Accelerating Innovation: Industry & Research Creating Value Together

PHYSICS MATTERS — On-line Colloquia Series

Raffaella Geometrante

Managing Director – **Kyma**

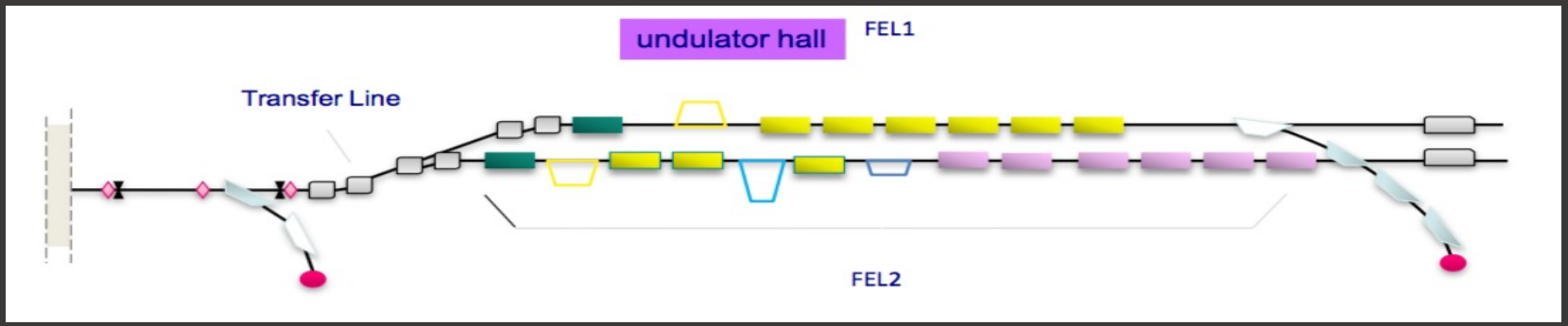
https://kyma-undulators.com/

Co-Chair **AIPF** – Accelerator Science and Technology Industry Permanent Forum

