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

WP7: VAriable Dipole for the Elettra Ring - VADER

IFAST Steering Committee, 16/11/2021

Yannis Papaphilippou, CERN

iFAST

VAriable Dipole for the Elettra Ring - VADER

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

Y. Papaphilippou

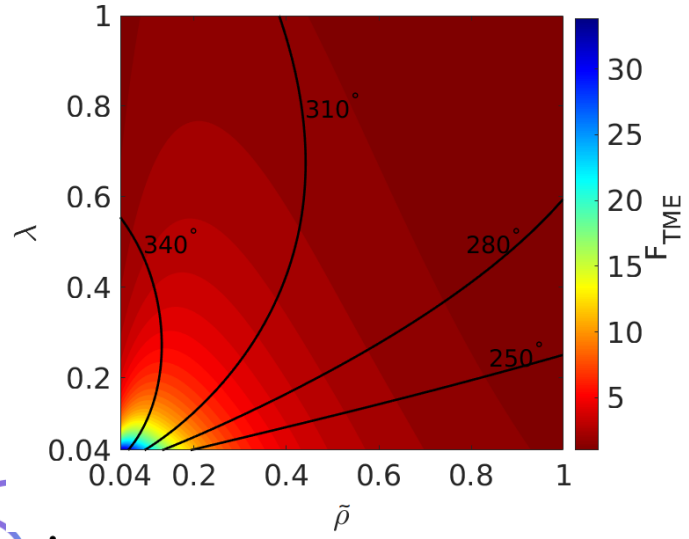
F. Toral

