



M. Vretenar, CERN, Project Coordinator

Trieste, 19 April 2023

Welcome to the 2nd I.FAST Annual Meeting

After the long Covid break and the 1st I.FAST meeting at CERN, we restart our tradition of visiting different European partners for our Annual Meeting.

Despite the difficult connections, Trieste has been able to attract a large participation (144 registered participants!) thanks to an exciting programme:

- ❑ Industry Workshop on HTS developments and applications, Tuesday 18/4
- ❑ Roadmap for Technology Infrastructure Workshop, Wednesday 19/4
- ❑ Plenary sessions Wednesday 19/4 - Friday 21/4.
- ❑ Multidisciplinary Workshop on AI and accelerators, Thursday 20/4.
- ❑ Presentation of Innovation Fund Projects, Friday 21/4.
- + Governing Board Meeting, Friday 21/4.



The poster for the I.FAST 2nd Annual Meeting features a dark background with several circular images: a cityscape, a building, a satellite, and a particle detector. The text on the poster includes the event title, dates, location, program details, and organizing committee members.

I.FAST
2ND ANNUAL MEETING

17-21 April 2023
NH Hotel,
Trieste, Italy

The I.FAST (Innovation Fostering in Accelerator Science and Technology) project is organising its 2nd Annual Meeting in Trieste, Italy. The project as well as the activities and recent results of the different Work packages will be presented.

Programme

- Monday 17 April afternoon
 - Parallel Meetings
- Tuesday 18 April
 - Parallel Meetings
 - I.FAST Industry Workshop - HTS Applications
- Wednesday 19 April
 - Workshop on Roadmap for Technology Infrastructure
 - Plenary Sessions
- Thursday 20 April
 - Plenary Sessions
- Friday 21 April
 - Final Session

Organising Committee

- Valeria Bruner (CERN)
- Cerasca d'Auria (Elettra)
- Raffaella Georghiannou (Kyriakos)
- Annalisa La Gall (CERN)
- Maurizio Vietener (CERN)

Extra Sponsors Trieste:
Logo of the University of Trieste (UNIV-TRIESTE) and the European Union flag.

I.FAST has received funding from the European Union's Horizon 2020 Research and Innovation programme (CA No 1010004730)

Logistics and social events

- All sessions and meetings take place at the NH Hotel.
- **Visits:** ELETTRA and FERMI on Wednesday 11:30, Kyma company on Friday 10:30 (bus leaves from NH Hotel).
- Presentation on Trieste and its **history** (by the project coordinator!) on Wednesday at 18:10.
- **Welcome cocktail** at Caffé Tommaseo, Wednesday 19/4 from 19:00.
- **Banquet dinner** at the Adriaco Yachting Club, Thursday 20/4 at 20:00.
- **Historic walk** (again under my supervision) from NH Hotel on Friday from 14:15.

Note that both Tommaseo and Adriaco are on the seaside, a short walk from the Hotel.

Many thanks to Valérie and to the local organisers Gerardo and Raffaella for setting up these outstanding events!

I.FAST in a nutshell



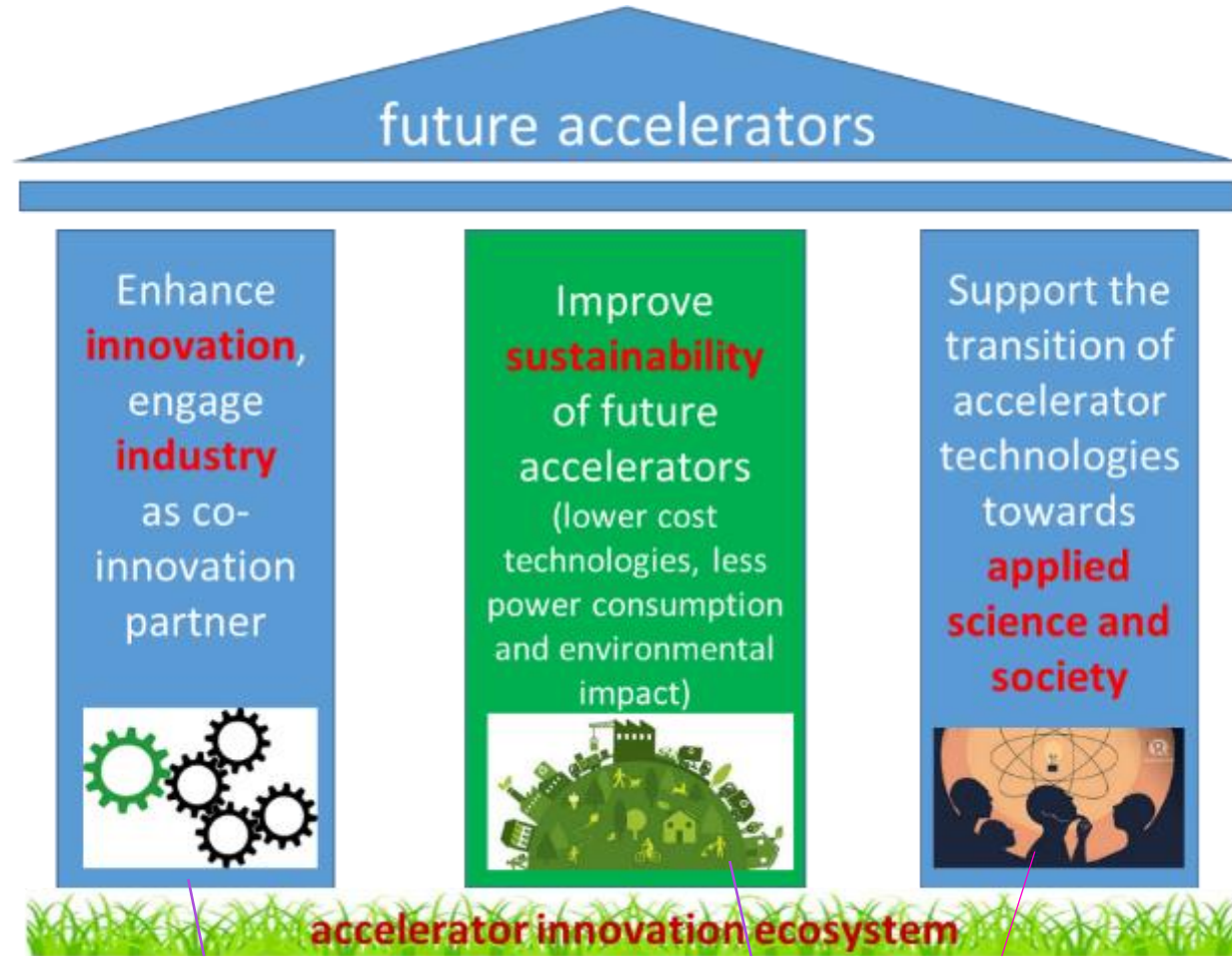
Innovation Fostering in Accelerator Science and Technology

