



Material Research @ HFML-FELIX

Precisiebeurs 15 November 2023

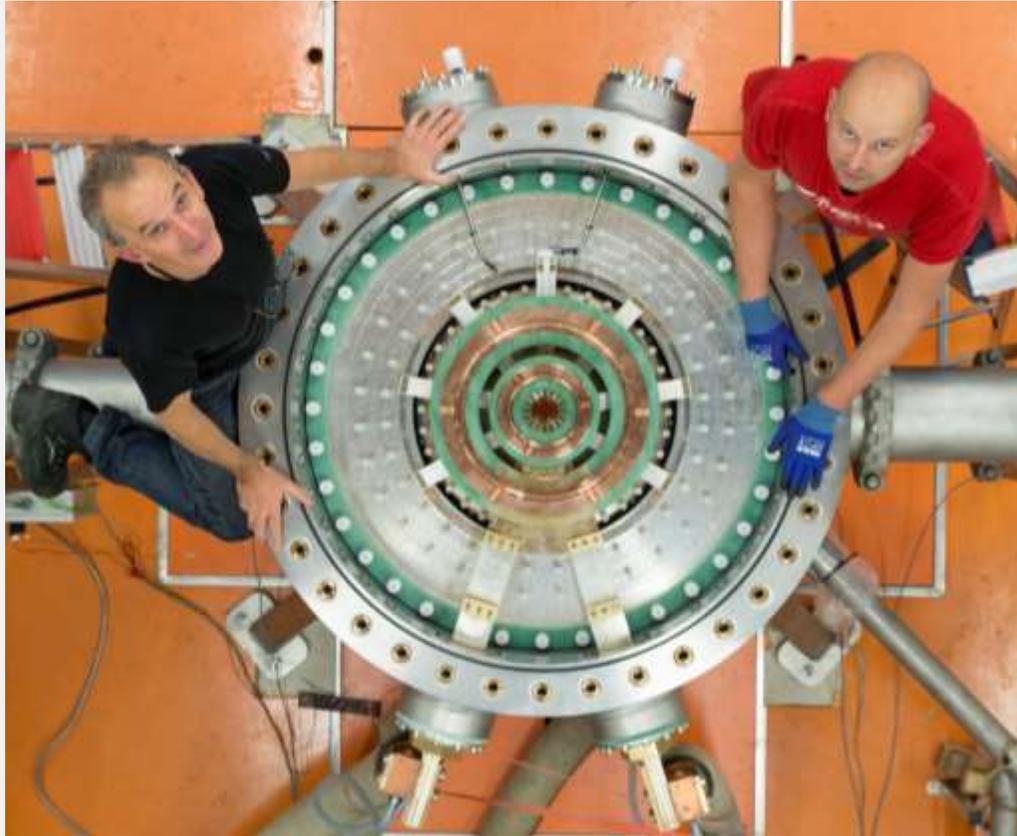
Peter Christianen
On behalf of the HFML-FELIX team

HFML-FELIX – A LARGE-SCALE RESEARCH INFRASTRUCTURE

HFML-FELIX is a collaboration of Radboud University and NWO-I: a research facility for (inter)national researchers, working with **high magnetic fields** and intense **infrared/THz radiation**.



