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# Selected experiments conducted on attosecond beamlines at ELI ALPS

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ELI Ultrafast Science Workshop  
Hamburg, Germany



EXTREME LIGHT  
INFRASTRUCTURE

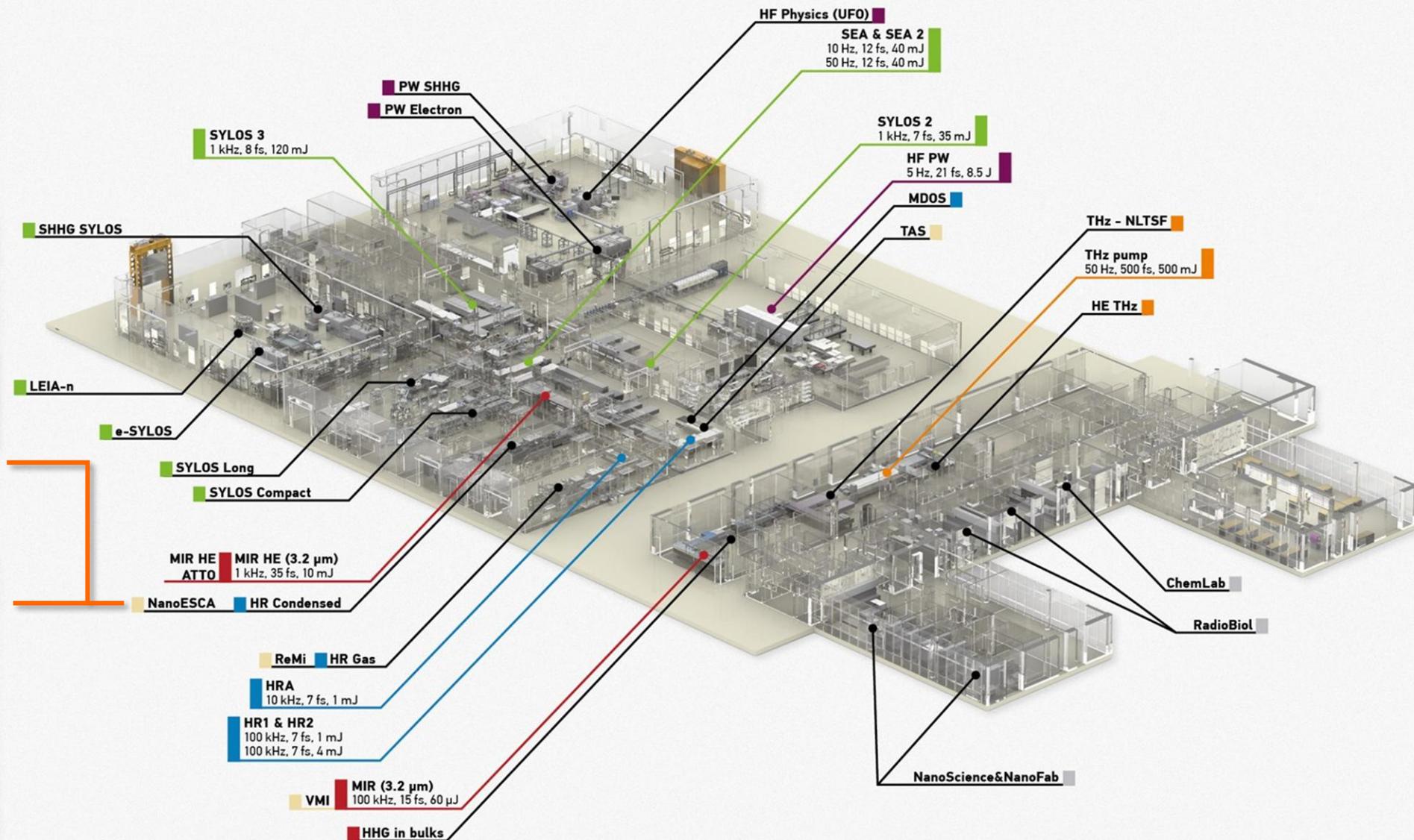
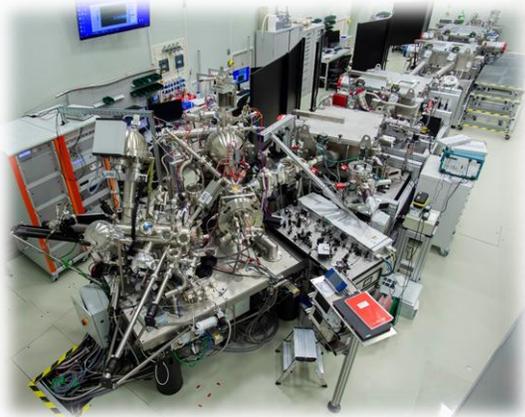


