



EARLY STAGE RESEARCHER

Ioannis Makos

PROJECT: *XUV-pump – XUV-probe studies of molecular dynamics at 1fs temporal scale*

Host institution: Foundation for Research and Technology- Hellas

Supervisors: Prof. Dr. Dimitris Charalambidis, Dr. Paris Tzallas, Prof. Dr. Reinhard Kienberger, Dr. Federico Canova

Start date: 01-10-2016

General info: Investigation of nuclear and electronic molecular dynamics in H₂/D₂ including coupled electronic-nuclear motion and autoionization dynamics

CURRICULUM VITAE

- **Diploma of Physics**

Department of Physics, University of Ioannina, Greece.

Thesis : Modeling the harmonics generation in strong field laser-matter interactions.

- **Erasmus Intensive Programme CPOTS**
University of Crete, Heraklion, Greece.

Charged Particle Optics: Theory and Simulation

- **MSc in Photonics**

Faculty of Physics and Astronomy, Friedrich Schiller University Jena, Germany.

MSc Thesis : Gas analysis using two beam ultra-broadband femtosecond Coherent Anti-Stokes Raman Scattering.

- **Internship**, Institute of Applied Physics, Jena, Germany.

Laser Induced Damage Threshold in Sapphire

- **PhD**

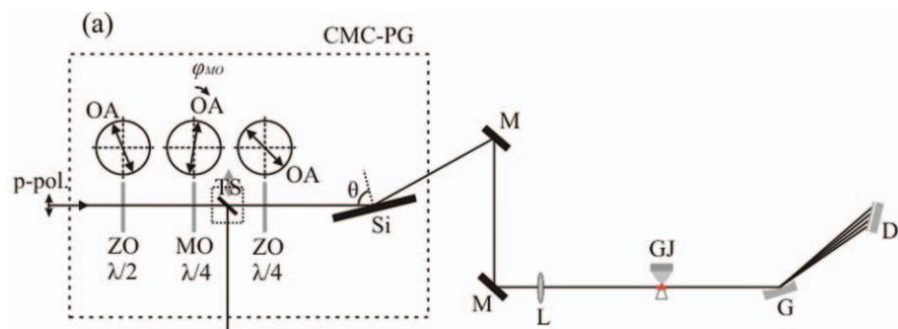
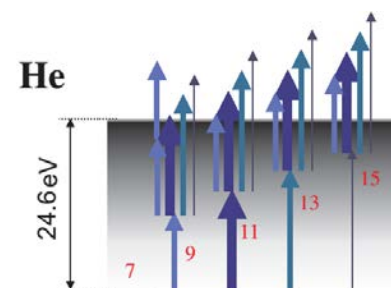
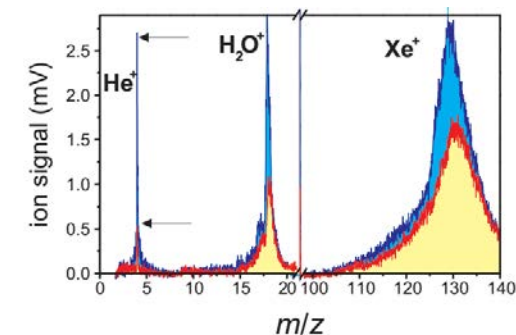
Physics department, University of Crete - Foundation for Research and Technology - Hellas, Heraklion, Greece.

XUV-pump - XUV-probe studies of molecular dynamics at 1fs temporal scale

SCIENTIFIC SCOPE OF THE PROJECT

Time resolved studies of ultrafast dynamics in molecular systems utilizing attosecond resolution XUV-pump - XUV-probe measurements

