

NEXT

NON-LINEAR EXTREME ULTRAVIOLET TO HARD X-RAY TECHNIQUES

Newsletter NEXT Grant Period 1: 2023 - 2024

NEXT COST ACTION OBJECTIVES

The **NEXT COST Action** aims to create the first concerted experimental and theoretical effort devoted to the implementation of **EUV/X-ray non-linear spectroscopy at table-top HHG and XFEL sources**.

This Action holds a strong impact towards the development of innovative methodologies underpinning the **smart design of novel materials, nanodevices, quantum computing and chemistry**.

Moreover, it will foster the **training of young scientists as well as the next generation of researchers**, that will fully exploit these novel technologies and tools.

NEXT will also act as a **key research and innovation bridge** between academia and industrial partners.

Specifically, the NEXT COST Action **main pillars** are:

- **EUV / X-ray nonlinear spectroscopy in atomic, molecular and optical (AMO) physics (WG1)**
- **EUV / X-ray nonlinear spectroscopy in condensed matter (CM) physics (WG2)**
- **EUV / X-ray nonlinear spectroscopy in (bio-) chemistry (WG3)**
- **Geographical, gender and age balance (ITC and YRI inclusiveness).**

IN THIS ISSUE

1. NEXT Cost Action objectives
2. Management board and COST contacts
3. Working Groups
4. STSM & Grant awarding: who, what, how
5. Communication platforms: website and social media
6. Annual meeting GP1
7. Meeting NEXT'S members
8. Upcoming events
9. Facts and figures



ca-next.eu



info@next.eu



Funded by
the European Union

MANAGEMENT BOARD AND COST CONTACTS



ACTION CHAIR / GRANT HOLDER SCIENTIFIC REPRESENTATIVE

Prof. Cristian Svetina
Senior Research Professor

IMDEA Nanoscience, Madrid (ES)
cristian.svetina@imdea.org

ACTION VICE-CHAIR

Prof. Giulia Fulvia Mancini
Associate Professor

University of Pavia (IT)
giuliafulvia.mancini@unipv.it



SCIENCE COMMUNICATION COORDINATOR

Prof. Barbara Ressel
Associate Professor

University of Nova Gorica (SI)
barbara.resessel@ung.si

GRANT AWARDING COORDINATOR

Prof. Wojciech Gawelda
Distinguished Researcher
Associated Research Professor

Autonomous University Madrid (UAM), Madrid (ES)
IMDEA Nanoscience, Madrid (ES)
wojciech.gawelda@uam.es
wojciech.gawelda@imdea.org



WG 1 GROUP LEADER

Dr. Caterina Vozzi
Research director

CNR-IFN (IT)
caterina.vozzi@cnr.it

WG 2 GROUP LEADER

Prof. Martin Beye
Professor

Stockholm University (SE)
martin.beye@fysik.su.se



WG 3 GROUP LEADER

Prof. Majed Chergui
Emeritus Professor EPF-Lausanne
(CH) and Group leader

ELETTRA-Sincrotrone, Trieste (IT)
majed.chergui@epfl.ch
majed.chergui@elettra.eu

CPC ON GEOGRAPHICAL INCLUSIVENESS AND ITC CG MANAGER

Dr. Jaroslav Nejd
Group leader

ELI Beamlines Center (CZ)
jaroslav.nejd@eli-beams.eu



CPC ON GENDER BALANCE

Dr. Laura Cattaneo
Max Planck Group Leader

MPIK Heidelberg (DE)
laura.cattaneo@mpi-hd.mpg.de

SHORT TERM SCIENTIFIC MISSION (STSM) COORDINATOR

Prof. Andrea Cannizzo
Associate Professor

Bern University (CH)
andrea.cannizzo@unibe.ch



COST CONTACTS

Dr. Fatima Bouchama – Science Officer fatima.bouchama@cost.eu

Mrs. Cassia Azevedo – Administrative Officer cassia.azevedo@cost.eu

WORKING GROUPS

WG1

EUV / X-ray nonlinear spectroscopy in atomic, molecular and optical (AMO) physics

N. participants 198

Non-linear EUV/X-ray spectroscopy represents an **innovative technique within Atomic, Molecular, and Optical (AMO) physics**, utilizing the distinctive properties of extreme ultraviolet (EUV) and X-ray radiation to examine the electronic structure and dynamics of matter at an atomic scale.