HFML-FELIX – A LARGE-SCALE RESEARCH INFRASTRUCTURE

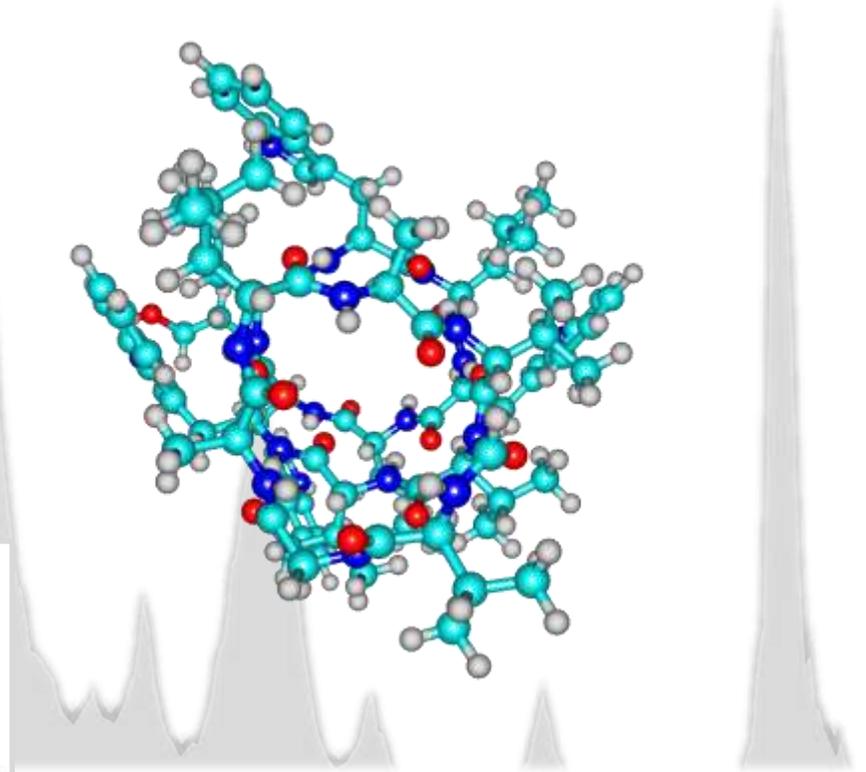


High-field magnets up to 38 T

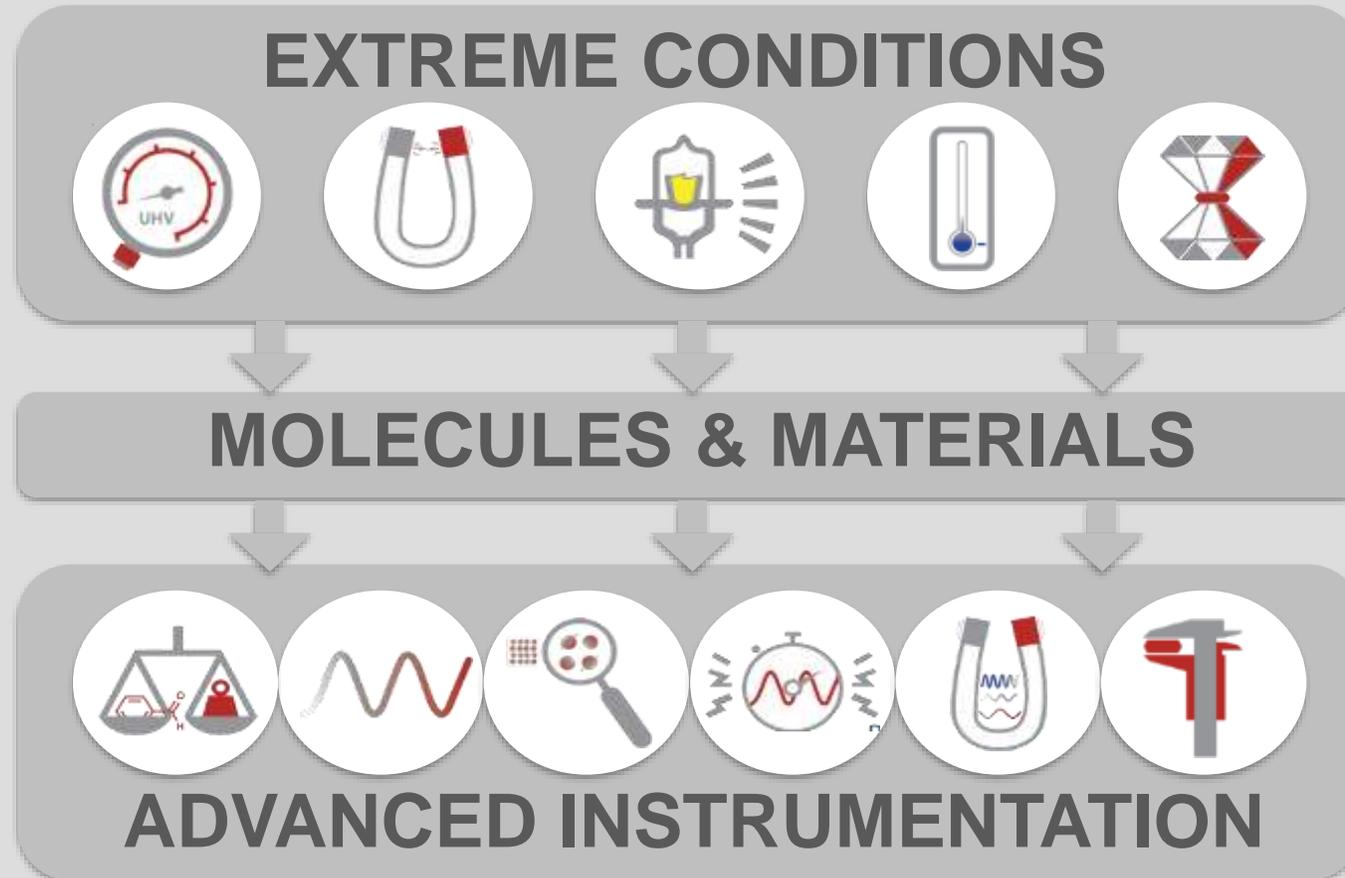


Infrared/THz free electron lasers (5-1500 μm)

