



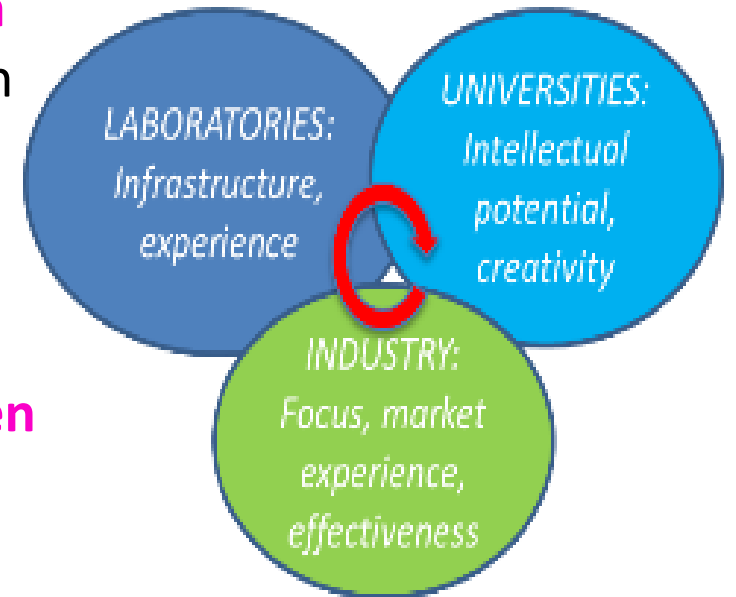
Maurizio Vretenar, CERN
Project Coordinator

EURO-LABS Meeting, CERN, 28.10.2024



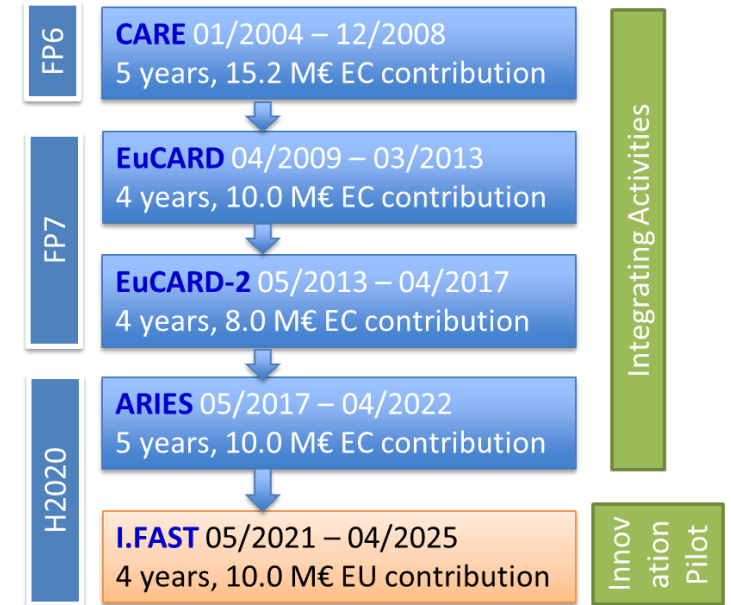
What is I.FAST?

- A **collaborative European project** for the development of advanced **particle accelerator technologies in collaboration with industry**, supported by the European Commission under Horizon 2020.
- 10 M€ EU funding, total budget 24 M€, 48 partners from 15 European countries – 35% industrial partners.
- Goal: translate the particle accelerator community towards **Open Innovation**.
- Programme focus on sustainability and innovation in 9 thematic areas strategic for the future of particle accelerators.



Genesis of I.FAST and coordination with other accelerator initiatives

- Accelerator proposals to EC calls coordinated by the **TIARA Collaboration Council**, representing the community involved in accelerator R&D.
- The **Innovation Pilot I.FAST** as a pillar of TIARA strategy follows 4 successful Integrating Activities (CARE – EuCARD – EuCARD2 – ARIES).
- In the TIARA vision, Integrating Activities and Innovation Pilots are the **cradle of new ideas** and the places to **generate collaborations** that will evolve into dedicated high-level proposals.
- TIARA guarantees the **coherence** of the overall strategy, defines the **boundaries** and controls that there are **no overlaps** between projects.