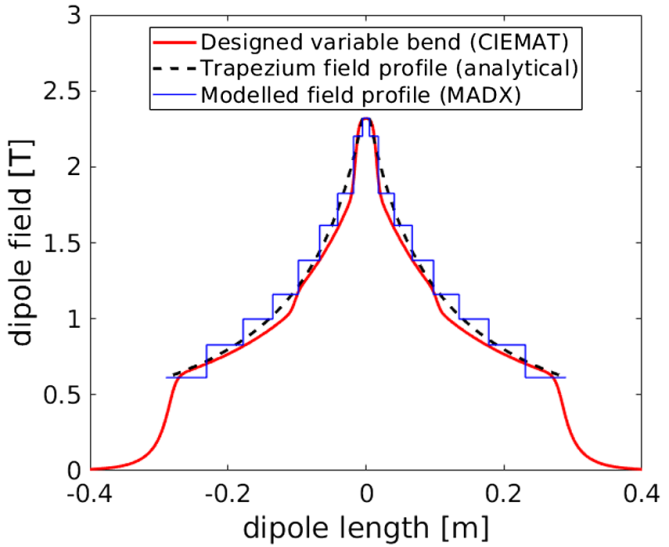
E. Karantzoulis

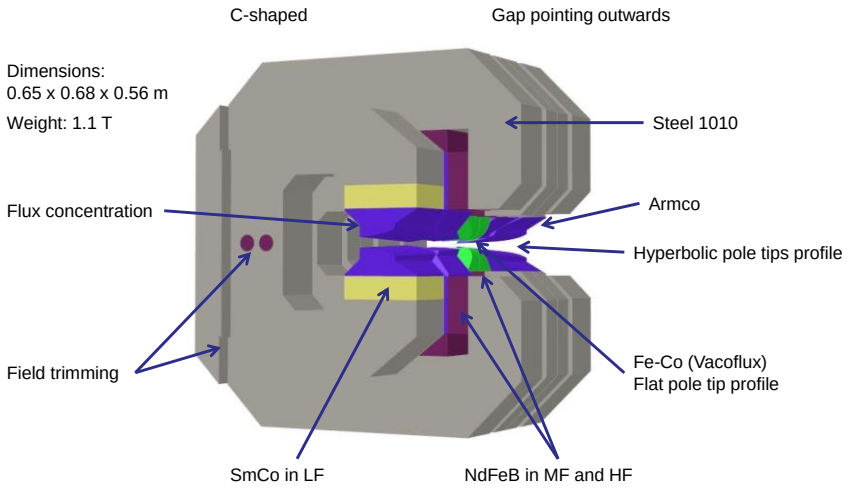
R. Geometrante

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** by CIEMAT

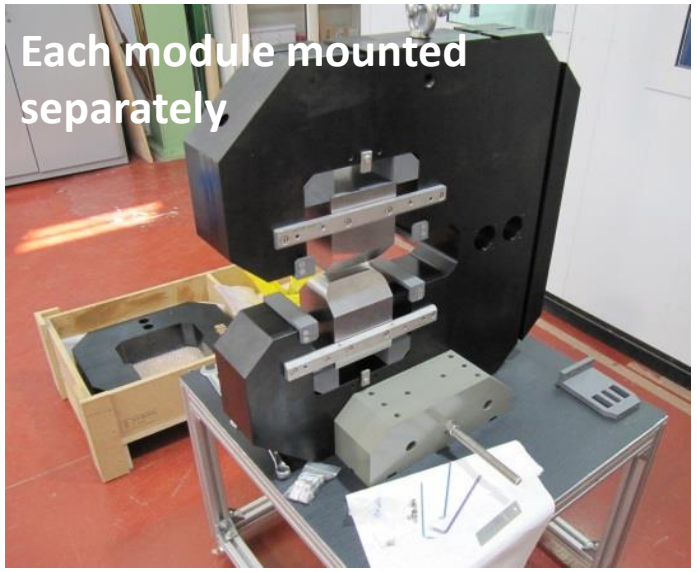


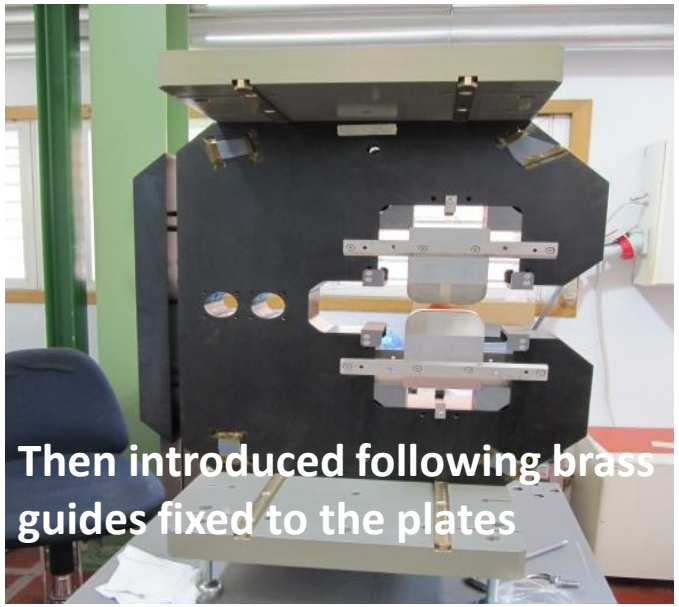




Preliminary assembly without PM


Modules' approach method was tested


Each module mounted separately