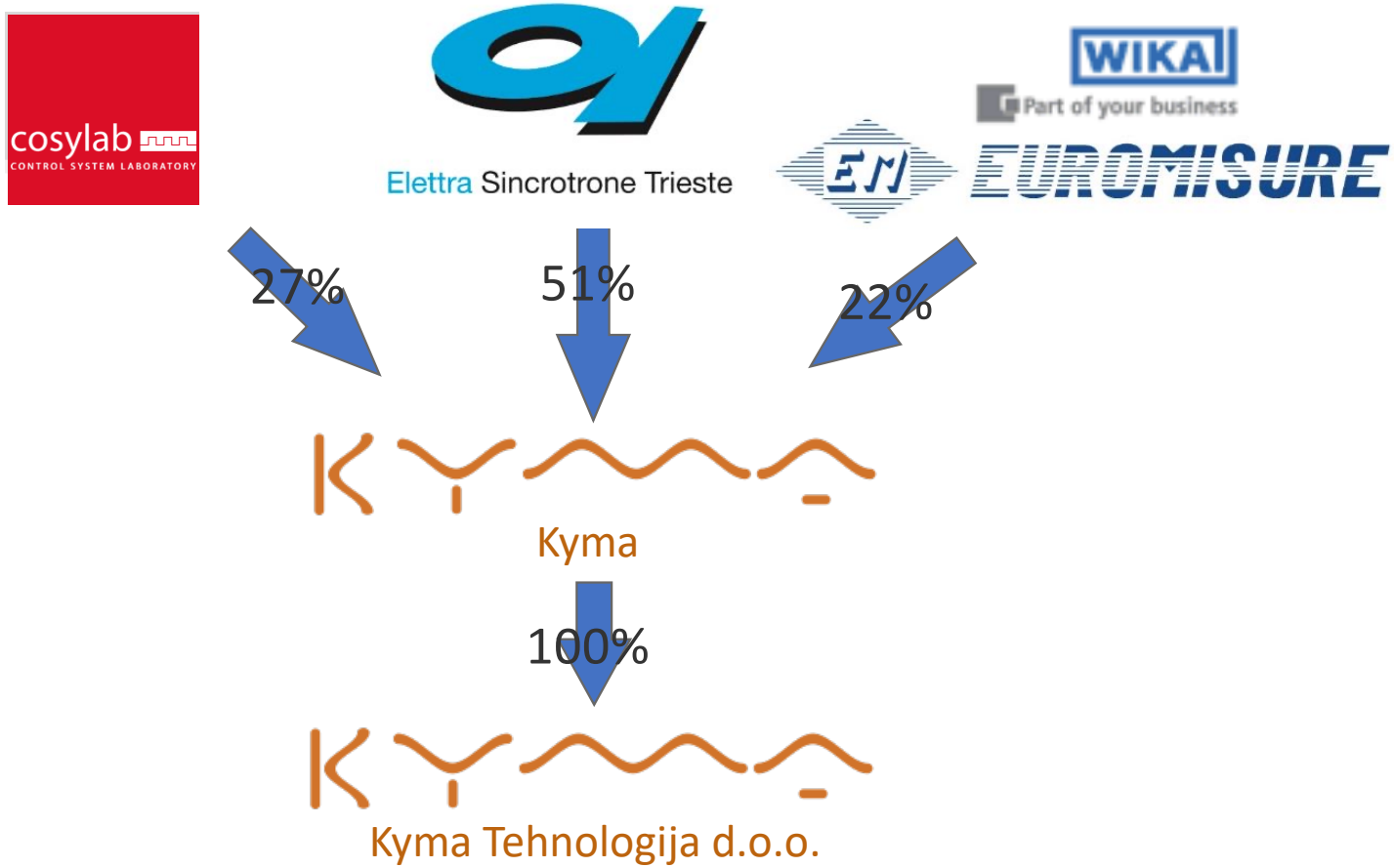
https://aipf.web.cern.ch/

FERMI@Elettra

Elettra Sincrotrone Trieste

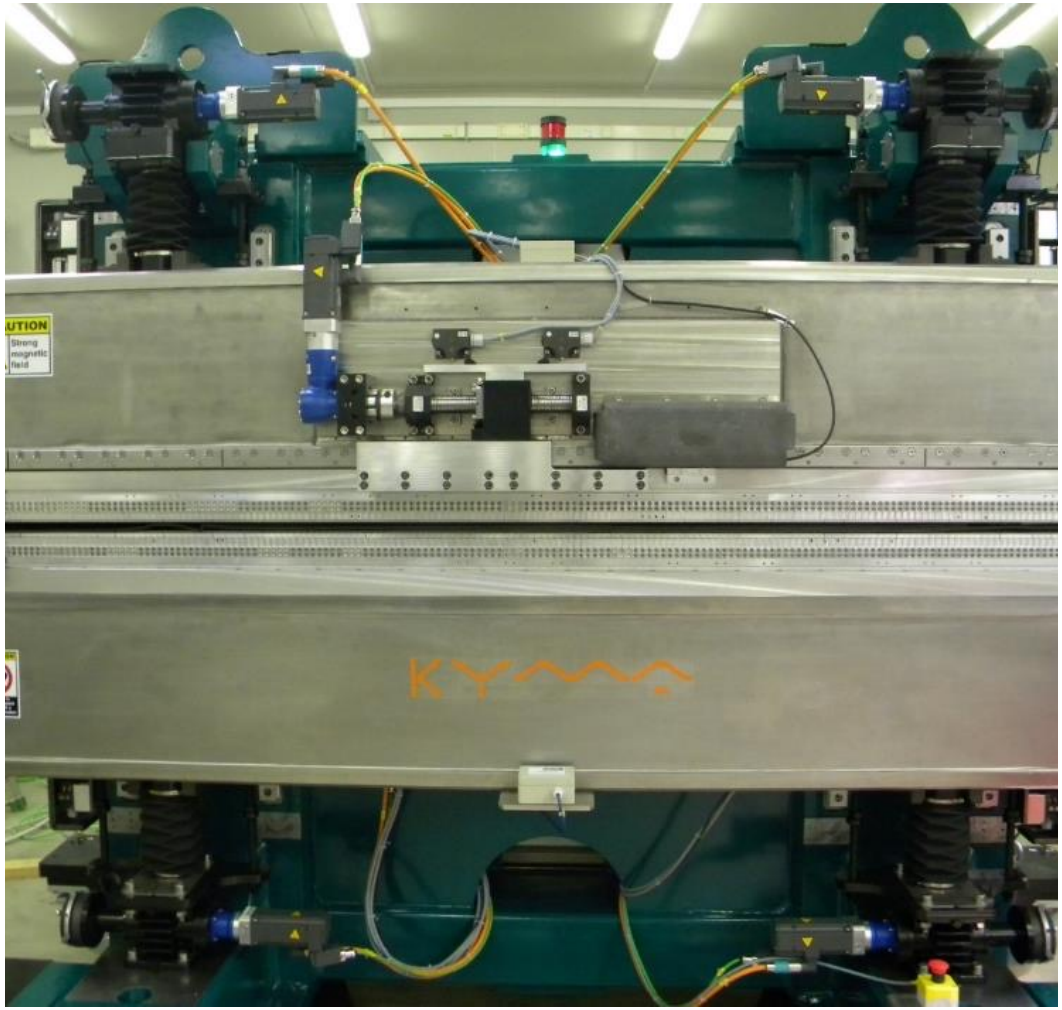


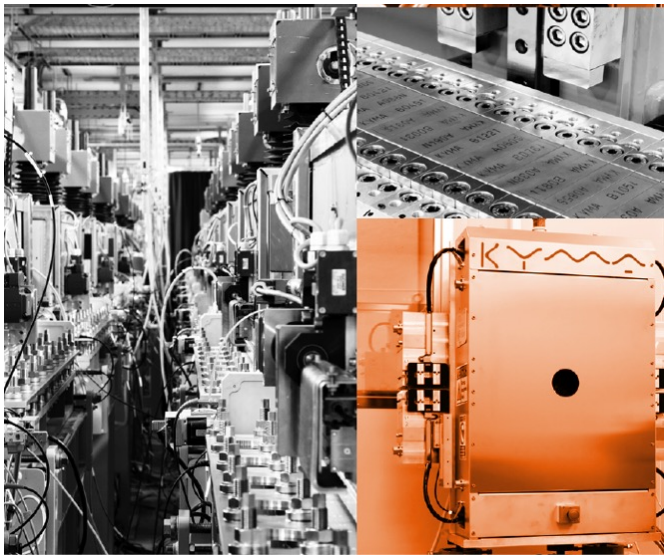
The company and the Partners - 2007

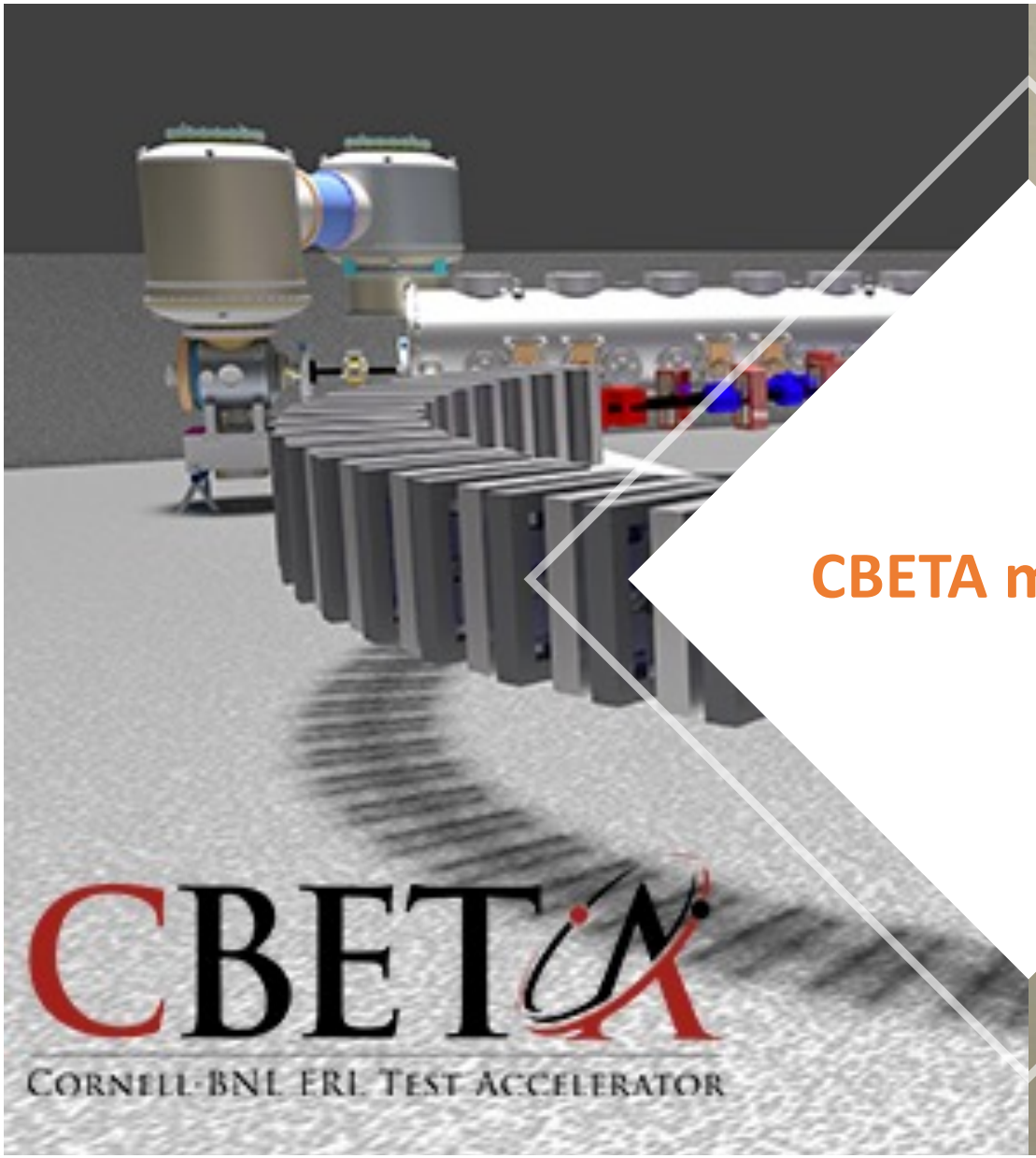


Kyma tehnologija d.o.o., Sežana, Slovenia