The cost and time for development of “deep-tech” accelerator technologies requires a long-term strategy articulated among different projects and funding structures

FCC-IS Future Circular Collider Innovation Study H2020-INFRADEV-2019-3, Nov 2020 - Nov 2024; 7.4 (3) M€	HITRI+ Heavy Ion Therapy Research Integration plus H2020-INFRAIA-2020-1, April 2021 - Sept 2025; 5 (5) M€
iFAST Innovation Fostering in Accelerator Science and Technology H2020-INFRAINNOV-2020-2, May 2021 - April 2025; 10.6 (10.0) M€	EUROLABS EUROpean Laboratories for Accelerator Based Science HORIZON-INFRA-2021-SERV-01, Sept 2022 - Aug. 2026; 1.2 (0.9) M€

9 ongoing projects with TIARA support

IA – Innovation Pilot

INFRA-TECH

INFRA-DEV

Other calls

EURO-LABS has inherited the network of accelerator test infrastructure Transnational Access from the ARIES Integrating Activity

+ PACRI (INFRA-TECH 2024)



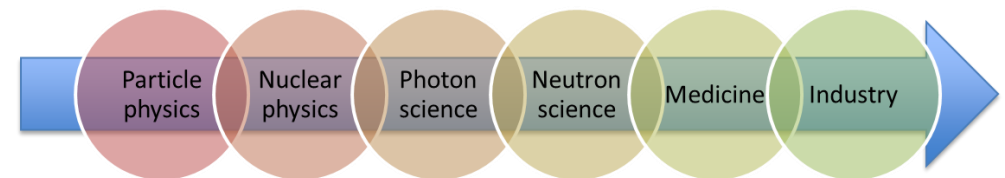
Goals and structure of I.FAST

Goals:

- Foster innovation, leading accelerator technologies from **open science** to **open innovation** – sharing of ideas within academia, and between academia and industry.
- Cover a **portfolio of technologies**, not related to an individual project, and explore new opportunities.
- Build a **wide and open consortium** that can be the foundation for an innovation ecosystem.
- Promote **sustainability** as a primary objective of accelerator evolution.
- Create **synergies** between accelerator types and user communities and favour the **translation of accelerator technologies** to society.

Structure:

- Programme based on **9 thematic areas** strategic for the future of particle accelerators, transversal between accelerators for particle physics, photon and neutron sources, and applications.
- Large consortium with **strong industry participation**: 48 beneficiaries – 8 RI operators, 12 national research centres, 12 universities, 16 industrial partners (11 SMEs) - from 15 European Countries, supported by 12 partner organisations and >20 collaborating institutions.
- Use an **Innovation Fund** (cascade funding tool) for fast-track support of innovation.



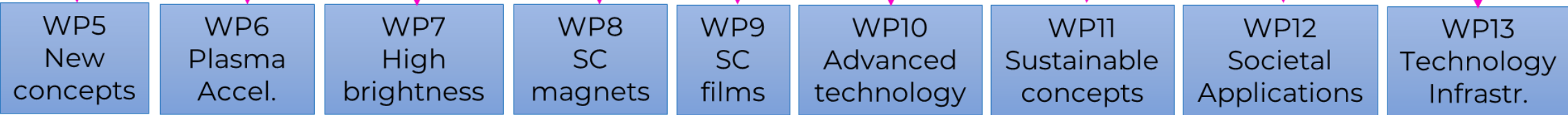
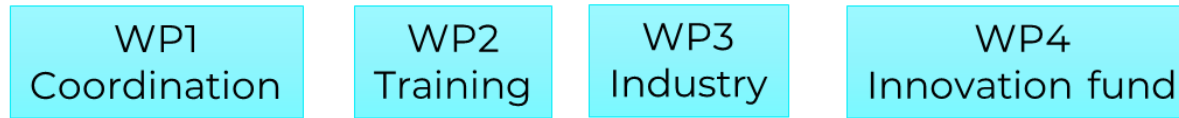
Basic science Applied science Applications

Workpackages and content of I.FAST

Mixture between exploratory work and prototyping of deep-tech technologies to higher TRL

iFAST activities cover 9 thematic areas, strategic for the future of particle accelerators.