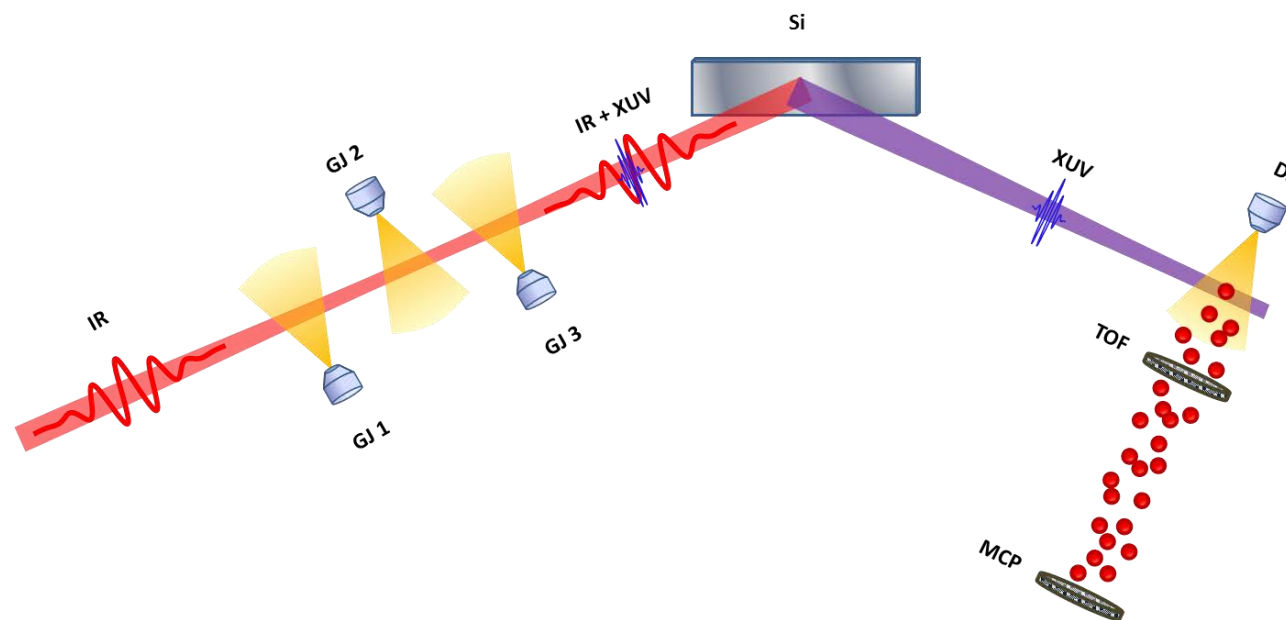
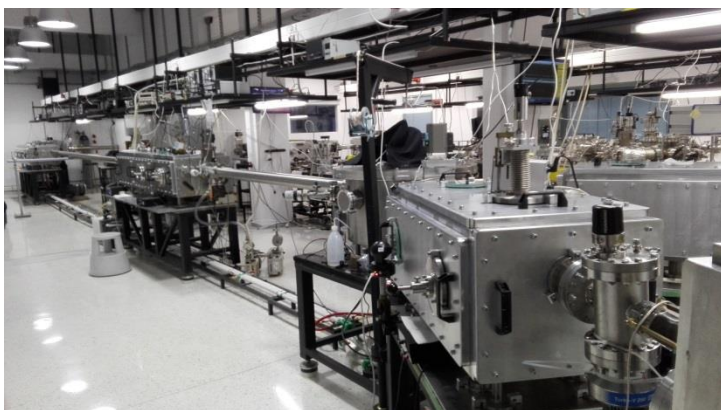
- Investigation of nuclear and electronic molecular dynamics in H₂/D₂ including coupled electronic-nuclear motion and autoionization dynamics
- Experimental realization
 - wave-plate polarization gating device (PG) \Rightarrow isolated attosec pulses
 - XUV wave-front splitting Silicon device (S-Si)
 - 2nd order IVAC for characterization implementing CEP tagging of spectra (no CEP stabilized many cycle laser pulses)

Koliopoulos *et al.* Rev. Sci. Instrum. 83, 063102 (2012)Tzallas *et al.* Nature 426, 6964 (2003)

SCIENTIFIC ACTIVITIES AND GOALS IN PROGRESS

Quasi phase matching with multiple gas jets

- increasing the XUV energy $\sim \mu\text{J}$
- loose focusing configuration $f=9\text{m}$, $\sim 20\text{ m}$ long XUV beam line
- quasi-phase matching conditions
- multiple (three) gas jets

