

# FEL-NL

The Netherlands Free Electron Laser Infrastructure for Soft X-rays



## A STUDIO TO SHOOT ACTION MOVIES OF THE NANOWORLD

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ADVANCED RESEARCH CENTER FOR NANOLITHOGRAPHY



university of  
 groningen

zernike institute for  
 advanced materials

# FEL-NL launch platform



ADVANCED RESEARCH CENTER FOR NANOLITHOGRAPHY



university of  
 groningen

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- @Science Park Amsterdam
- Start October 2014
- Research on EUV generation and its interaction with matter
- Co-funded by **ASML**, FOM/NWO, and the Amsterdam Universities
- University of Groningen
- national Top+ research institute
- Research on advanced materials nanophysics
- Only non-US institute in top 10 of nanophysics institutes

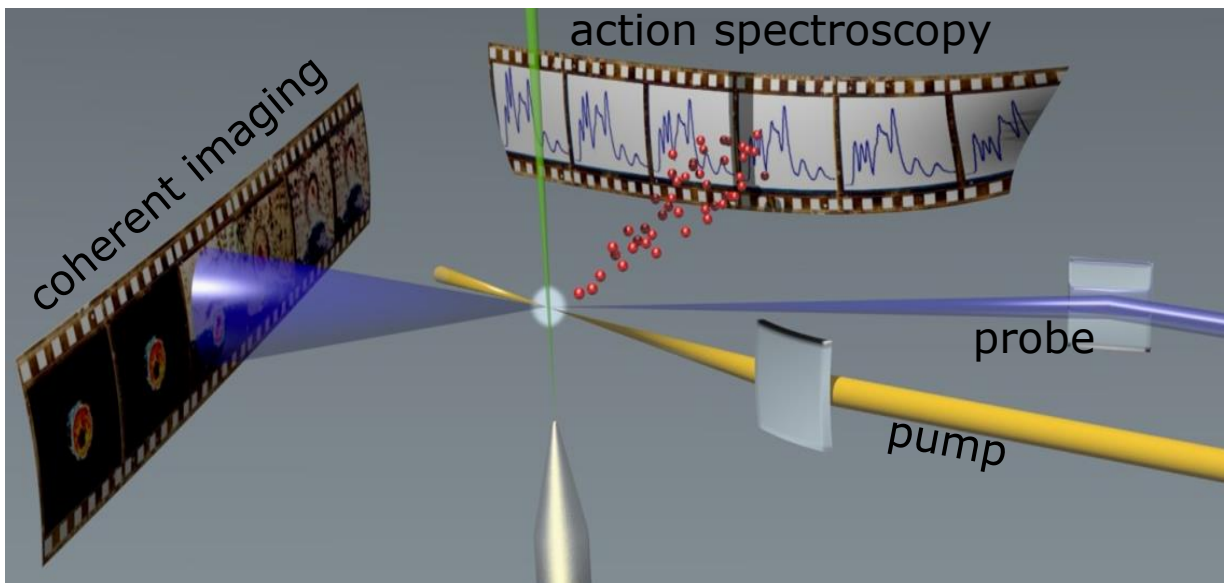
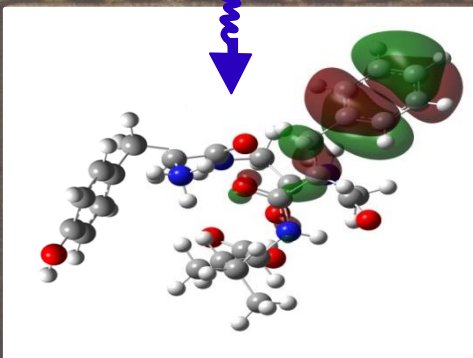
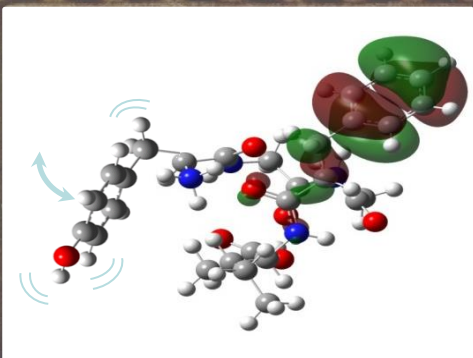
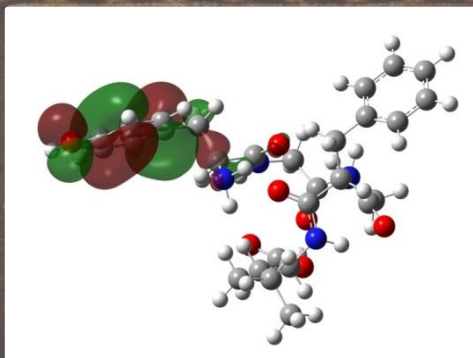
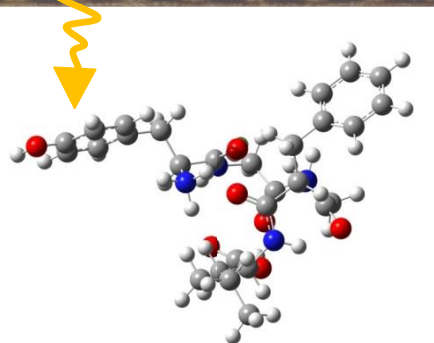
collaborations/contacts/.... established within the  initiative (2011-2013)

