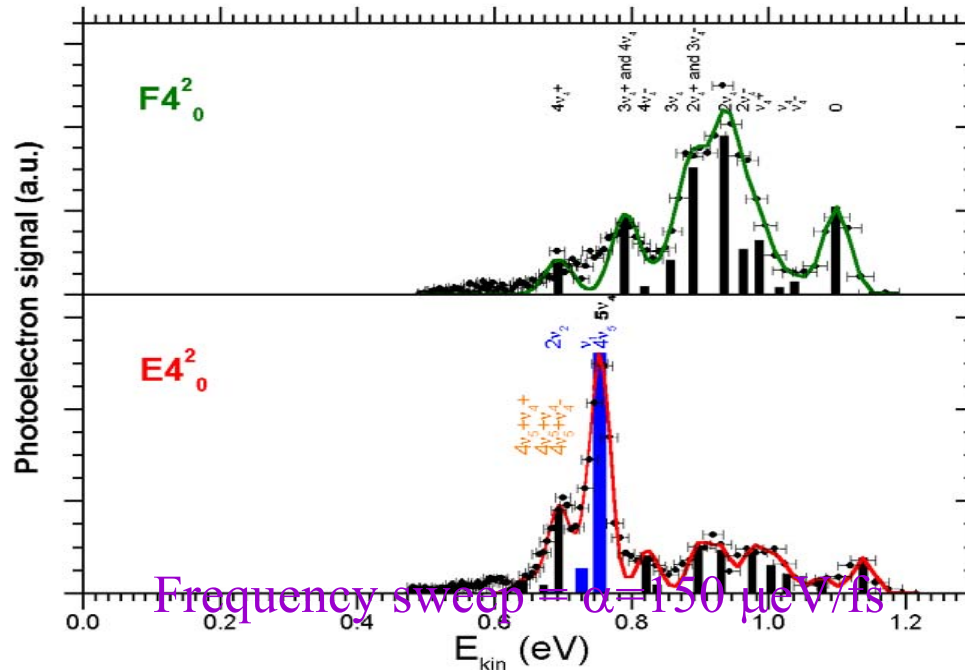
# PREDISSOCIATION



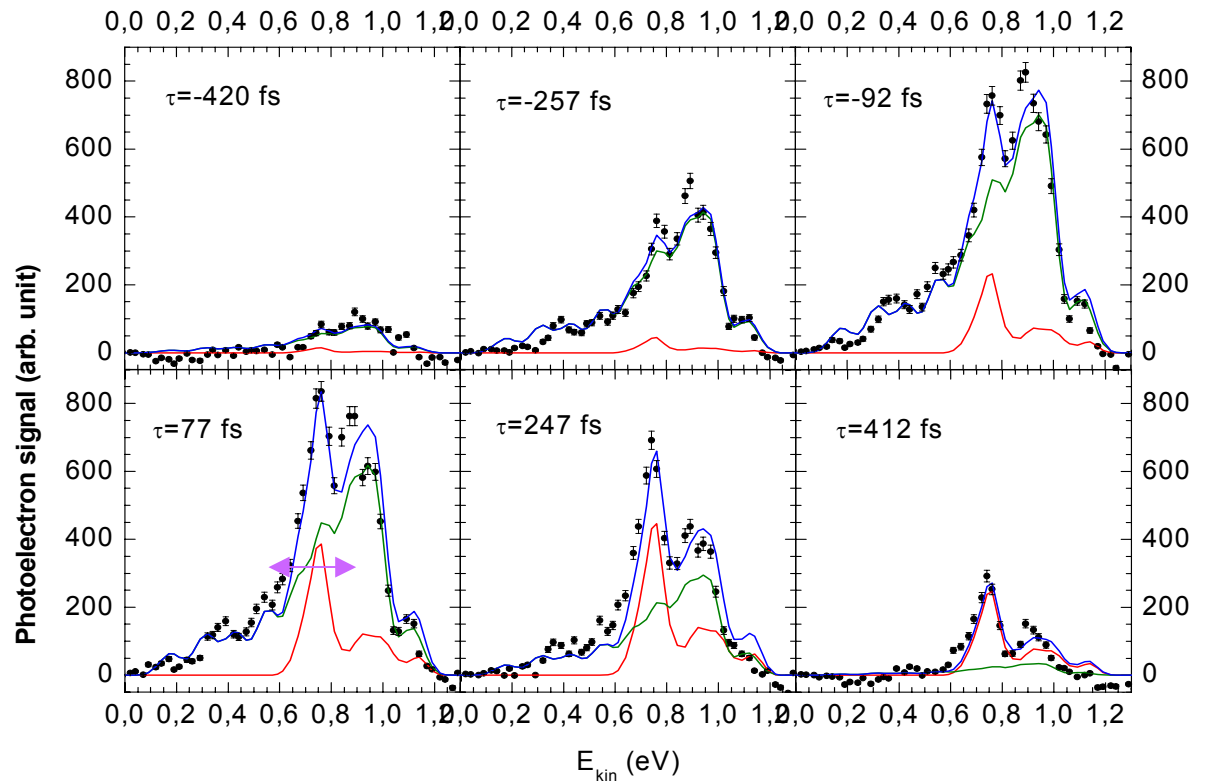
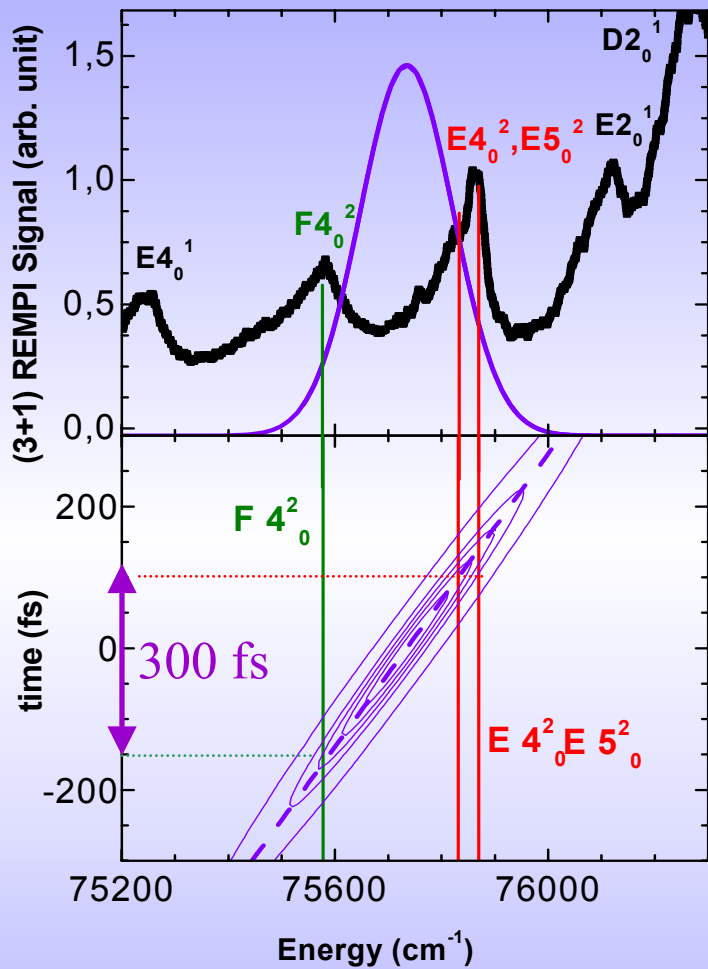
Frequency sweep =  $\alpha = 150 \mu\text{eV}/\text{fs}$