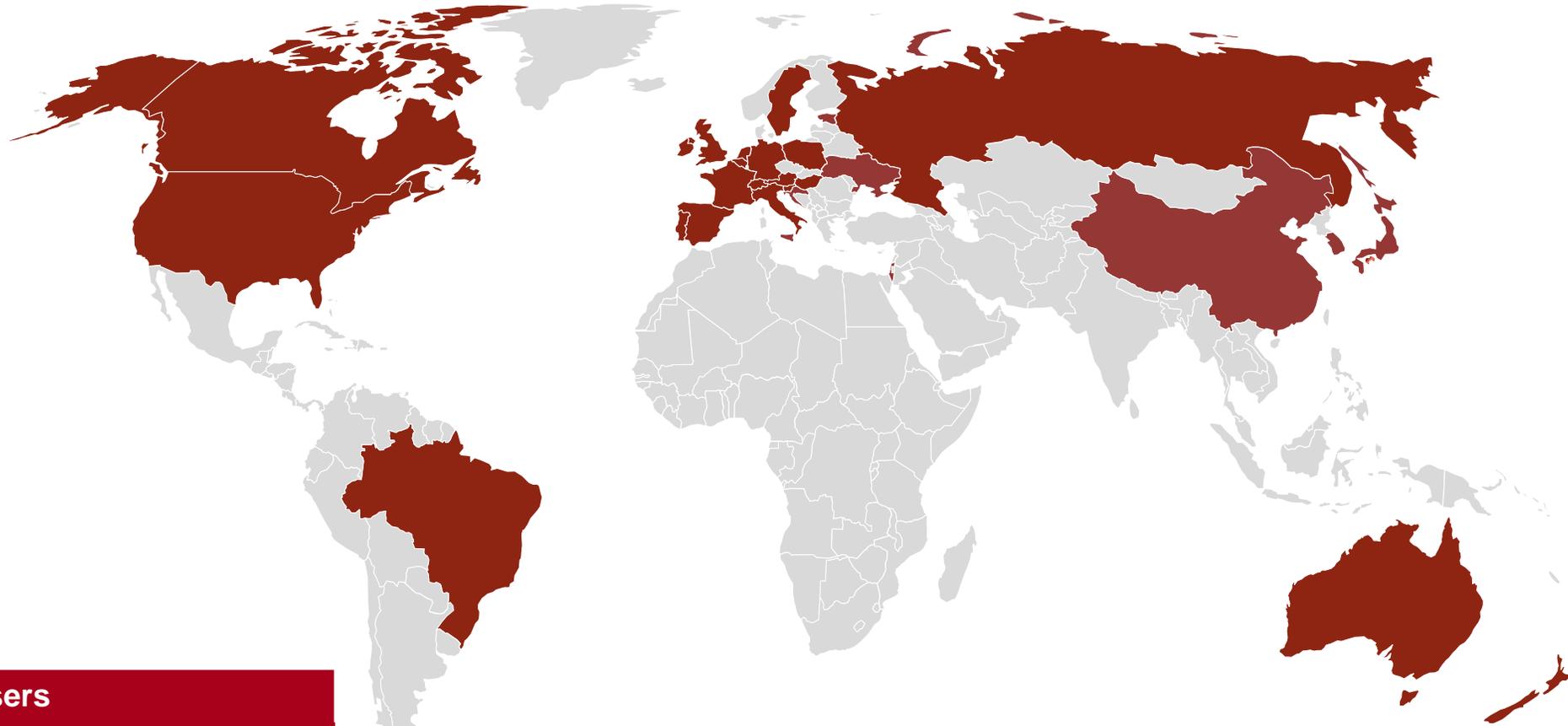
MAGNETISM AND SPECTROSCOPY



UNIQUE POSSIBILITIES FACILITATE BREAKTHROUGHS



SOME KEY FIGURES



HFML-FELIX users

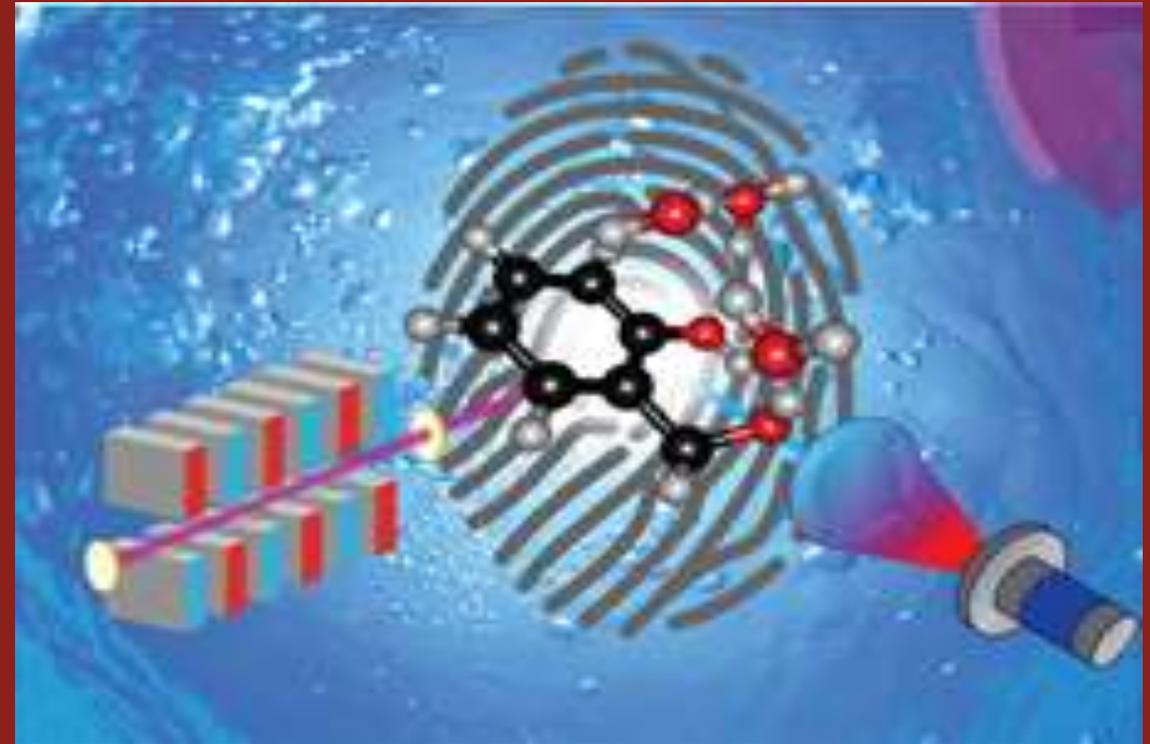
The Netherlands	38%
EU	44%
Other	18%

- > 2500 magnet and 4000 FEL hours
- > 150 projects/year – two calls for proposals/year
- > 400 guest researchers/year from 25 countries

INNOVATE & DISCOVER



TECHNOLOGY state-of-the-art magnets,
free electron lasers & instrumentation



SCIENCE an excellent research
programme

MATERIAL DEVELOPMENTS @ HFML-FELIX – ECOSYSTEM

Technology driven



Science driven



MATERIALS FOR HIGH FIELD MAGNETS

Resistive magnet coils:

High strength conductors

Superconducting magnet coils:

LTS: low temperature superconductors

HTS: high temperature superconductors



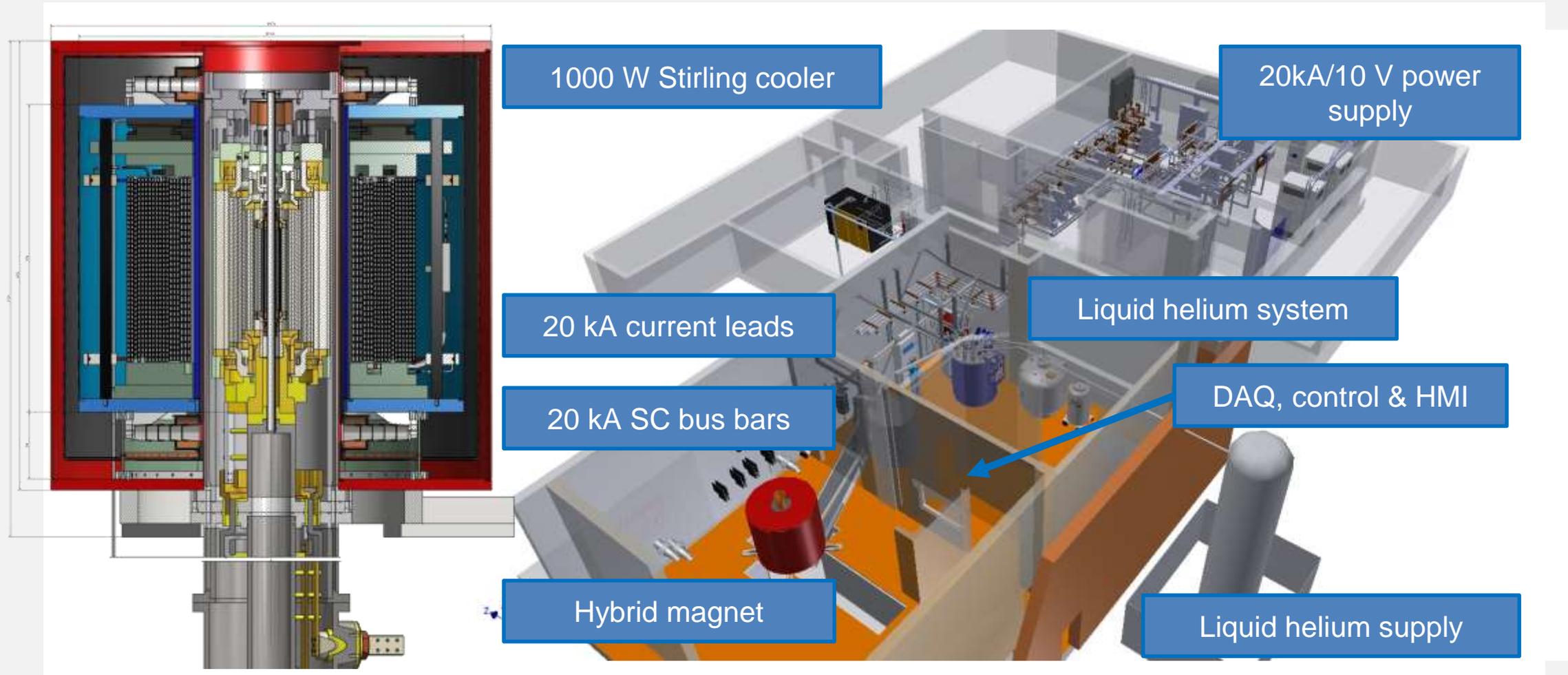
Electrical Power: 22 MW (40 kA, 550 V)

Water cooled: 160 l/s

Limited by mechanical stress



45 TESLA HYBRID MAGNET SYSTEM



TOWARDS ALL-SUPERCONDUCTING USER MAGNETS

Superconductors for high magnetic fields - A change of paradigm -



Combination: Low Temperature Superconductor outsert
High Temperature Superconductor insert

Conceptual **design** for a suite of beyond-state-of-the-art superconducting **user** magnets – 40 T



KNOWLEDGE – INNOVATION CHAIN



Andrei Geim and Kostya Novoselov

People and Ideas

Unique properties of graphene



Magnifying glass for first discovery

Applications



'For groundbreaking research of the 2D material graphene'