Innovation Pilot, A new pilot instrument to demonstrating the role of Research Infrastructures in the translation of **Open Science** into **Open Innovation**, an evolution of our R&D programmes towards more industry participation, **supported by the European Commission**.

- **48 beneficiaries of EC funding:** 8 large RI operators, 12 national research centres, 12 universities, 15 industrial partners (**1/3**, including 11 SMEs) - from 15 European Countries, supported by 12 partner organisations and >20 collaborating institutions.
- **40 R&D** Tasks to develop a portfolio of technologies for the next generation of particle accelerators, 15 with industry participation.
- Timeline: **4 years**, starting 1 May 2021.
- Resources: **10 M€** EC contribution, total project cost **19 M€**.



The three I.FAST pillars



- Three «pillars» defined the priorities given in the **selection of I.FAST activities** following a bottom-up call.
- Additional focus areas: **training** and management of **technology infrastructure**.
- This strategy is coherent with the priorities announced in the **2020 Update** of the European Strategy for Particle Physics, and more at large with the priorities of the particle accelerator user communities, as overseen by the **TIARA** Collaboration.

Work Packages and Tasks

| WP | |
|----|---|
| 1 | Coordination, dissemination |
| 2 | Training, communication, outreach |
| 3 | Industry engagement |
| 4 | Managing Innovation, new Materials |
| 5 | New concepts, performance improvements |
| 6 | Novel particle accelerators concepts and technologies |
| 7 | High brightness synchrotron light sources |
| 8 | Innovative superconducting magnets |
| 9 | Innovative superconducting cavities |
| 10 | Advanced accelerator technologies |
| 11 | Sustainable concepts and technologies |
| 12 | Societal applications |
| 13 | Technology Infrastructure |
| 14 | Ethics Requirements |

9 thematic areas

9 “thematic areas” plus 4 general WP’s (coordination, training, industry, innovation).