Oct 2016: FEL-NL on Large Scale Facilities Agenda of the KNAW  
Royal Netherlands Academy of Sciences

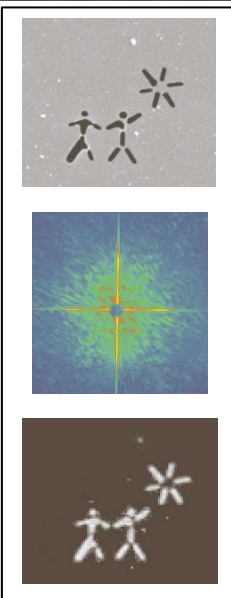


**KNAW**

Pump = light, electron, chemical reaction  
hydrogenation, .....



Gaffney and Chapman Science. 316 (2007) 1444

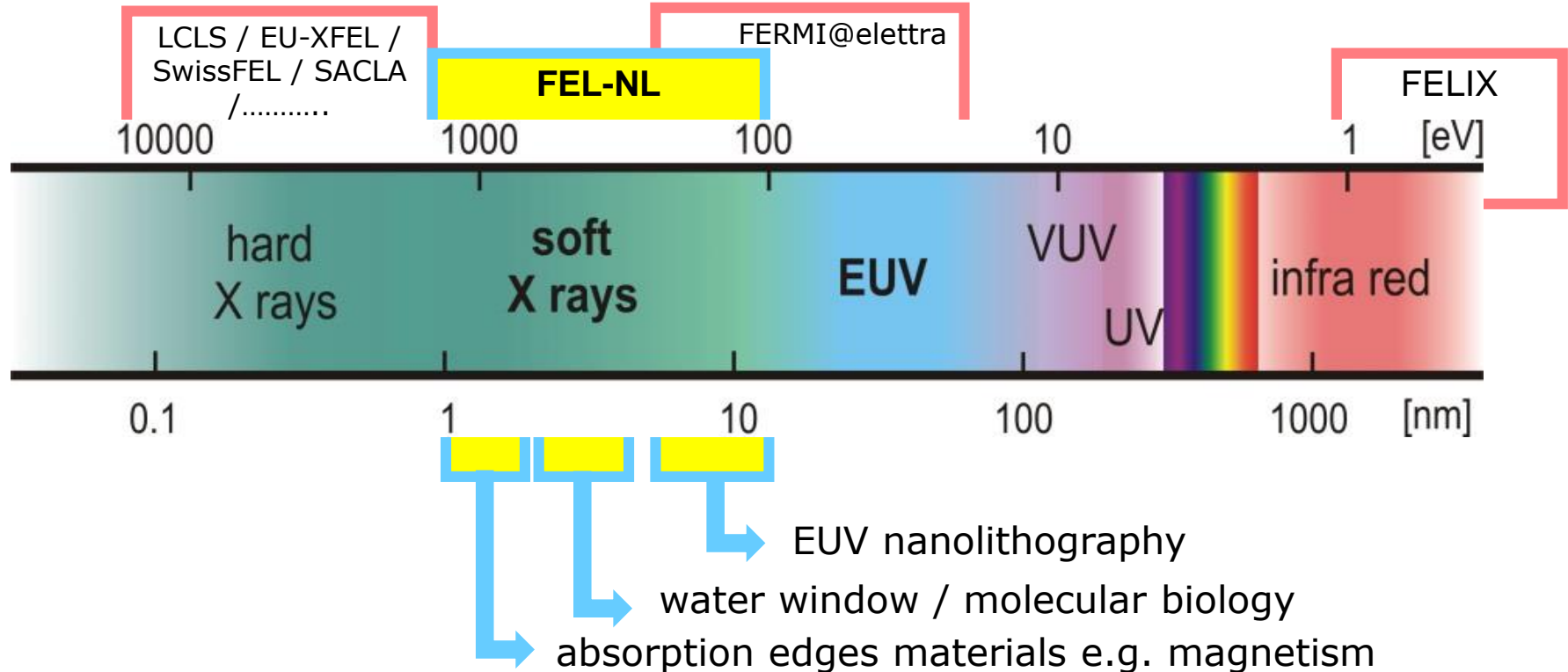


object  
single-shot image  
reconstruction

- *nanometer resolution*
- *ultrashort (fs) flashes*
- *ultrabright, coherent source*

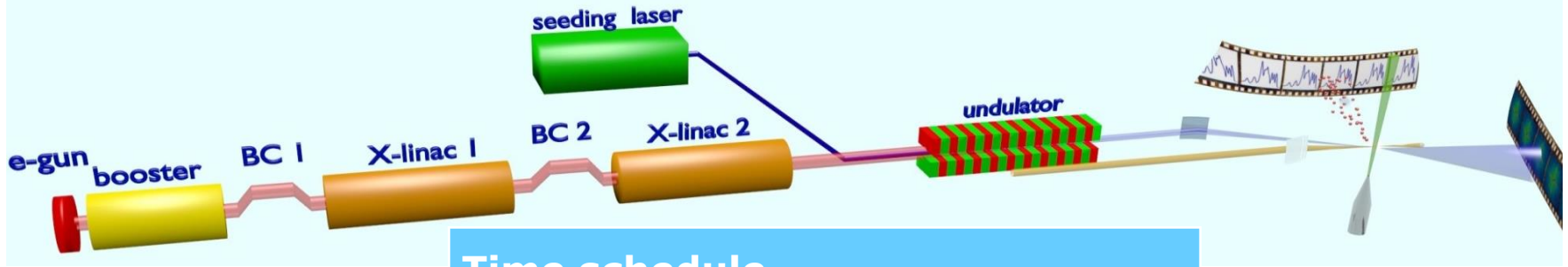
**ultrastrong pulsed laser  
in the soft-X-ray /XUV**

**Free Electron Laser**



## FEL-NL parameters and motivation

1 – 15 nm Soft X ray – EUV (photon interactions $E^{-3}$ )	advanced materials, biophysics (water window), catalysis, light-matter interactions, ..... spectroscopy, reaction microscopy, nanoscale coherent imaging
1 – 5kHz single-pulse	pump-probe spectroscopy: 1-10 fs; maximum measurement rate 1 – maybe up to 5 kHz.
external HHG seeding	pulse-to-pulse stability, reproducibility and control
tunable polarization	magnetic and chiral systems
X band accelerator + low emittance source	compact < 100 m low bunch charges 10-100 pC



## Time schedule

Yr 1	baseline design organisational scaffolding
Yr 2	sub-unit design building site
Yr 3	full machine design building construction
Yr 4	building infrastructure full machine design
Yr 5	start commissioning infrastructure
Yr 6	commissioning machine
Yr 7	first soft-X-ray lasing
<b>Yr 8</b>	<b>user operation</b>

team up with

**SMART\*Light** *A Dutch Tabletop Synchrotron for Science*

Jom Luiten -TU/e

tunable hard X-rays for material and medical applications

start Dutch X-band research cluster

feasibility and limits of a X band  
accelerator driven soft X ray FEL