# ALPS overview

## HR CONDENSED



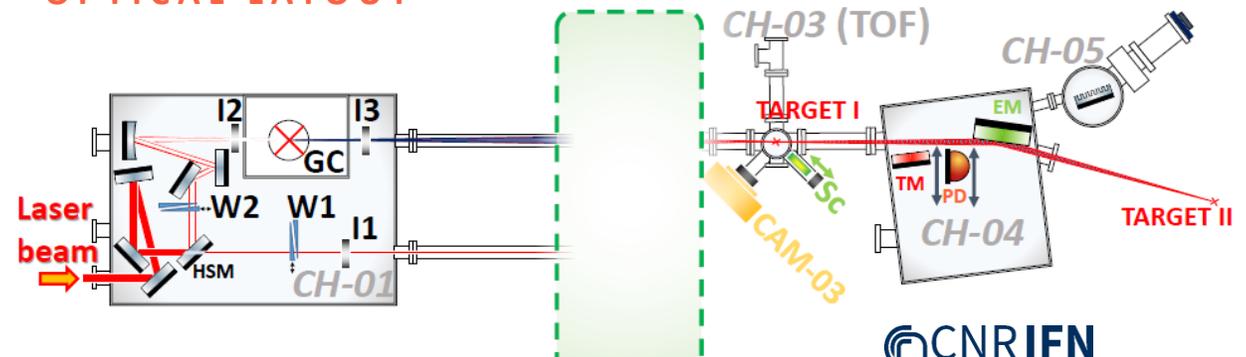
## NANOESCA



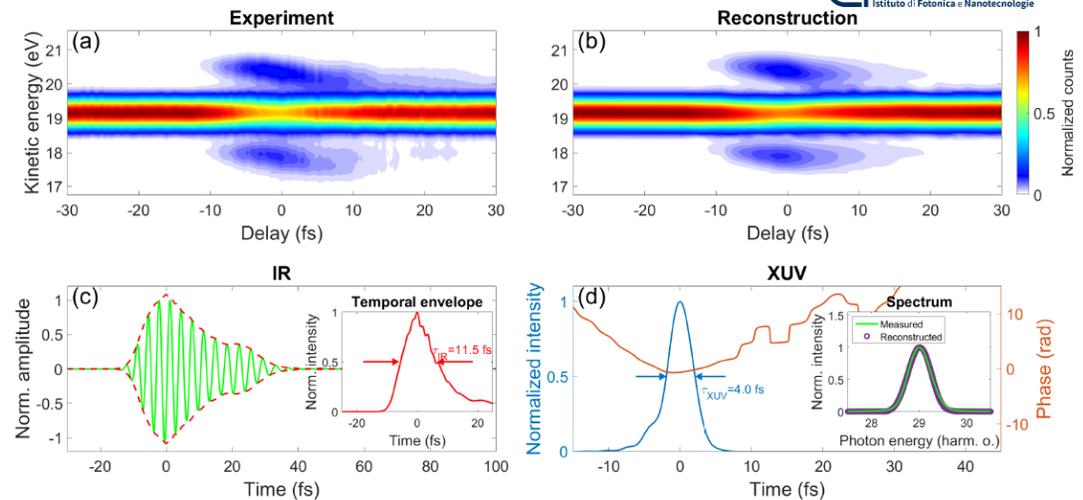
# HR Condensed

Femtosecond/attosecond pulse(-train) for extreme ultraviolet (XUV) – infrared/visible (IR/VIS) pump-probe measurements on condensed (and gas)-phase targets.