58 Tasks

| | | | | |
|------|--|---|-----------|---|
| WP1 | Management, coordination and dissemination | M. Vretenar (CERN) | Task 1.1 | Project management, external coordination, sustainability |
| | | | Task 1.2 | Information flow management and cross-coordination |
| | | | Task 1.3 | Internal communication and dissemination |
| | | | Task 1.4 | Relation with other innovation pilots |
| WP2 | Training, communications and outreach for accelerator science and technology in Europe | P. Burrows (UOXF) | Task 2.1 | Management |
| | | | Task 2.2 | Communication and outreach |
| | | | Task 2.3 | Challenge-based innovation (CBI) with particle accelerators |
| | | | Task 2.4 | Industrial Training associated with knowledge transfer |
| WP3 | Industry engagement | M. Morandin (INFN) | Task 3.1 | Coordination and industrial partnership support |
| | | | Task 3.2 | Knowledge transfer and business opportunities in accelerators R&D |
| | | | Task 3.3 | Extended participation of industry in collaborative R&D activities |
| WP4 | Managing innovation, new materials | M. Losasso (CERN) | Task 4.1 | Innovation management and committee |
| | | | Task 4.2 | Management of the Innovation Fund |
| | | | Task 4.3 | Innovative beam windows for high-power accelerator applications |
| | | | Task 4.4 | Large scale Carbide-Carbon Materials for multipurpose applications |
| WP5 | Strategies and Milestones for Accelerator Research and Technologies | F. Zimmermann (CERN), N. Pastrone (INFN), P. Fork (GSI) | Task 5.1 | MUon colliders STRategy network (MUST) |
| | | | Task 5.2 | Pushing Accelerator Frontiers (PAF) |
| | | | Task 5.3 | Improvement of Resonant slow EXtraction spill quality (REX) |
| WP6 | Novel Particle Accelerators Concepts and Technologies | R. Assmann (DESY), ... | Task 6.1 | Novel Particle Accelerators Concepts and Technologies |
| | | | Task 6.2 | LASers for PLASMA Accelerators |
| | | | Task 6.3 | Multi-scale Innovative targets for laser-plasma accelerators |
| | | | Task 6.4 | Laser focal spot stabilization systems |
| WP7 | High Brightness Accelerators for Light Sources | R. Bartolini (DESY), ... | Task 7.1 | Coordination & communication |
| | | | Task 7.2 | Enabling Technologies for Ultra-Low Emittance Ring |
| | | | Task 7.3 | Variable Dipole for the upgrade of the ELETTRA storage ring |
| | | | Task 7.4 | Very high gradient RF Guns operating in the C-band RF technology |
| | | | Task 7.5 | CompactLight Prototype Accelerating Structure |
| WP8 | Innovative superconducting magnets | L. Rossi (INFN), L. Quettier (CEA), C. Roux (GSI) | Task 8.1 | Coordination and HTS Strategy Group |
| | | | Task 8.2 | Preliminary Engineering design of curved CCT magnet |
| | | | Task 8.3 | Preliminary Engineering design of HTS CCT |
| | | | Task 8.4 | Construction of curved CCT magnet demonstrator |
| | | | Task 8.5 | Construction of HTS CCT magnet demonstrator |
| | | | Task 8.6 | Development of ReBCO HTS nuclotron cable |
| WP9 | Innovative superconducting thin film coated cavities | C. Antoine (CEA), O. Malyshev (UKRI) | Task 9.1 | Coordination and Strategy for Innovative Superconducting Accelerating Cavities |
| | | | Task 9.2 | Innovative Superconducting Accelerating Cavities |
| | | | Task 9.3 | Optimisation of process parameters and target development for SRF cavity coating with |
| | | | Task 9.4 | Surface Engineering by Atomic Layer Deposition (ALD) |
| | | | Task 9.5 | Improvement of mechanical and superconducting properties of RF resonator by laser |
| | | | Task 9.6 | Optimization of flat SRF thin films production procedure |
| WP10 | Advanced Accelerator technologies | T. Torimis (RTU) | Task 10.1 | Coordination and communication |
| | | | Task 10.2 | Additive Manufacturing – Survey of applications and potential developments |
| | | | Task 10.3 | Refurbishment of accelerator components by AM technologies |
| | | | Task 10.4 | Development of AM-manufactured superconductive RF cavities |
| | | | Task 10.5 | Photon Stimulated Desorption (PSD) from NEG coatings for accelerator vacuum chamb |
| | | | Task 10.6 | Machine learning techniques for accelerator and target instrumentation |
| | | | Task 10.7 | Development of electro-optical waveguide sensors as beam electric field sensors |
| WP11 | Sustainable concepts and technologies | M. Seidel (PSI) | Task 11.1 | Sustainable Concepts for Accelerator driven Research Infrastructures |
| | | | Task 11.2 | High Efficiency Klystron Industrial Prototype |
| | | | Task 11.3 | Permanent Magnet Quadrupoles & Combined Function Magnets for Ultra Low-Emitter |
| WP12 | Societal Applications | R. Edgecock (HUD), | Task 12.1 | A Strategy for Implementing Novel Societal Applications of Accelerators |
| | | | Task 12.2 | Design of advanced electron accelerator plant for biohazards treatment |
| | | | Task 12.3 | Design of Internal RF Ion Source for Cyclotrons |
| WP13 | Technology Infrastructure | S. Leray (CEA) | Task 13.1 | Strategy for the development of the AMICI TI |
| | | | Task 13.2 | Developing and promoting services to industry in AMICI TFs |
| | | | Task 13.3 | New RF amplifiers based on GaN Semiconductors |
| WP14 | Ethics Requirements | P. Foka (GSI) | Task 14.1 | Protection of Personal Data: POPD Requirements |
| | | | Task 14.2 | Ethics Position Requirements: EPQ Requirements Nr 2 |



Most of the Annual Meeting presentations report on individual Tasks

Where are we after 2 years?

Successfully completed the 1st EC Periodic Review (1.5.2021-30.10.2022):

- Periodic Report prepared in October-December 2022, submitted in January 2023.
- Scientific Review by external reviewer on 9 February.
- Periodic Report resubmitted with financial information on 9 March.
- Acceptance letter from EC for Period 1 payments received on **12 April**.



Many achievements but also many delays, partly due to the complex environment.

Comments
from the EC
Reviewer:

1. Overall assessment

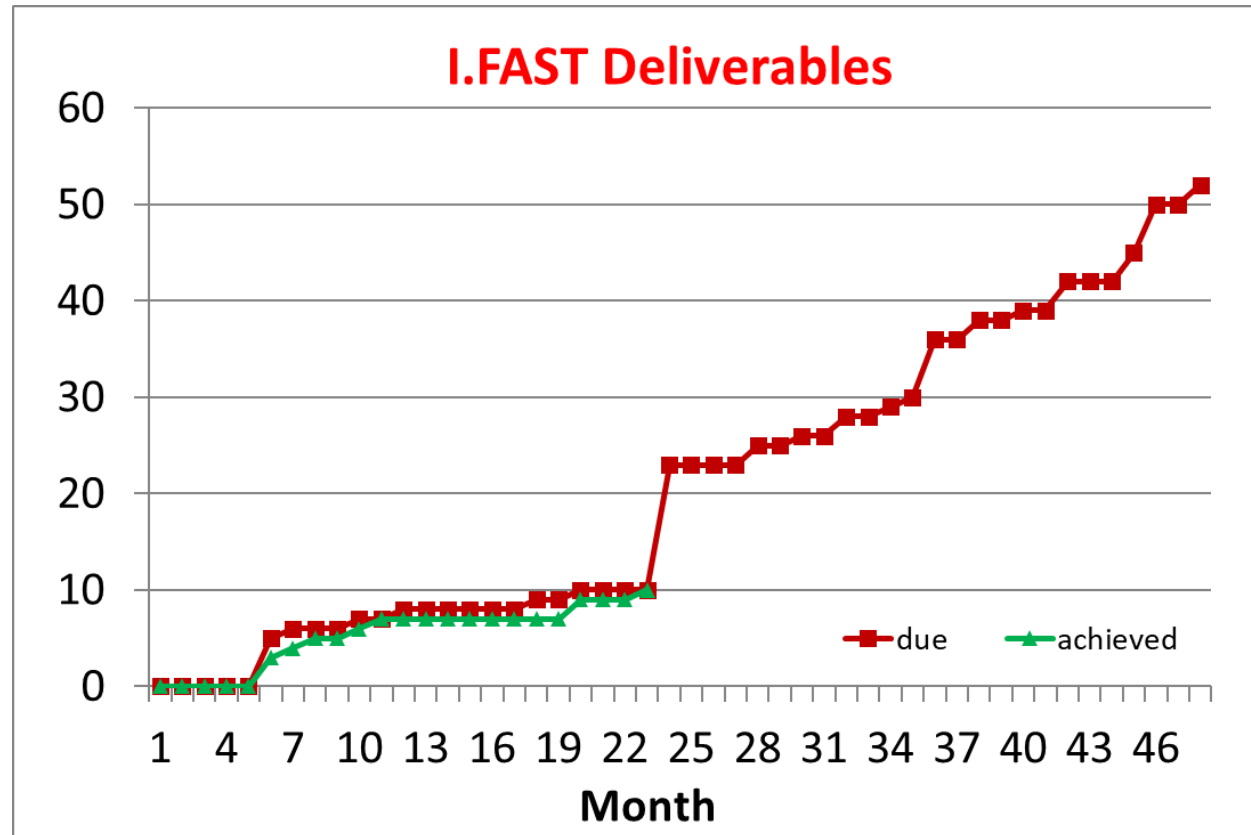
Project has achieved most of its objectives and milestones for the period with relatively minor deviations.

The project has already delivered some significant results in both accelerator developments (additive manufactured RFQ) and also in training and networking activities (challenged based innovation with particle accelerators, management of innovation fund, industry participation) are all very good achievements.

5. Recommendations concerning future work, if applicable

The delayed milestones and deliverables should be achieved and delivered. The number of significant results in accelerator developments from the thematic Work Packages should be increasingly delivered. As one of the main objectives of the project is to promote co-innovation with industry, it is expected that efficient networking, training and also innovation fund management are critical during the future work.

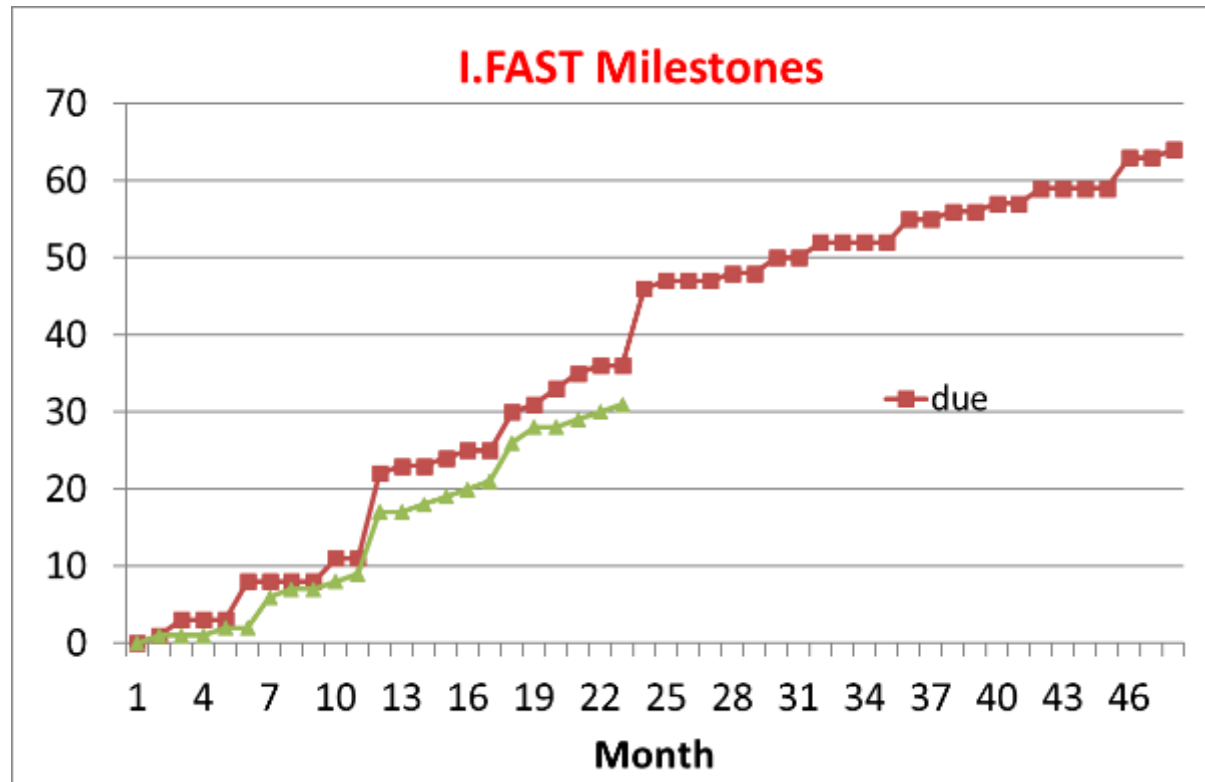
Status of I.FAST - Deliverables



Might look good, but out of the **13 Deliverables** expected by end of April:

- for 6 has has been announced a delay between **6 and 12 months**
- for 1 Deliverable we have no news (S. Gibson, **Task 10.6, Electro-optic performance report**).
- 2 Deliverable are in preparation, should come by the end of the month.
- 4 Deliverables have been just submitted (deadline for revision was one month in advance!).