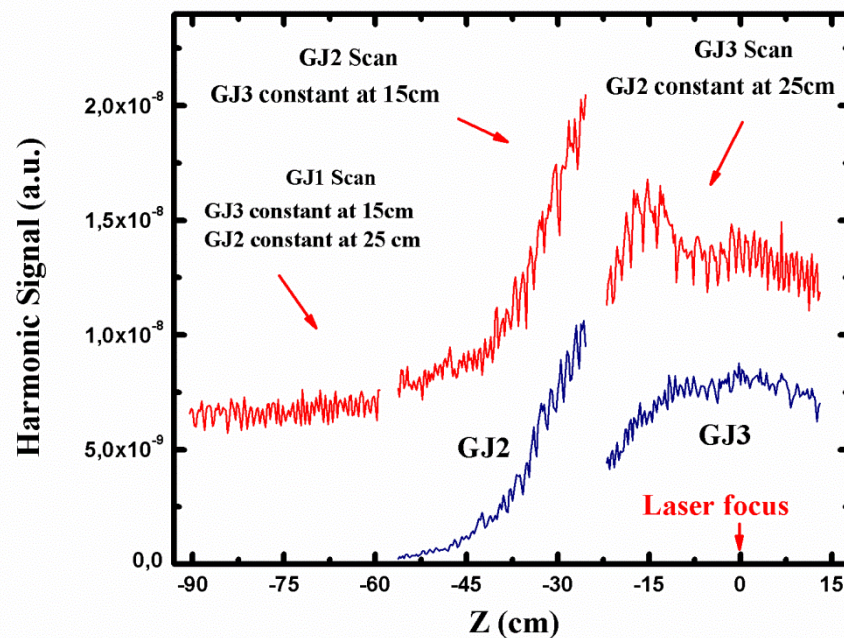


Experimental setup:

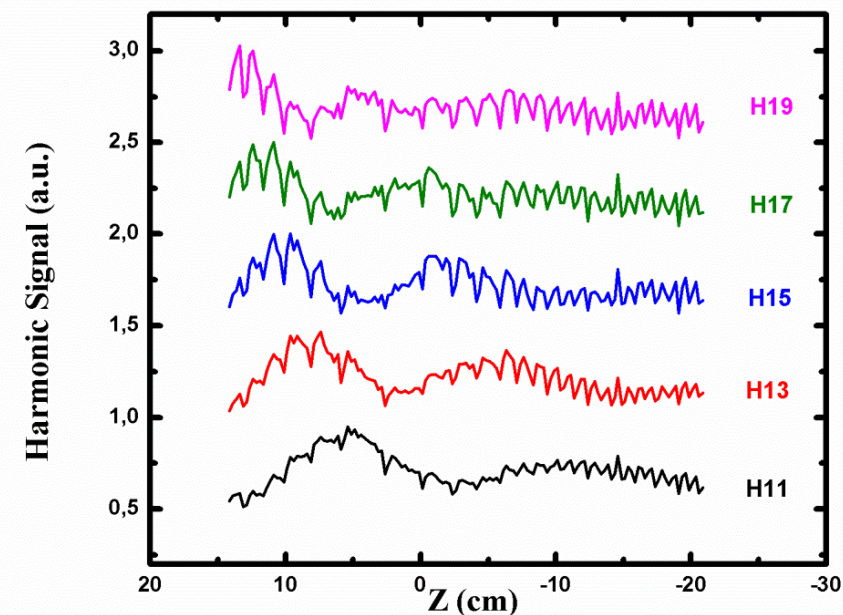
Ti: Sapphire ($\lambda=800\text{ nm}$, $\tau=20\text{ fs}$, $f_{\text{rep}}=10\text{ Hz}$, 400 mJ energy/pulse, $\varnothing 2.5\text{ cm}$), GJ1; GJ2; GJ3: generation gas jet, Si: silicon plate, DJ: detection gas jet, TOF: time of flight, MCP: micro-channel plate.

SCIENTIFIC ACTIVITIES AND GOALS IN PROGRESS

Integration of the electron spectra for single and multiple jets over the hole spectrum.



Integration of the electron spectra for multiple jets over single harmonics.



- XUV yield rises using multiple jets by a factor of two
- Oscillations observed are attribute to phase matching conditions
- Shift of maximum yield for different harmonics to phase matching as well

CAREER DEVELOPMENT PLAN AND FUTURE ACTIVITIES

Research activities - Work plan

- Results in multi jet quasi phase matching
- CEP tagging of spectra
- 2nd IVAC measurements of isolated XUV pulses applying CEP tagging
- Measurement of XUV-pump-XUV-probe spectra using CEP tagging
- Study of coupled electron-nuclear motion dynamics in H₂/D₂
- Complementary measurements in O₂ and C₂H₂ to previous work at FORTH

Planned secondments

- MPQ ➡ Generation of intense UV few-cycle pulses using HHG in dense gas.
- Lund University ➡ Study of non-linear XUV processes using HH.
- Amplitude Technologies ➡ CEP stabilization of intense amplified laser pulses.

Planned outreach activities based on the Photonics Explorer Kit

- 2nd, 4th, and Experimental High School of Heraklion visiting FORTH

ACKNOWLEDGEMENTS

Thank you for your attention.

Gratitude to:

I. Orfanos, E. Skantzakis, E. Mavrotsoupakis, P. Tzallas, D. Charalambidis