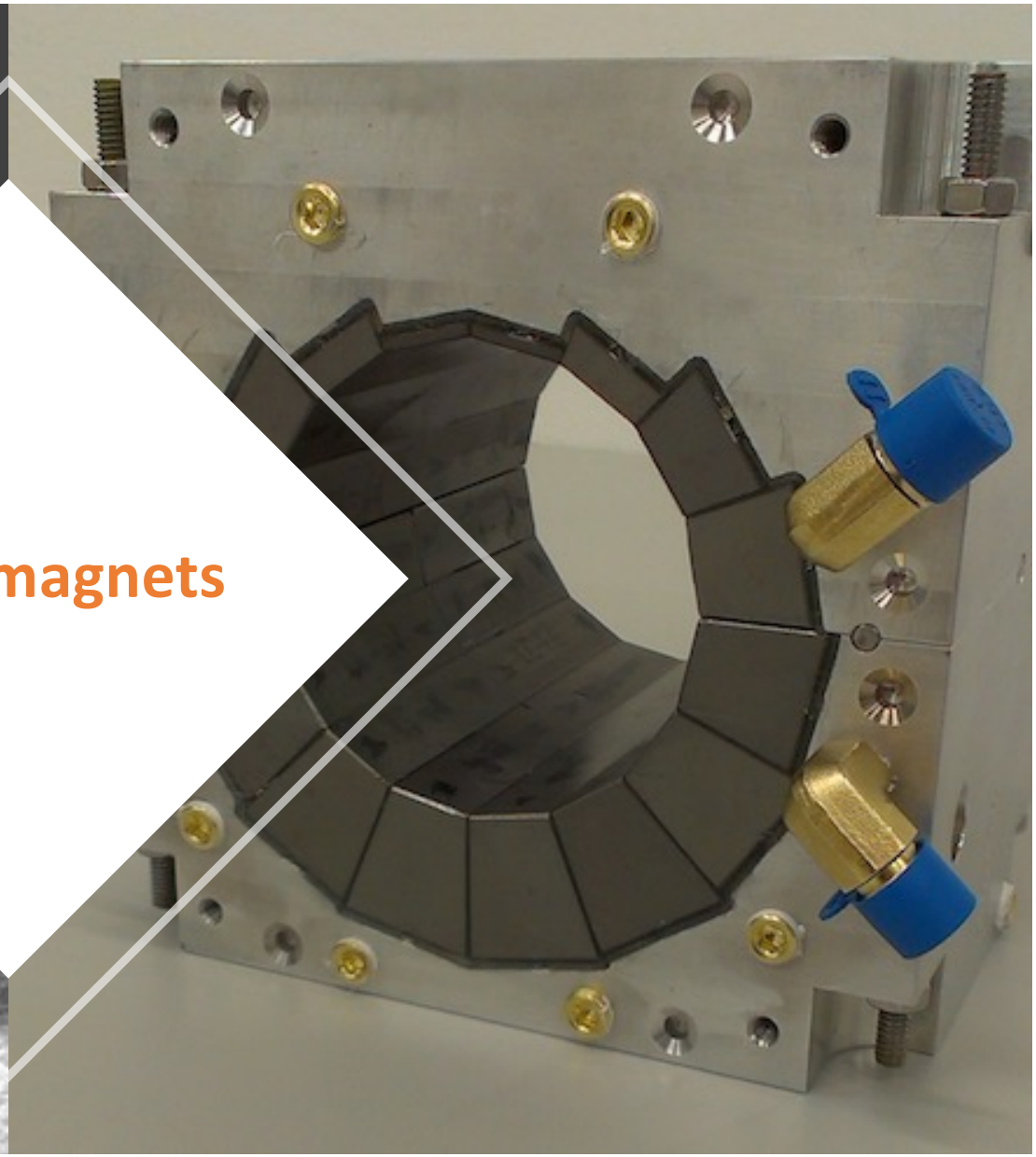

Elettra Sincrotrone Trieste
ELETTRA
Synchrotron
FERMI
Free Electron Laser


KYMA

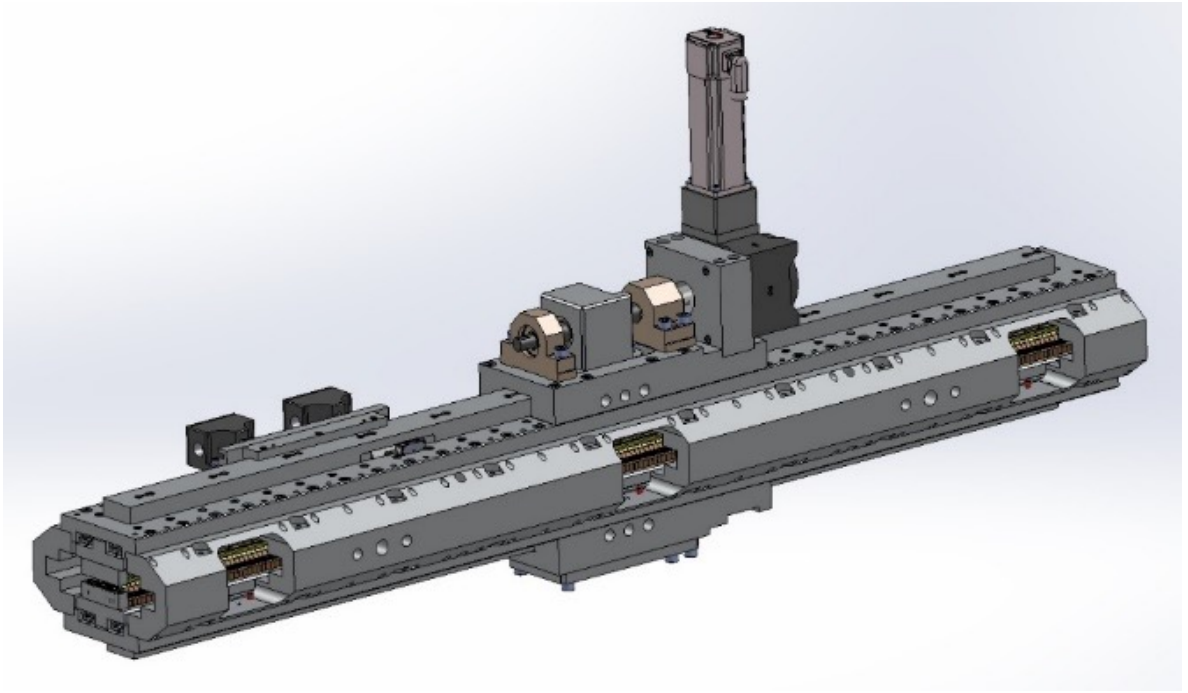

KYMA

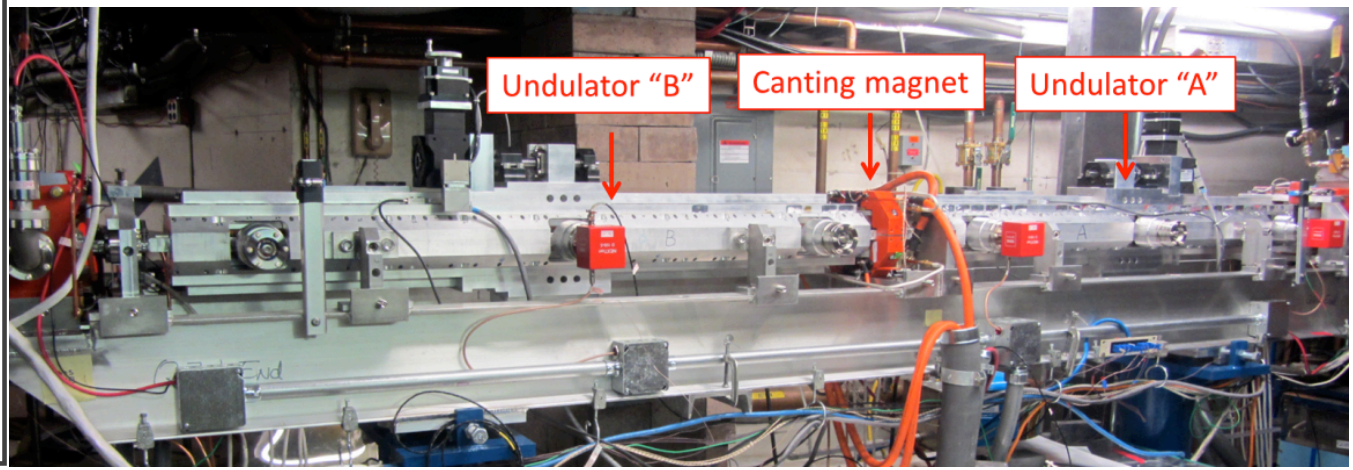


CBETA magnets



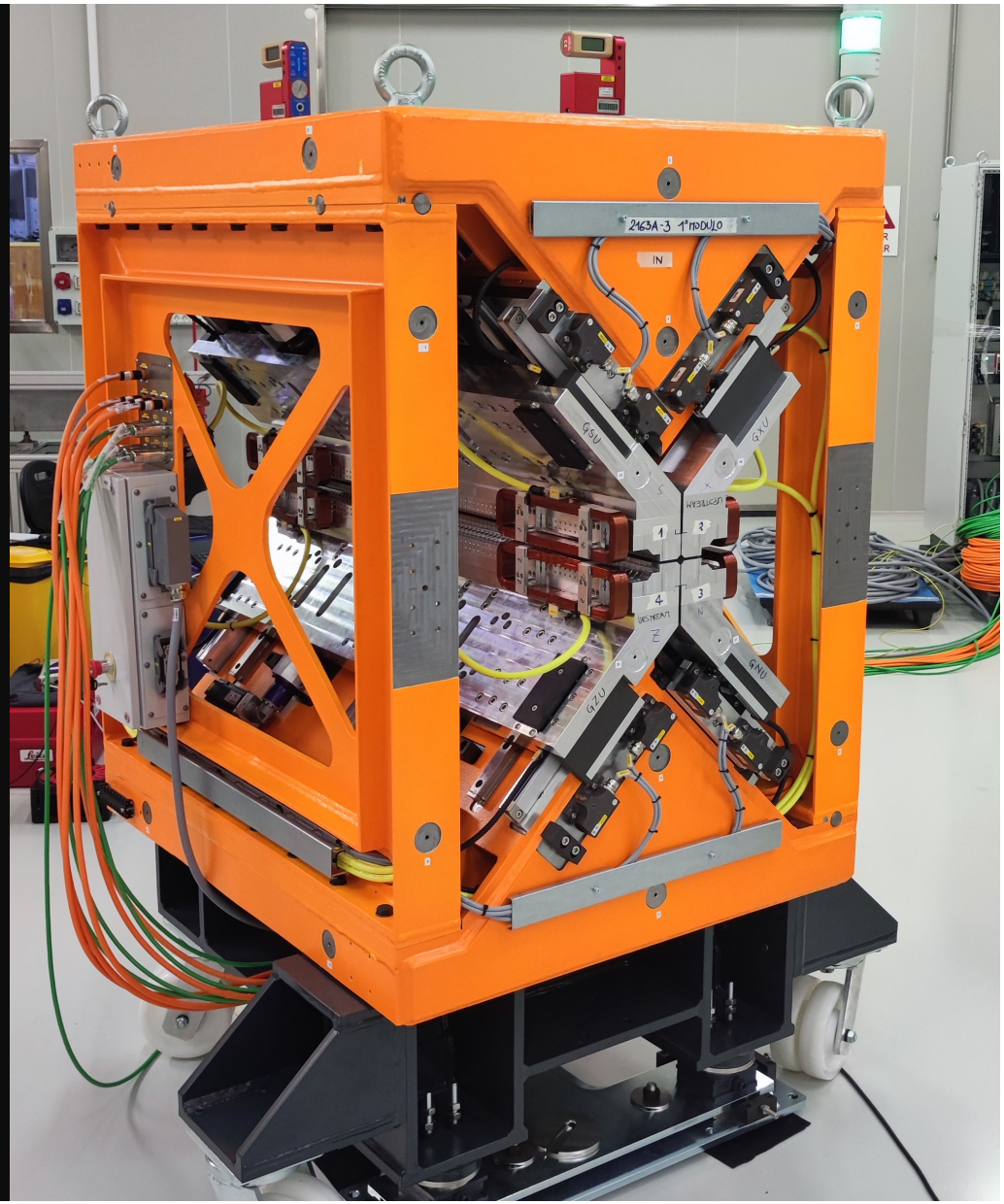
CHESS Compact Undulator (CCU)