## OPTICAL LAYOUT



CNR IFN  
Istituto di Fotonica e Nanotecnologie



# NanoESCA

Photoemission electron microscope (PEEM) with energy, spin and time resolution. It can be used for both real space and momentum space imaging of condensed phase samples

## CHARACTERIZATION

**LEED** (Low Energy Electron Diffraction)

**XPS** (X-ray Photoelectron Spectroscopy) quantitative chemical analysis of the surface  
monochromatic Al  $K_{\alpha}$  X-ray source

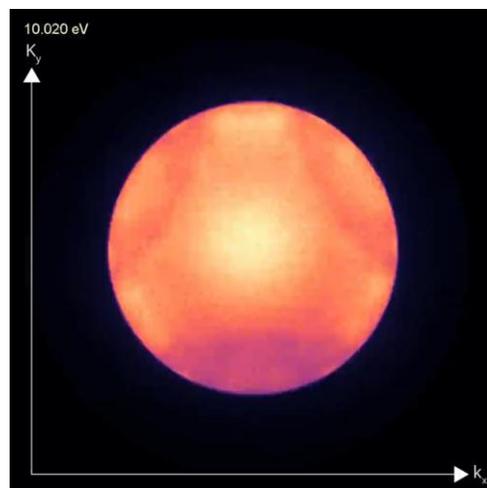
## STANDALONE OPERATION

**Internal light source** (He lamp): HeI: 21.2 eV  
and HeII: 40.8 eV

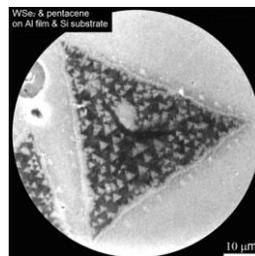
**Ultrafast laser oscillator** (Venteon) few-cycle pulses of low energy for pump-probe in the IR

Gy. Halasi *et al.*, *npj 2D Mater. Appl.* **8**, 48 (2024).  
<https://doi.org/10.1038/s41699-024-00487-4>

Momentum space



Real space

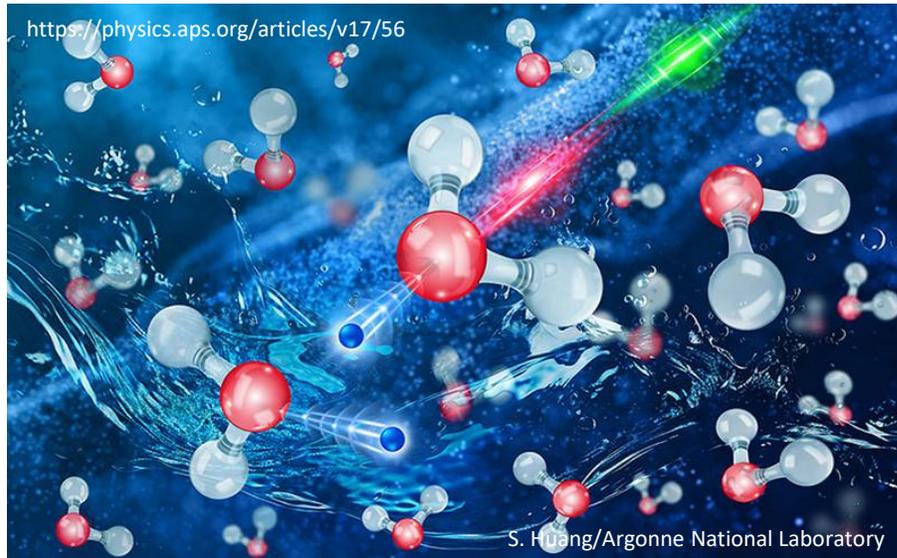


FOV: 74 mm – WSe<sub>2</sub>



# A recap from the morning

Two examples of experiments at HR Condensed and NanoESCA by user teams from Germany.

