



HFML-FELIX

The (attracting) power of Magnets and Lasers

ILO-meeting, 14 -10-2024 MECC Maastricht

Meike Arnold
ILO-officer HFML-FELIX team

HFML-FELIX

HFML-FELIX is a partnership between Radboud University and NWO-I – A research facility for national and international researchers with a world leading in-house research programme



HFML-FELIX – LARGE-SCALE RESEARCH INFRASTRUCTURE

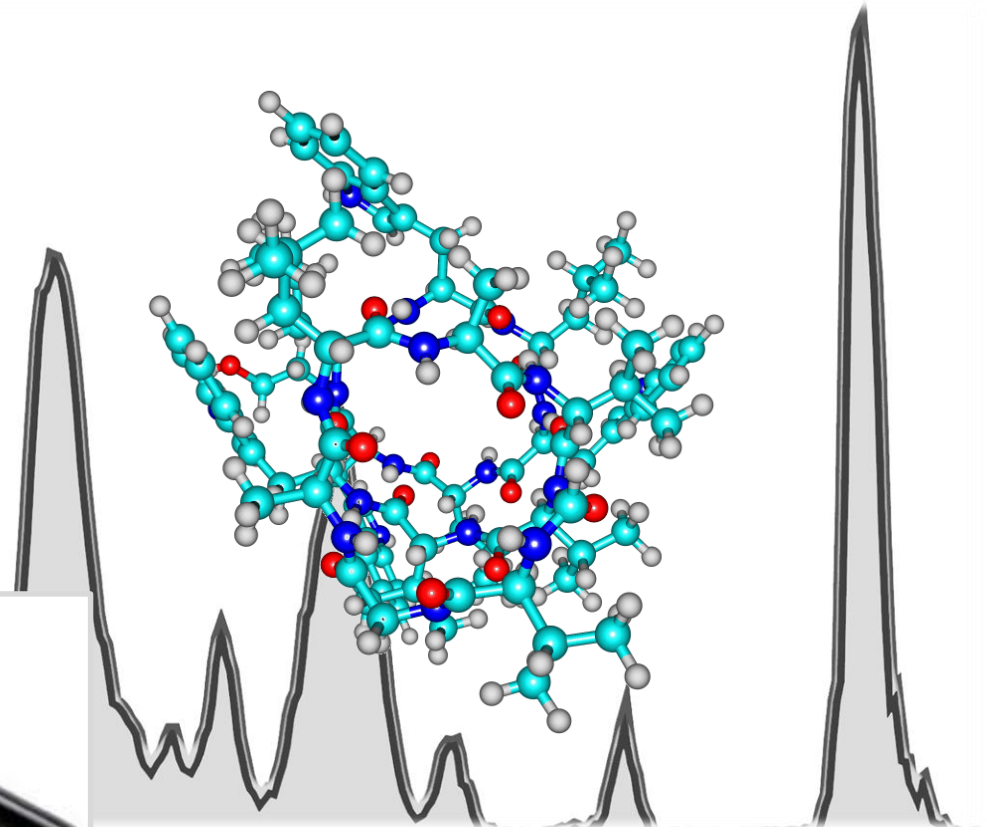
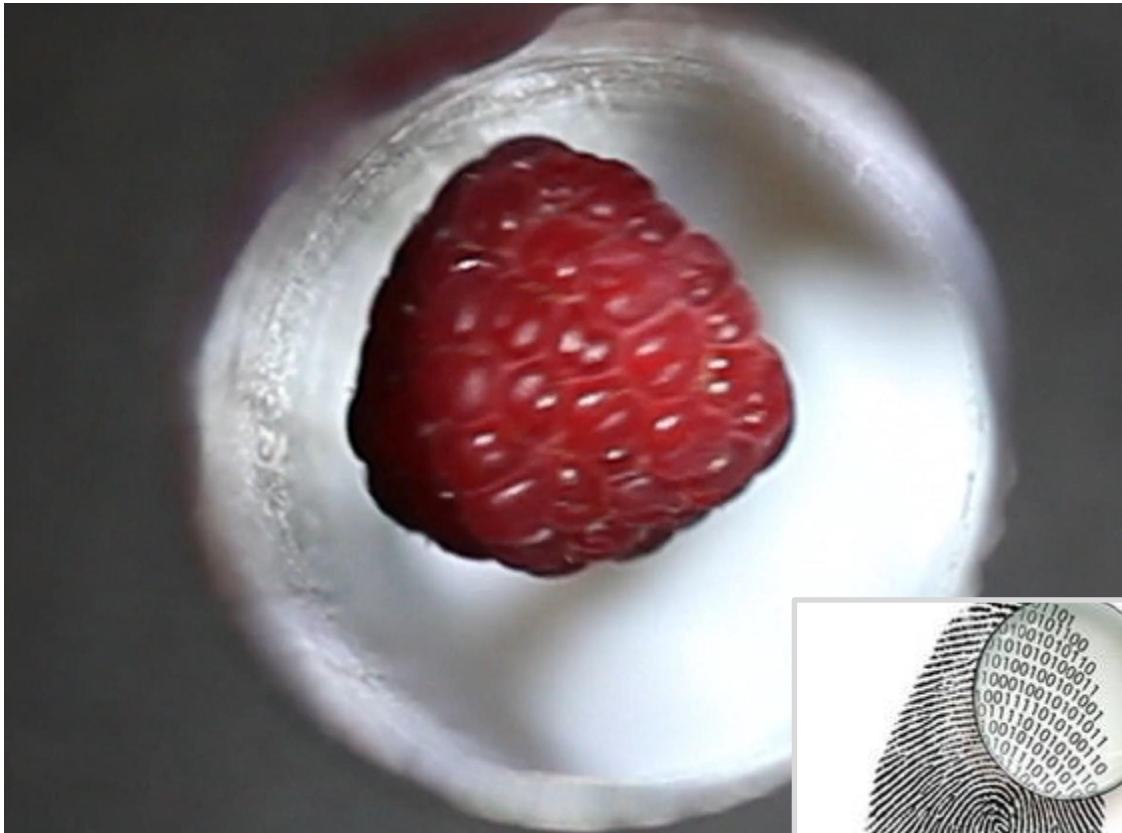