# PREDISSOCIATION

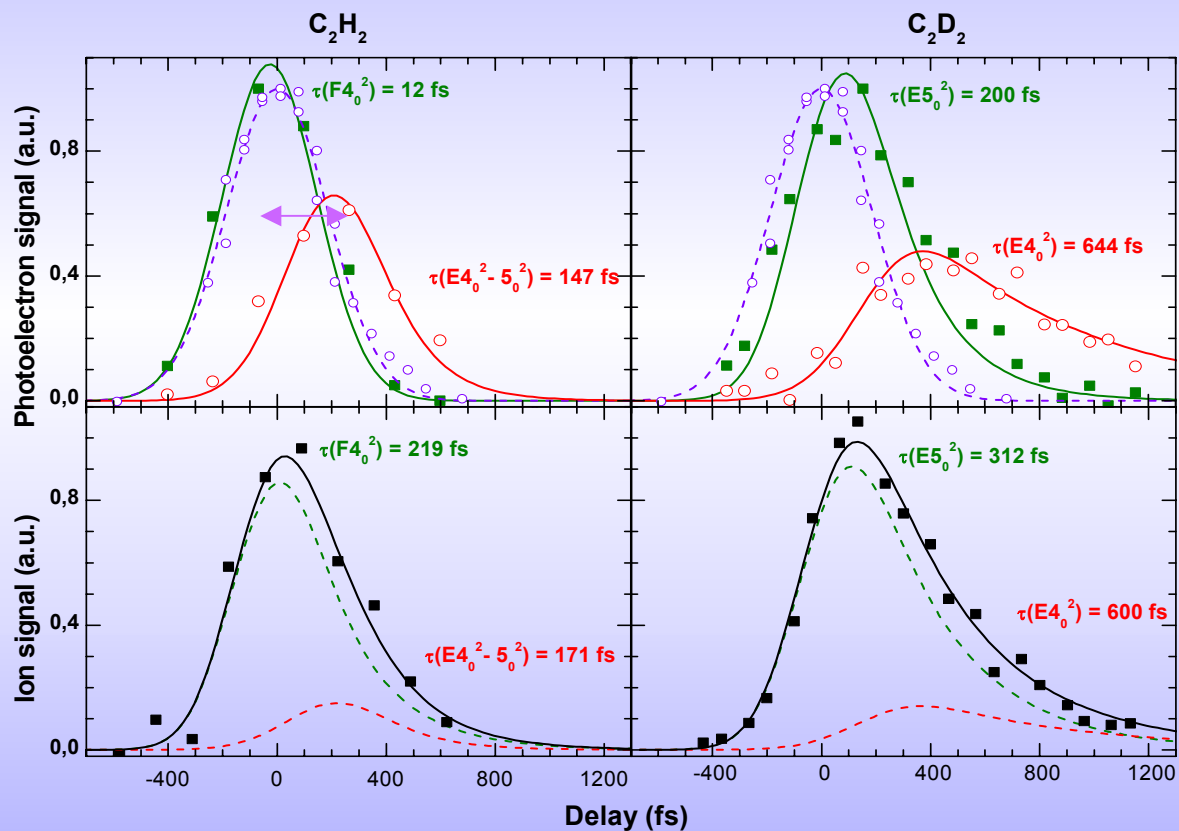
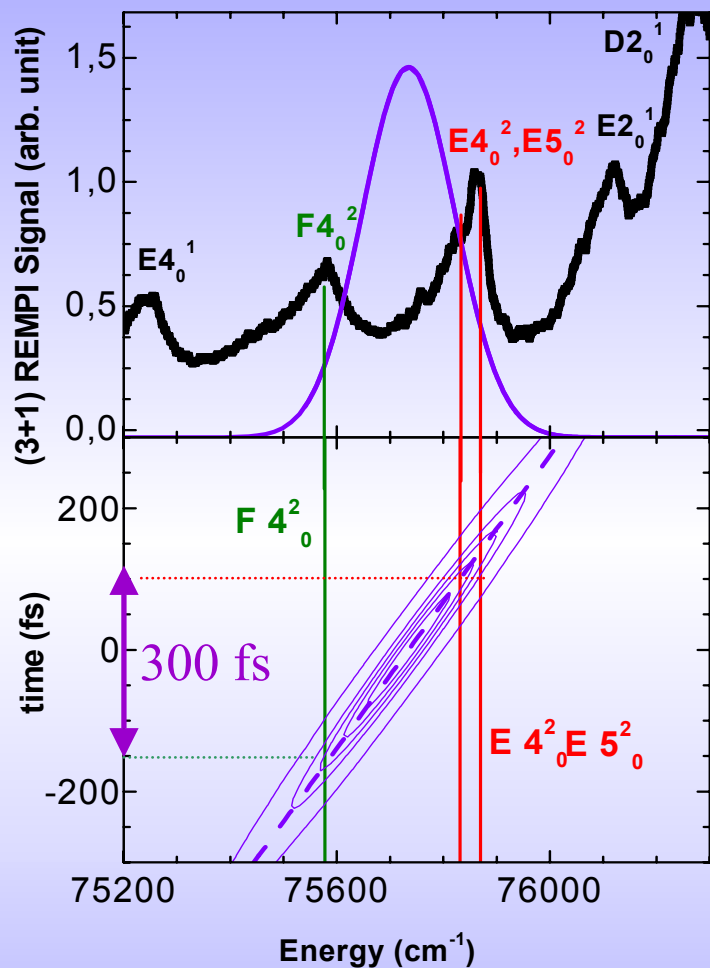