APPLE X @ INFN-Laboratori Nazionali di Frascati

- Period: 55.0 mm
- Length: 1323 m
- Min. gap: 5 mm

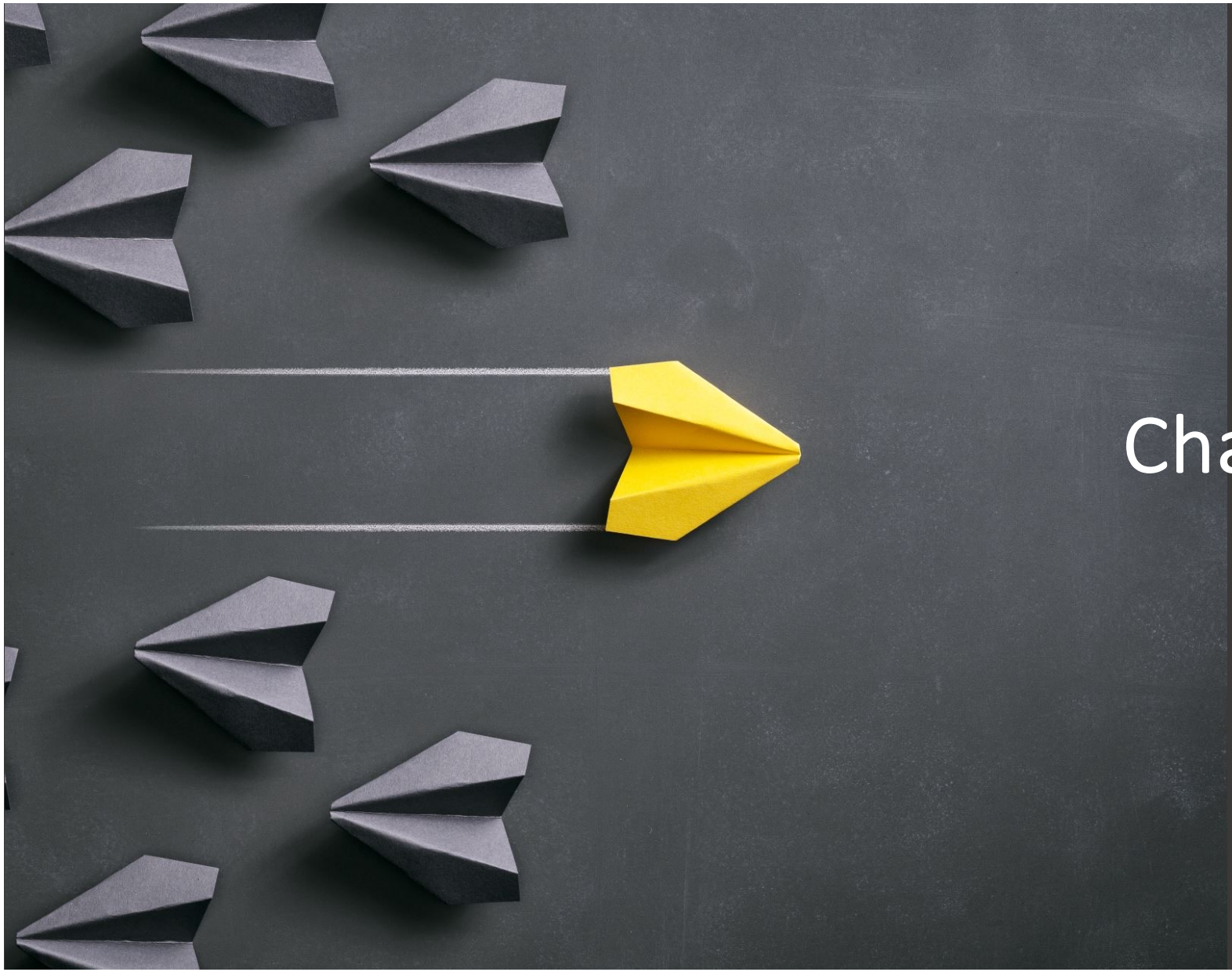


Kyma ID summary table

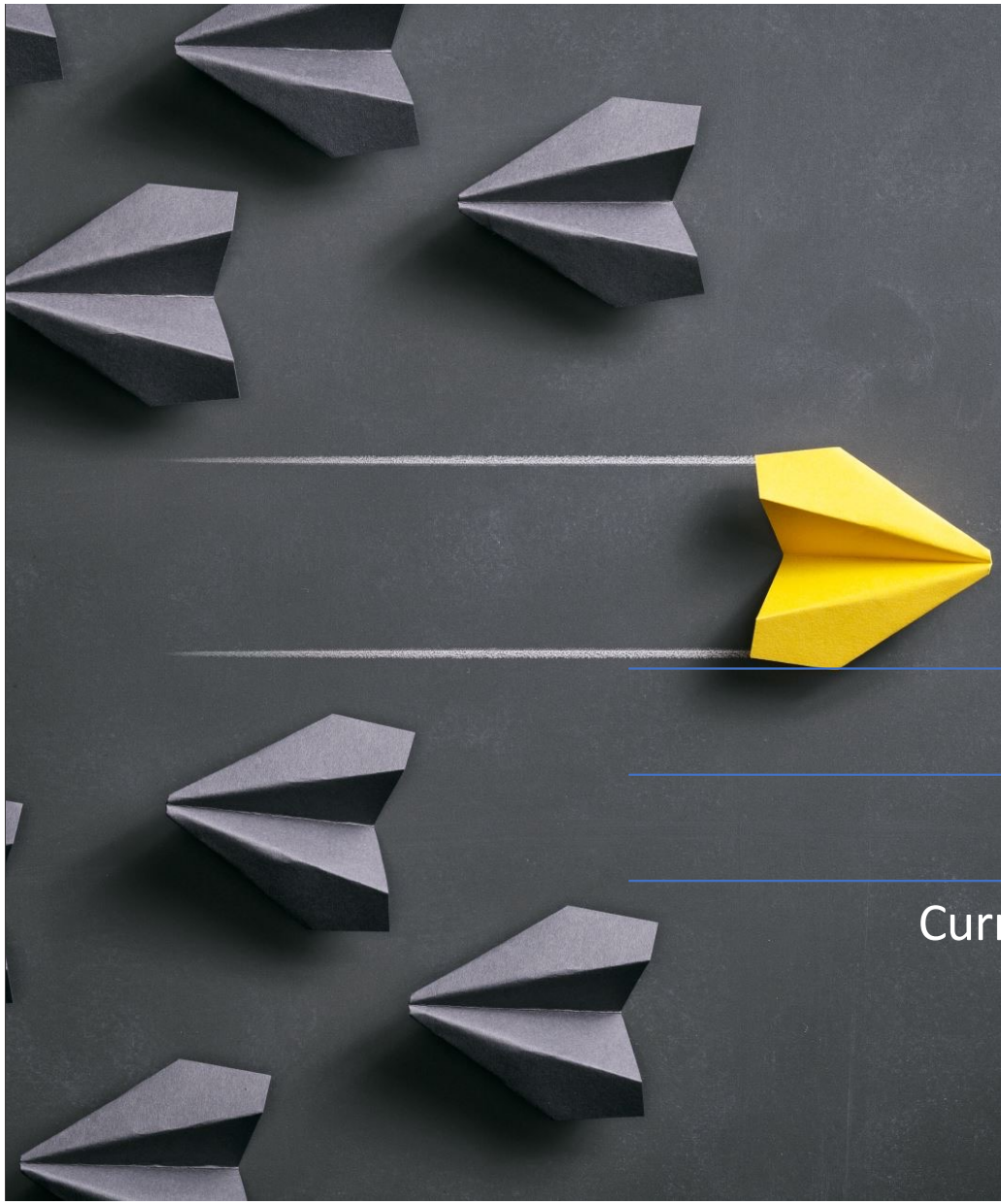
Permanent Magnet Devices	Short name	# of units	Status
Linearly Polarizing Undulators	LPU	16 2	Operation On-going
Vertically Polarizing Undulators	VPU	1 1	Operation On-going
Elliptically Polarizing Undulators – APPLE-II	EPU	32 4	Operation On-going
Adjustable Phase Fix-Gap Undulator	APU	17	Operation
In-Vacuum Hybrid Undulator	IVU	5 6	Operation On-going
Wiggler	W	3	Operation
Phase Shifter	PS	>60 10	Operation On-going
Short-Period Linearly Polarizing Undulator	SP-LPU	1	Operation
APPLE-X		3	Operation
Permanent magnet Dipoles and Quadrupoles		>240	Operation

Kyma Customer Overview

- Ankara University, Turkish Accelerator & Radiation Laboratory, Golbasi Campus, Ankara (Turkey);
- Anhui University, Hefei, Anhui (China);
- Argonne National Laboratory, Lemont, IL (USA);
- Brazilian Synchrotron Light Laboratory, LNLS Campinas, Sao Paolo (Brazil)
- Brookhaven National Laboratory, Upton (USA);
- Canadian Light Sources, Saskatoon (Canada);
- Centro Nacional de Pesquisa em Energia e Materiais - CNPEM, Campinas (Brazil);
- Consortium for the Construction, Equipping and Exploitation of the Synchrotron Light Source (CELLS)-ALBA, Barcellona (Spain);
- Centro Ricerche ENEA, Frascati, Italy, (EU);
- Cornell University, Ithaca (USA);
- CERIC ERIC, Trieste, Italy, (EU);
- Deutsches Elektronen-Synchrotron - DESY Hamburg (Germany);
- Diamond Light Source Limited, Harwell Science and Innovation Campus, Fermi Ave (UK)
- Elettra-Sincrotrone Trieste S.C.p.A., (Italy)
- European Synchrotron Radiation Facility – ESRF, Grenoble (France);