Then introduced following brass guides fixed to the plates


Poles fixed in nominal positio using gauges


No major issues…

M. Dominguez Martinez,
F. Toral

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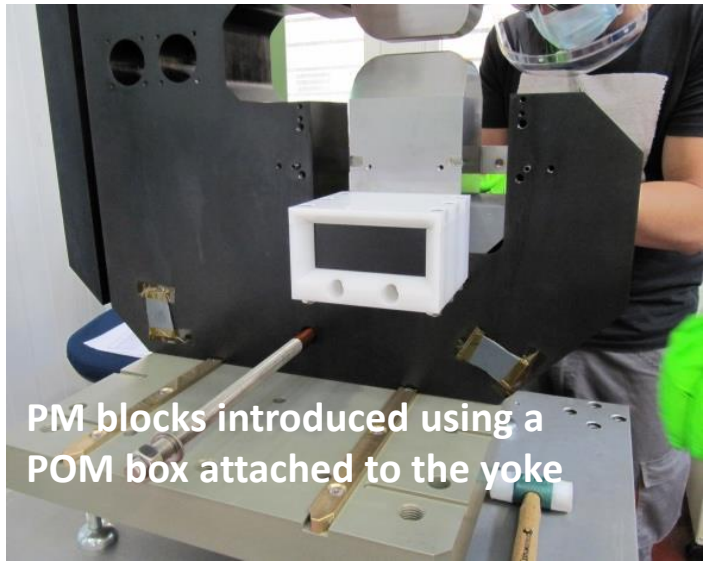
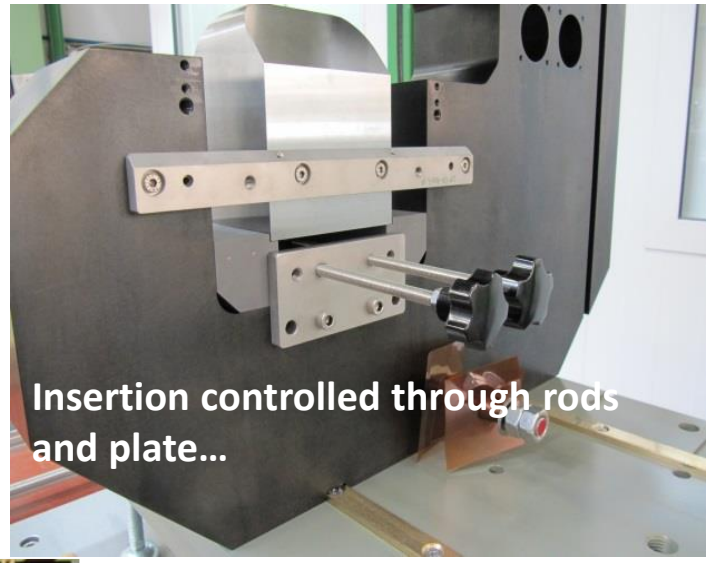
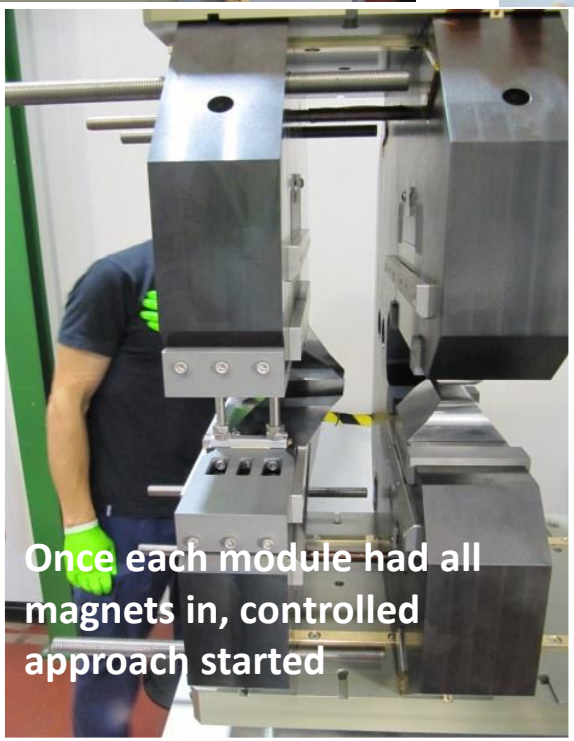
Assembly with PM