# PREDISSOCIATION



Frequency sweep =  $\alpha = 150 \mu\text{eV}/\text{fs}$   
Pump chirped from 50 fs to 300 fs

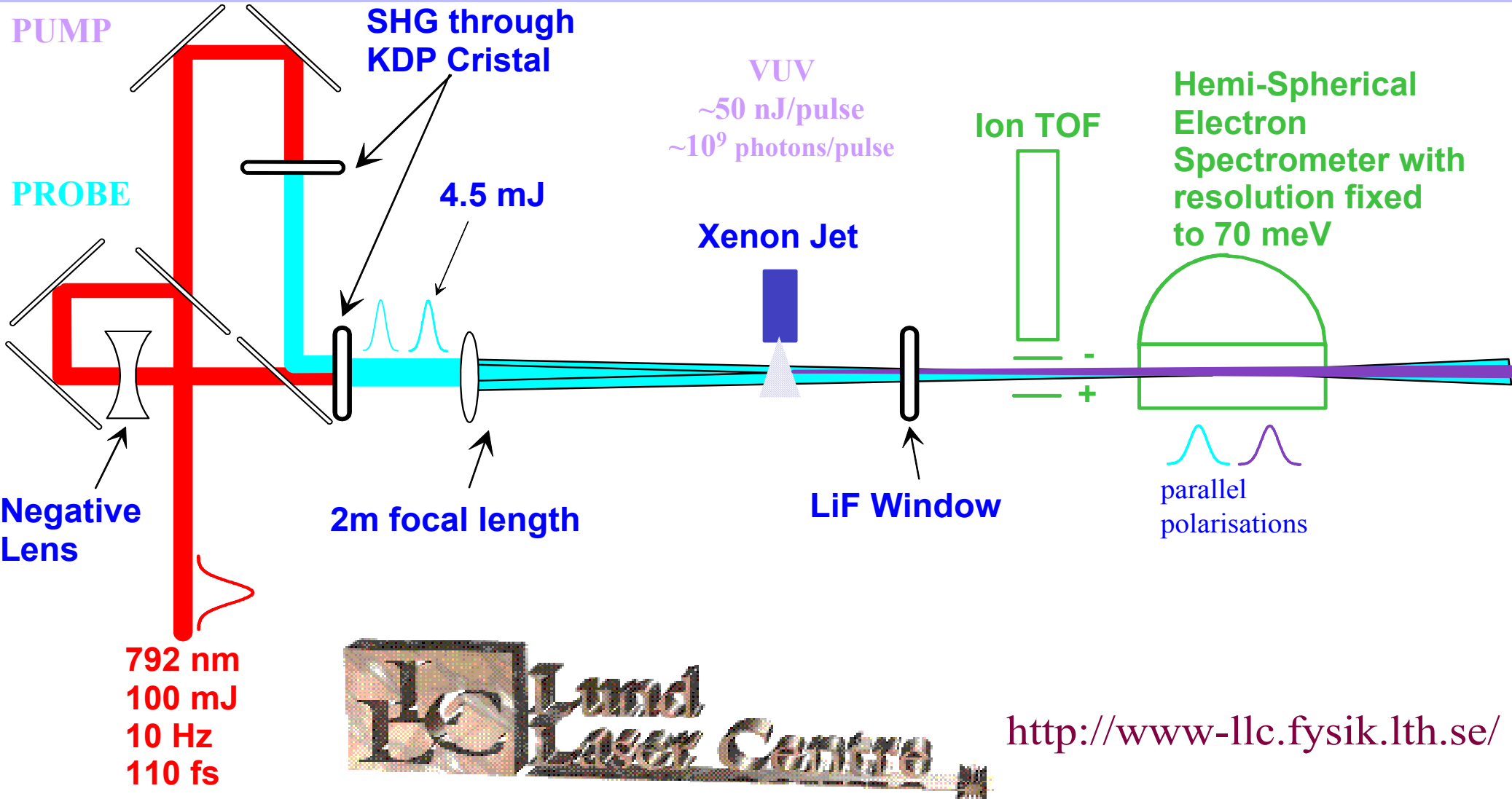
# PREDISSOCIATION



Frequency sweep =  $\alpha = 150 \mu\text{eV/fs}$   
 Pump chirped from 50 fs to 300 fs

# VUV pump pulse

- automatic spatial overlap
- low repetition rate



# Comments and Improvements

10 Hz –  $10^9$  photons/pulse –  $C_2H_2$  vapour

averaging over  $\sim 10000$  lasershots/delay – **JCP 119 (2003)**

☺ Frequency sweep

☺ Cross-correlation time measurement

☺ Photoelectron spectroscopy

🔔 Tunable pump VUV :

\* 9.0-9.8 eV (3th of SHG)

\* 7.5-8.2 eV (5th of the fund.)