This method expands traditional spectroscopy by investigating non-linear interactions that arise when the intensity of incident radiation is sufficiently high to induce multi-photon absorption processes, thereby deepening our understanding of light-matter interactions. It allows researchers to study phenomena such as **electron correlation, many-body dynamics, and quantum coherence under extreme conditions**. This foundational knowledge not only enhances our comprehension of the physical world but also paves the way for future technological advancements.

The WG is dedicated to developing new methodologies and techniques in EUV/X-ray non-linear spectroscopy. This involves creating novel experimental setups and theoretical models to better understand high-intensity light-matter interactions.

We aim to advance technology related to EUV/X-ray sources, detectors, and experimental apparatuses by **improving sensitivity, resolution, and data acquisition methods** to enhance spectroscopy studies' capabilities.

Through collaborations within the NEXT network, involving physicists, chemists, materials scientists, and biologists, we seek to answer fundamental questions in AMO physics regarding electron dynamics, quantum coherence, and the behavior of matter under extreme conditions by leveraging diverse expertise and perspectives.

WG2

EUV / X-ray nonlinear spectroscopy in condensed matter (CM) physics

N. participants 120

Essentially all devices in our everyday life depend on functional elements made up from complex solids. Functionality emerges from an interplay of many degrees of freedom, like charges, spins and nuclear motions that are strongly coupled in the condensed phase.

The energy scales involved range from tiny excitations across the Fermi level in a metal that makes it conducting up to large band gaps of several electron volts in highly transparent and inert materials. Length scales in solids are characterized by **strong bonds on the atomic length scale up to the size of highly symmetric domains reaching to microscopic length scales**. The translational symmetry then makes a description in momentum space useful. A full understanding of the inner workings of solid matter thus requires to access or even bridge a large range in energies and length scales.

The focus of this working group is to **stimulate the development of the new methodologies on scientifically interesting samples and to trigger the demonstration of novel, relevant information content**. A few examples: (i) all X-ray transient grating; (ii) mixing waves of different wavelengths in Sum- or Difference Frequency Generation (S/DFG); (iii) use core resonances and harness chemical sensitivity to identify active elements in complex solids.

Developments in this working group will partially follow demonstrations of the working principles, the developed theoretical ideas and mechanisms gathered on simpler systems, like atoms as studied in WG1. Dedicated discussions in meetings (virtual and in-person) will foster the exchange and **provide opportunities for cooperation between groups that have different backgrounds, expertise, scientific questions and approaches**.

EUV / X-ray nonlinear spectroscopy in (bio-) chemistry

N. participants 93

In the optical domain, non-linear methods have become standard tools to probe dynamical properties of (bio)chemical systems. While EUV/X-ray NL methods are already frequently used to investigate gas or solid samples, very little has so far been demonstrated in the case of solution phase (bio)chemical systems.

