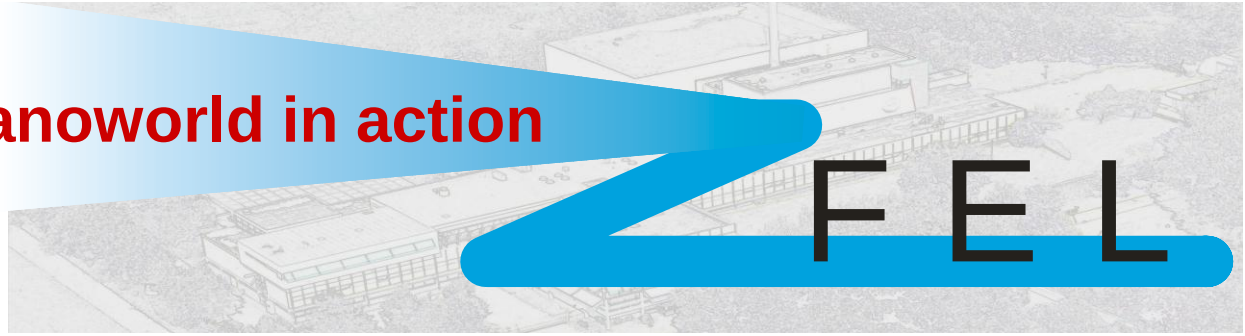
The nanoworld in action



a compact soft-X-ray free-electron laser facility in the Netherlands

Ronnie Hoekstra
for the ZFEL team

www.zfel.nl

KVI

university of groningen

zernike institute for advanced materials

University of Twente The Netherlands

MESA+ INSTITUTE FOR NANOTECHNOLOGY

FOM Institute for Plasma Physics Riinhuizen

TU/e Technische Universiteit Eindhoven University of Technology

VU VRIJE UNIVERSITEIT AMSTERDAM

LASERLAB Amsterdam

KVI and the Zernike Institute for Advanced Materials

KVI

“Nuclear Accelerator Institute”

international user facility

AGOR
ZERNIKE-LEIF

Zernike Institute for
Advanced Materials

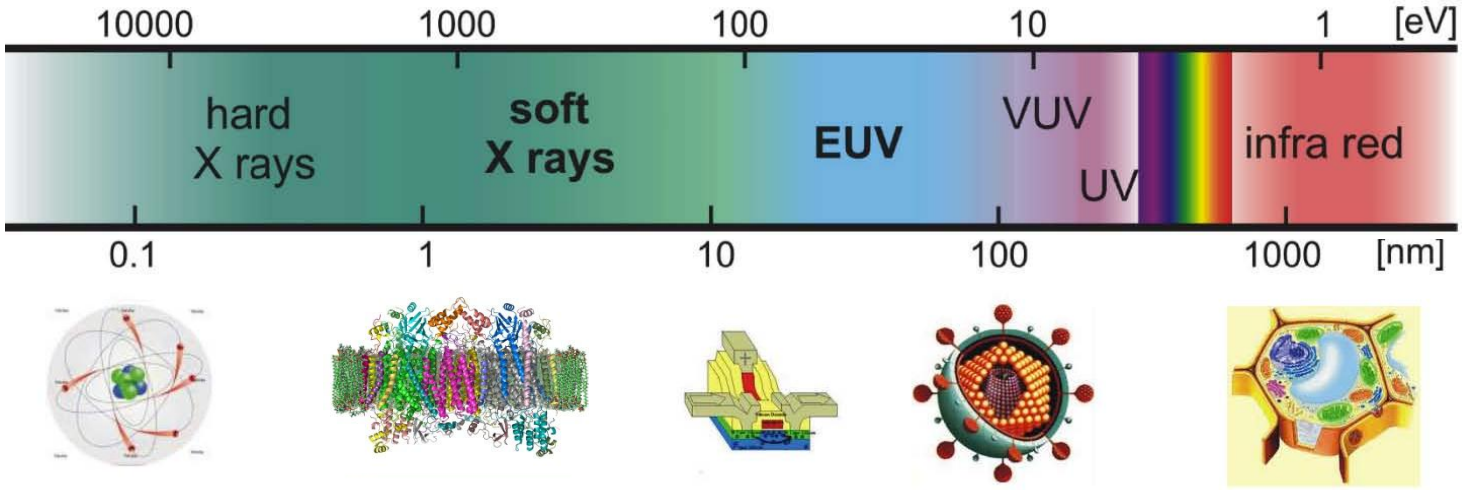
Why **"Z"**FEL?