M. Dominguez Martinez,
F. Toral

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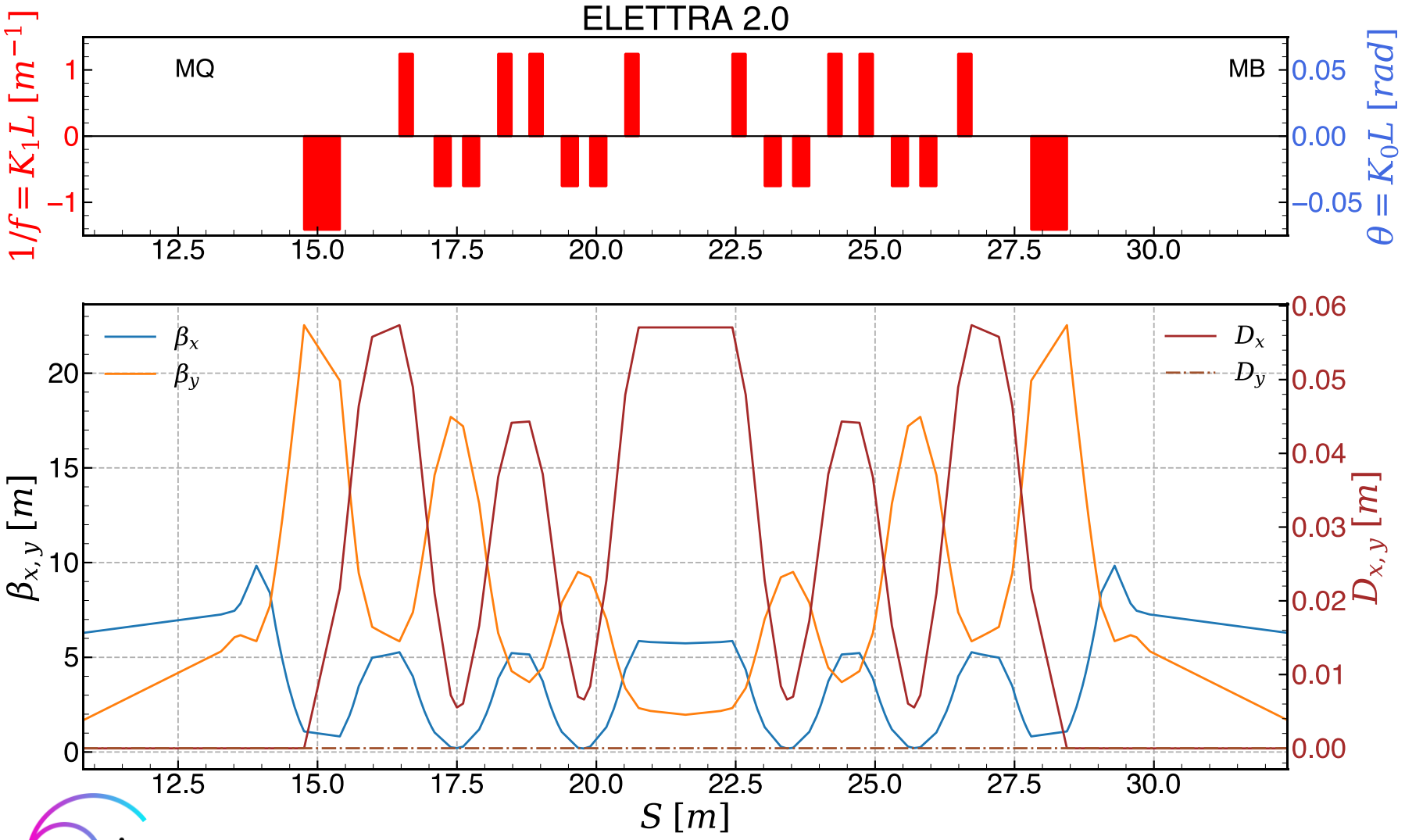
Lessons learned…

M. Dominguez Martinez,
F. Toral

- **Huge magnetic forces** involved necessitating redesign of **insertion rods** (8mm to 12mm diameter) and **support plates** (steel to bronze to reduce friction)
- **Order** of **PM blocks insertion** highly **important**, found **optimal** for lowering maximum force through **simulation** of all alternatives
- **PM blocks insertion** very **critical** and **risky** process for both personnel and material
- Everything went **smoothly**!
- Magnet shipped to **ALBA-CELLS** for high precision **magnetic field mapping**