The strongest DC-magnets in Europe

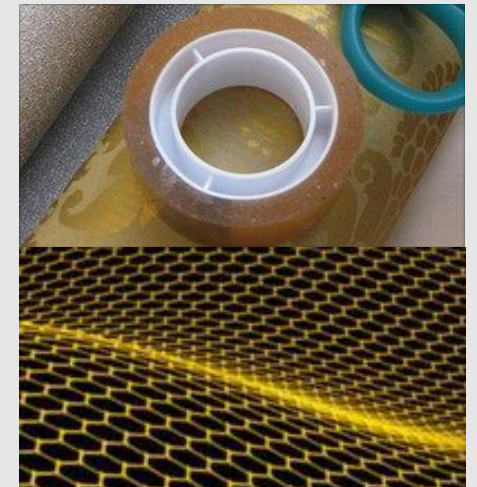
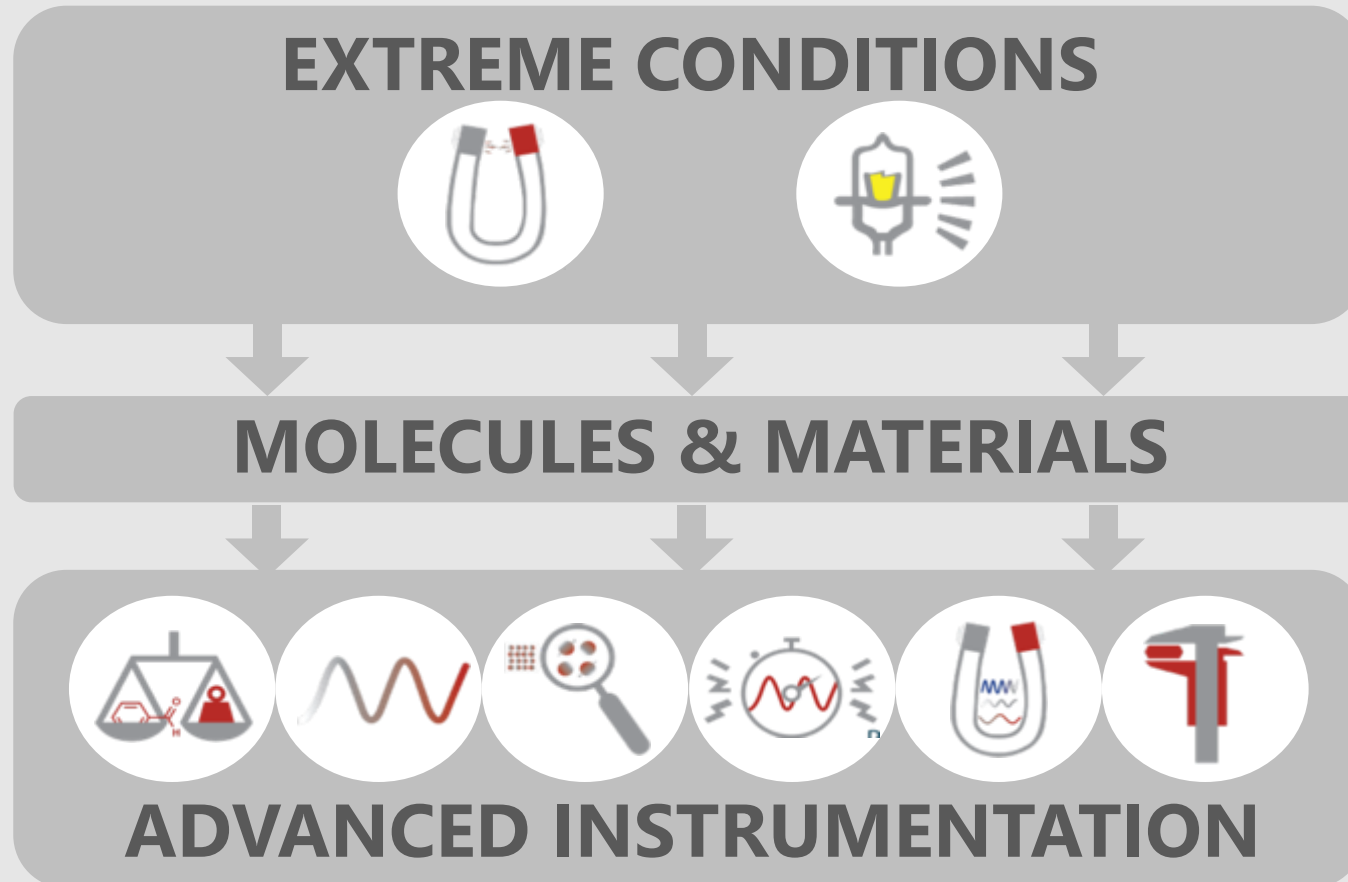


