Knowledge & Technology Transfer with Industry in EU projects

P. Giacomelli (INFN Bologna)
AIDAinnova Scientific coordinator
EURO-LABS coordinator

These projects have received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreements No. 101057511 (AIDAinnova), 101004728 (LEAPS-INNOV), 101004730 (I.FAST), 101057511 (EURO-LABS), Horizon 2020 RI programme under Grant Agreement no. 953219 (EASI-STRESS).

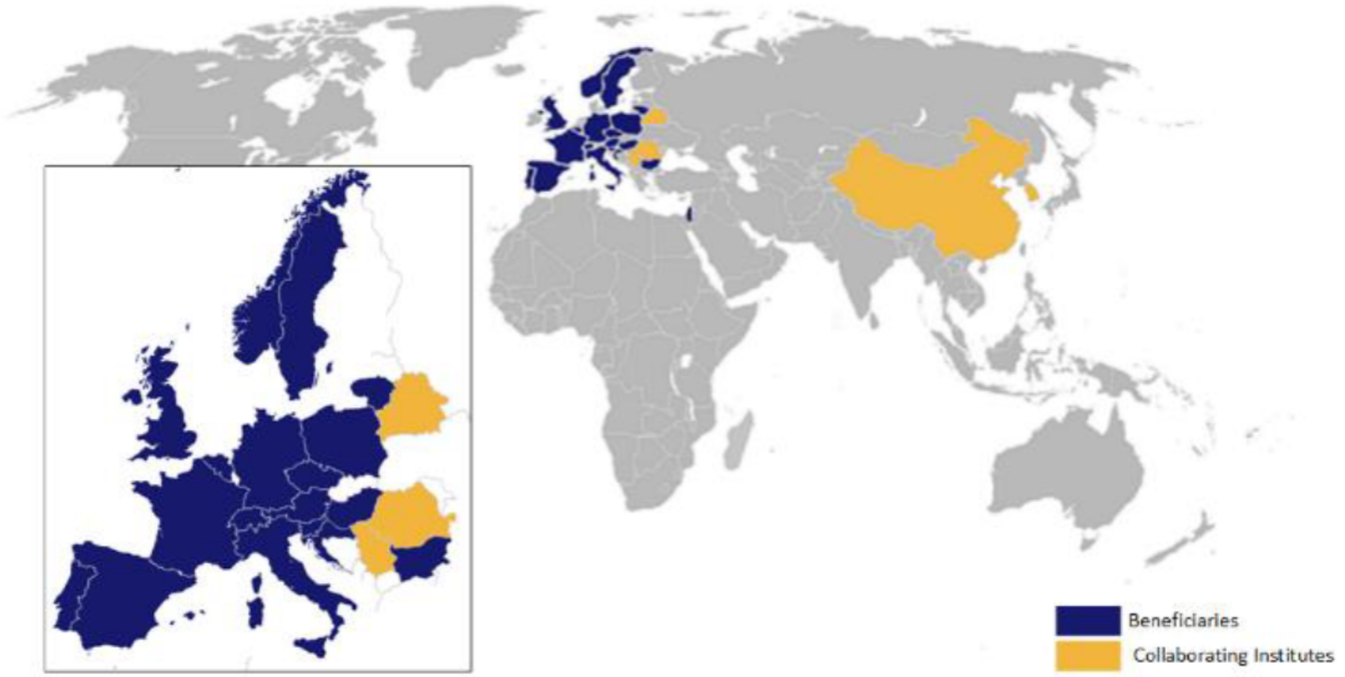
Preamble

- Future experiments in particle physics typically have a large scale in terms of complexity, size, technological requirements and associated costs
- These experiments therefore cannot be realised like in the past, where most of the equipments were designed, tested, built, and installed by academic researchers
- For future experiments cooperation with industry will be essential from the early stages of R&D in order to achieve success
- This calls for co-creation and co-development between Academia and Industry for a rather extensive period
- EU-funded projects are very useful to develop strong links with Industry and pursue the necessary R&D, and we appreciate the EU efforts to continue with these types of calls (and eventually increasing the funding devoted to these calls)