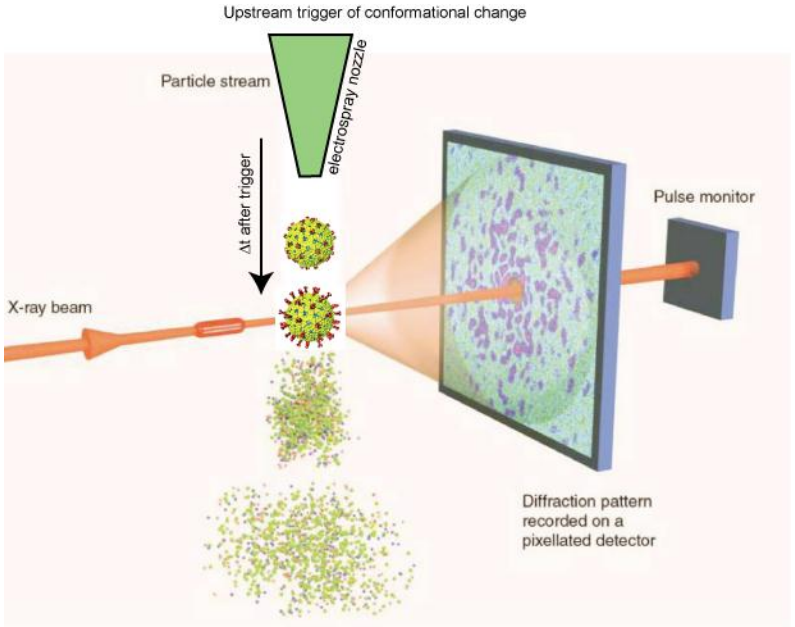
"soft X ray" in Dutch: "**Z**achte-röntgenstraling"

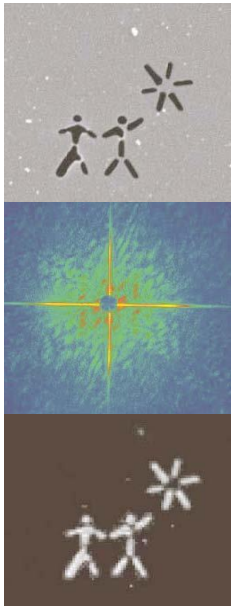
Frits **Z**ernike
(1888-1966)

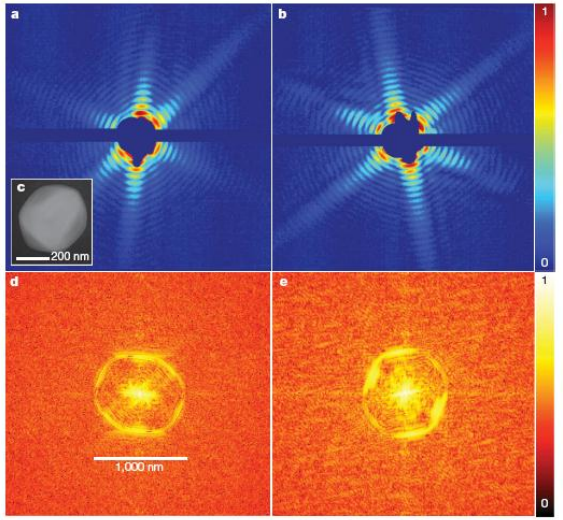
To whom the Nobel Prize in Physics 1953 was awarded *"for his demonstration of the phase contrast method, especially for his invention of the phase contrast microscope"*.