- European X-ray Free Electron Laser, Hamburg (Germany);
- European XFEL Laser Heater for Uppsala University, Uppsala (Sweden);
- FMB Feinwerk-und Messtechnik GmbH, Berlin (Germany);
- Hitachi Metals Europe GmbH, Düsseldorf, Germany, (EU);
- Huazhong University of Science and Technology (China);
- Istituto Nazionale di Fisica Nucleare - INFN, Laboratori del Sud Catania, (Italy);
- Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali di Frascati, Frascati, (Italy);
- Italian National Agency for New Technologies, Energy and Sustainable Economic Development ENEA, Rome (Italy);
- ISA, Institute for Storage Ring Facilities – Arhus University Denmark, (EU);
- Jagiellonian University, Krakow, (Poland);
- Lawrence Berkeley National Laboratory Berkeley, CA, (USA);
- Los Alamos National Laboratory, LANL Los Alamos, NM, (USA);
- MAX IV Laboratory, Lund (Sweden);
- Max Planck Postech Korea Research Initiative, Pohang, (Korea);
- National Centre for Nuclear Research - NCBJ, Otwock, Poland, EU;
- National Synchrotron Radiation Laboratory - NSRL, Hefei (China);
- National Synchrotron Radiation Research Center, Taiwan (R.O.C.);
- Pohang Light Source - PLS-II, Pohang (Korea);
- Raja Ramanna Centre for Advanced Technology, Indore (India);
- SESAME Synchrotron-light for Experimental Science and Application in the Middle East (Jordan);
- SOLARIS National Synchrotron Radiation Centre, Krakov (Poland);
- SOLEIL Synchrotron, Saint-Aubin (France);
- Synchrotron Light Research Institute (Thailand);
- University of Aarhus – ISA, Institute for Storage Ring Facilities, Aarhus (Denmark);
- UK Research and Innovation STFC, Sci-Tech Daresbury, Daresbury, Warrington, Great Britain, (EU).