Status of I.FAST - Milestones



- Out of 36 MS due by end of March, only 31 have been achieved (5 are late: AM SC, ACO Workshop, plasma in source, workshop efficient magnets, CCT readiness).
- Out of the additional 10 MS due by end of April, only 4 have been achieved (6 are late).

Known delays (at 6.3.23)

Snapshot at the date of publication of revised P1 Report:

| | | |
|--|------------------------------|--|
| Task 2.4: industrial trainee projects | Significant delay (1 year) | Only 3/7 proposals received |
| Task 7.3: Magnet specifications | Minor delay (3 months) | Delayed hiring of a post-doc at CERN |
| Task 7.5: CompactLight prototype structures | Significant delay (1 year) | Decease of a key collaborator. Task reorganised, end date moved. |
| Task 10.4: Additive-manufactured SC cavities | Significant delay (6 Months) | Problems in the supply of material. |
| Task 11.2: Preliminary Klystron Design Rev. | Significant delay (9 m.) | THALES short of resources |
| Task 11.3: Prototype adjustable PM quad and CF magnet | Significant delay (6 months) | Magnet specification and mechanical design, took longer. |
| Task 13.3: First GaN amplifier module | Significant delay (9 months) | Unavailability of some electronic components. |
| Task 12.3: Internal source for cyclotrons | Significant delay (1 year) | Redesign and fabrication difficulties. |



Main problems so far:

- Personnel issues
- Material procurement.

But:

- inflation and increase in material prices are also coming into the scene (see next slide).

Plus many other “physiological” delays (< 6 months) related to late Workshops or events.

Navigating in a changing world

We are all facing the **increase of material and energy costs** (and related inflation and delays in deliveries) due to the ongoing worldwide crisis.

This is particularly affecting a project like I.FAST with a large quantity of **prototype production** often made in industry, for which budget estimates were made at the **end of 2019!**

We are conscious of the problems encountered by some partners and we are ready to discuss **solutions**, remaining in the limit of the strict budgetary and time limitations of an EU project.

Mitigations: redistribution of work between partners to reduce **costs** (but increase **risks**), descope of some activities (e.g. smaller prototypes), ...



The SC magnet case and solution

WP on SC magnets Tasks 8.4, **Construction of a combined function CCT magnet demonstrator** and Task 8.5, **Construction of the HTS CCT demonstrator**.

Two industrial companies have asked to quit the project. One sent a letter to the Coordinator with the message that they “cannot fulfil the milestones to **build the requested hardware with the budget available** ... material and energy prices have risen dramatically since the start of the project... We are thus not any more in the position to allocate R&D money ... into I.FAST.”

Actions:

Instead of declaring the companies as defaulting partners, the Project will keep them in the collaboration, with 0 or minimum EC contribution, and try to redistribute their work to others.

- **Elytt** (3rd magnet company in the project) has already agreed to take BNG’s part in Task 8.5.
- The part of BNG and Scanditronix in Task 8.4 will be instead internalised and go to **CIEMAT**. Excellent solution, but unfortunately this comes at the price of increased risk and possibility of delays.

Highlights of the first 2 I.FAST years



Disclaimer:

What follows is the personal view of the Coordinator on some particular achievements that have reached a high level of internal and external visibility.

My apologies to all those who have worked hard reaching important results and are not (yet) in the list and please keep in mind that we are eagerly looking for success story to communicate. If you have one, please send a mail to antoine.le.gall@cern.ch or valerie.brunner@cern.ch or directly to myself.



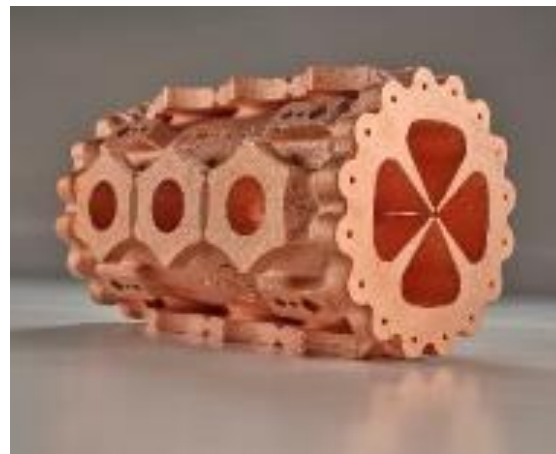
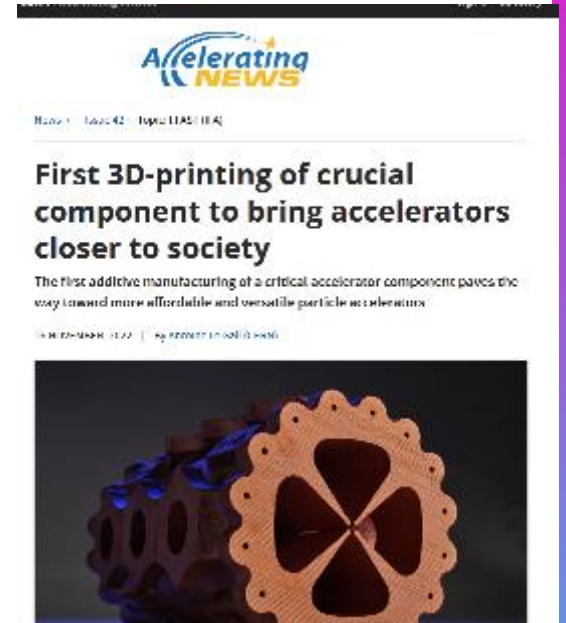
Additive-Manufactured RFQ

Task 10.2, **Additively-Manufacturing (AM)** survey and potential developments.