The largest wavelength range in ONE facility

MAGNETISM AND SPECTROSCOPY



UNIQUE CAPABILITIES FACILITATE BREAKTHROUGHS



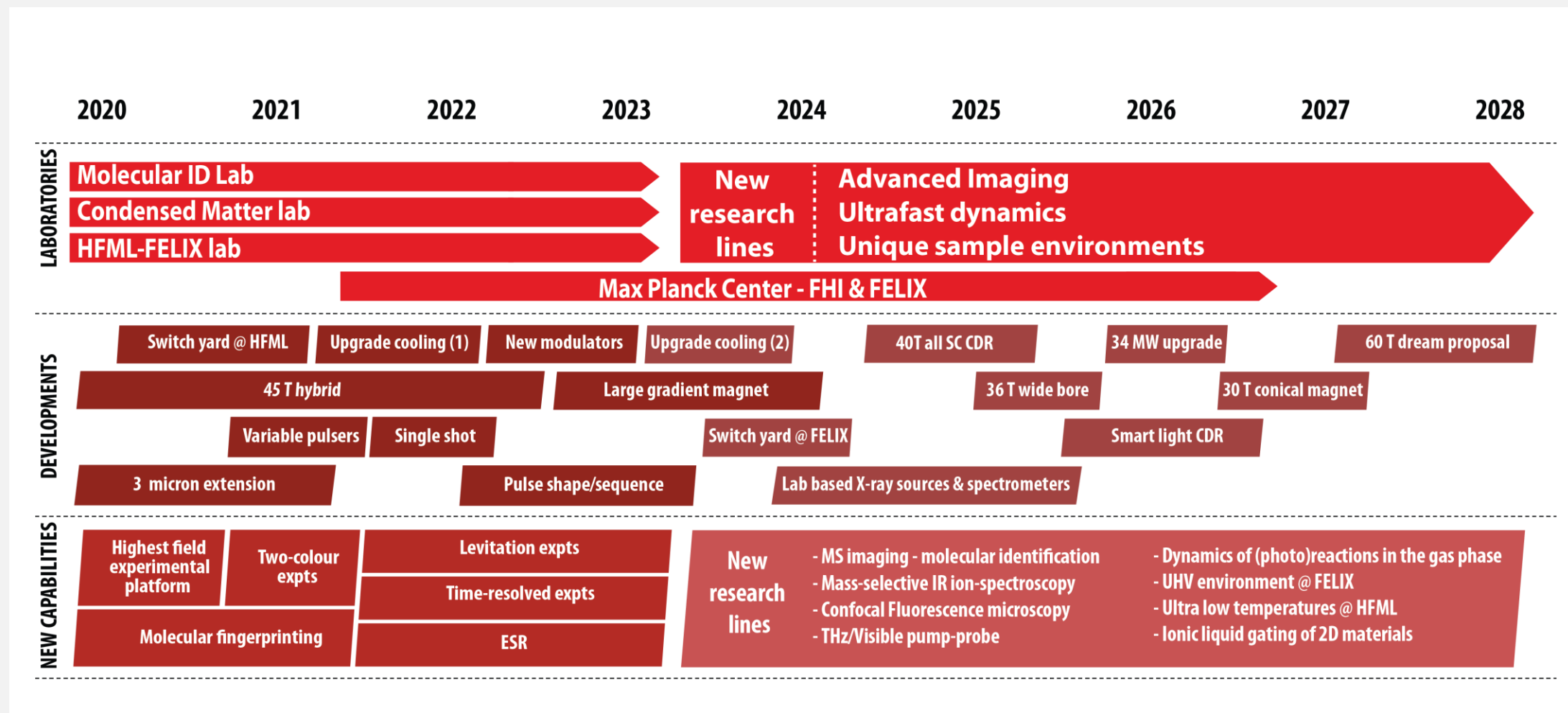
THREE PILLARS: INNOVATE, OPERATE, DISCOVER