X ray vision of the nanoworld



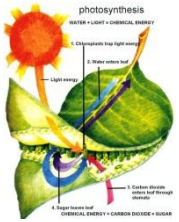


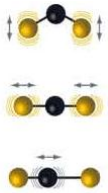


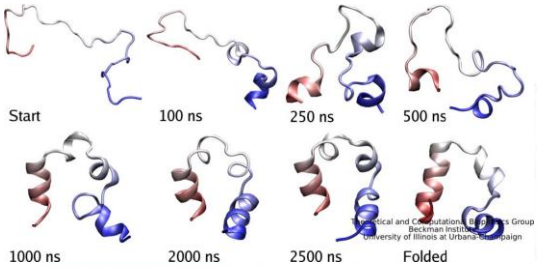


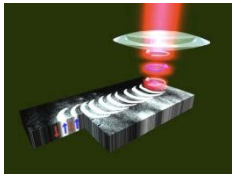
Seibert et al, *Nature* 2011 470, 78

the time scales in the nanoworld

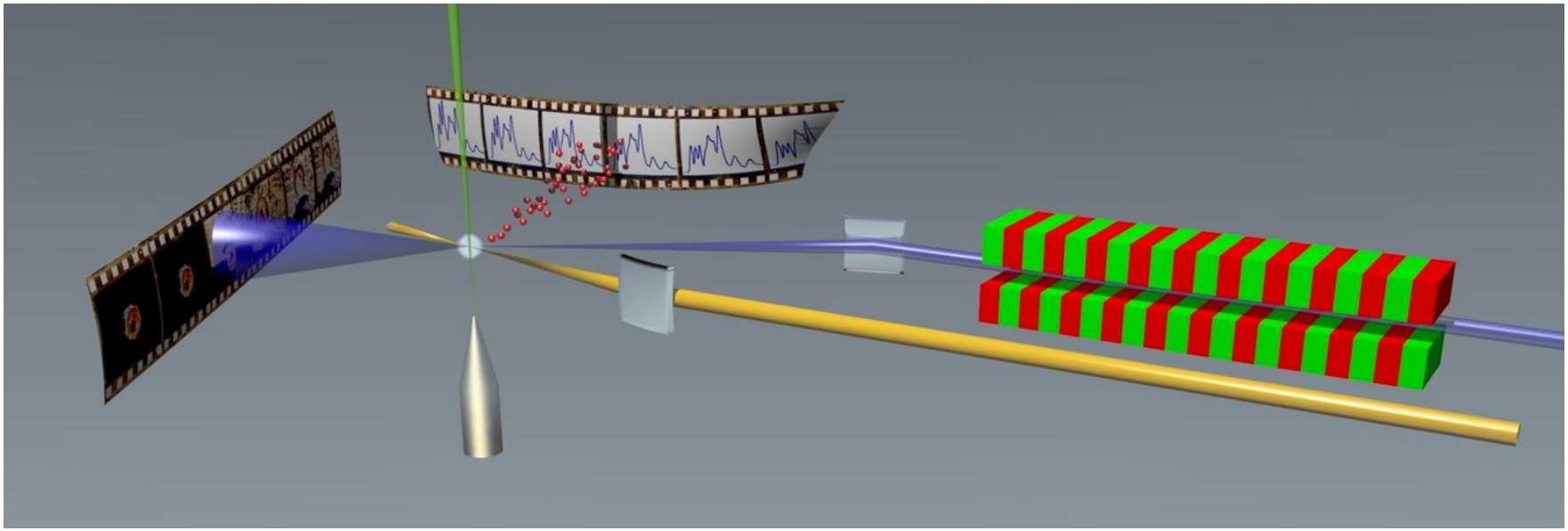




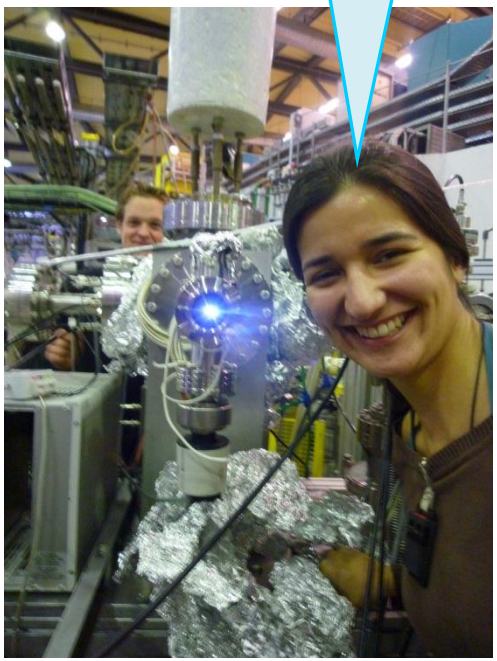




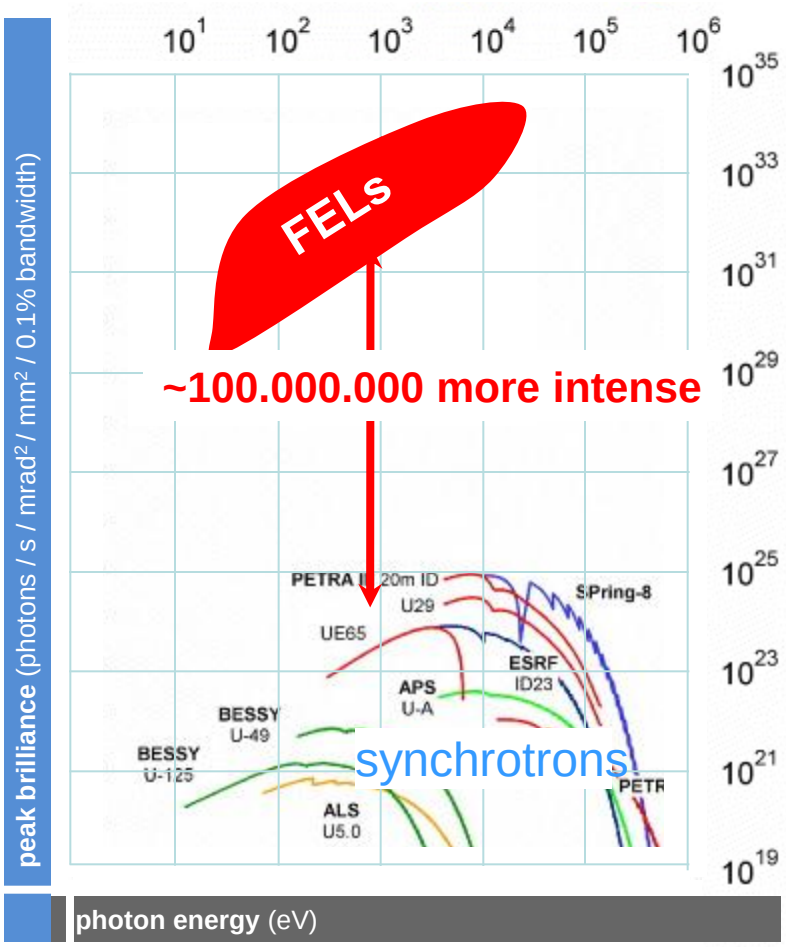
10^{-15} s 10^{-12} s 10^{-9} s 10^{-6} s



But this requires **ultrabright, ultrashort** flashes of light of a **X ray laser**.