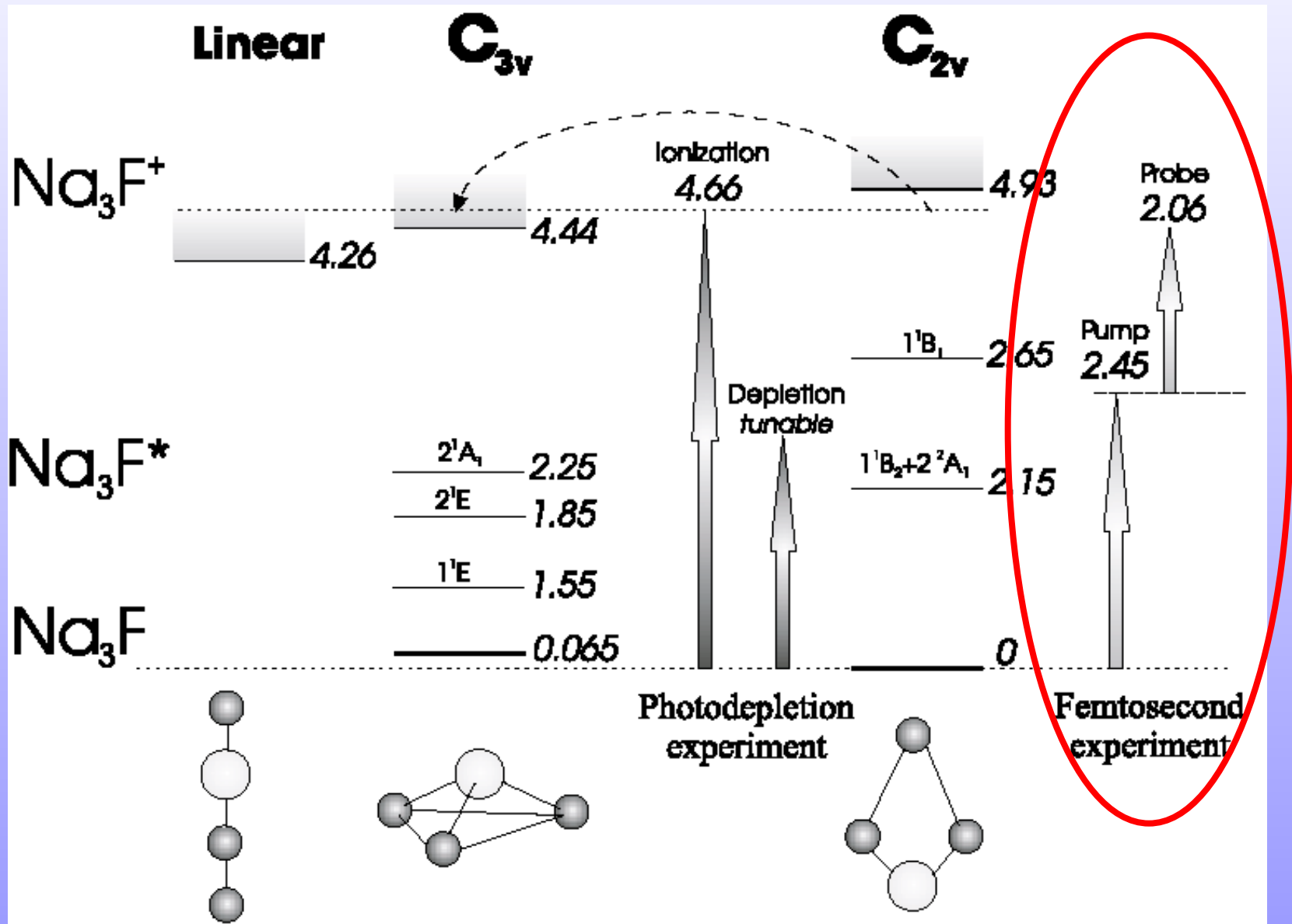
\* 10.6-11.4 eV (7th of the fund.)