Aimed at identifying specific needs for AM (3D printing) in accelerators, no prototyping foreseen. At the start of work, the **Radio Frequency Quadrupole (RFQ)** compact copper linear accelerator for **medical and industrial applications** was identified as a component that could greatly profit from AM in terms of production time and cost.

The Task has contacted industrial partners, and Trumpf AG has agreed to produce at **no cost for the project** a full-scale prototype that is being tested by the Task. Trumpf is joining the Consortium as Partner Organisation.

Wide impact: articles, exhibitions, press release, CERN Bulletin, Accelerating News, CNRS newsletter, CORDIS.



The 3D-printed RFQ



Challenge Based Innovation



The poster features the iFAST logo at the top right. The main headline reads "YOUR KNOWLEDGE CAN HELP THE ENVIRONMENT". Below this, it specifies "10-DAY STUDENT CHALLENGE @ ESI & CERN 25 JULY - 03 AUGUST 2023". The target audience is "FOR MASTER-LEVEL STUDENTS FROM ALL BACKGROUNDS AT EUROPEAN UNIVERSITIES". The poster includes a QR code and logos for the European Commission, iFAST, University of Paris-Saclay, CRIS, ESI, and University of Oxford. On the left, there are circular images showing a presentation of "PROJECT CYAN" and students in a meeting.



The screenshot shows a CORDIS news article titled "Advancing accelerator science and technology in different ways". The article text states: "From student challenges to 3D-printed copper components for particle accelerators, it's all in a day's work for the EU-backed iFAST project." The article is attributed to "EUROPEAN TECHNOLOGIES" and "ESI". Below the text is a vibrant image of a particle accelerator's internal structure, showing glowing blue and orange components.

Task 2.3, **Challenge-Based Innovation (CBI)** with particle accelerators.

Residential challenge for 24 master students with different backgrounds organised in 4 teams to propose new applications of accelerators for the environment.

Winner: project CYAN for stopping eutrophication (harmful algal bloom) in lakes.

Strong success, projects will be followed-up, articles on CERN Bulletin, Accelerating News and other newsletters, CORDIS. Will be repeated in 2023.



I.FAST Innovation Fund



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. In advance on schedule (awarding at M20 instead of M24)

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:

Smooth selection procedure and excellent quality of the selected projects.

Budget allocations approved by the Governing Board by e-mail vote.

IIF Projects

1. **Permanent magnet solenoid for High efficiency Klystron** (CERN, ELYTT) - design and build a permanent magnet solenoid for an available klystron.
2. **High-Temperature High-Gradient Superconductors** (CERN, CSIC, CERACO) - *develop and optimize a 3D coating technology and demonstrate its scalability to make practical RF high power devices.*
3. **Field Emission Cathode for a Travelling-Wave RF gun for High Brightness Beams** (PSI, VDL) - develop a versatile high brightness MeV electron source based on a field emission cathode.
4. **KAIO Accelerator** (CNRS, CNR) - industrially develop a cost- efficient and stable high-power laser technology in the kHz class, apt to be used in radiobiology and testing applications.
5. **Development of Highly Efficient MW Class Cross Field Vacuum Tube Amplifier for Particle Accelerators Driven by a Solid-State Power Amplifier at 750 MHz** (UU) - develop a megawatt class cross-field amplifier (CFA) based RF system for particle accelerator applications.
6. **Millisecond flash lamp treatment for SRF accelerating cavities** (INFN, HZDR, PICCOLI) - develop a novel thermal process to improve performances of superconducting (SC) coating by suppressing (reducing) Cu substrate heating.
7. **AM applications of refractory metals for Ion Source cavities** (INFN, CNR) - develop new Refractory Metals Alloys specifically designed for Additive Manufacturing (AM) to improve the physical performance of the ion sources (Ta-based and/or Nb- based alloys).
8. **Demonstration of additive manufacturing for large and complex shaped vacuum chambers by Plasma Metal Deposition** (RHP, SBI) - demonstrate the Plasma Metal Deposition (PMD) as AM of a large and complex vacuum chamber geometry.

The selected projects will be executed by 10 partners that are already I.FAST Beneficiaries, and by 4 new partners (CSIC, CERACO, HZDR, SBI). The IIF Projects will start activities in January 2023.

Industry participation



Task 3.1 Industry engagement coordination and industrial partnership support

Engagement of industry has been so far excellent:

- 16 industrial partners,
- 12 industry members in the I.FAST Industry Advisory Board,
- **230** registered participants in the 1st I.FAST Accelerator-industry co-innovation workshop, **91 from industry**.

Many interesting discussions, resulting in the creation of the “**Accelerator Science and Technology Permanent Industry Forum**” that will continue after I.FAST. The Terms of reference will be presented and discussed at the next Annual Meeting.

The Coordinator was invited to present the I.FAST industrial strategy at the **2022 International Particle Accelerator Conference** (Bangkok, June 2022), at the EPS Forum in Paris, and at the Big Science Business Forum in Granada.



Diversity

Important point, highlighted during the review.