INNOVATE

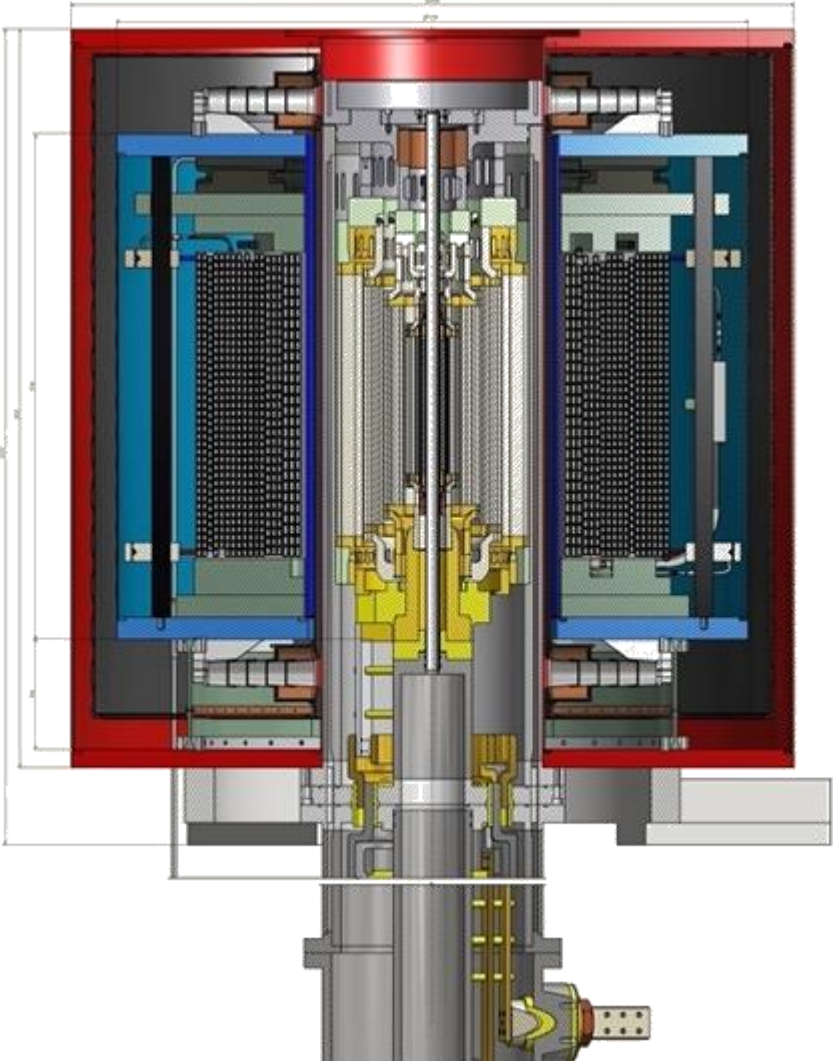


TECHNOLOGY state-of-the-art magnets, lasers & instruments

MAJOR INFRASTRUCTURE REQUIRES LONG-TERM VISION



45 T HYBRID MAGNET



1000 W Stirling cooler for radiation shields

20kA/10 V power supply

20 kA power wires

Liquid helium system

20 kA SC bus bars

DAQ, control & HMI

Hybrid magnet

Liquid nitrogen

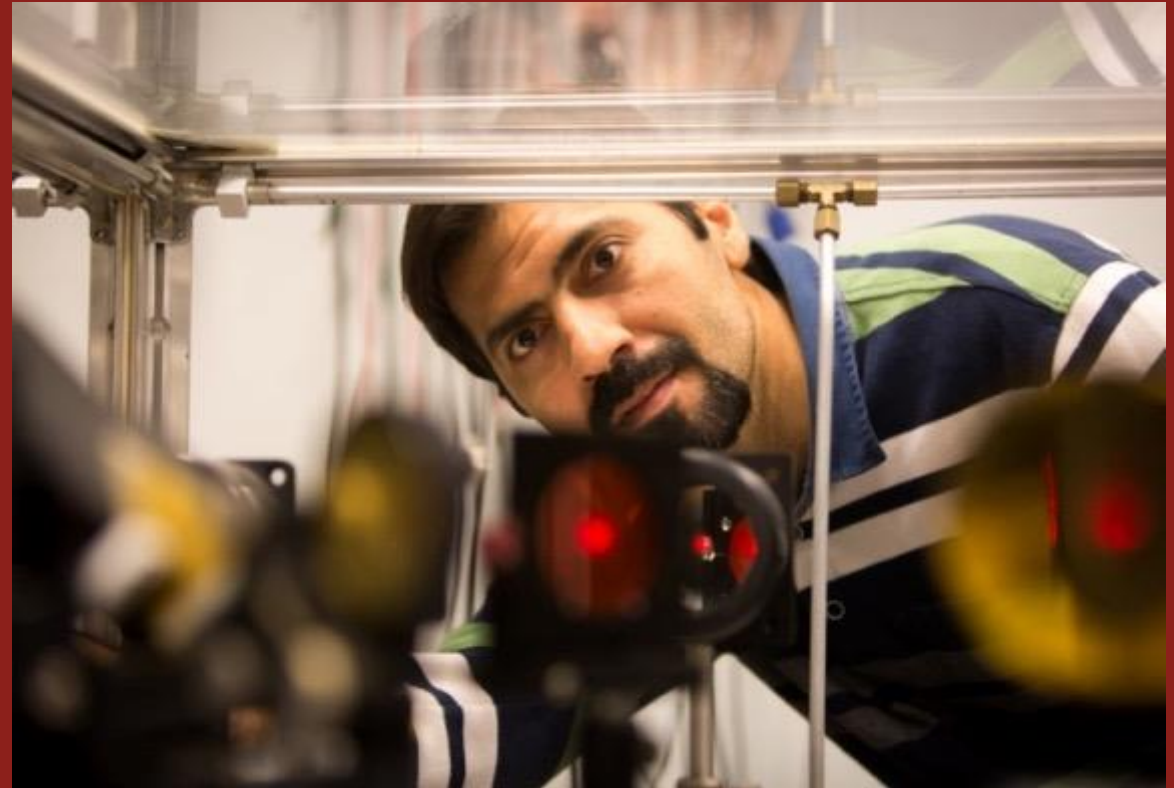
Ready for experiments in 2025

45 T HYBRID MAGNET



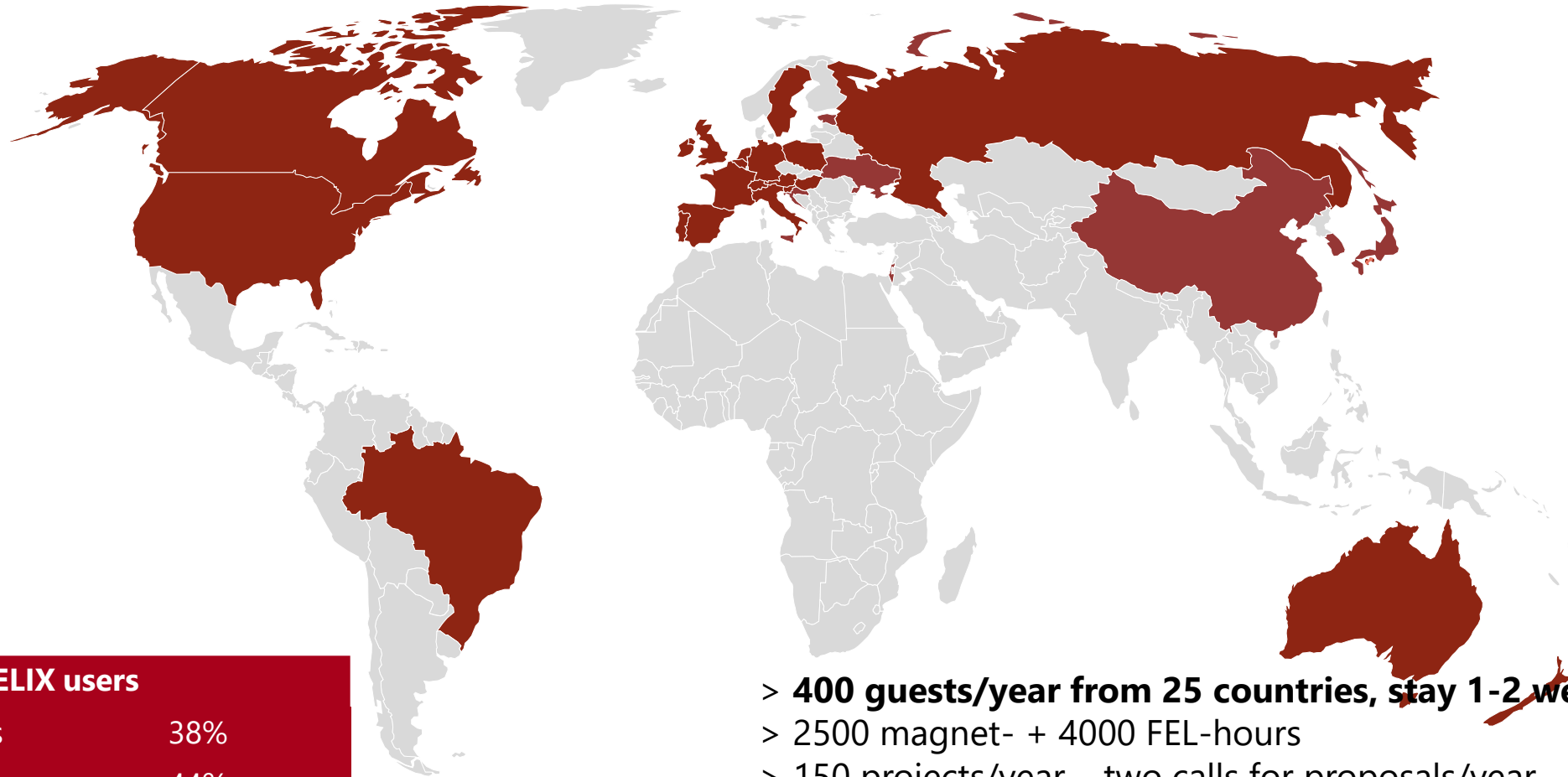
THREE PILLARS: INNOVATE, OPERATE, DISCOVER

