

Challenging students into developing accelerator-based innovations to protect the environment

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Abstract. The I.FAST CBI is an immersive challenge-based innovation program funded by the H2020 I.FAST project. The 10-day face-to-face challenge brings together students of different disciplines from all over Europe to work together on innovative projects using accelerator technology applied to environmental challenges. We report on the first edition of the I.FAST CBI, the proposed projects and feedback from the students.

1. Introduction

Research in accelerator technology has led to significant innovations. In Europe, the European Union has funded a program to capitalize on such innovations: the I.FAST project (Innovation Fostering in Accelerator Science and Technology)[1]. In this project a task is dedicated to engage with students and young professionals and challenge them into suggesting new innovations using accelerator technology. This task is called “Challenge Based Innovation” or “The I.FAST CBI”. To our knowledge, this is the only initiative that encourages students to use accelerator technology to suggest innovative applications but we are aware of similar initiative with different duration in related fields[2, 3].

2. The I.FAST CBI

The challenge takes place during 10 days at the European Scientific Institute[4] in Archamps (France) near Geneva. Selected students and young professionals are invited for an all expenses paid stay at the institute. They form 4 teams of 6 people and each team has to suggest an innovation using accelerator technology. The topic of the challenge is inspired from the Horizon Europe Missions[5] and has been selected by a panel of experts working on accelerators and their applications. For 2022 the topic was “Accelerators for the environment” and given the success of the 2022 edition it was decided to keep the same topic for 2023. At the end of the 10 days, the teams write a short report on the innovation they suggest and make a presentation in front of a jury.



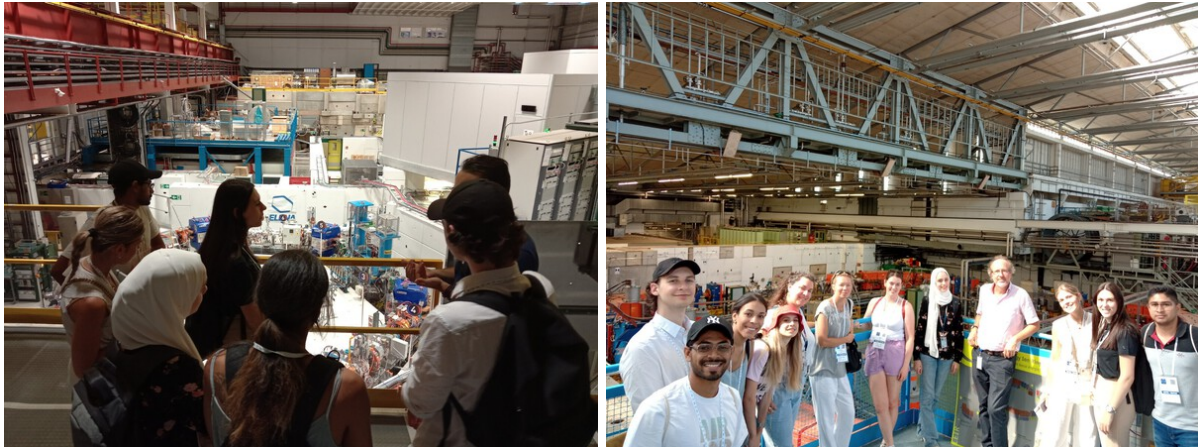


Figure 1. Participants of the I.FAST CBI visiting particle accelerators at CERN. Left: ELENA, Right: LEAR.

More details on the I.FAST 2022 can be found in [6]. Two articles have been published in the “Accelerating News” newsletter [7, 8] and one was published in CORDIS [9].

3. Program of the I.FAST CBI 2022

To educate the participants about accelerator technology, seminars by accelerator experts are organised both before the challenge as online seminars and in person during the challenge.

The seminar program of the 2022 edition was given in [6]. For 2023 the program will be almost the same.

The participants also had the opportunity to visit several accelerators at CERN (ELENA, Linac 4, CLEAR, the Synchro-Cyclotron and CLOUD). For most of them it was the first time they saw a particle accelerator (figure 1).

Alike the accelerator community, it was felt important to create a collaborative spirit between the teams. To achieve this, two special days called “conferences” were dedicated to cross-pitching across teams.

During the first “conference” each participant was asked to present his/her perspective on the challenge based on his/her academic studies. At the end of the day, each team presented briefly the ideas on which they were working.

This was an opportunity to ensure that the teams were working on different ideas and to exchange though on these ideas.

The second “conference” was dedicated to longer presentation by each team during which they presented in details the project they were working on from the perspective of each team member. The other teams were invited to give ideas and advices.

4. Diversity and participants selections

During such events diversity is key to ensure fruitful exchanges of ideas. To achieve this goal the committee in charge of participants selection paid careful attention to different aspects of diversity: diversity in academic fields and diversity in countries of origin and diversity in gender.