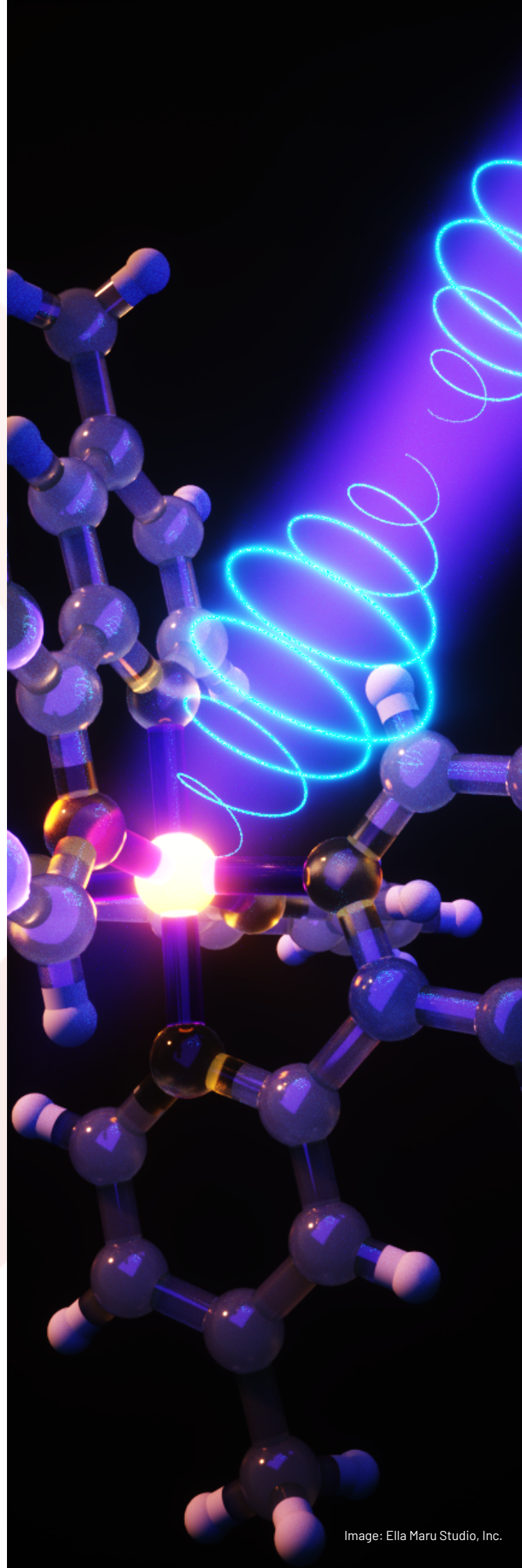
The use of NL phenomena with short wavelength radiation allows several new insights such as **element-selectivity, high spatial resolution and high momentum transfer**. In combination with an optical pulse, which is resonant with valence transitions, one may envision exciting $\chi^{(2)}$ experiments, which would allow elemental-sensitivity of processes on-going at an interface via Optical+X-(OX) ray Sum- or Difference frequency generation (S/DFG) and second harmonic generation (SHG).

In this WG, we would like to foster the use of the above-mentioned techniques to monitor with element-selectivity and high temporal resolution **dynamics at liquid-gas and liquid-solid interfaces**, specifically exploiting (whenever possible) both valence and core resonances to enhance the signal and boost the selectivity of the method.

Another goal is to **implement 4-wave mixing methods** to track charge and energy transport in (bio)chemical systems, as well as follow the diffusion of photochemical products in liquid solutions.

In terms of interdisciplinarity, there is an obvious complementarity with the other WGs in terms of instrumentation and methodologies to be developed. This also goes for theoretical modeling.

In addition, several systems/phenomena to be investigated are common to the other two WGs. For example, molecular systems with WG1 and solids such as perovskites or transition metal oxides with WG2. This is reflected in the fact that all but 10 of WG3 members are also members of the other two WGs.



STSM & GRANT AWARDING: WHO, WHAT, HOW

At the core of the COST Action are the **Short Term Scientific Missions (STSM)** enabling master and PhD students to spend a limited amount of time in collaborating labs or companies on a project closely related to the NEXT mission.

The STSM applications must be submitted online using this e-cost platform. STSM applications are managed by the STSM-Coordinator, Prof. Andrea Cannizzo directly through e-cost.

STSM beneficiaries will be asked to **provide a scientific report and a summary** for outreach purposes after completion of the research mission. The agreed budget is usually of 1000 EUR/week all inclusive, but can reach up to 4000 EUR max when justified.