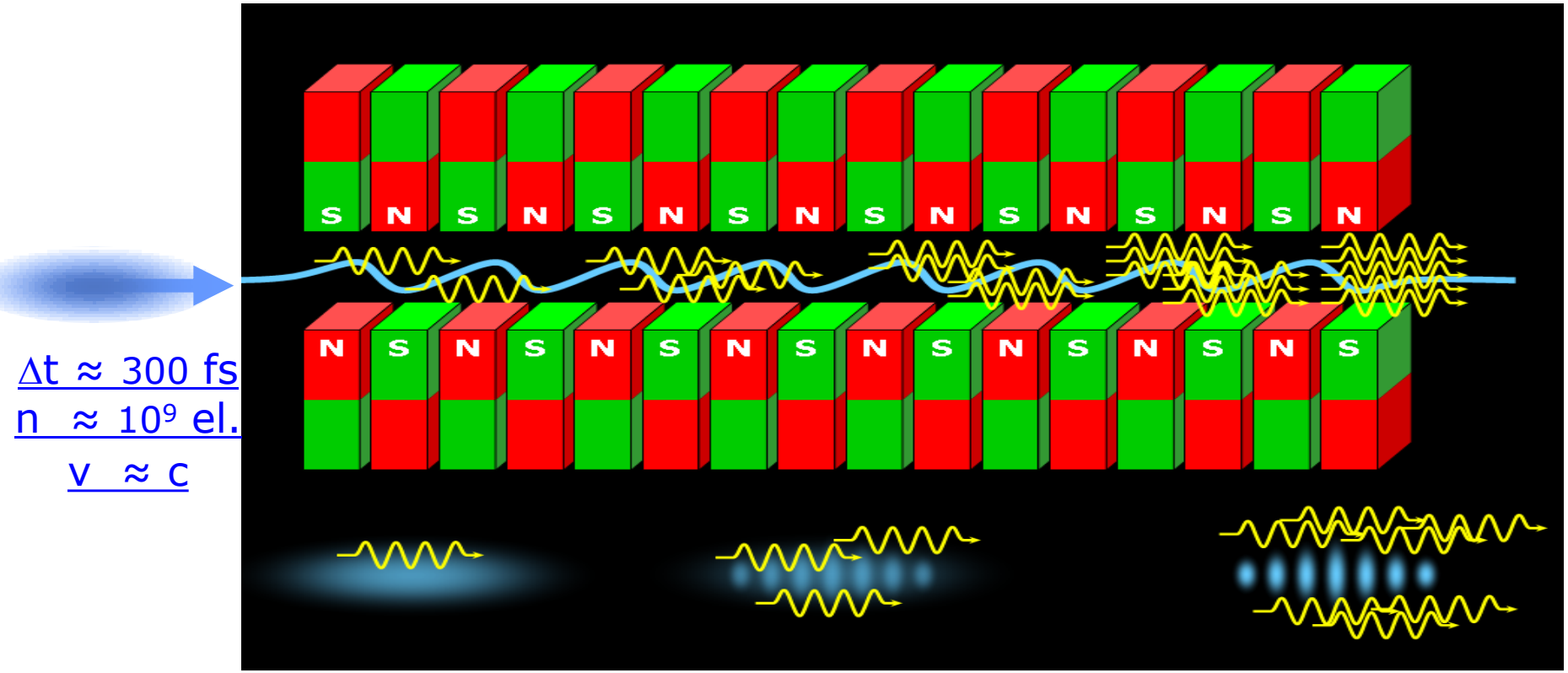
“state of the art” X ray sources



X ray FELs produce intrinsically

Ultrabright, ultrashort (femtosecond) flashes of X rays

the principle of operation of a X-ray FEL



$\Delta t \approx 300$ fs
$n \approx 10^9$ el.
$v \approx c$

electrons through „undulator" non-coherent

micro-bunches of photons

coherent emission **laser**

X ray FELs

FLASH – Hamburg

LCLS – Stanford

facility	start of operation	e beam energy [GeV]	minimum wavelength [nm]	hard X rays / soft X rays (0.1 – 1 – 10)	repetition rate [Hz]
FLASH	2005	1.2	4.12		10
LCLS	2009	13.6	0.15		120
FERMI@ELETTRA	2011	1.2	10		10
SCSS	2012	8	0.1		60
EU – XFEL	2016	17.5	0.1		10
SwissFEL	2017	5.8	0.1		100
ZFEL	2017	2	0.8		1000