4 support Work Packages and 9 thematic Work Packages



new ideas *integration* *new concepts* *HTS* *new techniques* *additive manufacturing, ML* *strategies* *strategies* *policy, procedures*



exploratory work

experimental activities

high-level prototyping



Industry in I.FAST

- 17 industrial partners
- 12 industries in the I.FAST Industry Advisory Board
- Creation of the Accelerator Science and Technology **Permanent Industry Forum (AIPF)**.
- 3 Industry Workshops with excellent participation.



IFAST Industrial partners:

RHP Technology GmbH
Bergoz Instrumentation
Sigmaphi
Thales AVS France SAS
Bilfinger Noell GmbH
Barthel HF-Technik GmbH
Comeb S.R.L.
KYMA S.R.L.
Piccoli S.R.L.
VDL Enabling Tech. Group
CYCLOMED Technologies
Elytt Energy S.L
Nanoker Research
GEMS PET Systems AB
Scanditronix Magnet AB
TRUMPF
TMD Technologies Limited

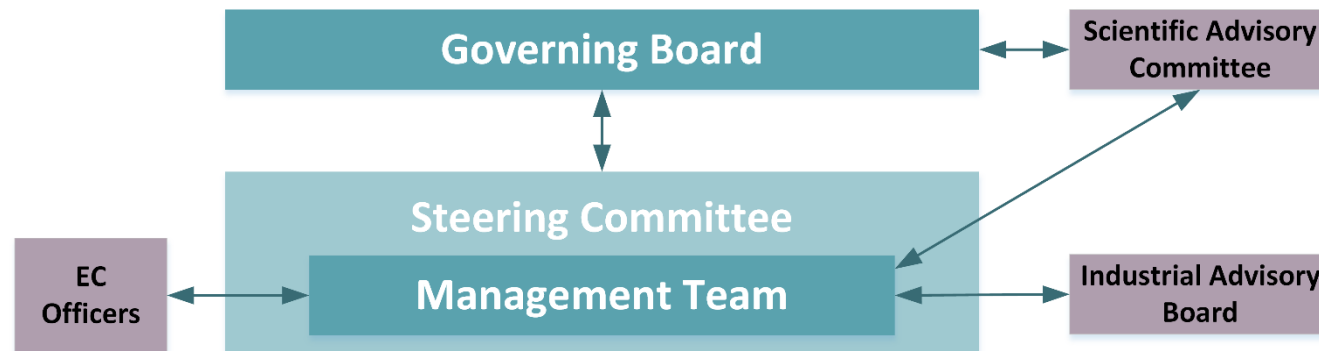


Management and coordination

Challenge: Management of a large consortium mixing scientific and industrial partners and procedures

Scientific Advisory Committee

- **Akira Yamamoto (KEK)**, Head of Linear Collider Project Office at KEK, expert in applied superconductivity, already member of EuCARD2, ARIES and AMICI SAC.
- **Michiko Minty (BNL)**, Head of Accelerator Division at the BNL Collider Accelerator Department, with wide experience in accelerator design and beam optics.
- **Carsten Welsch (U. Liverpool)**, Head of Physics Department at U. Liverpool, has participated in many accelerator projects, with expertise in beam instrumentation and optics, science communication and outreach, etc.



J.M. Perez, Chair of Governing Board (and Coordinator of TIARA)

M. Vretenar, CERN, Project Coordinator

T. Torims, RTU, Deputy Coordinator

V. Brunner, CERN, Project Assistant

S. Stavrev, CERN, Administrative Manager



I.FAST Highlights

after 42 months of work

The additive manufactured RFQ

- iFAST has reserved a small budget for a “proof-of-principle” of Additive Manufacturing for accelerators.
- Evolved into the idea of 3D-printing a **complete small linear accelerator** (Radio Frequency Quadrupole, RFQ) – never tried before!
- The novelty of the idea attracted additional funding from industry and from universities, much beyond what available in iFAST.