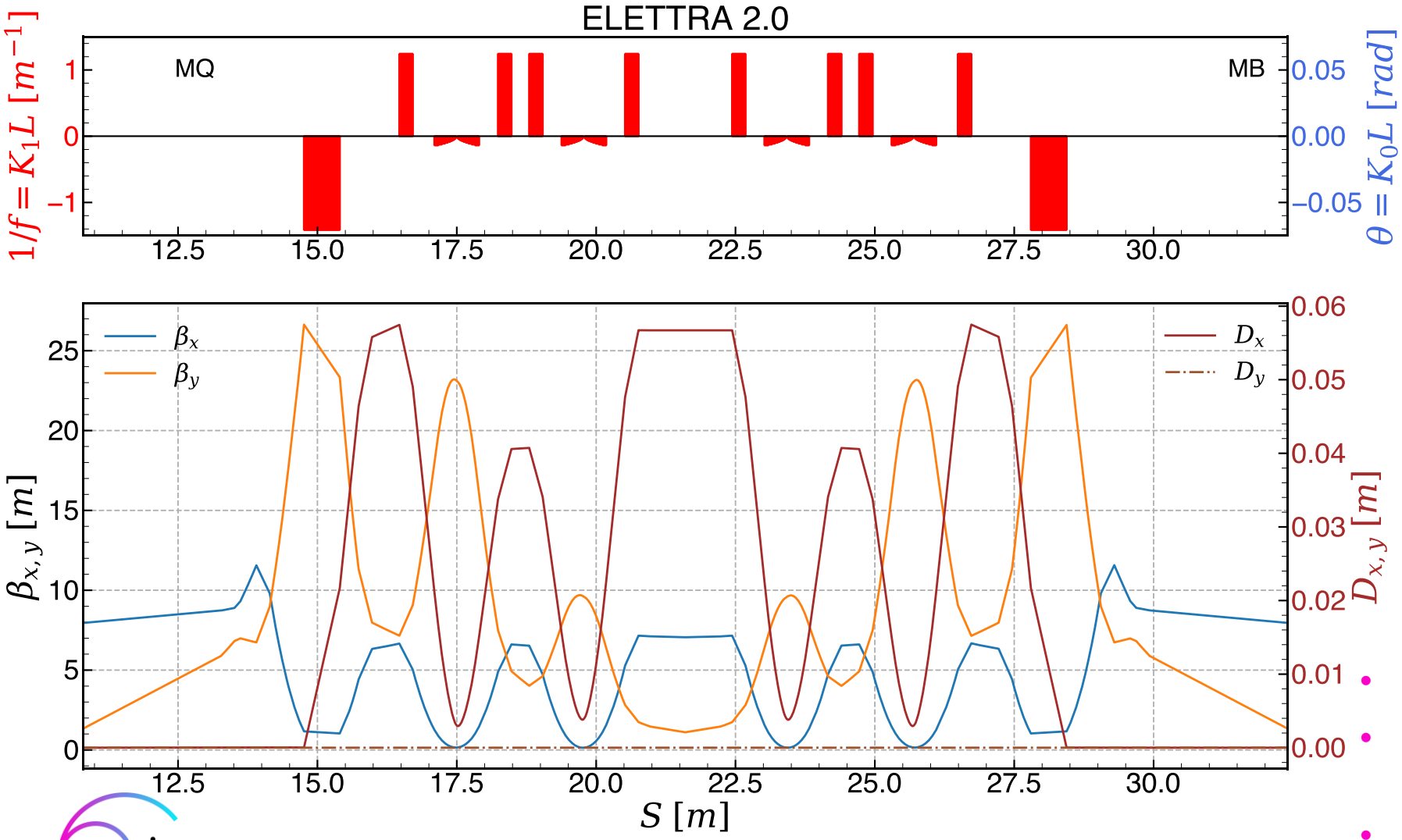
Original 6BA-E Lattice



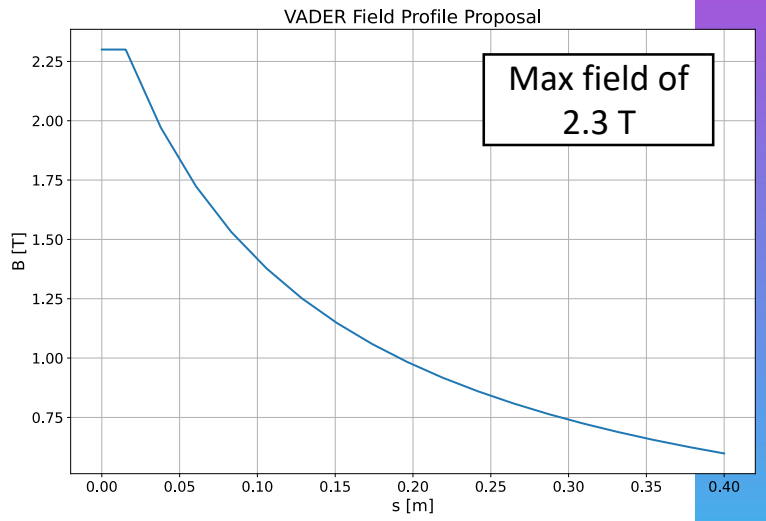
- **Horizontal emittance of 200 pm**
- 4 longitudinally variable dipoles (step) out of 6 dipoles
- Use of anti-bends

E. Karantzoulis, A. Poyet

First optics with new VADER



- **Horizontal emittance of ~160 pm (- 20-25%)**
- 4 longitudinally variable dipoles (VADER) out of 6 dipoles
- Use of anti-bends



- **Fine tuning** of optics in achromat
- Replace anti-bends by normal quadrupoles
- Replace remaining uniform dipoles by VADERs

E. Karantzoulis, A. Poyet

Y. Papaphilippou – IFAST Steering Committee

VADER timeline

	Deliverable description	Month
1	Magnet Specifications based on optics calculations for ELETTRA	12
2	Magnetic and mechanical design (including fabrication drawings)	24
3	Fabrication of the prototype	42
4	Acceptance tests	48