OPERATE



GUEST PROGRAMME Internationally renowned research facility

FACTS AND NUMBERS

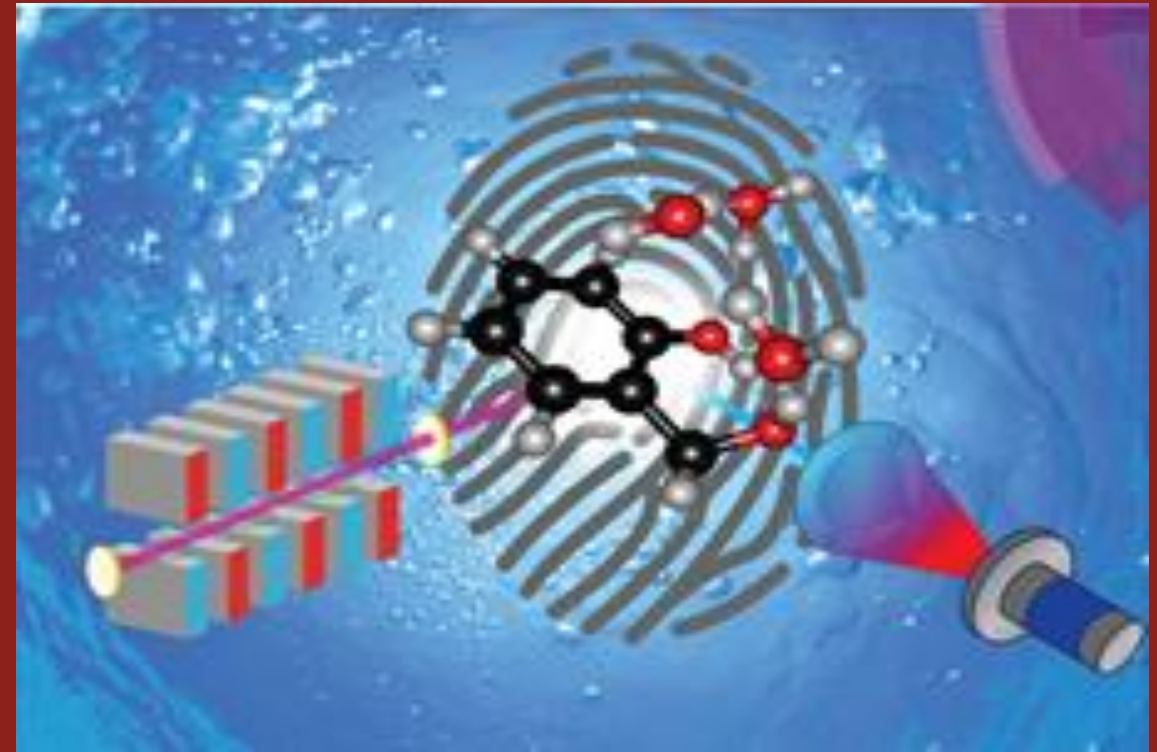
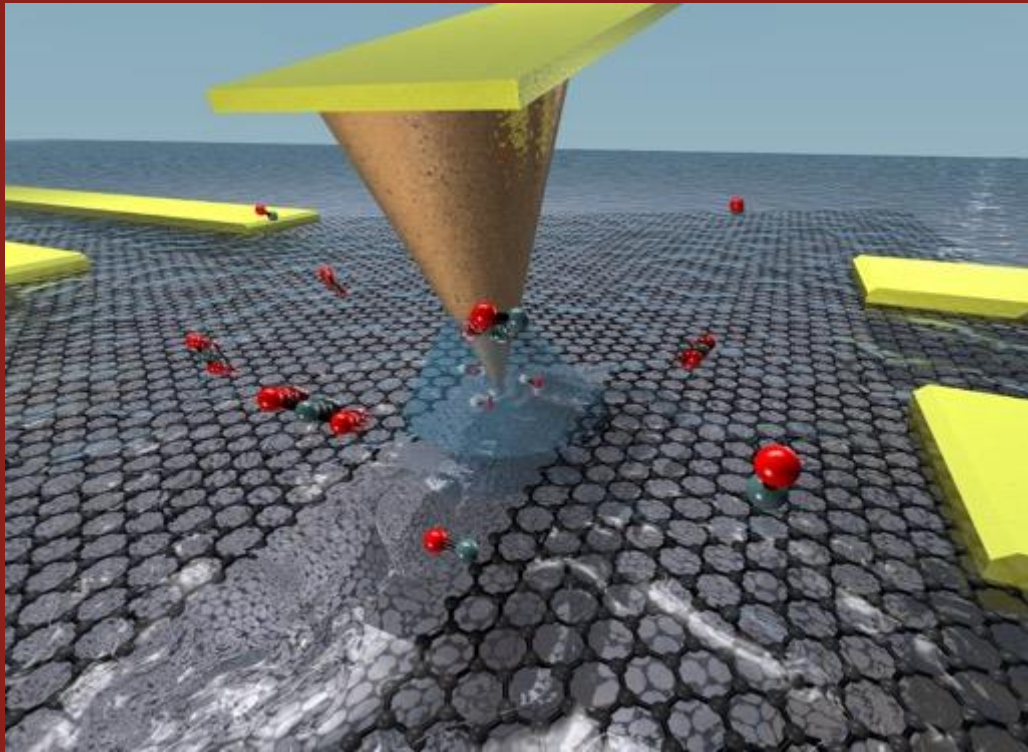