A lot of interest

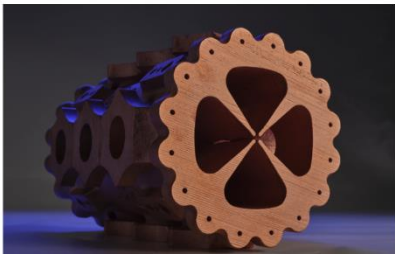
News - Topic: Engineering

Voir en français

First 3D printing of crucial component to bring accelerators closer to society

The first additive manufacturing of a critical accelerator component paves the way for more affordable and versatile particle accelerators.

14 NOVEMBER, 2022 | By Antoine Le Gall

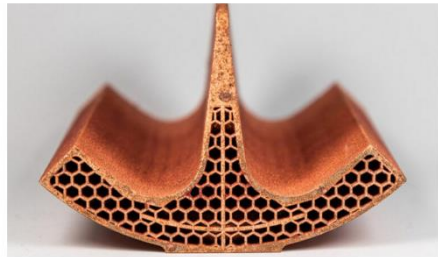


NEWS 3D PRINTING GUIDES BUSINESS DIRECTORY EVENTS 3D PRINTING JOBS

3D PRINTING NEWS 3D MATERIALS

A 3D Printed Copper Radio Frequency Quadrupole (RFQ) Component for the Large Hadron Collider

Published on November 15, 2021 by Madeleine R.



Related Articles



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VoxelMatters News Analysis Resources VM Focus Events

Additive Manufacturing VM Research Metal Additive Manufacturing Research & Education

TRUMPF shows off completed copper RFQ for CERN I.FAST project

The complex radio frequency quadrupole (RFQ) was 3D printed in one piece and will be on display at Formnext.

VoxelMatters November 31, 2022

2 minutes read



Trumpf manufactures core component for CERN-coordinated project

NEWS November 18, 2022 APPLICATIONS COMPANIES & MARKETS

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European Commission

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Home > News > Advancing accelerator science and technology in different ways

Advancing accelerator science and technology in different ways

From outdated challenges to 3D printed copper components for particle accelerators, it's all in a day's work for the EU-backed I.FAST project.

Related projects

HORIZON 2020

IFAST Innovation Partnering in Accelerator Science and Technology

5 August 2024

A core copper component of future particle accelerators has been produced using additive manufacturing as part of the I.FAST project. What makes this component special is that it has been 3D-printed in one piece for the first time.

Image courtesy: trumpf.com

sina 财经头条 新浪财经APP 标题

宏观经济 A股 港股 美股 基金 理财 黄金 期货 能源

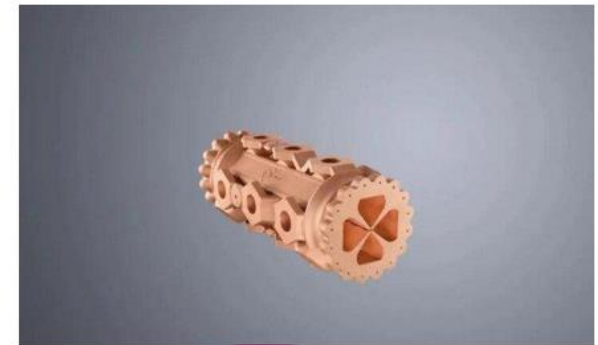
通快绿光3D打印设备制造纯铜粒子加速器复杂核心部件

2022年11月15日 15:27 3D科学谷



近日，全球领先的机床和激光技术方案提供商德国通快集团（TRUMPF）作为欧盟I.FAST项目的重要成员，首次以增材制造的方式制造了未来粒子加速器的一个核心部件。它的特别之处在于：首次实现了对这一关键部件的整体打印。