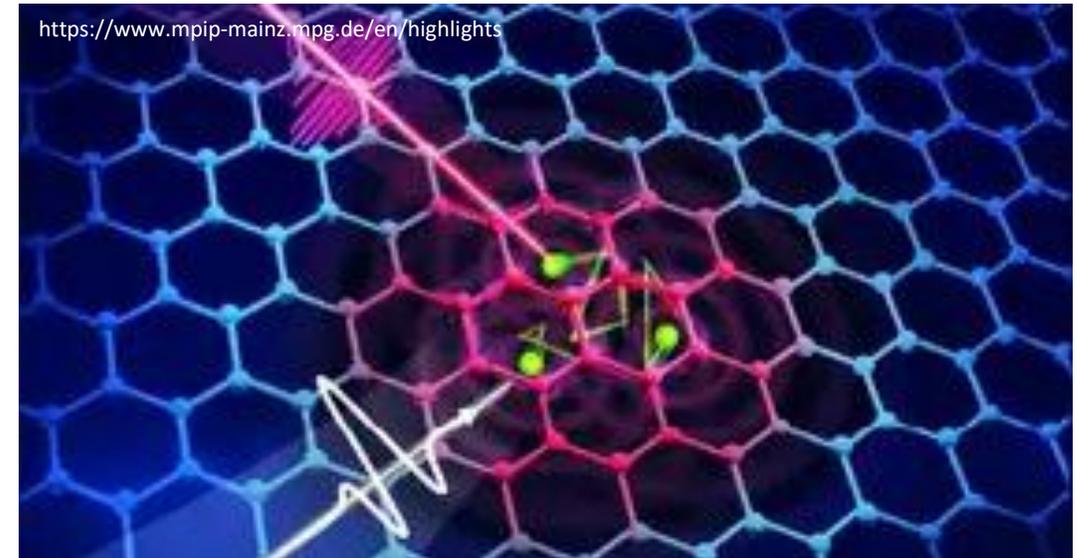


Andrea Trabattoni: **Attosecond photoionisation dynamics in large water clusters**

**PI:** Francesca Calegari (DESY)

**User experiment ID:** ELIUPM3-86\_HRGHHG\_WATERTIME\_FC

**Proposal title:** Time-resolved photoelectron spectroscopy of water clusters with attosecond resolution



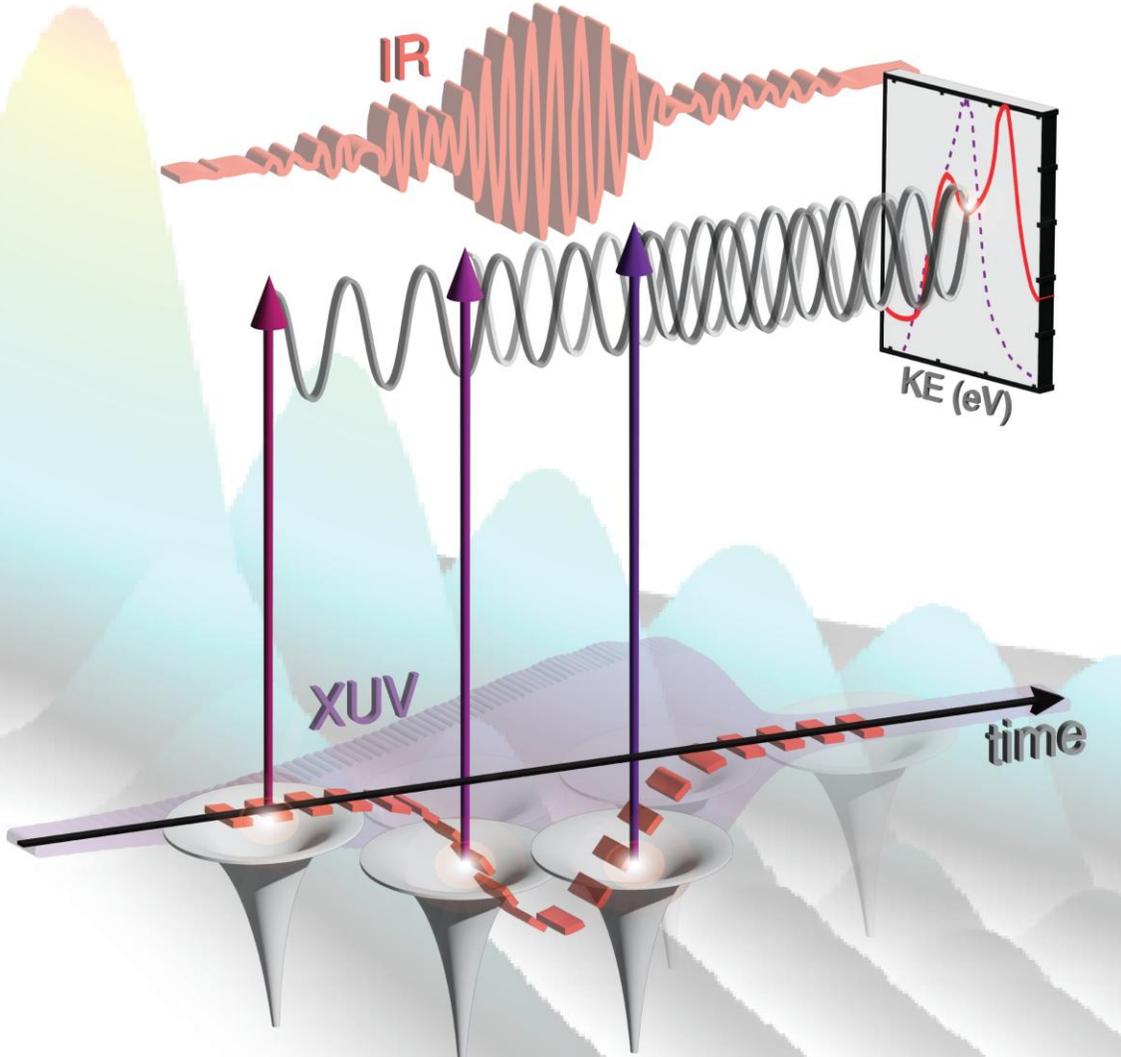
Benjamin Stadtmüller: **Imaging the Ultrafast Charge and Spin Carrier Dynamics of Low Dimensional Heterostructures in Momentum Space,**