Diversity considerations in the most broad sense regarding: nationality/culture, competences/profession, age/generation, gender, individual differences such as ethnic origin, belief, sexual orientation or disability



I.FAST suggests and encourages:

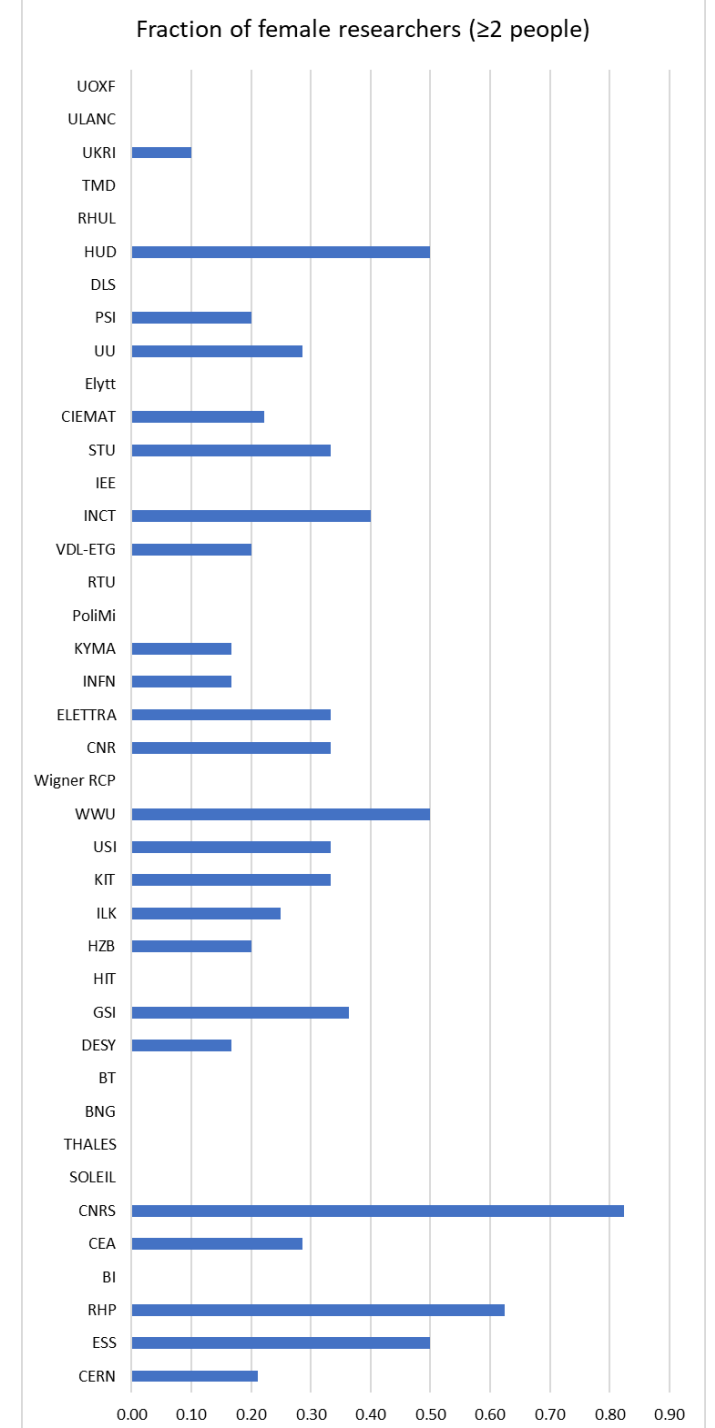
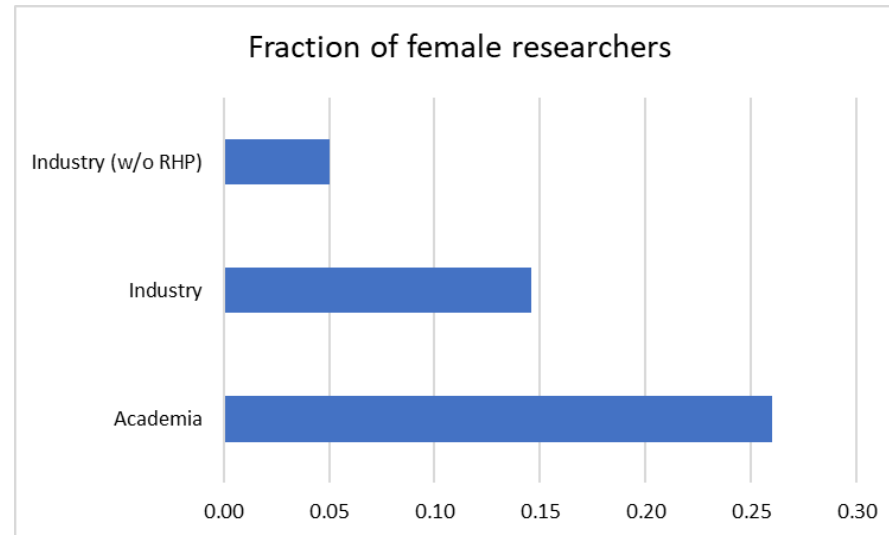
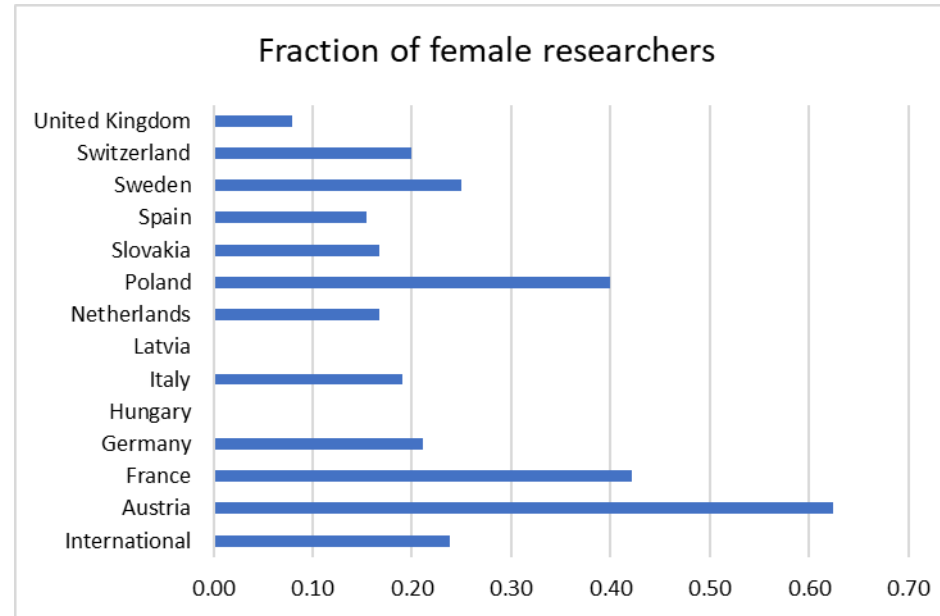
- pro-active **measures** in sourcing and pre-selection **recruitment** stages (addressing gender distribution in project teams)
- enable women in decision-making positions appointing **women in leadership roles**
- make women contributors **visible as speakers**: provide role models
- encourage **outreach events**, with participation of women, targeting young scientists including women
- encourage participants to ensure working environment that allows **work/life integration**, family-friendly policies (e.g. avoid meetings after 17:30)
- communicate experiences and **best practices** in gender policies