通快增材制造专家Michael Thielmann表示，“这证明了通快的设备可以高精度3D打印高达400毫米的大型铜部件。而且3D打印让高精密度部件的生产制造更快、更便宜、更节能。”这家高科技公司正在本周在德国法兰克福举行的3D打印展览会Formnext上展示这个粒子加速器部件。



3D打印的纯铜射频四极加速器（RFQ）©通快集团

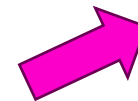
射频四极加速器（Radio Frequency Quadrupole），是任何大型加速器设备中最复杂的部件之一。射频四极加速器为粒子束提供能量，使其不断接近光速。

“目前全世界有超过3万台加速器，其中大部分用于医疗和工业。”I.FAST的项目协调员、欧洲核子研究组织（CERN）的Maurizio Vretenar提到，“增材制造可以优化和缩短加速器的制造过程，降低制造成本，在减小加速器占地面积的同时，大幅提高其性能。”



“SINA” web bulletin, 15/11/2022

https://t.cj.sina.com.cn/articles/view/2422410454/90630cd6001015hju?finpagefr=p_103



The iFAST Challenge Based Innovation



- During 10 days, 4 multidisciplinary teams of 6 students each gather at ESI Archamps, near Geneva, to propose innovative solutions based on accelerator technologies to address a specific societal challenge.
- On the last day they present their work in front of a jury at CERN.
- Targeting students (and young professionals) sufficiently advanced in their studies but not yet too specialized.
 - Students in their 2nd cycle of studies (typically 3rd to 5th year of University), before the start of doctoral studies.

1st edition (2022) challenge:

Accelerators for the environment

2nd edition (2023) challenge:

Accelerators for the environment (2)

3rd edition (2024) challenge:

Accelerators for healthcare



The poster for the iFAST Accelerators for the Environment 10-Day Challenge features a central image of a presentation stage with a large screen displaying "PROJECT CYAN". Several circular inset photos show students in various settings: a group outdoors, a meeting around a table, and a hallway. The text on the right side of the poster reads: "iFAST ACCELERATORS FOR THE ENVIRONMENT 10-DAY CHALLENGE @ ESI & CERN 25 JULY - 03 AUGUST 2023". Below this, it lists eligibility criteria: "Are you... ...a senior bachelor or master student (all backgrounds) ...from a European university ...interested in making an impact". A prominent "APPLY NOW" button with a right-pointing arrow is located below the criteria. At the bottom, there is a QR code, the website "ifast-cbi.particle-accelerators.eu", and logos for the European Union, MCE, universitè della basilica, CIFS, esi, and OXFORD.

2023 CBI



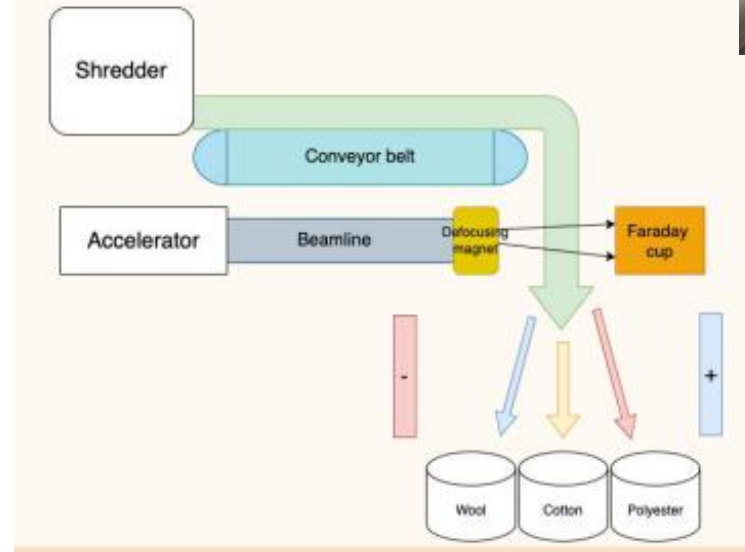
The winner - 2023

Project FabRec:

Only 1% of textile waste is recycled into new clothes. Costly and challenging separation of blended textiles – mixtures of different fibers, cotton or wool with synthetic materials.

