# PROBING XUV-INDUCED ULTRAFAST PHOTO-ISOMERIZATION IN MOLECULES

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IN COOPERATION WITH : Institut Lumière Matière
LEVEL : M2
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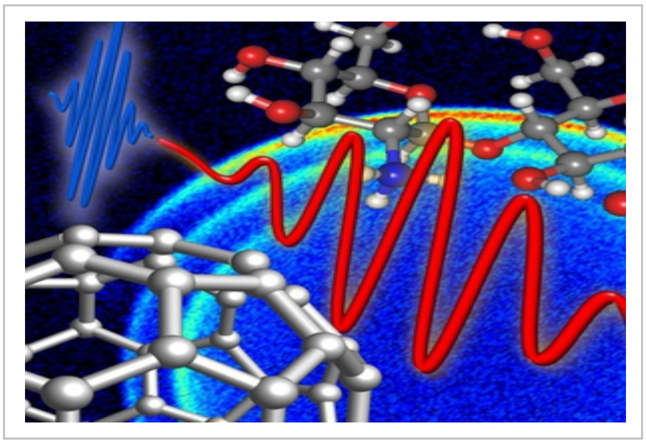
## SCIENTIFIC CONTEXT :



*Time resolved spectroscopy of complex molecules*

When a molecule absorbs a high-energy photon and gives up an electron, the residual molecular ion in an excited state can lose its excess energy via various processes. For example, though the ion itself may remain intact, a part of it can move to a different location changing the molecular geometry. This is known as the photo-isomerization process. It is responsible for many natural phenomena, e.g., human vision. Therefore, understanding the underlying physical cause that controls this process is fundamentally very important. To see it inside a molecule we need to follow a specific protocol: a 'pump' pulse starts the process and the 'probe' pulse takes snapshots of the subsequent structural changes in the molecular ion at various later stages. Since it is a very fast process (< 100 fs), we also need very short pulses to observe it in "real-time". Thanks to the recent development of attosecond science, we now have all the necessary tools to study these ultrafast processes. A notable example is the high-order harmonic generation (HHG) process. In here, a near infrared (wavelength: 800 nm) laser pulse, after passing through a dense medium of noble gas, can produce ultrashort (< 10 fs) extreme ultraviolet (XUV, wavelength: 10 - 100 nm) pulses. Being both high-energy and very short, these XUV pulses can act as an efficient tool to study the photo-isomerization process.

## MISSIONS :

The main goal of the project is to study XUV induced cis -> trans isomerization in a prototypical molecule, namely, ethylene (C2H4). The project will be carried out at the state-of-the-art attosecond beamline at the DYNAMO group in iLM. The candidate will learn how to generate XUV pulses necessary for the experiment, as well as have the opportunity to use a velocity map imaging spectrometer for detecting charged particles, such as ions and electrons. In addition to having basic knowledge of optics and quantum mechanics, the candidate should be able to communicate fluently in English. The future objective is to extend the methodology in systems that are more complex. The team has well-grounded collaboration in various free electron laser (FEL) facilities in the EU, which brings forward exciting opportunities to study similar processes in large molecules using X-rays.

## OUTLOOKS :

Upon *successfully* completing the project, the candidate *may* continue in the group as Ph.D. student.

## BIBLIOGRAPHY :

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