🔔 Analysis of the H fragments =  
VUV probe pulse with a rotating polarisation

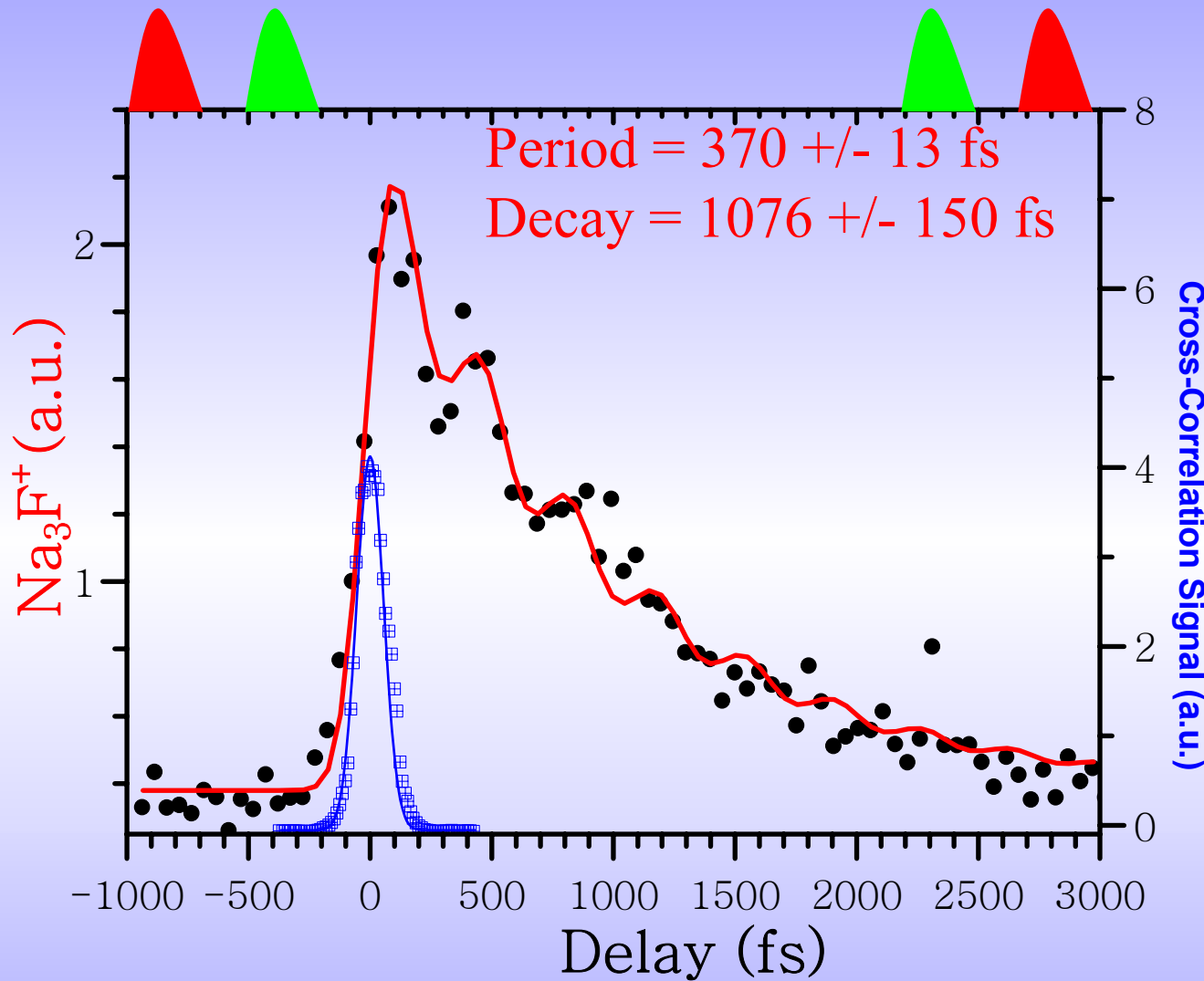
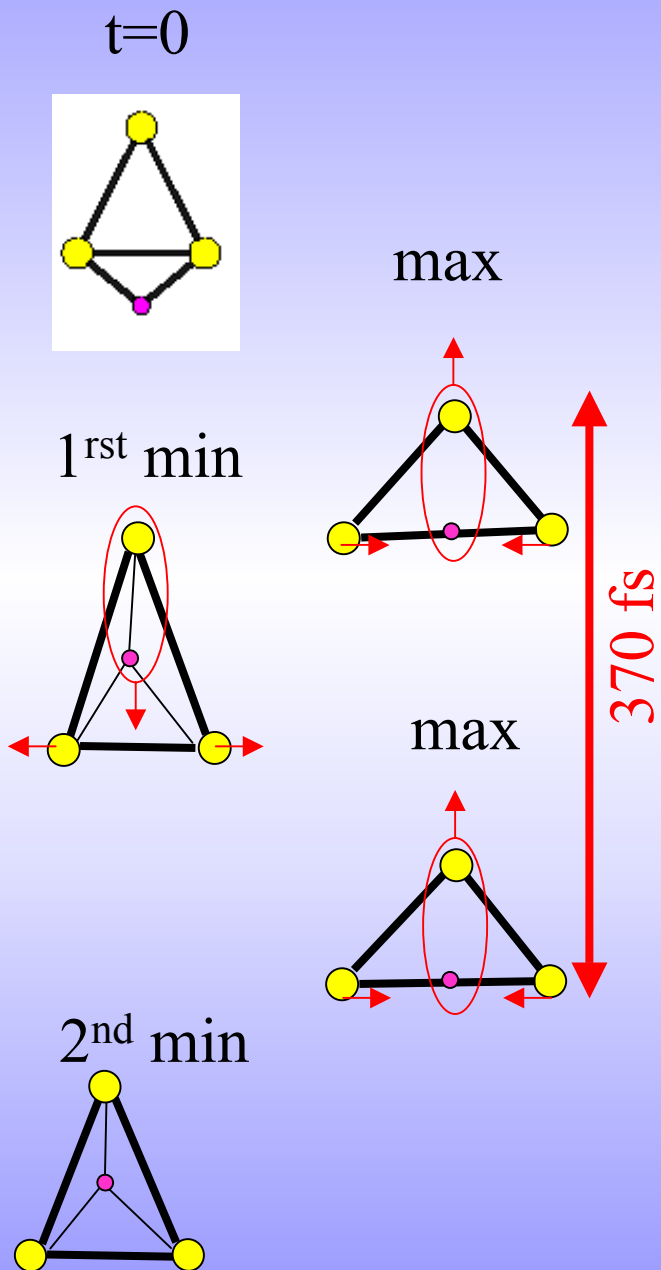
**Leone - JCP (2002) :** Dissociation of  $Br_2$

1 kHz -  $3 \times 10^6$  photons/pulse @ 47 nm –  $Br_2$  molecular beam – averaging over  $\sim 1 \times 10^5$  lasershots/delay – Crosscorrelation time ( $\sim 300$  fs) and spatial superposition optimized through the sideband photoelectron peak (Xe).