Proposed using of an electron beam to segregate different fabric components through electrostatic separation.

Attracted interest from a major sport clothing company and a large textile recycling company.



Segregation cost of 2-5 cents/kg



<https://www.greenbiz.com/article/textile-recycling-across-oceans>

2024 challenge - healthcare

2024 teams' composition:

1. physicist or engineer (accelerator background)
2. physicist (medical physics)
3. engineer (medical engineering)
4. chemist (medical chemistry or radiochemistry)
5. life scientist or biologist
6. medicine student



Accelerators for healthcare?

Come to take part in a challenge to imagine new multidisciplinary solutions to **address health issues by using particle accelerators**. This challenge will be tackled by multidisciplinary teams invited to stay, all expenses covered, for 10 days at the European Scientific Institute, near Geneva.

10-day innovation challenge open to all students

From **23 July to 1 August, near Geneva**

**ACCELERATOR PHYSICS ENGINEERING
CHEMISTRY LIFE SCIENCE MEDICINE**

Apply now at:
ifast-project.eu



iFAST has received funding from the European Union's Horizon 2020 Research and Innovation programme (CA No 101004730)
HITRIplus has received funding from the European Union's Horizon 2020 Research and Innovation programme (CA No 101008548)



At end of July 2025, we will organise another challenge on healthcare, with budget completely provided by external funding and donors (no EC budget available after the end of I.FAST).

Call for applications will be out in January (on I.FAST web site)



The I.FAST Innovation Fund



The poster for the I.FAST Internal Innovation Fund features a central purple circle with the text 'I.FAST Internal Innovation Fund'. Above it is the I.FAST logo. Below the circle are three icons: a lightbulb for 'Innovation', a leaf for 'Sustainability', and a dollar sign for 'Funding'. Each icon has a short description of the fund's contribution in that area. At the bottom, there is a purple banner with the text 'Apply by September 15, 2022' and 'More information: ifast-project.eu/iff'. A small EU logo and text are at the very bottom.

I.FAST Internal Innovation Fund

Innovation
The fund will contribute to advancing the status-of-art of I.FAST thematic areas.

Sustainability
The fund shall contribute to improving the sustainability of accelerator technologies.

Funding
The fund will finance projects, each receiving a contribution between 100 and 200 kEUR.

About the fund
The I.FAST Internal Innovation Fund (IIF) aims at stimulating the innovation potential of accelerator technologies. The primary objective of the fund is to encourage I.FAST beneficiaries to identify innovative solutions with viable industrial or commercial potential. This fast-track, competitive process will finance emerging technologies, processes, research, business models and other innovative solutions, at both development and prototype stages. Apply by September 15, 2022.

Apply by September 15, 2022

More information: ifast-project.eu/iff

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 10104736.

Task 4.2, **Management of the Innovation Fund.**

1 M€ funding to an internal competitive call for innovative projects, starting early 2023, for a duration of 2 years (to match termination of I.FAST in April 2025)

1. Funding between **100 and 200 k€** per project
2. Consortium: at least **one I.FAST beneficiary and one industry**;
3. **Initial TRL 3 or higher** (from proof-of-concept to laboratory/environment validation);
4. Project contributes to **improving sustainability of particle accelerator technologies**;
5. Project must have **potential for industrialisation or commercialisation**
6. Project must have potential to **attract more resources** than what deployed by IFAST alone.

18 projects submitted, 8 selected by a 10-member Evaluation Committee:

2 on high-efficiency RF sources, 2 on superconductivity, 2 on particle sources, 1 on laser plasma acceleration, 1 on additive manufacturing.

Smooth selection procedure and excellent quality of the selected projects

The selected projects

High-efficiency RF sources

Development of Highly Efficient Megawatt Class Cross Field Vacuum Tube Amplifier for Particle Accelerators Driven by a Solid-State Power Amplifier at 750 MHz.

Permanent Magnet for High Efficiency Klystrons (PM4HEK).