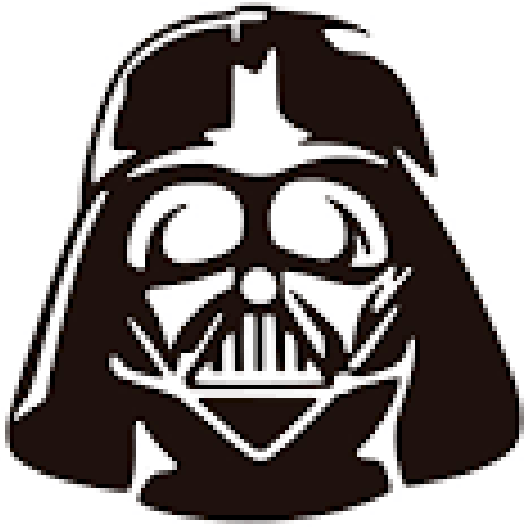
Milestone **MS 26**

Deliverable **D7.3**

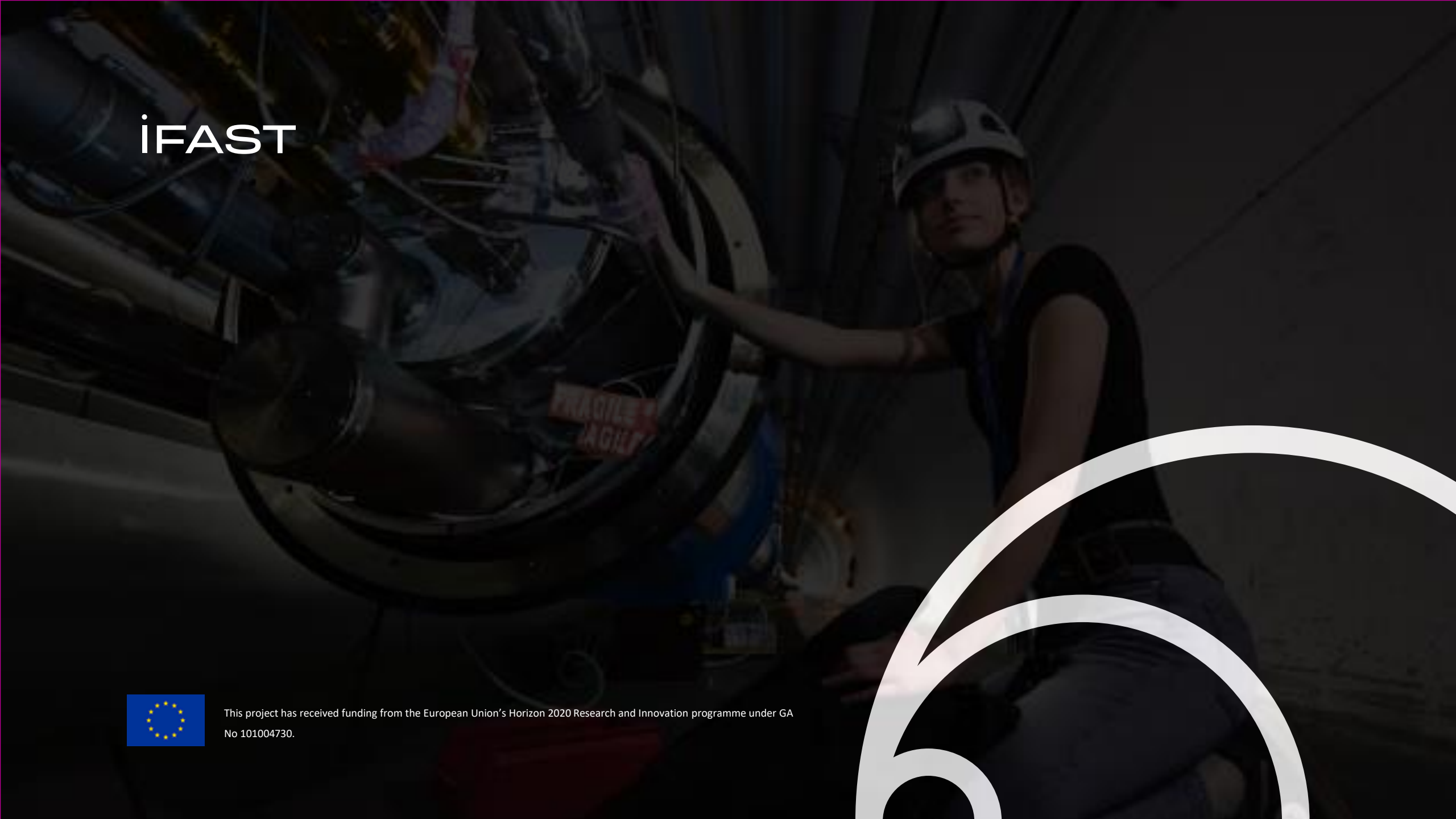
Milestone **MS 27**

- Several **collaboration meetings** discussing progress
  - CLIC DR prototype progress
  - Elettra ring constraints
  - Analytical approach for magnet specifications
  - Lattice design, exchange of optics files, tuning process
- **CERN Fellow hired** and optics work on-going between CERN/Elettra,
- When **optics** finalised (**spring 2022**), input of CIEMAT for **magnetic design specs**
- **Specification document** to be ready by **May 2022**
- **Magnetic and mechanical design** at **June 2022**, from CIEMAT with input from KYMA for fabrication
- Magnetic and mechanical design (including drawings) to be **ready** by **May 2023**
- Fabrication of the prototype by KYMA to start on **June 2023**, ready for acceptance tests by **January 2025**

VADER



MAY
THE FIELD
BE WITH YOU



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