Regarding academic diversity, in 2022, each team comprised an “accelerator expert” (i.e. a student who had attended an advanced training about accelerators), a physicist, an engineer, an environmental scientist, a lawyer and a business student or a communication student). At the time, the classification of students was done by the selection committee.

For the 2023 challenge we asked candidates to choose the academic field closest from their area of expertise in a list (physicists, engineers, environmental scientists, other scientific fields, lawyers or communication/marketing). In addition candidates were asked if they had attended an advanced training in accelerators to help the selection panel fill the “accelerator expert” category. This last question seem to have been misunderstood as many students tried to justify their expertise with accelerators even when they had almost none.

The teams for the 2023 challenge will comprise two accelerator experts (one with a more physics oriented profile and one with a more engineering oriented profile), one physicist, one engineer, one environmental scientist and one communication expert or a sociologist. This change in teams composition arose from the limited number of applications from lawyers and the very good field of applications from accelerator scientists.

Both in 2022 and 2023, the call for applications was circulated in December with a deadline in February.

The number of applications received versus the number of days before the deadline did not follow the same trajectory in 2022 and 2023 (see figure 2): in 2022 it was more or less linear until two days before the deadline during which we received 29 applications. We had then decided to extend the deadline by two weeks and had then received an extra 67 applications. In 2023 the number of applications received was more exponential with a steady growth and a peak of 47 applications during the last two days. In 2023 we did not extend the deadline for scientists and engineers, only for lawyers and communication/marketing candidates. As we had a limited number of candidates in these two fields, we launched a social network campaign to try to attract more applications from these fields but this brought only one extra application which was finally not selected.

We have no explanation of the difference in trajectories for the application curves but one should remember that when during the application period in 2022 there were still many uncertainties related to the CoVid-19 pandemic.

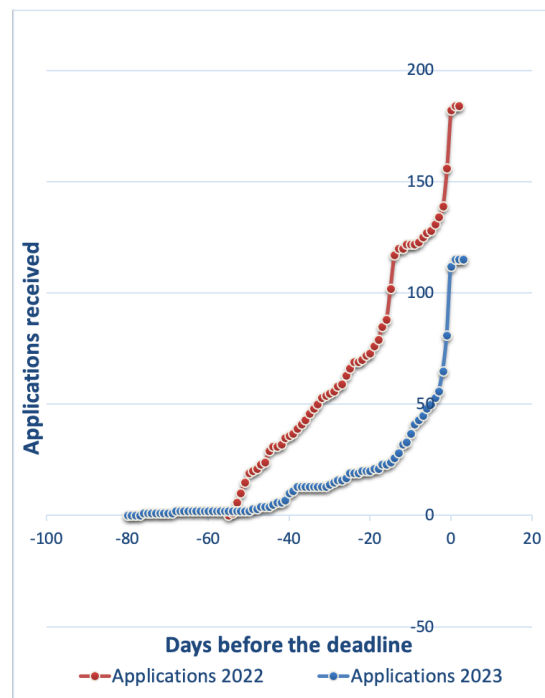


Figure 2. Number of applications received versus the number of days before the deadline.

The number of applications in each field for 2022 and 2023 are given in figure 3. Both in 2022 and 2023 the fraction of applications coming from physics and engineering was about three quarters but whereas in 2022 it was evenly split between physics and engineering, in 2023 there were twice as many physicists than engineers.

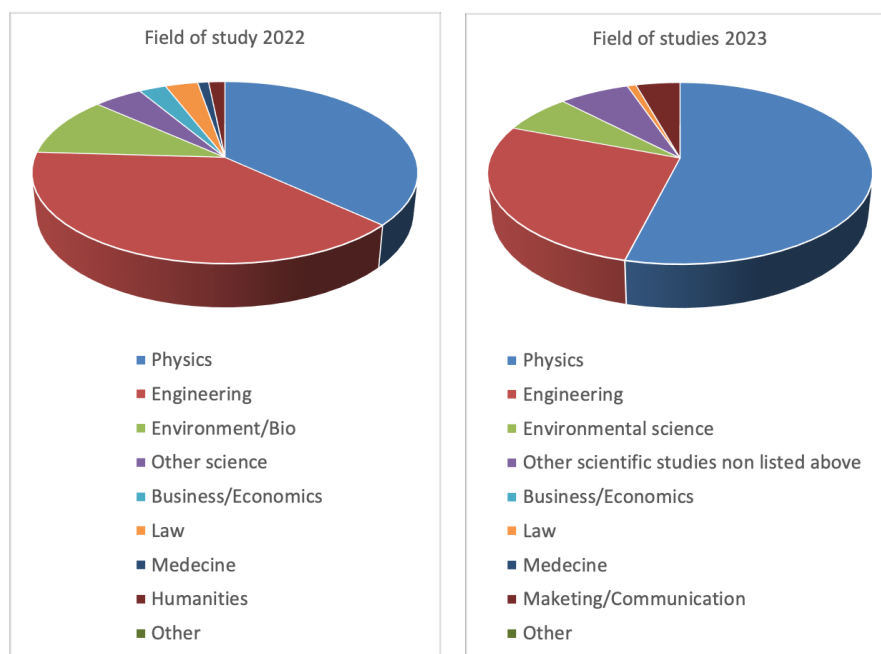


Figure 3. Repartition of the participants by field of studies in 2022 and 2023.