compact (~100 m), single pulse, …. 5 fs ….., seeded operation, on site users and facilities

key expertise in the Netherlands

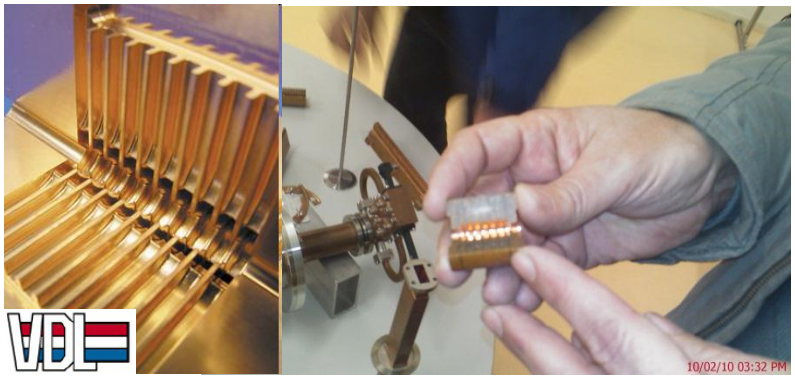
ZFELworkshop002

ZFEL – De Nederlandse sleutelexpertise

11 februari 2011 FOM - bureau - Utrecht

10:15	Aankomst/koffie	
10:30	KVI university of groningen	intro/welkom Ronnie Hoekstra
10:45	FOM Institute for Plasma Physics Rijnhuizen	infraroodFELs (FELIX/FELICE) Lex van der Meer
11:15	TU/e Technische Universiteit Eindhoven University of Technology	elektronenbronnen Seth Brussaard
11:45	KVI university of groningen	versnellertechnologie Sytze Brandenburg
12:15	Lunch	
13:00	MESA+ INSTITUTE FOR NANOTECHNOLOGY	zachteröntgenoptica Fred Bijkerk
13:30	LaserLaB Amsterdam	table top-zachteröntgengeneratie Kjeld Eikema
14:00	University of Twente The Netherlands MESA+ INSTITUTE FOR NANOTECHNOLOGY	undulatoren en seeding Peter van der Slot
14:30	NIKHEF	uitlijning en detectoren Niels van Bakel
15:00	Discussie ZFEL-technologie en expertise	
16:00	einde	

collaboration with CERN



Design and construction of the very first compact, 1000 Hz electron accelerator facility based on innovative X-band accelerator structures being developed for the next generation of accelerators at CERN.

(inter-)national attractive – brain gain

FEL workshop

What X-ray Coherent Imaging can do for Dutch Science

09:30 Registration and coffee
10:00 Welcome by Ronnie Hoekstra

10:15 Thomas Barends (Max-Planck Institute for Medical Research, Heidelberg) "FEL – Emerging opportunities for structural biology"
11:00 Joost Reek (UVA) "Transition metal catalysis and macromolecular chemistry"
11:30 Guus Rijnders (UT) "Strain engineering"

12:00 Lunch

13:15 Roberta Croce (RUG/VU) "Biological photosystems"
13:45 Bernard Dam (TU Delft) "Materials for energy storage"
14:15 Bauke Dijkstra (RUG) "Protein crystallography"
14:45 Han Goossens (TU/e) "Strain in non-crystalline polymers"

15:15 Coffee/Tea

15:45 Discussion
16:30 Closure

Organizers:
Beatriz Noheda (Zernike Institute for Advanced Materials, University of Groningen)
Ronnie Hoekstra (KVI, University of Groningen)