Challenges



Challenges

Market of accelerator → highly volatile

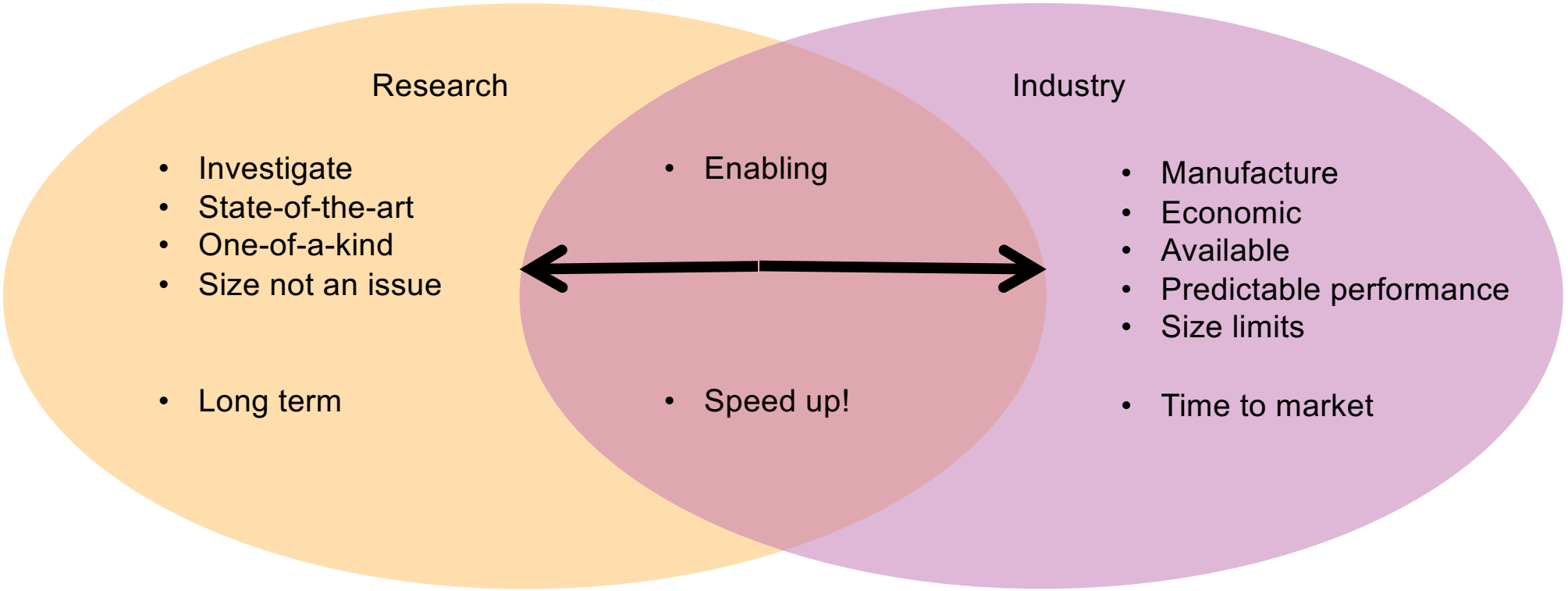
No standardization, no continuity in demand

Current peak in requests, but it could not last forever

How can companies stay competitive?


The true COMPETITIVE
ADVANTAGE come through the
RATE OF INNOVATION

Where science and industry meet – synergy



SLIDE COURTESY OF HANS PRIEM – VLD ETG

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA No 101004730.

I.FAST

Innovation Fostering in Accelerator Science and Technology

I.FAST aims to enhance innovation in the particle accelerator community, mapping out and facilitating the development of breakthrough technologies common to multiple accelerator platforms. The project involves 49 partners, including 17 companies as co-innovation partners, to explore new alternative accelerator concepts and advanced prototyping of key technologies.

May 2021 – April 2025

https://ifast-project.eu/home

iFAST

HEPTO
Hybrid Electromagnet-Permanent Magnet Tuneable Optics

- **WP11.3** - Permanent Magnet (PM) Combined Function Magnets for Ultra Low-Emittance Rings

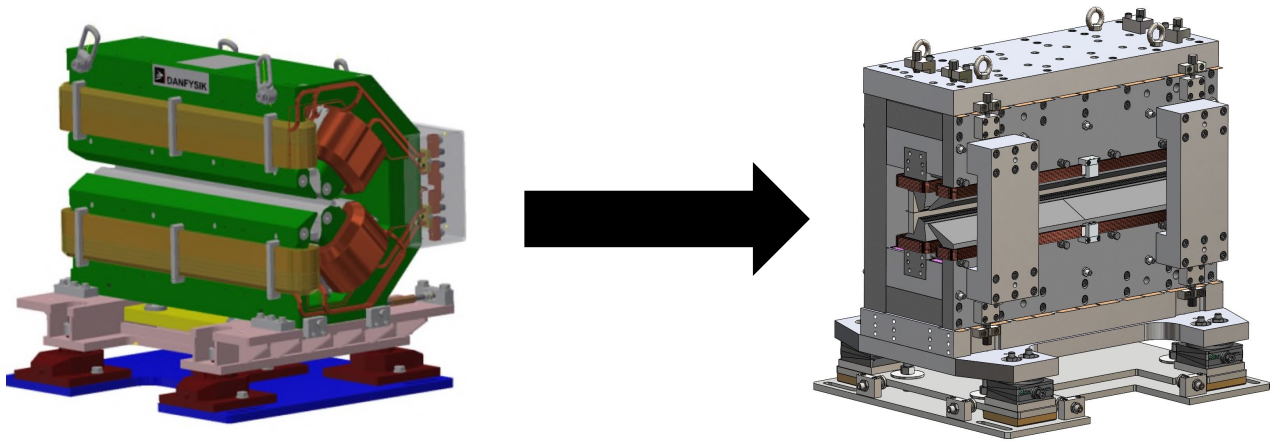
- Partners and collaborators:

UK Research and Innovation

KYMA

diamond

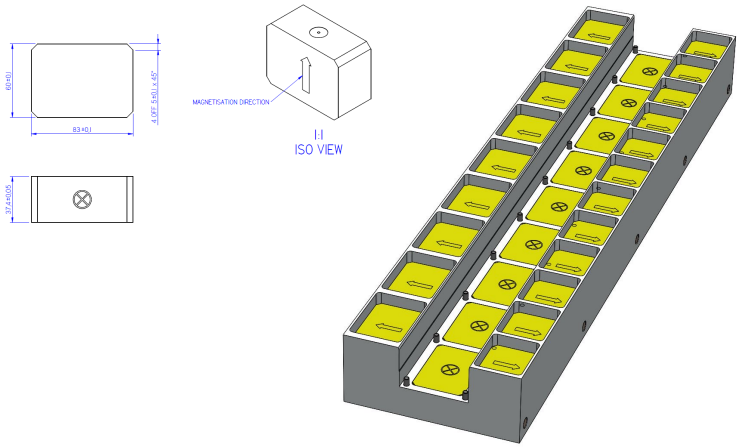
- Fourth generation synchrotron light sources make use of multi-bend achromat lattices to reduce beam emittance and increase radiation brightness.
- Lattices require combined function dipole-quadrupole (DQ) magnets.
- Diamond-II upgrade will require 48 DQ magnets drawing 2.3 kW each.
- Can permanent magnets achieve the same purpose with negligible power?