Origin HFML-FELIX users	
The Netherlands	38%
EU	44%
Other	18%

- > **400 guests/year from 25 countries, stay 1-2 weeks**
- > 2500 magnet- + 4000 FEL-hours
- > 150 projects/year – two calls for proposals/year
- > 80 publications/year
- > 90 employees (permanent & temporary) + students/trainees

THREE PILLARS: INNOVATE, OPERATE, DISCOVER

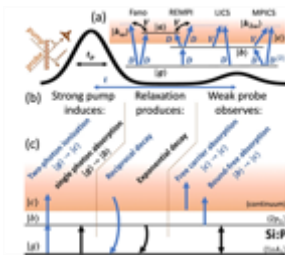
DISCOVER



SCIENCE Strong in-house research programmes

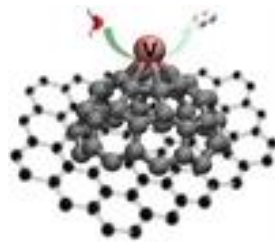
RESEARCH AREAS

Quantum technology



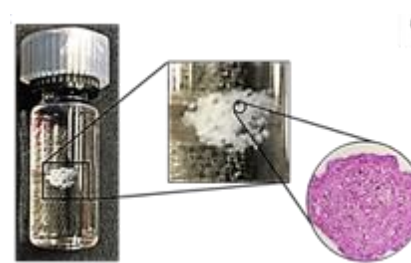
Nature Commun. **12**, 454 (2021)

Catalysis



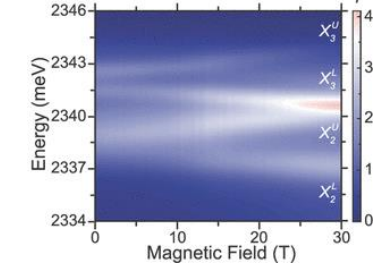
Angew. Chem **60**, 27095 (2021)

Magnetic Levitation



Biofabrication **12**, 045022 (2020)

Photovoltaics



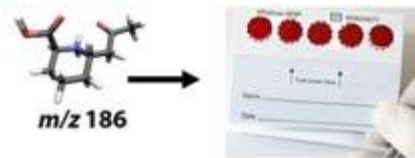
Nano Lett. **20**, 5141 (2020)

Astrochemistry



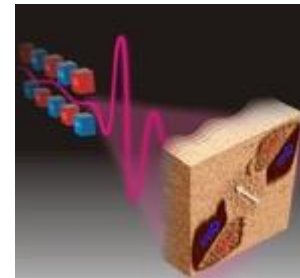
Nature Astronomy **4**, 240 (2020)

Biomarkers



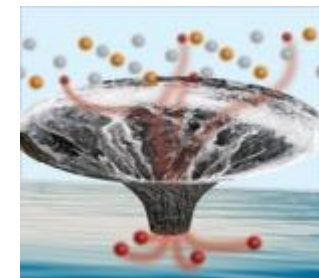
J. Clinical Inves. **131**, 148272 (2021)
Comm. Biology **4**, 367 (2021)
Anal. Chem. **93**, 1530 (2021)

Phononic Switching



Nature Physics **17**, 489 (2021)

Superconductivity



Nature **595**, 661 (2021)

HFML-FELIX FOCUS POINTS



SMART MATERIALS

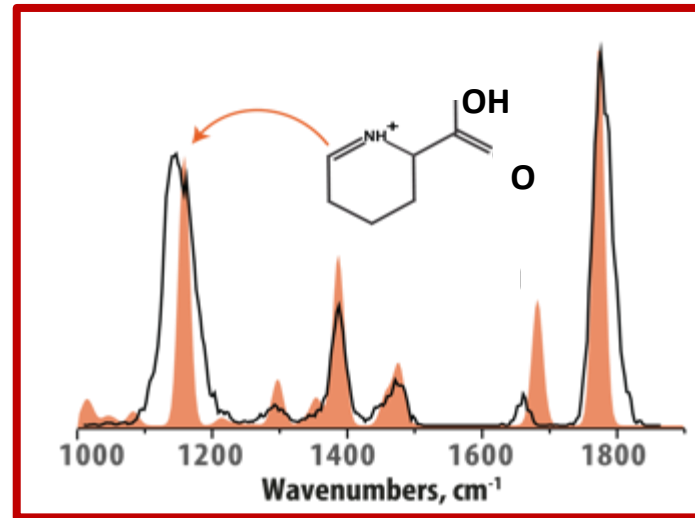


**ENERGY AND
SUSTAINABILITY**



HEALTH

HEALTH - DETECTING BIOMARKERS



Biomarker
identification



COLLABORATION

EMBEDDING HFML-FELIX

National



International



MAX PLANCK - RADBOUD UNIVERSITY CENTER

Infrared flashes for astronomy and medicine

The Max Planck–Radboud University Center will expand possible applications of infrared free–electron lasers in the coming years

JUNE 17, 2021

international

The application of free-electron lasers emitting infrared light reaches from biomedicine to chemistry and materials science to astrophysics. To further advance the technology and the research such lasers allow, the Max Planck Society and Radboud University (Nijmegen, NL) have established the Max Planck–Radboud University Center. Through their collaboration, they will focus not only on research, but also on training early career researchers.



