

**Report from Scientific Advisory Committee
for
the 1st I.FAST Annual Meeting**

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<https://indico.cern.ch/event/1133254/videoconference/>

Executive Summary: 1

- Overview -

General Comments:

- The 1st I.FAST annual meeting was very successfully held on 4-6 May 2022, hosted by CERN.
- The Scientific Advisory Committee (SAC) **congratulates** the successful hybrid meeting and the **excellent 1st year progress** in the I.FAST project. Based on the long-standing and highly successful track record of past EU initiatives, I.FAST is an excellent collaborative program focusing on innovation and partnership between academia and industry.
- The SAC appreciates the overall **high quality of the presentations** summarizing this first year's I.FAST project activities.
- The SAC commends the I.FAST management noting that of the 20 European Strategy for Particle Physics Update (**2020-ESPPU**) statements, 10 (**a half**) have been **already included** in the I.FAST initiatives. I.FAST has a **4-year timeline** starting on 1 May 2021 and comprises **48 beneficiaries**, as presented by the Project Coordinator.

Suggestions:

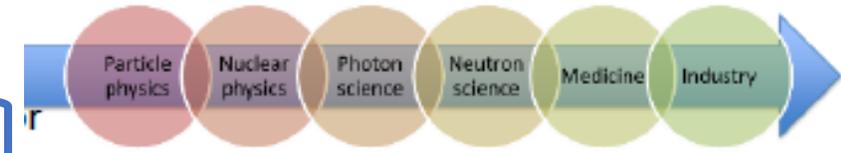
- In expectation that future I.FAST meetings could have a hybrid format, we suggest additional moderator support for enabling more active contributions of the remote participants.
- The SAC also suggests for future meetings consideration of a more systematic approach to grouping of the presentations; for example, grouping talks by thematic area.
- The SAC noted that early engagement of industrial partners proved effective in numerous cases, however this approach has not been consistently adopted across all work packages

Executive Summary: 2

- Comments and Advice for the Thematic Areas -

Thematic Area list: (<https://ifast-project.eu/about>):

1. **Strategies and Milestones for Accelerator Research Technologies**
2. **Novel Particle Accelerator Concepts and Technologies**
3. **High Brightness Accelerators for Light Sources**
4. **Innovative Superconducting Magnets**
5. **Innovative Superconducting Thin Film Coatings**
6. **Advanced Accelerator Technologies and Materials**
7. **Sustainable Concepts and Technologies**
8. **Societal Applications**
9. **Technology Infrastructure**



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

Executive Summary: 3

- Comments and Advice for the Thematic Areas -

1. Strategies and Milestones for Accelerator Research Technologies:

- I.FAST aims to map out and facilitate the **development of breakthrough technologies** common to particle accelerators. It aims to explore **new accelerator concepts** and to prototype **key technologies**.
- These technologies include new **advanced technologies** for magnets and cavities, strategies and technologies to improve the **energy efficiency** of accelerators and reduce their **environmental footprint**, as well as **new applications** of accelerators that benefit society.
- The I.FAST Innovation Fund (**IIF**) is an attractive mechanism to fast-track innovation. The SAC is pleased to hear of and **strongly supports** the new Innovation Fund initiative. We recommend that I.FAST engage strongly with approved proposals to provide continuous mentoring and support to those projects.
- The **Industrial Traineeship Programme** has good potential to create impact but had a difficult start. We recommend that I.FAST re-engage with businesses to refine the program and **enable bi-directional researcher exchange and more flexible work-scheduling periods**.
- The I.FAST **Challenge-Based Innovation Program** is a fantastic opportunity to **train students** and engage them with cutting-edge technology and opportunities. We recommend that a formal **certificate** be issued to successful participants.

Executive Summary: 4

- Comments and Advice for the Thematic Areas -

2. Novel Particle Accelerator Concepts and Technologies:

- Strategies and Milestones for Accelerator Research and Technologies (**SMART**) has very broad scope. The SAC suggests more detailed evaluation and **prioritization of the accelerator frontiers** and strongly supports the goal of issuing a **targeted list of R&D recommendations for future accelerators**.
- Work within the MUon Collider STrategy network (**MUST**) aims to further develop an optimized R&D roadmap concluding in 2045 for a 3 TeV muon collider. We comment that the ≥ 15 T superconducting magnet will be challenging to realize as will beam energies beyond 3 TeV. The SAC would like to see more clear identification of which portions of this large effort are to be addressed within I.FAST.
- The SAC commends the progress and developments in simulations, experiments and collaboration with industry in optimizing beam quality of Resonant slow Extraction (**REX**) as of high interest for numerous potential user applications.
- The workpackage on novel particle accelerator concepts and technologies has well-defined tasks and milestones. The **strong link** of this WP to other major research initiatives such as **EuPRAXIA** is commendable. It is good to see that **additional EU funding** was attracted into this field, **leveraging previous investment** and **training** of the **next generation** of scientists and engineers. The SAC would like to see more clear identification of which portions of this large effort are to be addressed in I.FAST.
- The SAC is impressed by the steady progress already made in LASers for PLasma Accelerators (**LASPLA**) and appreciates the **excellent industry involvement** in the development of high rep rate, high efficiency lasers.
- The SAC strongly supports the **I.FAST Machine Learning initiatives** and encourages collaboration between the existing task and SMART.