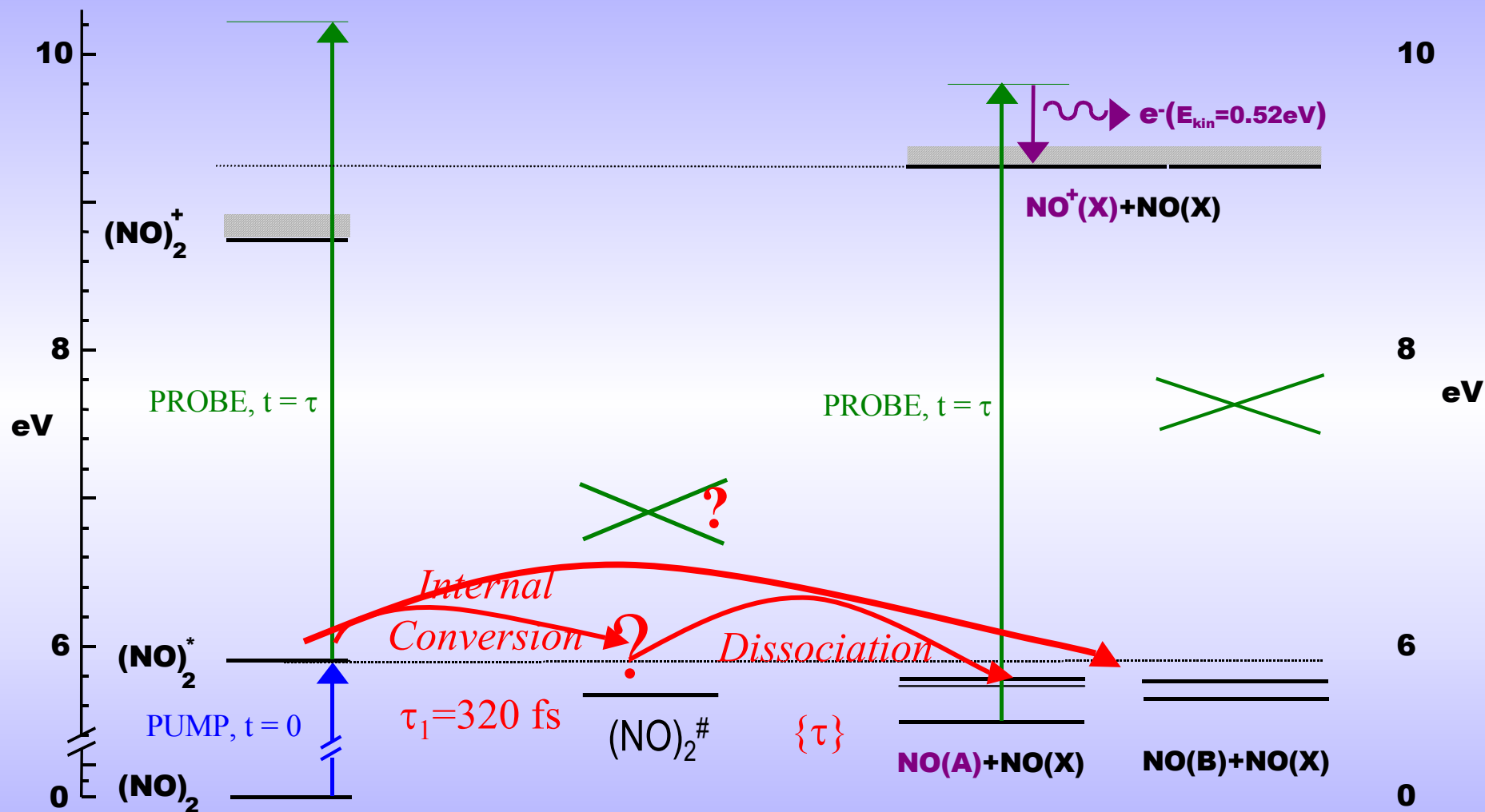
# Spectroscopy of $\text{Na}_3\text{F}$ : Two isomers