HFML-FELIX IMPACT



HEALTH

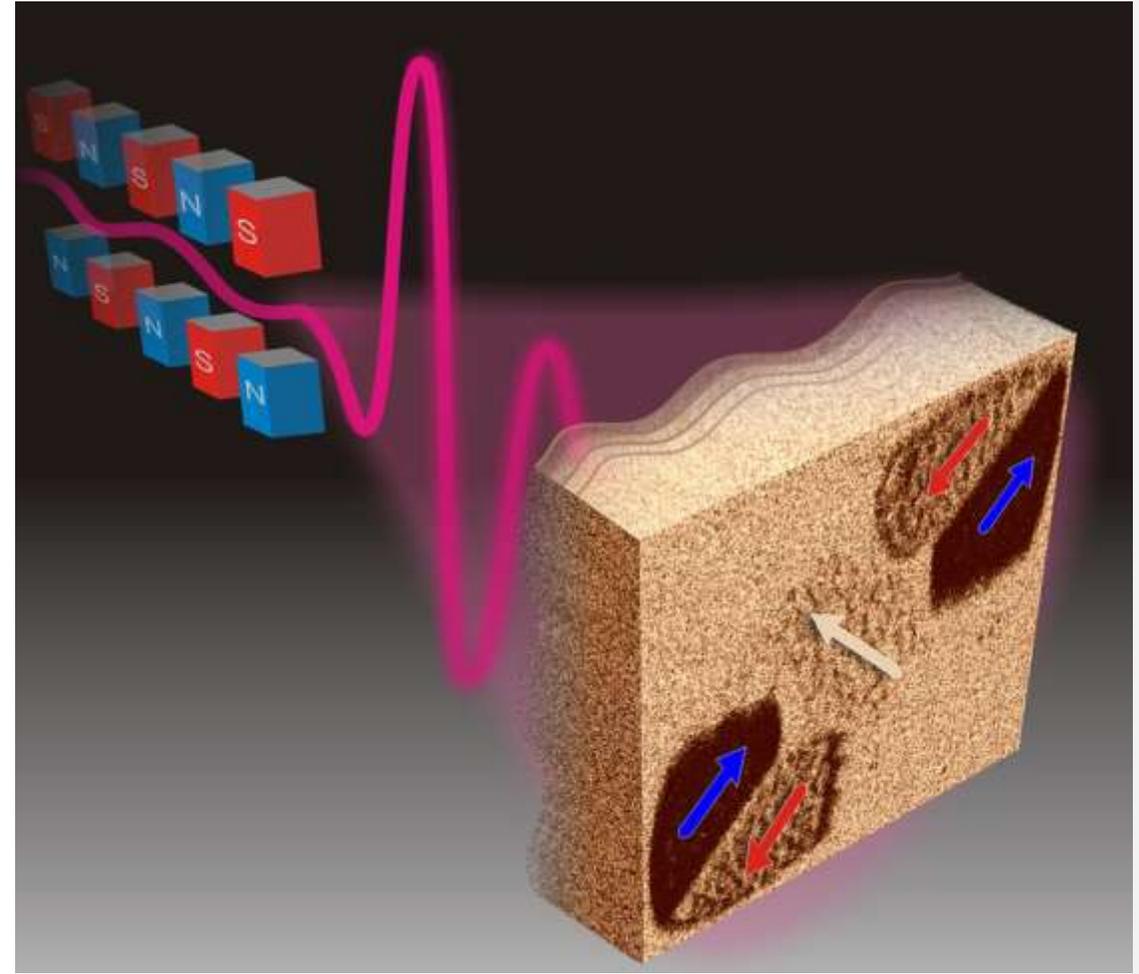


ENERGY

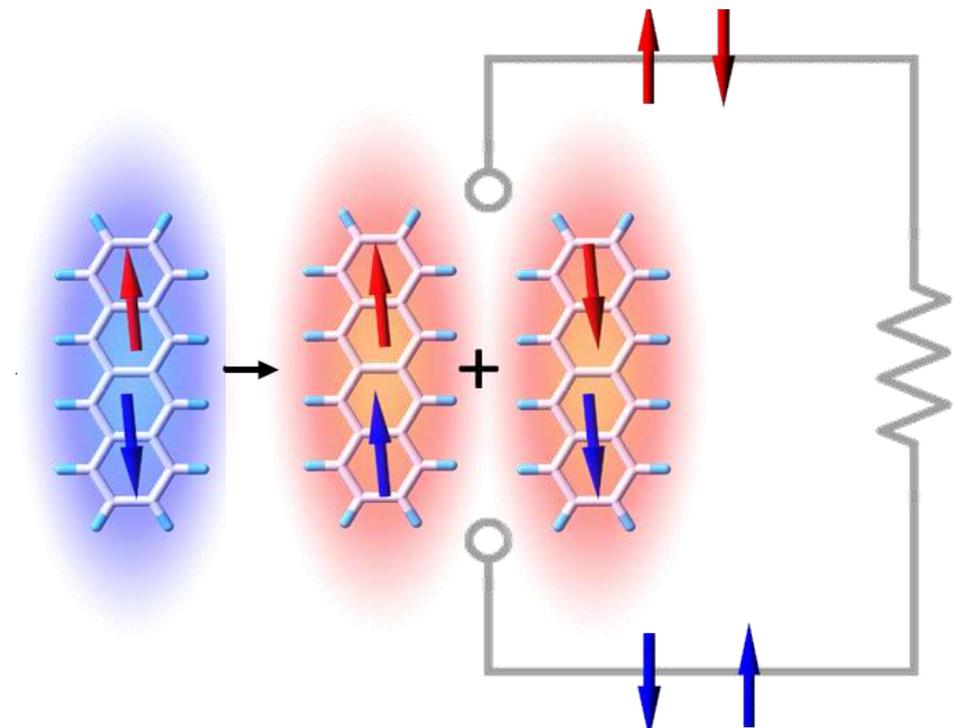
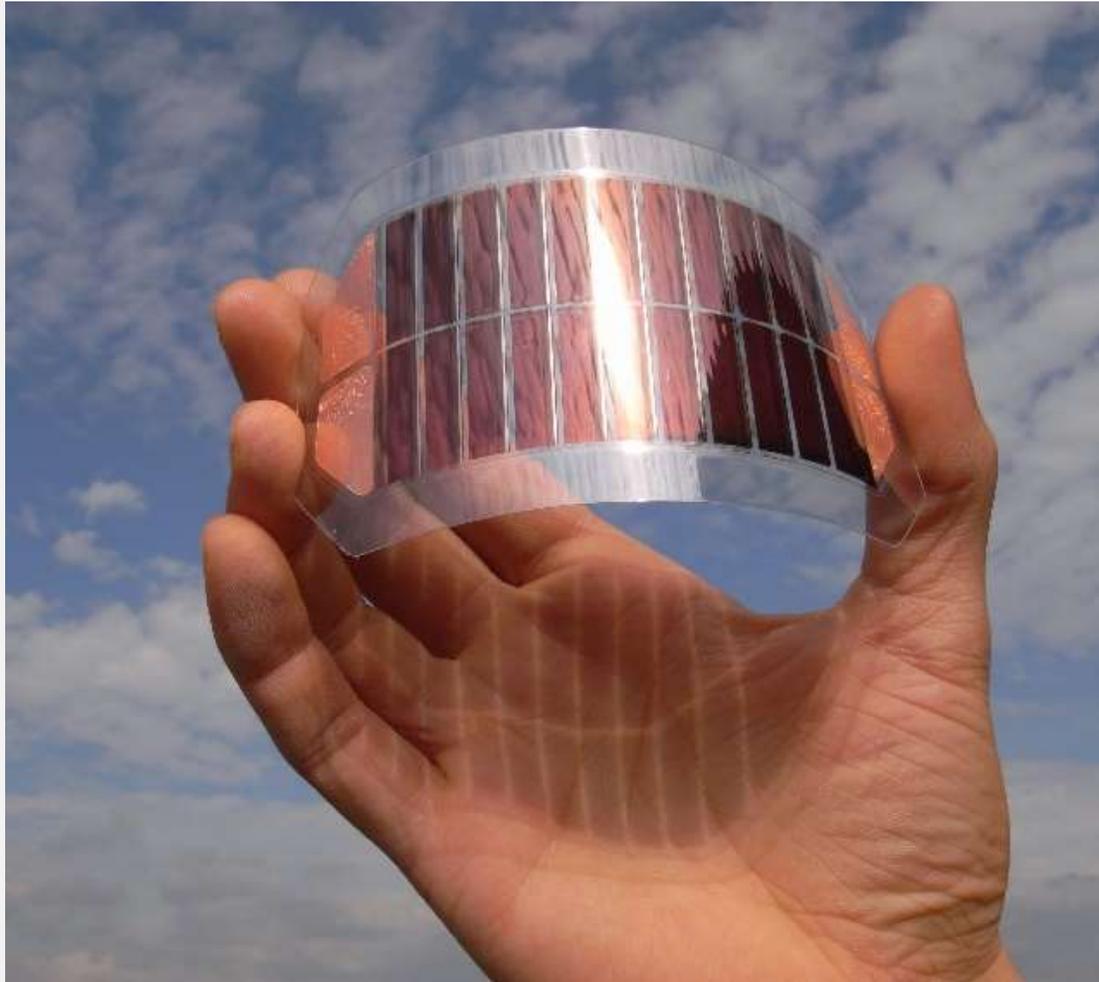