Jaarbeurs Utrecht, 25 February, 2011
Registration:
Please send an e-mail with your name and affiliation to
Amarins Petitiaux (KVI – University of Groningen)
petitiaux@kvi.nl

university of groningen / faculty of mathematics and natural sciences / zernike institute for advanced materials
KVI

FEL KVI university of groningen zernike institute for advanced materials

ZFELworkshop004

The nanoworld in the time domain

March 16, 2011 KNAW – Trippenhuis, Amsterdam

09.30	Coffee
10:00	Paul van Loosdrecht, Zernike Inst. for Advanced Materials, University of Groningen Ronnie Hoekstra, KVI, University of Groningen *Introduction*
10:30	Theo Rasing , Radboud University Nijmegen *Magnetism at the timescale of the exchange interaction*
11:00	Jeroen Goedkoop , University of Amsterdam *Resonant coherent diffraction: a new window to the dynamics of "soft electronic matter"*
11:30	Coffee break
12:00	Raoul Frese, VU University Amsterdam *Structures and dynamics of photosynthetic membranes*
12:30	Wing Kiu Siu, AMOLF Amsterdam *Resolving ultrafast molecular dynamics using XUV/X-ray FEL light pulses*
13:00	Lunch
14:00	Laurens Siebbeles, Delft University of Technology *Charge and exciton dynamics in organic materials and semiconductor nanoparticles*
14:30	Huib Bakker, AMOLF Amsterdam *Motion of water around ions*
15:00	Tea break
15:30	Wim van der Zande, Radboud University Nijmegen *The strengths of Free Electron Lasers: gate to non-linear processes in chemistry and physics*
16:00	Discussion
17:00	Drinks

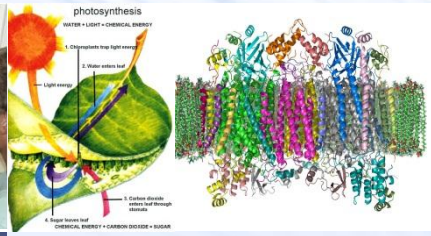
the KVI in 2017

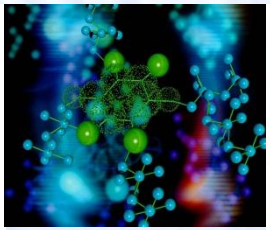
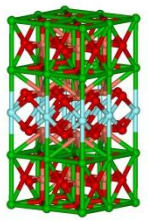
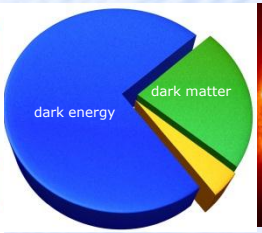
0.8 – 20 nm
seeded operation
circ. / lin. polarized
rep. rate …. 1 kHz

compact: X-band accelerator structures
in house users and facilities
(inter-)national user facility

world class science
innovations in technology for 21st century industry and society

working at the forefront of science and technology




PHYSICS
from atoms to matter
clusters, nucleation

CHEMISTRY
catalysis, colloids,
pharmaceutical processes

BIOLOGY
peptides, "biological" water,
membranes, virusses


MATTER UNDER EXTREME CONDITIONS
hot plasma, phase diagrams

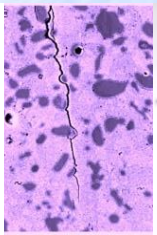
FUNDAMENTAL FORCES OF NATURE
QED, symmetries, axions, dark matter

CORRELATED MATERIALS
magnetism, phase transitions,
superconduction

MATERIALS
fatigue, stress, cracks,
radiation damage

FUNCTIONAL MATERIALS
new batteries, storage,
solar cells

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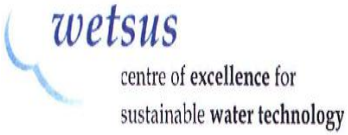
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