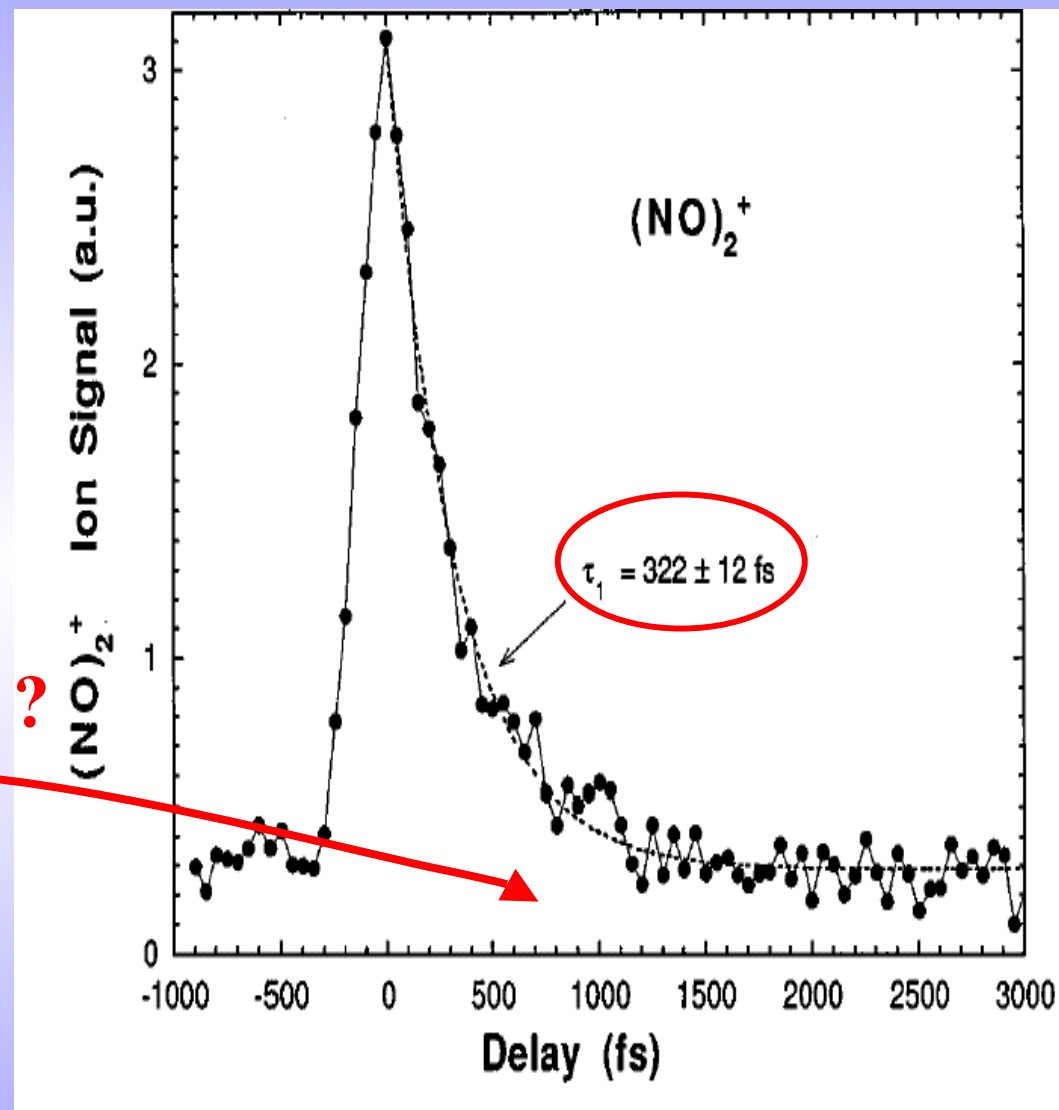
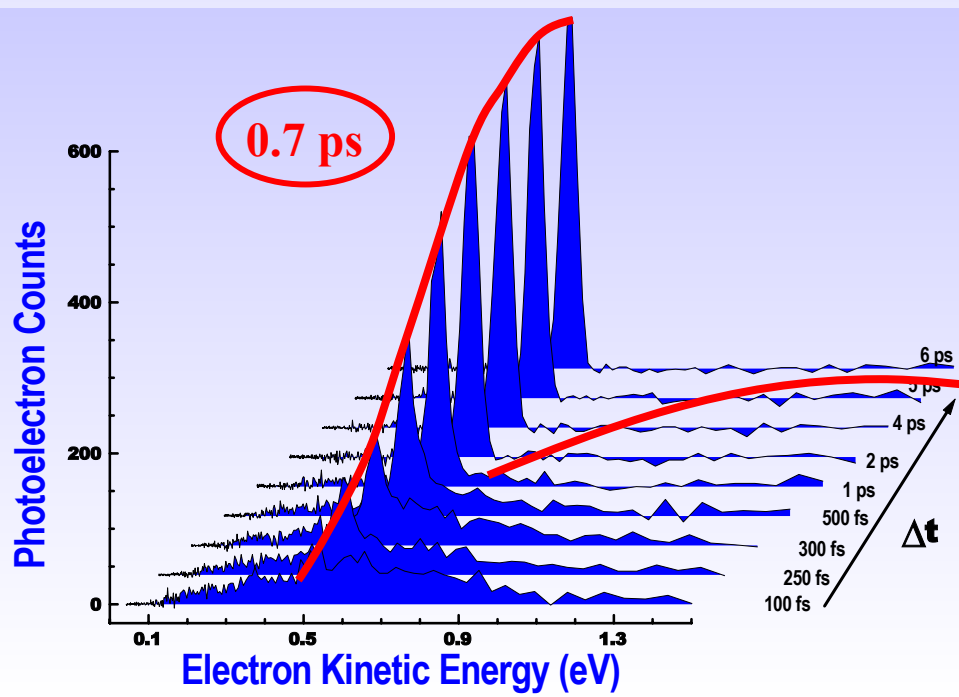
# Vibrational dynamics



# PREDISSOCIATION



# PREDISSOCIATION



# Comments and Improvements

10 Hz –  $10^{12}$  photons/pulse – Cluster Beam - averaging over  $\sim 5000$  laser shot/delay - **EPJD** DOI: 10.1140/epjd/e2003-00318-y (2004)

☺ Tunable probe and pump pulse

☺ Cross-correlation time measurement

☺ Slow vibrational dynamic resolved.