During the first grant period four STSM projects has been approved:

1. Nonlinear thermoelastic response and finite size effects in transient grating experiments (9 days),
2. High-order Harmonic Generation in Liquid Crystals by Two-Colors Laser Field (16 days),
3. Resonant and Single-digit nanometer Extreme Ultraviolet Transient Grating at the FERMI Free Electron Laser (10 days),
4. Installation and Optimization of a set up for Transient Grating Spectroscopy (17 days).



COMMUNICATION PLATFORMS: WEBSITE AND SOCIAL MEDIA

The NEXT website was created in order to disseminate and promote all activities related to our COST Action.

It includes general information on the network, such as **objectives, participants, activities, outcomes list, procedures to apply for the STSM grants and frequently asked questions (FAQ)**.

The current version of the website will be further strengthened by dedicated sections with **links to repositories** including Action results (either for data, software or publications), publish practical information on new methodologies, experimental set ups, scientific news, best practices, job and funding opportunities.

Moreover, it will report the **Action's Highlights, press releases, videos, Podcasts, and outreach activities in schools**, to maximize the Action visibility and social benefit deriving from the scientific knowledge acquired and to foster the engagement of general public and wider society.

The NEXT Action channels on Twitter/X, Instagram and LinkedIn are aimed to enhance interaction with the COST Action network at all levels, to **foster interconnection among the Action nodes and to promote career opportunities**, and to raise awareness on the societal relevance of the knowledge shared and produced by the NEXT Cost Action.

 Instagram: next_ca22148

 LinkedIn: COST Action NEXT

 Twitter/X: @NEXT_CA22148

To join the CA22148 Action:

<https://www.cost.eu/actions/CA22148/>



To visit the NEXT Action website:

<https://ca-next.eu/>



The NEXT Action brand identity was created with the support of WiderView Srl and it is reflected in all communication and dissemination material: flyers, posters, roll ups, social media.

ANNUAL MEETING GPI

The annual meeting (AM) took place from July 8th to 12th 2024 at the institute IMDEA nanociencia, Madrid, Spain. It focused on the latest **theoretical and experimental development in the models, generation and application of few-femtosecond and attosecond pulses at FELs and HHG Sources**, with emphasis on non-linear phenomena.

The workshop included **18 sessions, 31 invited speakers, 21 contributed speakers and 5 industrial participants**. Overall, we had 14 out of 57 talks given by women (24.5%), reflecting very closely the gender composition of our COST Action (24%).

One of the sessions has been entirely devoted to a **diversity and gender balance contribution**. Frauke Logerman, a social scientist and Head of Talent, Gender & Diversity Affairs in the Human Resources Development & Opportunities department of the Max Planck Society, was invited to give a talk regarding diversity and inclusion in science. Her talk was followed by a very alive Q&A session.

Regarding the participation of corporate partners, an informative campaign was made before the AM asking to different companies relevant for NEXT's network their participation while offering an opportunity to exhibit their latest technologies. Five companies accepted the invitation, including **Fastlite/Amplitude, Cinel, XRNanotech, Light Conversion, and Springer**. Each of them actively participated to the workshop, giving a 10' speech. This first step will strengthen future interactions and possible collaborations for STSM.

At the end of the AM an award ceremony was held for the **best poster** and the **best presentation** made by a young researcher. Prizes kindly offered by Springer Nature. The winners were:

Francesco Montorsi with his poster entitled: "Ultrafast photo-electron spectroscopy of competitive conical intersections"

Dr. Dietrich Krebs with his presentation entitled: "X-ray-optical wavemixing - From first-principles theory to crystallographic application".



MEETING NEXT'S MEMBERS



INTERVIEW WITH A YOUNG RESEARCHER

Dr. Gabriele Crippa

Postdoctoral researcher at CEA

Gif-sur-Yvette, Île-de-France, France

WHAT'S YOUR RESEARCH ABOUT?