As part of the cooperation project, experiments will be carried out with the FELIX free-electron infrared lasers.

© Radboud University



One of 23 Max Planck Centres worldwide

Collaboration: Fritz-Haber-Institut and HFML-FELIX

Duration: 5 year

HFML-FELIX - HITECH ECOSYSTEEM

Partners in innovation – technology driven

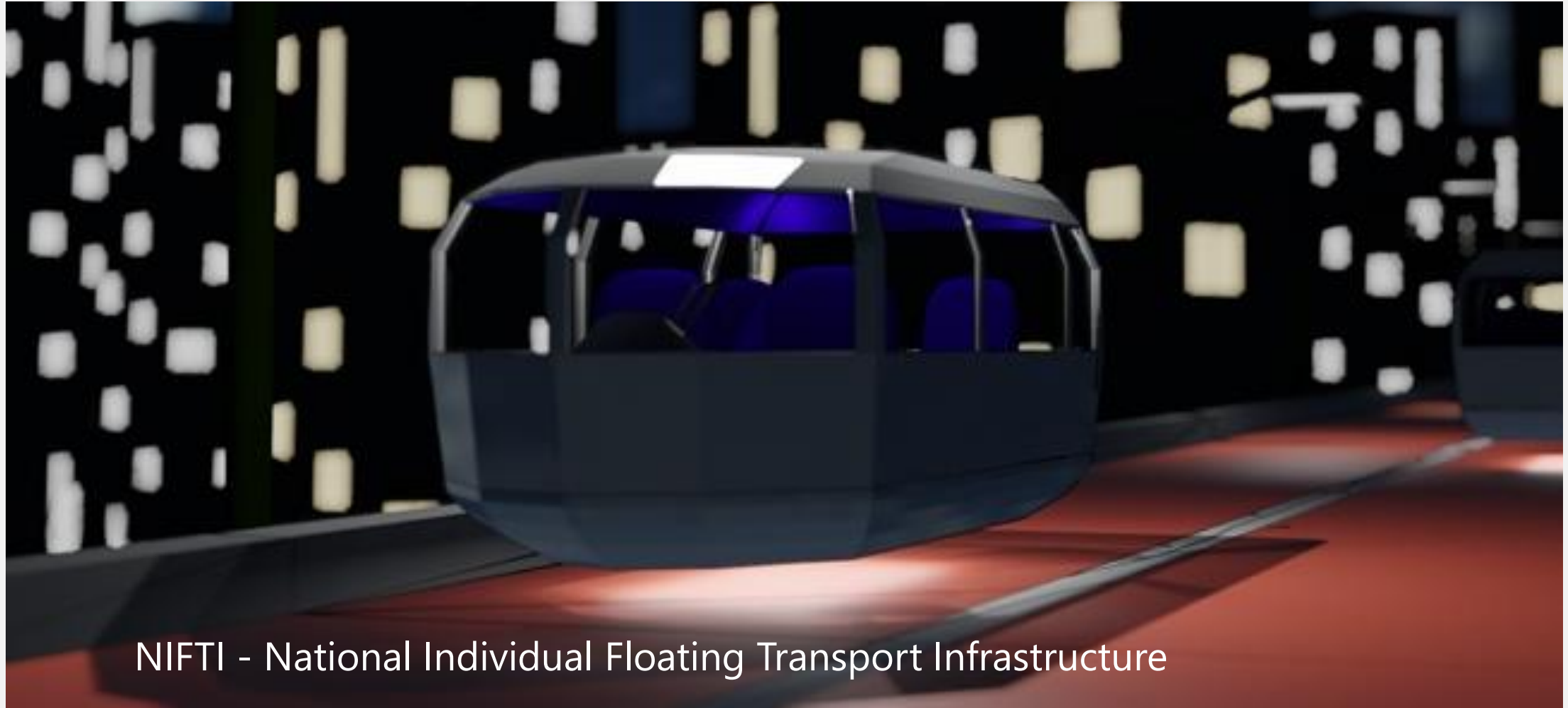


HFML-FELIX - HITECH ECOSYSTEEM

Partners in innovation - knowledge-driven



TRANSPORT OF THE FUTURE?



NIFTI - National Individual Floating Transport Infrastructure



www.ru.nl/HFML-FELIX

 www.linkedin.com/company/HFML-FELIX



WHERE DOES HFML COME FROM?



HFML opened in 2003

- 1970s University research group
- 1990s 'Magnetenlab' opens as facility
- 2001 33T magnet bought from Tallahassee
- 2003 33T copies home-made
- 2007 30T wide bore (50 mm) home-made
- 2014 37.5T – world's strongest magnet
- 2017 38 T – Europe's strongest magnet
- 2025 45 T - second of its kind

(2011)

Agreement

for the 'High Field Magnet Laboratory' Cooperative Alliance (HFML-CA)

Disclaimer: In cases of doubt, the Dutch version of this text takes preference.