🔔 Fragment analysis : UV-VUV probe

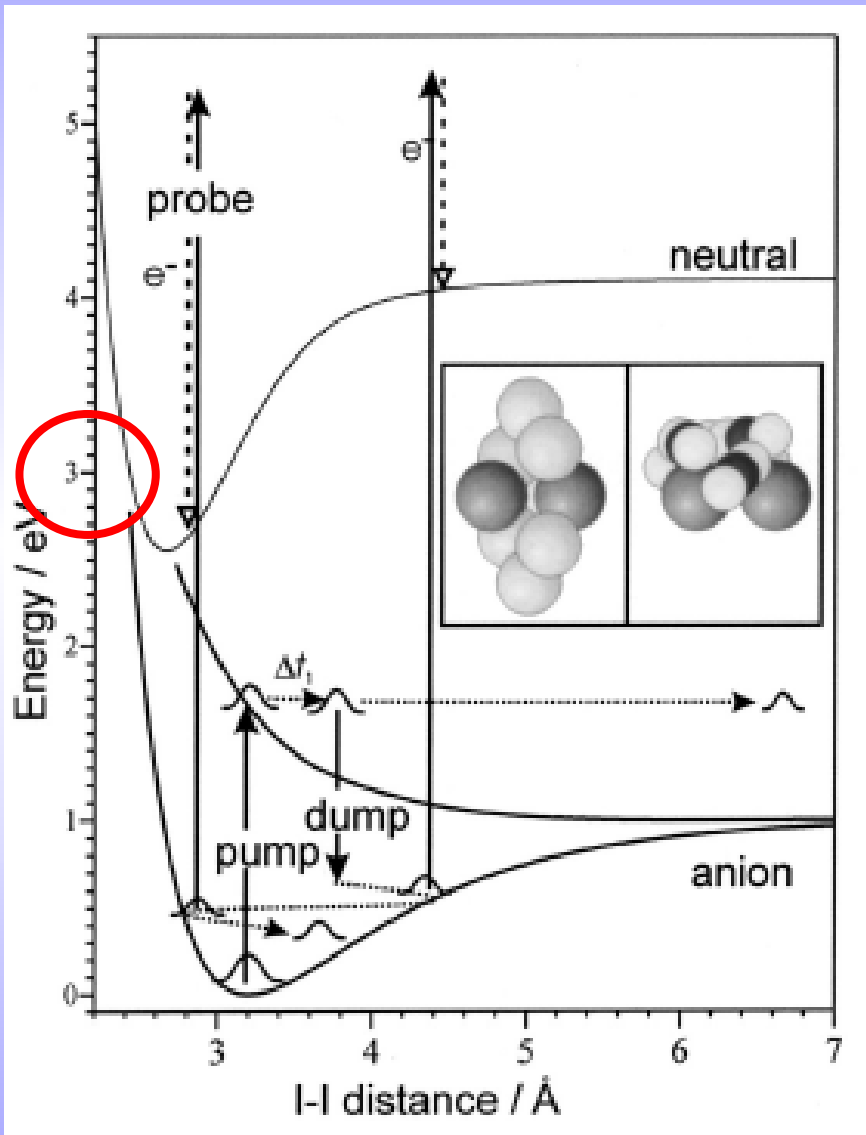
🔔 Need for short pulse

🔔 Coincidence photoelectron

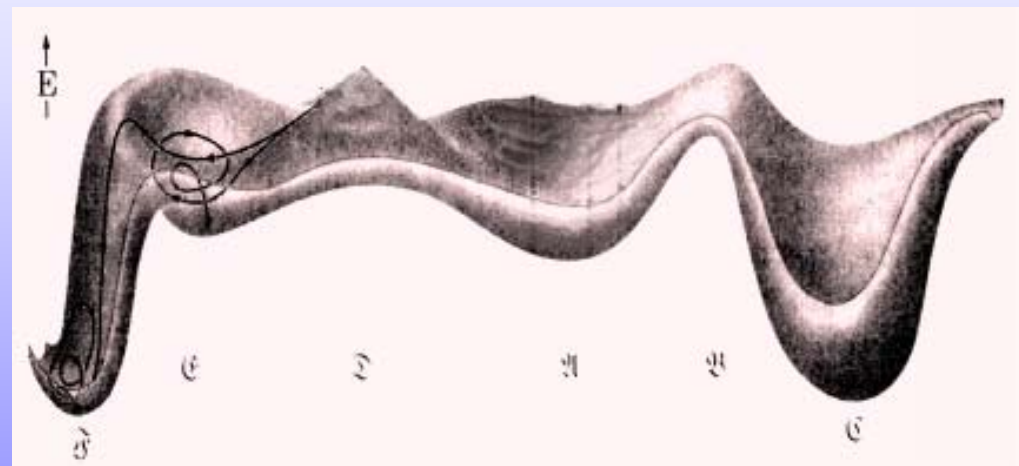
**Radloff - Chem. Phys. (2001)** : coincidence experiment on OClO dissociation - 1 kHz -  $10^{12}$  photons/pulse - multiphotonionization @ 266 nm - 0.05 events/pulse (10 % of false coincidence) -  $4 \times 10^5$  lasershot/delay

**Hayden - PRL (2000)** : coincidence experiment on NO<sub>2</sub> dissociation - 2.2 kHz - 0.01 events/pulse -  $2 \times 10^6$  lasershot/delay -  $4\pi$  acceptance for both detectors

# Pump-dump- VUV probe : fs-SEP - **VUV PES**



- Supported by ab-initio Calculation + wave packet dynamics
- IVR dynamics
- Dynamics around a barrier
- Conical intersection with the Ground electronic state





## Predissociation of acetylene

- (3+1) ns-REMPI (LPPM-Orsay) :

S. Zamith, S. Boyé, D. Gauyacq

- time-resolved studies (LUND + LCAR-Toulouse) :

S. Zamith, B. Girard

J. Norin, J. Mauritsson, A. L'Huillier + I. Hjelte,

J. Andersson, S. Sorensen

## Vibrational dynamics in $\text{Na}_3\text{F}$ (LCAR-Toulouse)

J.M. L'Hermite, A. Lepadellec, P. Labastie

The logo for IRSAMC, consisting of the letters 'IRSAMC' in a bold, blue, sans-serif font with a slight shadow effect, set against a white background.

## $(\text{NO})_2$ predissociation (Steacie Institute-Canada)

A. Stolow



National Research  
Council Canada

Conseil national  
de recherches Canada

END