SMART MATERIALS

ENERGY – ENERGY EFFICIENT DATA STORAGE



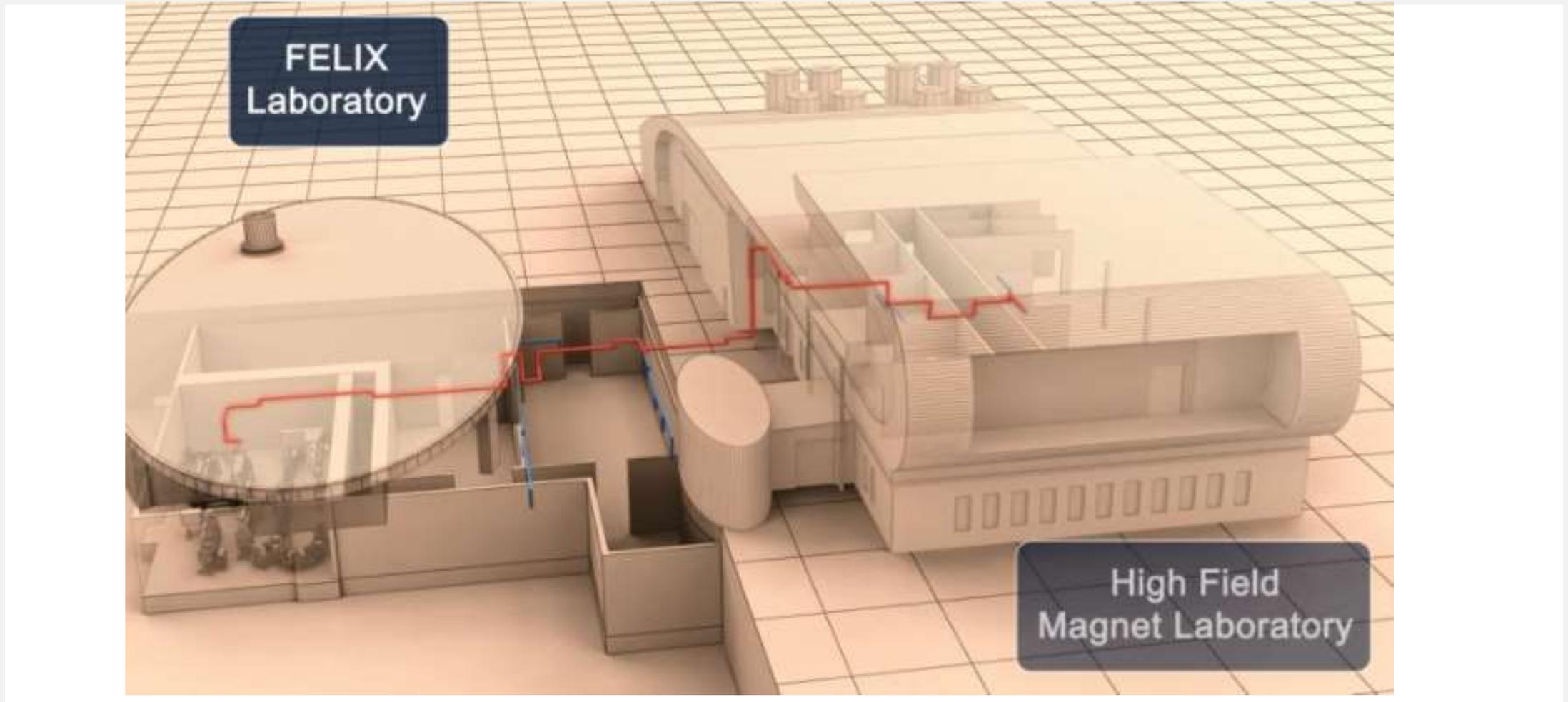
SMART MATERIALS – INNOVATIVE PHOTOVOLTAICS