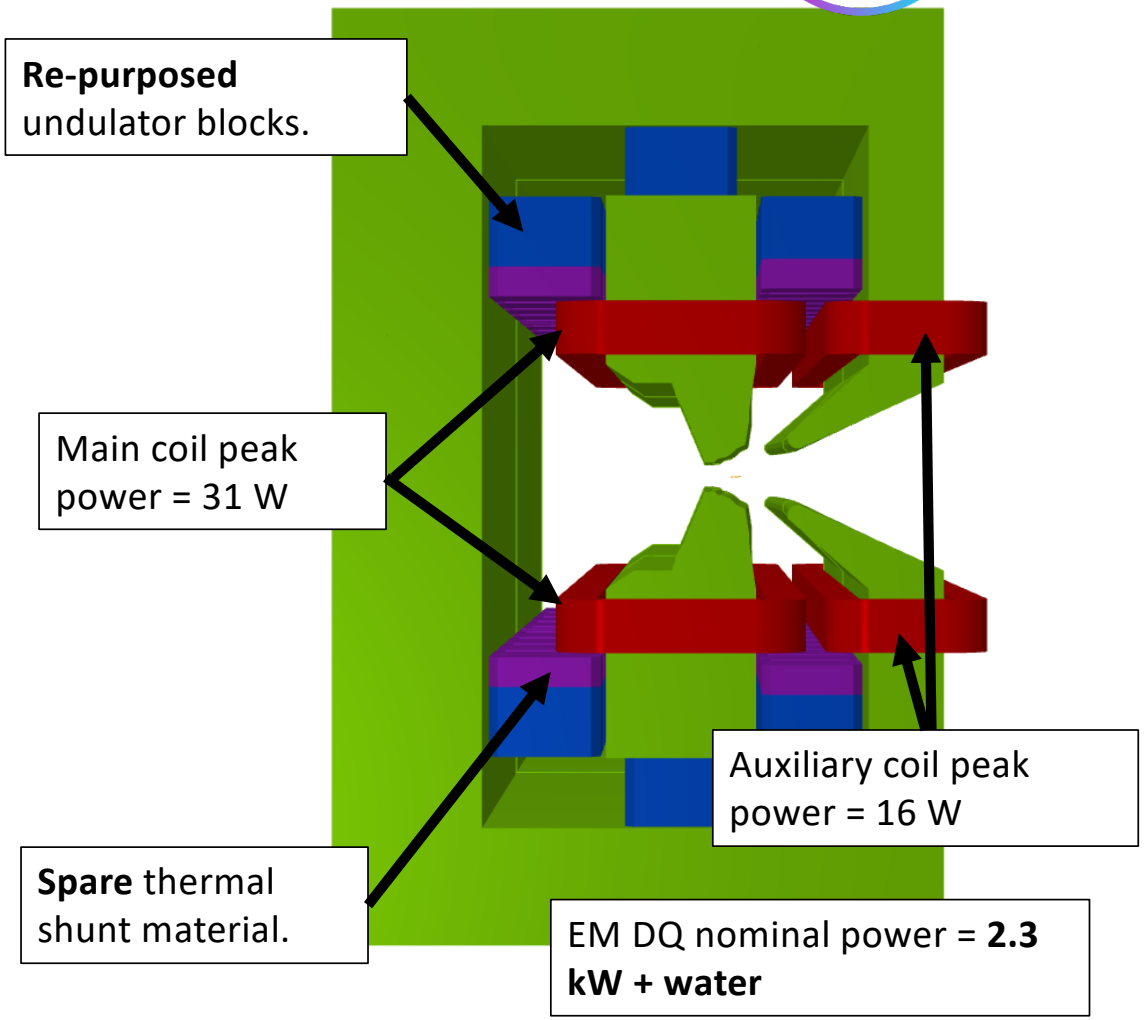


Slide Courtesy of Alex Hinton and Ben Shepherd

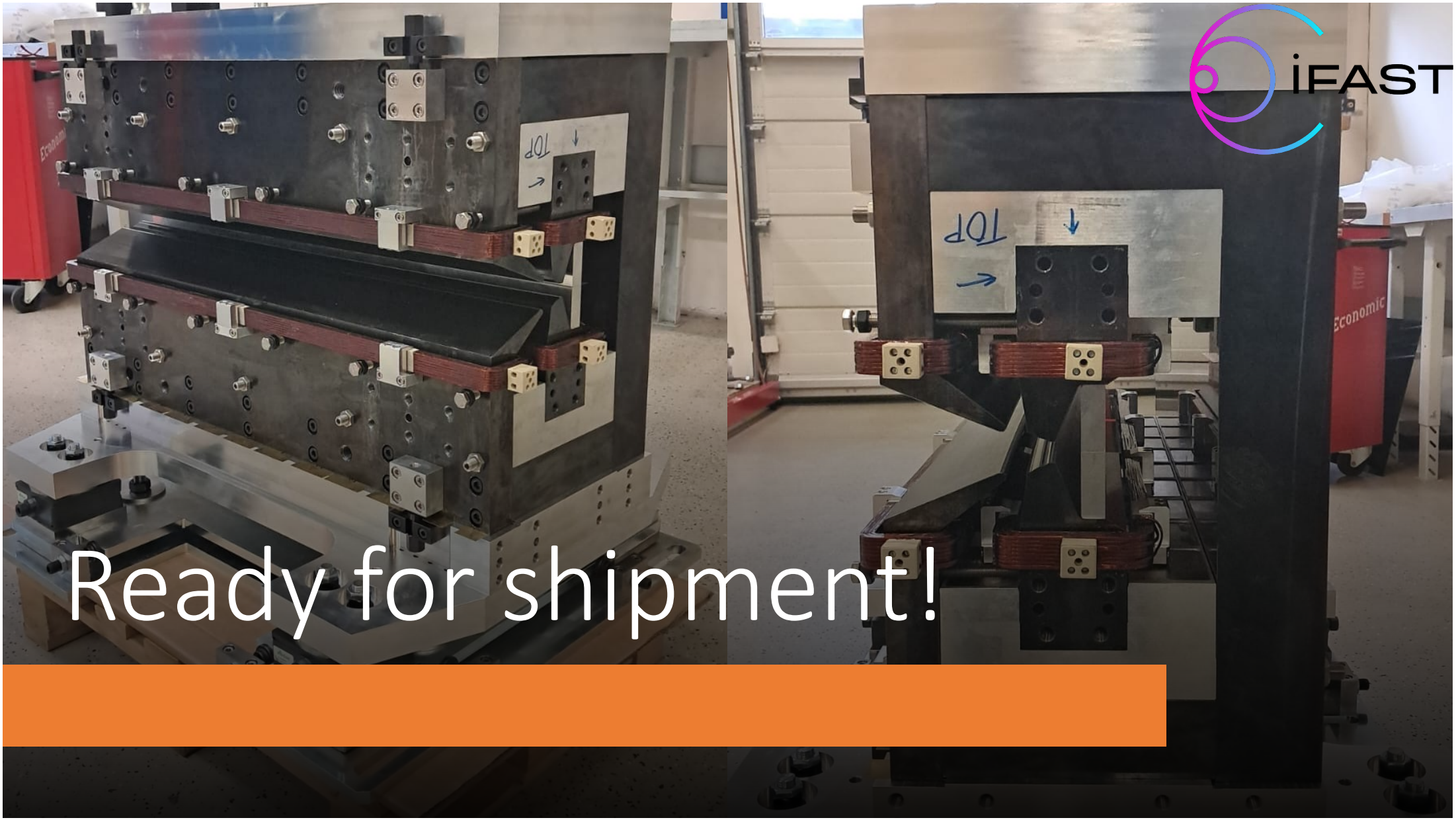
HEPTO
Hybrid Electromagnet-Permanent Magnet Tuneable Optics

- Dipole = 0.7 T, Gradient = 33 T/m.
- Effective length = 0.870 m.
- Main source of field = NdFeB permanent magnet blocks
- Dipole and gradient fields require independent tuning of **±2.5%** for commissioning purposes.
- Field tuning achieved by **air-cooled** trim coils.
- Yoke and poles made from **low-carbon steel.**





Courtesy of Alex Hinton and Ben Shepherd



Ready for shipment!

VAriable Dipole for the Elettra Ring - VADER

- **Task 7.3** within I.FAST **WP7**: High Brightness Accelerators for Light Sources
- Partners and collaborators:

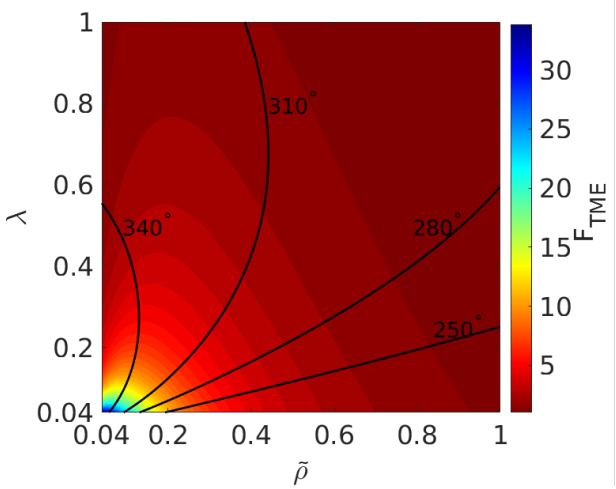
Slide Courtesy of Yannis Papaphilippou

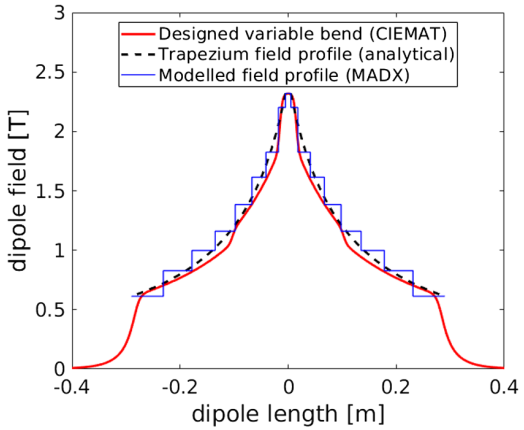
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA No 101004730.