Gender balance in I.FAST

Total I.FAST (P1):

- 24% female researchers
- 42% female non researchers

We can and we must do better, industry in particular



Thank you for your attention

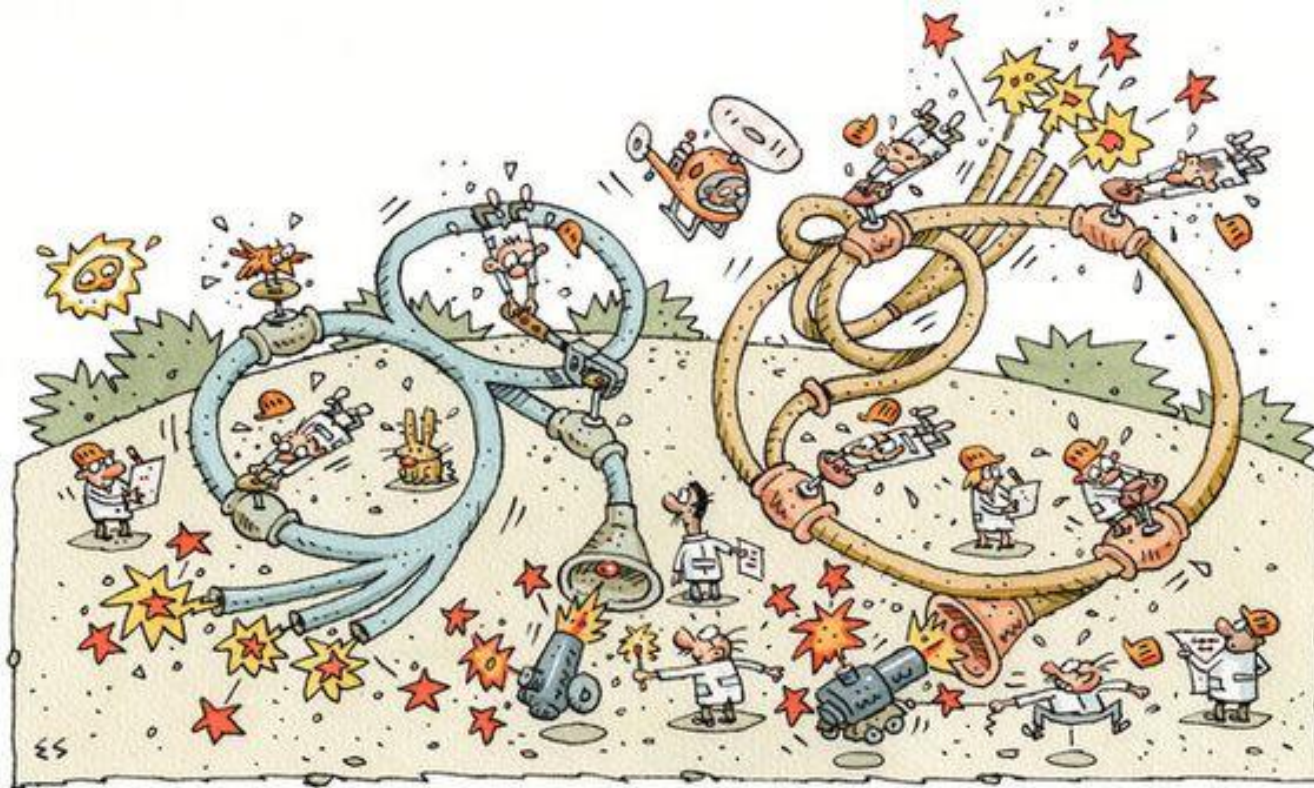


Image credit: Elwood Smith, NYT

And please do not forget to acknowledge the I.FAST Contribution in all your publications!



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