My research currently focuses on the study of attosecond time delays in photoionization. In particular, at AttoLab in Paris Saclay we are investigating the XUV photoionization dynamics in molecules and liquids, as well as the impact of quantum effects like coherences and entanglement during photoionization.

WHAT'S YOUR MOTIVATION TO BE PART OF THE NEXT ACTION?



I joined the NEXT Action because I saw it as a great opportunity to build connections with scientists working with a large variety of XUV spectroscopy techniques and with whom I normally wouldn't get in touch at more sectorial conferences, and to draw inspiration from their work.

WHAT WOULD YOU LIKE THE NEXT ACTION TO ACHIEVE?



Events like conferences and workshops are important moments to gather and exchange ideas within the community, but they do not provide a continuous platform of dialogue. Hence, I would like COST Actions such as NEXT to create a network for sharing and confrontation on a more regular basis, fostering collaborations and exchanges between research groups.

MEETING NEXT'S MEMBERS



INTERVIEW WITH A SENIOR RESEARCHER

Prof. Marie Abboud Mehanna

*Faculty of Science (FS) Laboratory
of Biophotonics and Ionizing Radiation (LBRI)
Saint-Joseph University, Beirut, Lebanon*

WHAT'S YOUR RESEARCH ABOUT?



My research centers on laser-matter interactions, focusing optical metrology and on optical imaging in diffusive media using laser speckle techniques, with applications spanning life sciences, medical diagnostics, and industry.

WHAT'S YOUR MOTIVATION TO BE PART OF THE NEXT ACTION?



I am motivated to be part of the NEXT Action because it fosters collaboration within the ultrafast and non-linear X-ray research community, enabling the exchange of ideas and potentially leading to joint research initiatives. As a researcher from a Mediterranean Partner Country (MPC), I am particularly keen to establish collaborations with European institutions through this network.

WHAT WOULD YOU LIKE THE NEXT ACTION TO ACHIEVE?



I would like the NEXT Action to provide opportunities for training and collaboration, and to bridge geographic and institutional gaps.

UPCOMING EVENTS

COST NEXT WORKSHOP

New Trends in Linear and Non-linear Spectroscopic Chirality Studies (NETLINCS)

 Trieste (Italy)

 December 3-4, 2024

 <https://indico.elettra.eu/event/48/>

MEETING

Annual Meeting & MC meeting

 Vipava (Slovenia)

 14-18 July 2025

 <https://ca-next.eu/events/>

INTERNATIONAL SCHOOL

The Frontiers of Attosecond and Ultrafast X-ray Science

 Ettore Majorana Center in Erice (Italy)

 7-12 April 2025

 <https://ca-next.eu/events/>

INTERNATIONAL SCHOOL

COST/ZCAM School on New Computational Methods for Attosecond Molecular Processes

 Zaragoza (Spain)

 May 2025

 <https://ca-next.eu/events/>

Stay tuned on our social media for next events!



FACTS AND FIGURES



MEMBERS

NEXT Action's
Members

250

ITC WG members

48%

YRI WG members

51%



GENDER DISTRIBUTION

WG member

24%F - 76%M

in all leadership roles

40%F - 60%M



INDUSTRIAL PARTNERS

Springer Nature

springer.com

Class5 Photonics

class5photonics.com

Amplitude

amplitude-laser.com

Cinel

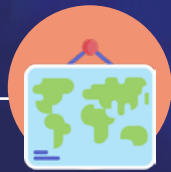
cinel.com

XRnanotech

xrnanotech.com

Light Conversion

lightcon.com



PARTNER COUNTRIES

Partner
countries ITC

52%



LEARNING SESSIONS

training schools

1 done (GP1)

2 planned (GP2)

workshop

1 done (GP1)

2 planned (GP2)

REMINDER!

Include the acknowledgement to COST/CA22148 Action on publications.
Note that Action results have to be co-authored by at least two Action participants from two countries participating in the Action.