Slide Courtesy of Yannis Papaphilippou

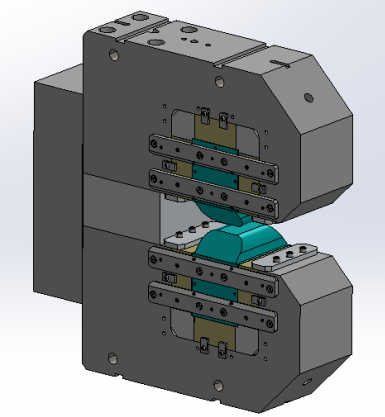
VADER objectives

- **Fabricate** an innovative dipole magnet prototype with longitudinal varying dipole field, including a transverse gradient for the ELETTRA upgrade
- Permanent magnet **concept** with trapezoidal bending radius, **2.3 T** peak field and **~10 T/m** gradient, already established (CERN/CIEMAT)
- Proved the **horizontal emittance reduction** to ultra-low levels of i.e. **~60 pm @ 2.86 GeV**, for the CLIC DR (M. A. Domínguez Martinez et al., IEEE Trans. Appl. Supercond. 28, 1, 2018; S. Papadopoulou et al, PRAB 22, 091601, 2019)
- First **demonstrator constructed/qualified** by CIEMAT

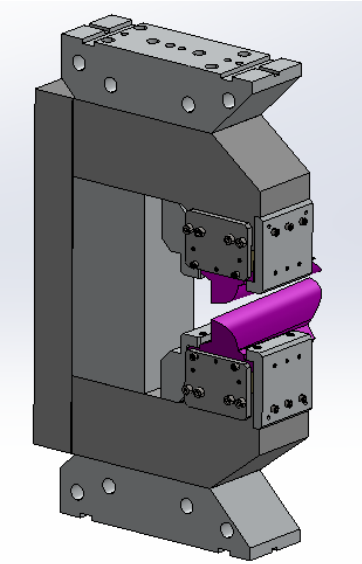




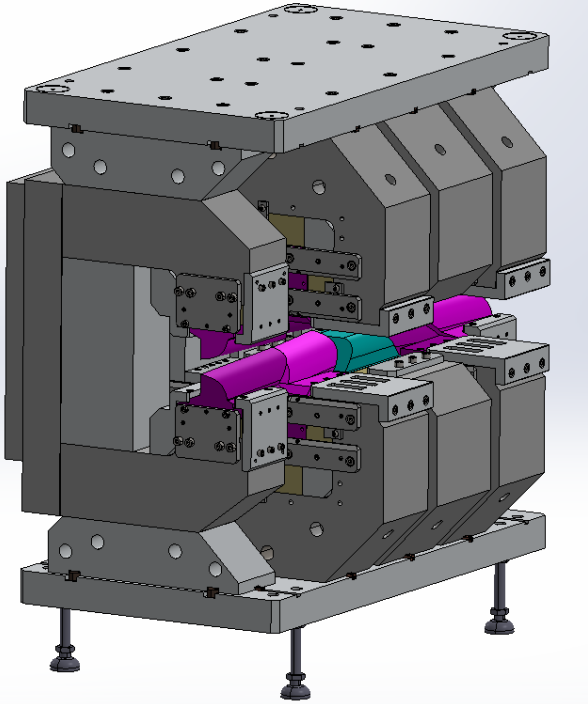
VADER: Final Mechanical Design



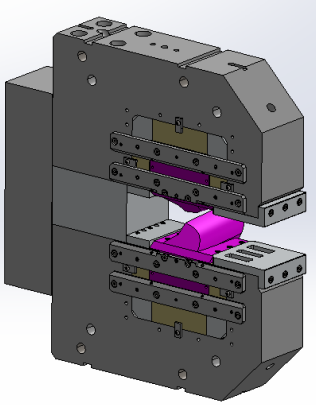
HF Module



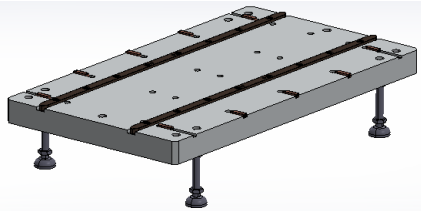
LF Module



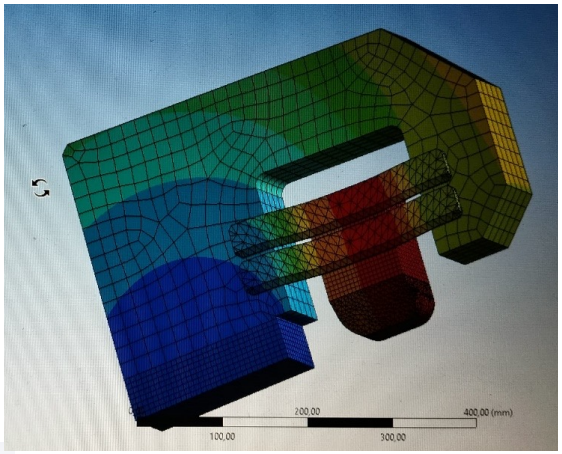
Final assembly



MF Module



Base with guides



Deformations in the HF module

Slide Courtesy of Yannis Papaphilippou

AIPF - Accelerator Science and Technology Industry Permanent Forum

AIPF
ACCELERATOR SCIENCE AND TECHNOLOGY INDUSTRY PERMANENT FORUM

https://aipf.web.cern.ch/

Endorsed by the TIARA Test Infrastructure and Accelerator Research Area - https://www.eu-tiara.org/ Governing Council on February 21, 2023

Established to:

- bring together the Accelerator Science and Technology (ASc&T) **community**
- foster a **coordinated** approach between industry and RI&TI in advancing knowledge
- increase integrated **innovation capacities**
- address together **societal challenges**

AIPF STEERING COMMITEE

INDUSTRY


Raffaella Geometrante
Co-chair


Josef Troxler


Hans Priem


Miguel Angel Carrera


Michael Gehring


Rok Hrovatin


Francois Sylla

RESEARCH INSTITUTIONS


Isabel Bejar Alonso
Co-chair


Luis Garcia Tabares


Mauro Morandin


Angeles Faus-Golfe


Anthony Gleeson


Antonio Falone


Nikolaj Zangenberg

ILOs

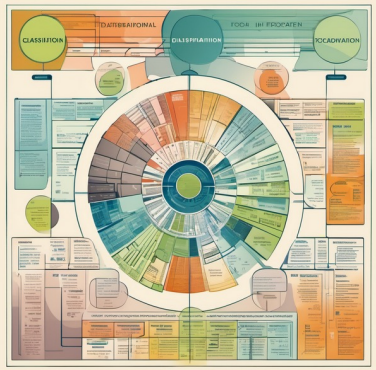

Jan Visser


Jose Antao

TIARA


Jose Manuel Perez

AIPF – 5 priorities, 5 Working groups

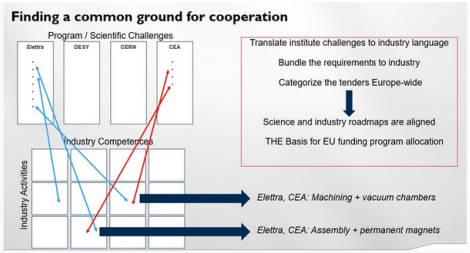


PROMOTE THE INTEGRATION, CLASSIFICATION, AND DISTRIBUTION OF INFORMATION

INDUSTRY INVOLMENT ON R&D FUNDING PROGRAMS

PROMOTE MECHANISMS TO SHARE THE RISK BETWEEN RESEARCH INFRASTRUCTURES AND INDUSTRY

STRENGTHEN THE RELATIONSHIP BETWEEN INDUSTRY AND RESEARCH INSTITUTIONS



PROMOTE THE INTEGRATION OF ROADMAPS WITHIN SYNERGETIC COMMUNITIES

What's next

European proposals

Kyma

CONCLUSION

In a world that moves fast, no one innovates alone!

The future belongs to those who **collaborate to accelerate.**