Additive manufacturing

Demonstration of Additive Manufacturing for Large and Complex Shaped Vacuum Chambers by Plasma Metal Deposition (PMD®)

Superconducting materials

Millisecond flash lamp treatment for SRF accelerating cavities.

High-Temperature High-Gradient Superconductors (HIGHEST).

Laser-plasma acceleration

KAIO Accelerator

Particle sources

AM applications of refractory metals for ION Source cavities

A Field Emission Cathode for a TW RF gun for High Brightness Beams in Industrial and Small Research Facility Settings (FE Cathode)

High-level prototypes in I.FAST

in co-innovation laboratories - industry (TRL 4/5):

1. **Variable dipole** for synchrotron light sources, CERN-CIEMAT-ELETTRA with KYMA
2. **RF guns** for FEL, INFN-PSI with COMEB-VDL
3. **X-band structures** for FEL, ELETTRA-CERN with COMEB-VDL-TMD
4. **CCL Superconducting magnets** for medical synchrotrons (combined functions and HTS), INFN-CERN-UU-Wigner with Elytt
5. **High efficiency klystron**, CERN-ULAN with Thales
6. **Variable PMQ** for synchrotron lights, UKRI-DLS with KYMA

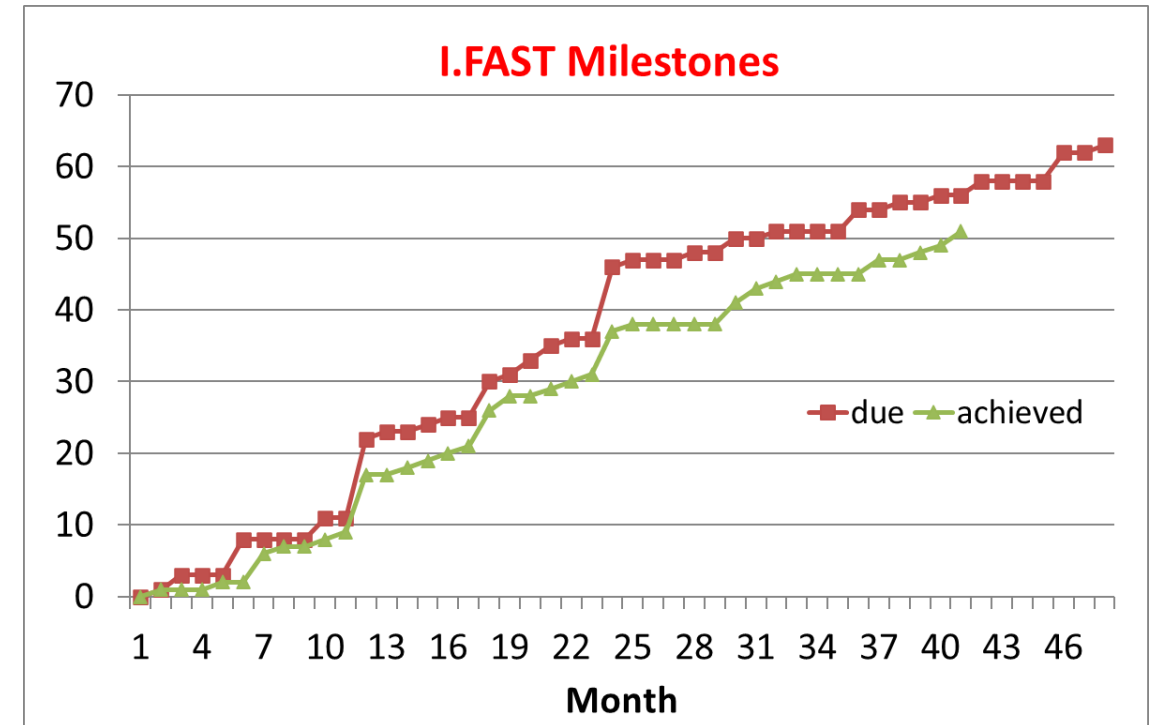
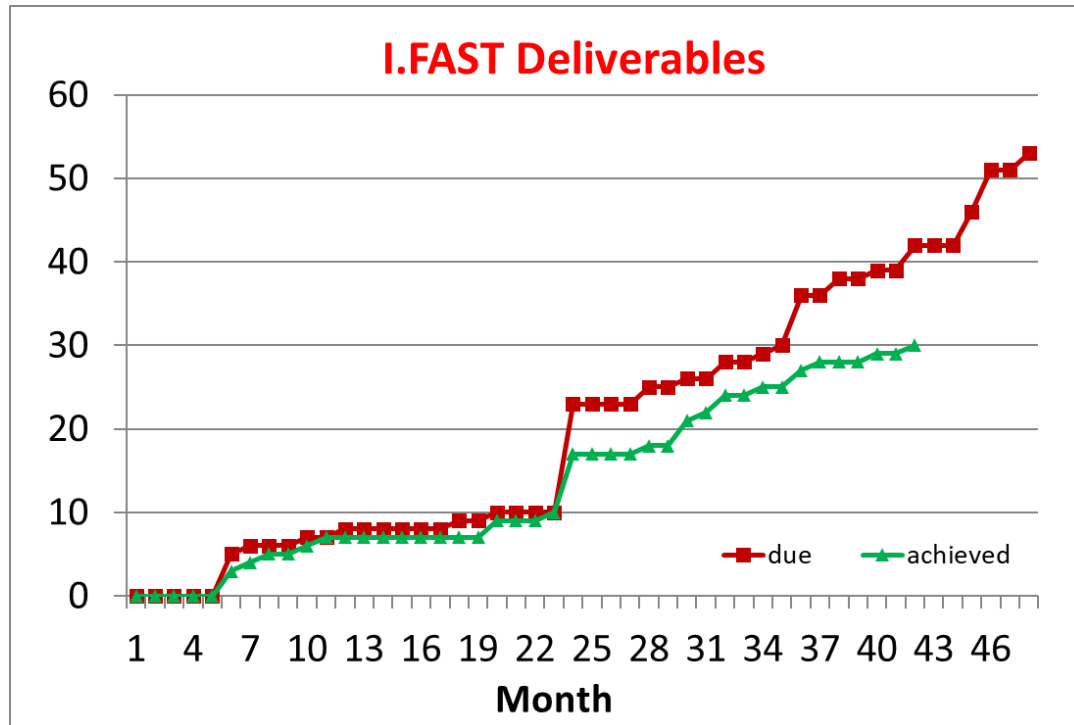