SMART MATERIALS – TOPOLOGICAL MATERIALS



UNIQUE COMBINATION

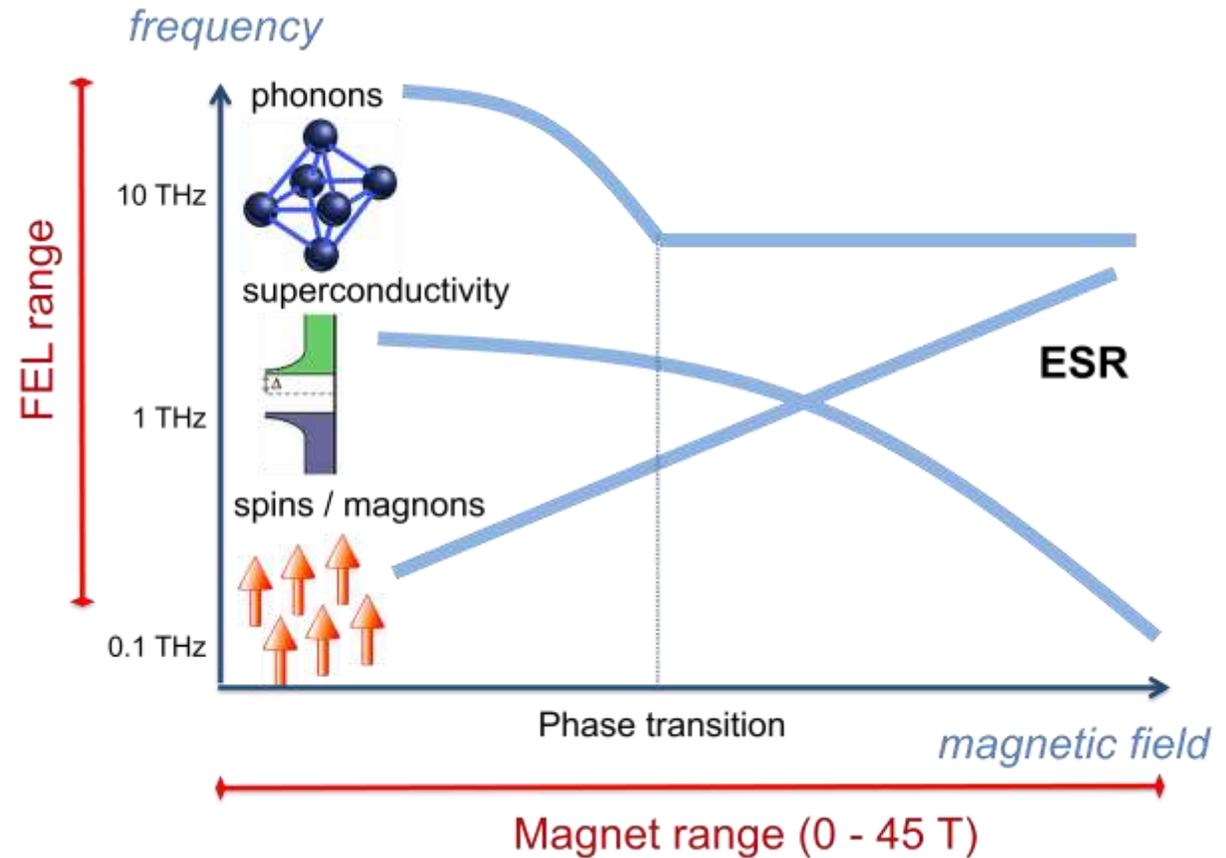


UNIQUE COMBINATION

Unique facility

Advanced characterization of:

- Magnetic Materials
- Semiconductors
- 2D materials
- Superconductors
- Topological materials



TRANSPORT OF THE FUTURE

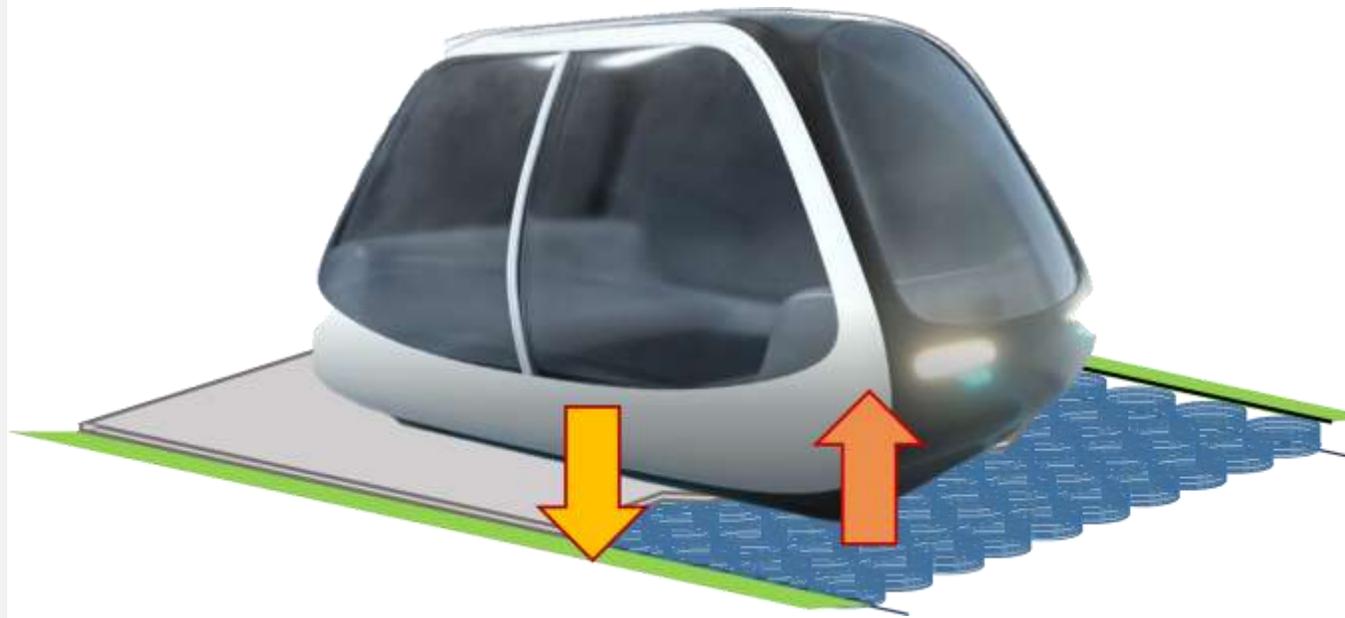


NIFTI - National Individual Floating Transport Infrastructure

TRANSPORT OF THE FUTURE – BASED ON MAGNETIC LEVITATION



N I f T I



- (i) Given today's materials and technologies, can a system based solely on the principle of magnetic levitation be as energy efficient as an EV?
- (ii) If so, could it be a better alternative to self-driving EVs for our long-term transportation needs?