**PI:** Benjamin Stadtmüller (University of Augsburg)

**User experiment ID:** ELIUPM3-56\_NANOESCA\_HOTMETAL\_BS

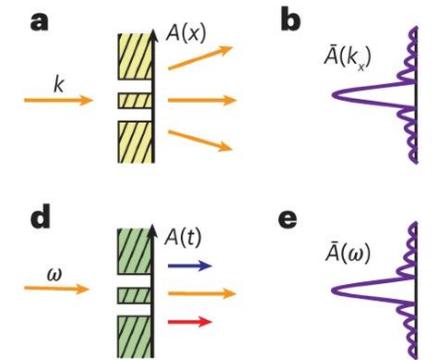
**Proposal title:** Functionalization of the hot electron dynamics of graphene on metallic surfaces by intercalation of heavy metals

# Controlling electron interference in time



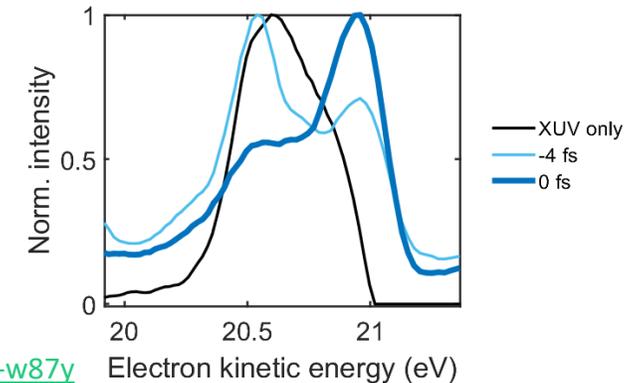
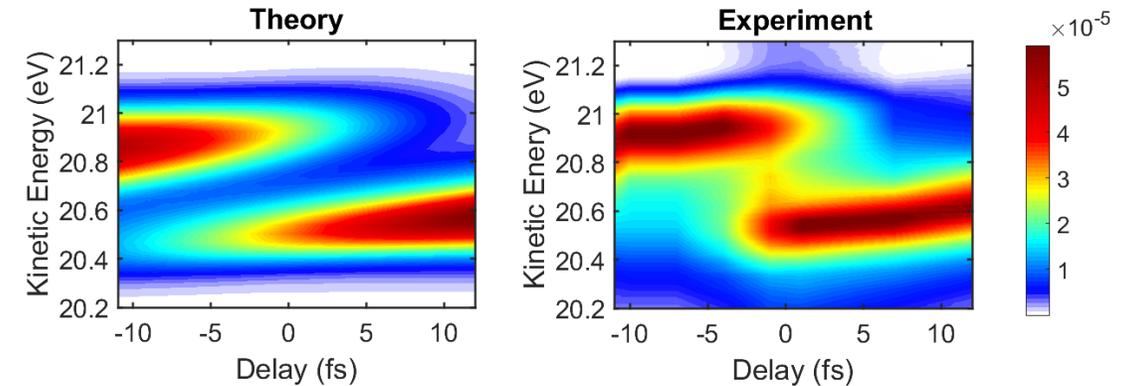
## A double-slit experiment in time

Chirped laser-assisted dynamic interference (cLADI) — to manipulate temporal quantum interference during photoionization.



## EXPERIMENT VS. THEORY

R. Tirole *et al.*, *Nat. Phys.* **19**, 999–1002 (2023).



F. Vismarra *et al.*,  
*Phys. Rev. Lett.* **135** (3),  
033202 (2025).

<https://doi.org/10.1103/73tl-w87y>

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**Thank you!**



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