ALL COMING!



I.FAST at Month 42

Deliverables and Milestones at Oct. 24



Many delays that are difficult to catch up

Request for 6-month extension sent to Project Officer, justified by “force majeure” related to initial delays and disruption of supply chains during Covid times, and need to apply mitigations for the increase in material costs after the Ukraine war.

Some feedbacks after 42 months

- 48 beneficiaries + 12 partners are difficult to coordinate. Too many small activities and too many partners at low budget level.
- Industry is delighted to be in, but participation had mixed success (some were reluctant to join the new scheme but performed very well, some were enthusiastic but jumped out as soon as the crisis brought material costs up).
- High-level prototyping (deep-tech!) means high-level risk, we could find solutions to all technical problems, but many prototypes are late – our built-in safety margin was not sufficient!
- Interaction with Project Officers from REA Agency is not easy, strong attention to technical reporting issues that need a lot of time to be addressed, and little apparent interest for results or impact.

EU projects: opportunities and challenges

EU-supported projects for accelerator technologies are co-funded actions based on a large multinational community including laboratories, universities and industry, to develop specific accelerator R&D topics.

Opportunities:

- Help to make people meet and to build trust.
- Provides a well-defined framework to establish collaborations.
- The reputation of being in an EU project helps leveraging additional funding.
- Encourages co-funding schemes.



Challenges:

- Administration, paperwork.
- IP management.
- Collaboration with competing industrial partners.
- Limited funding.
- Still far from application or market (low TRL).



iFAST

Thank you for your attention!



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