The undersigned:

I. The Catholic University Foundation, in this case specifically **Radboud University Nijmegen** (address: Comeniuslaan 4, Nijmegen, NL), hereinafter to be referred to as RU, lawfully represented for the purposes of this Agreement by the President of the Executive Board, R.J. de Wijkerslooth,

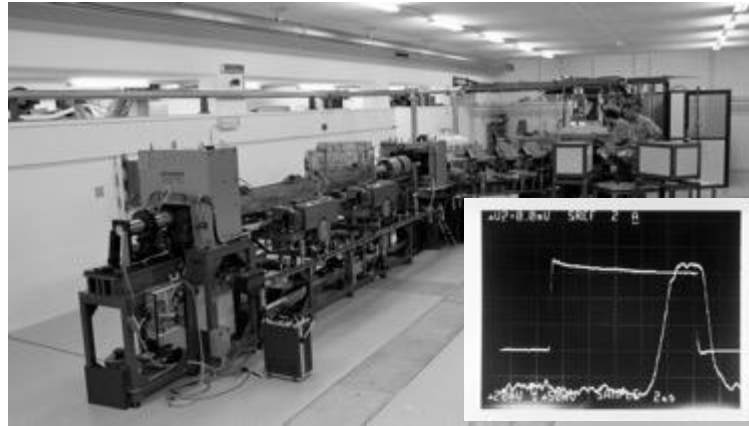
and

II. the **Foundation for Fundamental Research on Matter** [*Stichting voor Fundamenteel Onderzoek der Materie*] (address: Van Vollenhovenlaan 659, Utrecht, NL), hereinafter to be

WHERE DOES FELIX COME FROM?



FELIX Starts 1987 at FOM Institute
Rijnhuizen, in Nieuwegein



First Lasing 1991



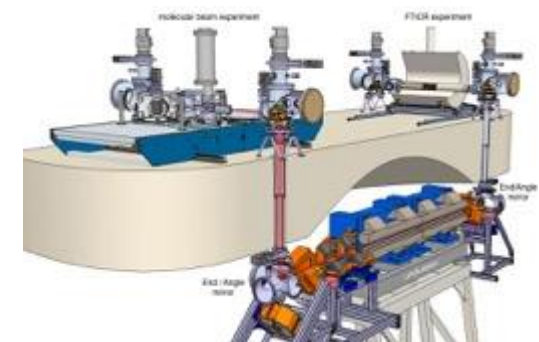
Int. User Facility 1994



Relocation 2012/13



FLARE 2006
1st lasing 2011



FELICE 2003
1st lasing 2007

WHERE DO WE COME FROM?



- 2006 NCAS project: FLARE + 45 T
- 2012 Unilocation
- 2017 HFML-FELIX strategy document
- 2018 1st HFML-FELIX Roadmap project
- 2019 HFML-FELIX opening
- 2020 2nd HFML-FELIX Roadmap project



ORGANISATION

Two units in the Faculty in the Faculty of Science

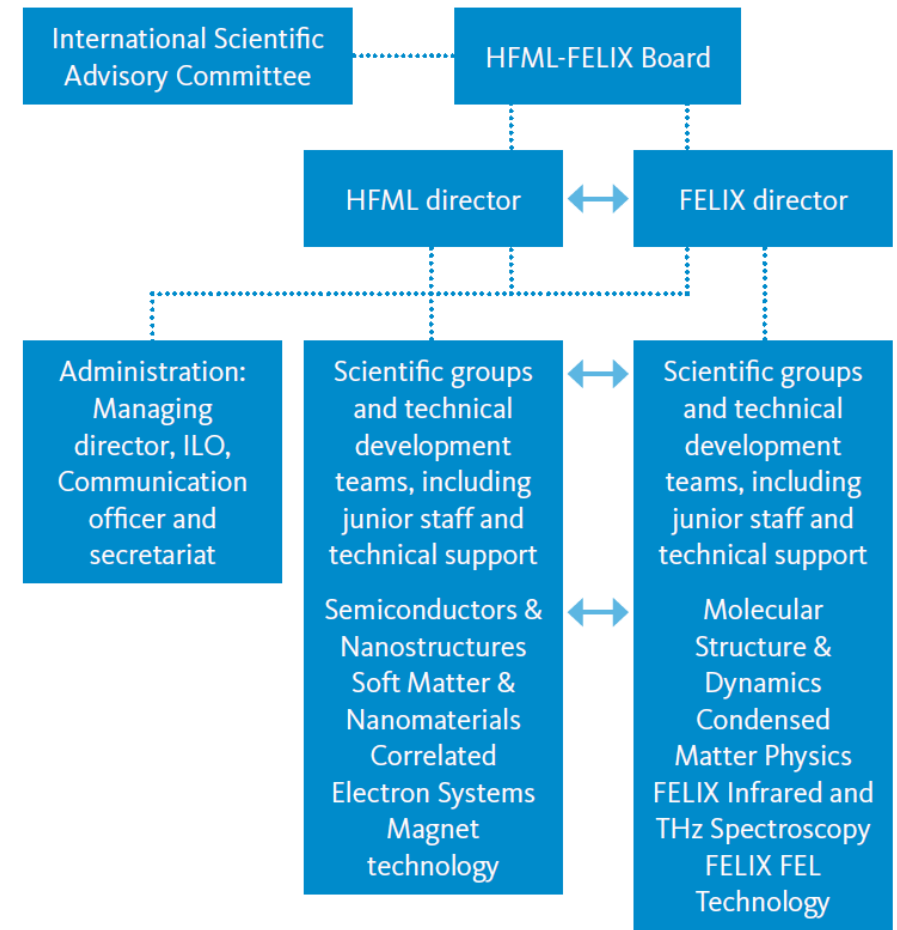
One HFML-FELIX board:
Radboud University and NWO-I

Scientifically embedded in the
Institute for Molecules and Materials (IMM)

1 Office

6 research groups + 1 new group in creation
(sectorplan – centered on combination HFML-FELIX

2 technology groups



COLLABORATIONS WITH INTERNATIONAL PARTNERS



HZDR, RU, NWO-I
Memorandum of Understanding

Renewal in 2023



EMFL and FELIX awarded status of
"UK National Research Facility"

Collaboration agreement renewed for 5
years