Figure 3 highlights the fact the challenge is seen as very attractive for physicists and engineers but we have more difficulties reaching out to other fields.

Diversity of geographical origin (country of affiliation) is also important. In 2023 the applicants came from universities in 18 different countries in Europe and a few came from Asia and Africa. Also, 23% of the applicants were part of the Erasmus Mundus program. The selection process ensured that there were not more than 4 participants coming from the same country (one per team maximum).

Gender diversity is also good both among the applicants (47% male, 52% female and 1% non binary in 2023; 57% male, 40% female and 3% non binary in 2022) and the selected participants (13 males, 11 females in 2023; 12 males, 11 females and 1 non-binary in 2022).

5. Projects proposed during I.FAST CBI 2022

On the last day of the challenge the teams presented their work in front of a jury made of senior accelerator physicists and knowledge transfer expert. In 2022 the jury was chaired by Frederick Bordry, former head of Accelerator and Technology sector at CERN. The other jury members were Giovanni Anelli and Luisa Ulrichi from the CERN Knowledge Transfer group and Julien Levallois from University of Geneva.

Each team had 15 minutes to present their project followed by 15 minutes of questions by the jury. The evaluation matrix that was given to the Jury is given in table 1.

The projects presented are briefly described below.

	Oral	Report	Total
Does the report include material covering all the academic fields present in the team?	5%	10%	15%
Have the strength and weaknesses of the proposal been correctly identified?	5%	10%	15%
What level of innovation is conveyed?	5%	10%	15%
Potential impact of the proposed activity	5%	10%	15%
Quality of the oral pres.	10%		10%
Support material	10%	10%	20%
Answer to questions	10%		10%
Total	50%	50%	100%

Table 1. Evaluation metric of the students proposals

5.1. *A.M.M.I.R.A : Accelerators for Marine Microplastics Investigation and Research Agency*

This proposal was to fit a Compact Compton source on a boat from a research fleet. The boat would then sail to the oceanic gyres to study in situ the microplastics found in the ocean and their effect on the plankton and other small marine life.

5.2. *Durablade - Accelerating the Green Transition*

The idea behind this proposal was that the lifetime of wind turbine blades is limited by the hardness of the polymer there are made of. They proposed to extend this lifetime by irradiating this polymer and thus making it harder.

5.3. *Project CYAN*

This project arose from the fact that lakes are sometimes affected by algal blooms that kill all forms of life underwater. To stop these algal blooms it was suggested to mount a small electron accelerator on a boat and irradiate the surface of the lake to kill all the algae.

5.4. *SOIL SAVIOUR 2.0*

In a similar spirit but on land, this project suggested to treat some polluted grounds by excavating the soil and irradiating it to destroy the toxic products that it contains. To perform such operation in situ a truck would be fitted with a small electron linac and driven where the treatment was needed.

5.5. *Winner*

The jury was impressed by the quality of the projects: “I was impressed by the skills and passion shown by the four teams. Such events are a great opportunity for students to learn more about accelerator science and to work on concrete challenges. Their different backgrounds allowed them to think about projects from distinct perspectives – from the scientific and technical to the economic and legal – the way it’s done in actual organizations,” said Frédérick Bordry.

The winning proposal was project CYAN.

6. Students feedback

At the end of the CBI all participants were asked to fill a feedback form. The students feedback on the event was rather positive. Below we reproduce the first few questions of the form and the average mark given by the students.

- How do you rate your overall experience at I.FAST CBI? Mark: 9,4/10
- Did the challenge fulfil your expectations? Mark: 9,4/10
- How did you find the timetable in terms of volume of hours, number and length of sessions, balance between lectures and group work, etc.? Mark: 7,6/10
- How did you find the programme content in terms of balance between topics? Mark: 7,3/10
- Was the speakers' expertise sufficiently diverse to help you build your project? Mark: 7,6/10

7. Conclusions

The I.FAST CBI 2022 was a great opportunity to engage with students and young professionals. The proposals were of good quality given the short amount of time the participants had to work on them.

The preparation for the I.FAST CBI 2023 is well underway and we expect that it will lead to other interesting ideas of applications of accelerators to the environment.

Discussions have started to find how to organise a follow-up of some of these innovative proposals.

The funding received by the European Union will allow us to organise at least a third challenge in 2024. Applications will be welcome starting in December 2023 at <http://www.ifast-cbi.particle-accelerators.eu/>.

8. ACKNOWLEDGEMENTS

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

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