Executive Summary: 5

- Comments and Advice for the Thematic Areas -

3. High Brightness Accelerators for Light Sources:

- Overall **good progress** in all work contained in this thematic area. Two workshops held with impact on multiple light sources presently being upgraded or constructed.
- Efforts are responsive to the needs of the light source community.
- The SAC was impressed by the early involvement of industry in the CompactLight prototype structure development as part of optimization of the production process.
- **Schedules and milestones** for these efforts appear to be **well-defined** with commensurate progress.
- The SAC advises closer **collaboration** with the **LEAPS** community.

Executive Summary: 6

- Comments and Advice for the Thematic Areas -

4. Innovative Superconducting Magnets:

- An **innovative** superconducting magnet **development is in progress** with academia and industry cooperation. It features with a **curved CCT coil winding** as well as **combined function** (dipole and quadrupole) and **conduction cooling** using cryocoolers.
- CCT magnets are best suited for medium-field (2~4 T) magnets with potential applications in medicine.
- It will first use LTS (NbTi) while keeping within scope extension to HTS superconductors.
- We strongly encourage this as a leading innovative project in the I.FAST program. We advise that when using a cryocooler, operation with lower currents is important to achieve very **high reliability**.

Executive Summary: 7

- Comments and Advice for the Thematic Areas -

5. Innovative Superconducting Thin Film Coatings:

- The WP builds global strategy enabling to produce superconducting RF cavities coated with a superconducting film.
- It includes fundamental optimization **research and industrialization** for substrate **preparation**, metallographic **polishing**, and **pre- and post-treatment** (also with lasers). The production of **seamless copper** cavities may significantly contribute to **cost-effective production with better cooling**.
- The optimization **deposition techniques** will be a key approach including multilayer films (SIS) with ~ nm thickness.
- The SAC advises closer **collaboration with industry** from the early stage (even during feasibility studies).

Executive Summary: 8

- Comments and Advice for the Thematic Areas -

6. Advanced Accelerator Technologies and Materials:

- Innovative and advanced accelerator technology developments have significantly **progressed in** various fields such as (i) **solid state RF amplifiers**, (ii) **high efficiency klystrons**, (iii) **permanent magnets**, (iv) **carbide-carbon materials**, (v) **internal RF ion sources**, (vi) **additional machining technology**, (vii) **beam windows**, and more.
- The SAC **strongly encourages** these innovative efforts to be advanced in **close cooperation with research institutes and industries**.

Executive Summary: 9

- Comments and Advice for the Thematic Areas -

7. Sustainable Concepts and Technologies:

- The SAC **endorses strong and sustained effort** in this strategic area, which includes the development of permanent combined function magnets, high efficiency klystrons and **sustainable concepts** for research infrastructures. These show great promise for **reducing the environmental footprint** of accelerators considerably.
- Work is **progressing in close collaboration** between leading research centers, universities, and key industry partners.
- We strongly support the development of novel technologies but **recommend** these to be critically assessed with regards to a **realistic pathway to identified markets and the time scales** required.
- It would be beneficial to distinguish the Technology Readiness Levels of different technologies **more clearly**; not all developments have the same level of market-readiness and having this information available will help strategic planning and investment.

Executive Summary: 10

- Comments and Advice for the Thematic Areas -

8. Societal Applications:

- The SAC acknowledges that a **very broad range of activity** was presented with some excellent opportunities for **generating societal impact**.
- We commend I.FAST noting that an **interdisciplinary network** of partners has been established and recognize the benefits from **exploiting complementary skills and capabilities**.
- We recommend that **more information** be **gathered** about the **respective market opportunities** in order to generate a more **stable platform for decisions**.
- As stated earlier, the I.FAST Innovation Fund (**IIF**) has excellent potential to **fast-track innovation**. I.FAST should consider taking a **more active role in project support and mentoring** after the awarding of grants. The Industry Advisory Board (**IAB**) and wider I.FAST network should be in an excellent position to help optimize project implementation and exploit research results.

Executive Summary: 11

- Comments and Advice for the Thematic Areas -

9. Technology Infrastructure:

- The development of the European Technology Infrastructure for accelerators and magnets is recognized to be an **extension** of the efforts integrated by **AMICI**.
- The SAC encourages continuation of efforts to optimize usage of available infrastructure by academia with renewed emphasis on **attracting and enabling industrial users**.
- The SAC advises, in consultation with the Industrial Advisory Board, informing potential academic and industrial partners of Industry Day at next year's annual I.FAST meeting.

Comments and Advice for the Individual Presentations

to be reported in the SAC report (in Word)

Session 1

Session 2

Session 3

Session 4

Session 5

Session 6

*Many thanks for Excellent Presentations
and
Fruitful Discussions for the next steps.*