TRANSPORT OF THE FUTURE – BASED ON MAGNETIC LEVITATION



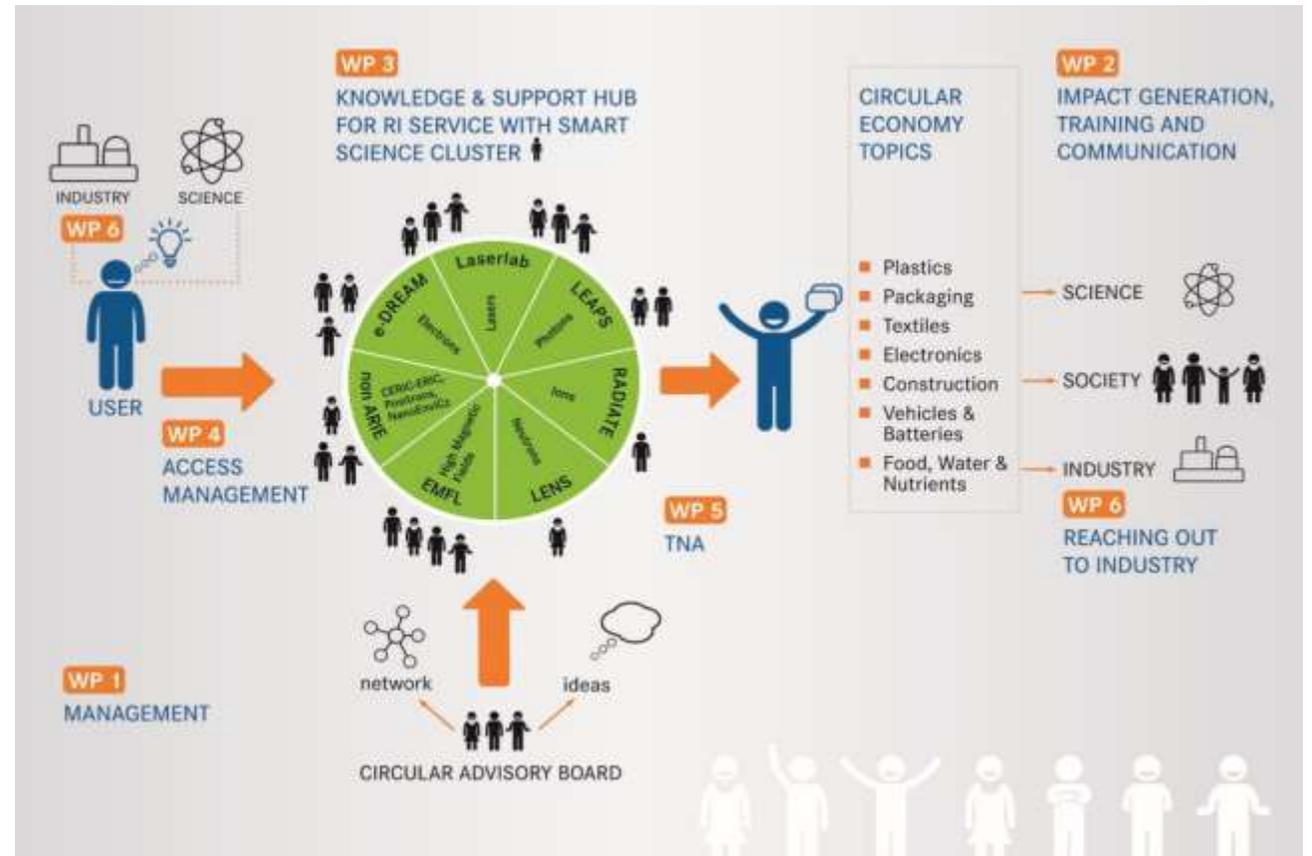
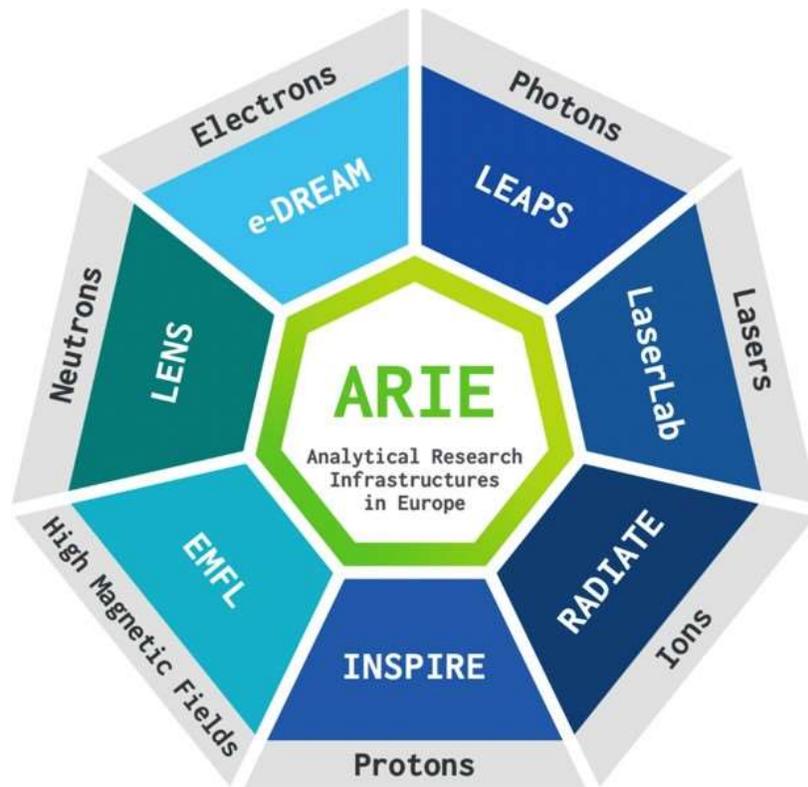
N I f T I

Vehicle itself is **propelled by series of electromagnets** located just below the surface of the road that are **pulsed at the precise moment the vehicle passes over them.**

Levitation and propulsion provided by the same source.

REMADE @ ARI – MATERIALS FOR CIRCULAR ECONOMY

Recyclable materials development at analytical research infrastructures



CONCLUSIONS

HFML-FELIX is a large-scale research infrastructures that

- drives technological innovations
- provides a platform to characterize novel materials
- helps to tackle societal challenges
- serves as a seed for (inter)national collaboration





www.ru.nl/HFML-FELIX

 www.linkedin.com/company/HFML-FELIX

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