Advanced European Infrastructure for Detectors at Accelerators

AIDAinnova is the **largest** European program on R&D for detectors for High Energy Physics (HEP)

- Collaborative framework
- Infrastructure: common interest
- 15 countries
- 46 beneficiaries
  - 35 academic + 11 industrial and RTOs
  - + 10 associated partners
- Duration: 01/04/2021 - 30/03/2025
- Coordinating institute: CERN
- Scientific coordinator: Paolo Giacomelli (INFN)
- EC contribution **10.0 M€**
- Total budget **~26 M€** (co-funding of **~16 M€)**
- Activities:
  - Joint Research & Networking activity
- Website: https://aidainnova.web.cern.ch



Participants bring in complementary competences and a balanced coverage of projects.

AIDAinnova structure

- 13 Work Packages (WPs)
  - 2 Administration WPs
  - 10 Scientific WPs
  - 1 “Blue-sky” WP
- 2 coordinators/WP

- Scientific and Industrial Advisory Panel
  - I. Ionak-Auer (AMS AG)
  - D. Fournier (LAL)
  - M. Kasemann (DESY)
  - P.S. Marrocchesi (Univ. Siena)
  - P. Merkel (FNAL)
  - J. Strait (LBNL)

- WP1: Project management and coordination
- WP2: Communication, Education and Innovation
- WP3: Test beam and infrastructure
- WP4: Upgrade of Irradiation and Characterization Facilities
- WP5: Depleted Monolithic Active Pixel Sensors
- WP6: Hybrid pixels sensors for 4D Tracking and Interconnection Technologies
- WP7: Gaseous detectors for frontier science
- WP8: Calorimeters and Particle Identification detectors
- WP9: Cryogenic neutrino detectors
- WP10: Advanced mechanics for tracking and vertex detectors
- WP11: Microelectronics
- WP12: Software
- WP13: Prospective and Technology-driven Detector R&D

Industrial beneficiaries

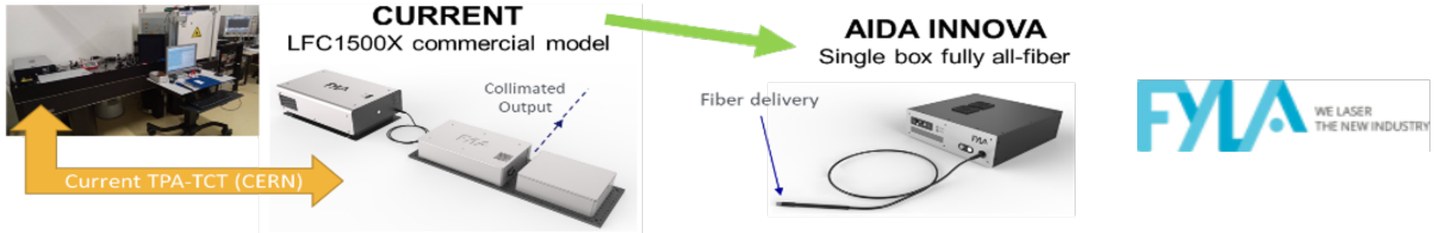
- Lithoz (A): ceramics (WP 10)
- Picotech (F): fast RPCs (WP 7)
- Weeroc (F): ASICs (WP 11)
- Workshop (F): composite materials (WP 10)
- CAEN (I): Electronics and power supplies for Nuclear and Particle Physics (WPs 4, 7, 8)
- ELTOS (I): PCBs (WP 7)
- FBK* (I): silicon detectors and SiPMs (WP 10)
- Conpart (N): Metalised polymers (WP 6)
- FYLA (E): ultrafast fibre lasers (WP 4)
- ITAINNOVA* (E): electrom. compatibility (WP 4)
- CSEM* (CH): Electronics and power supplies

✳ RTO (Research and Technology Organisation)

- *Particle physics applications: industrial scale in view from the beginning*
- *Earliest possible technology transfer to applications for other markets*

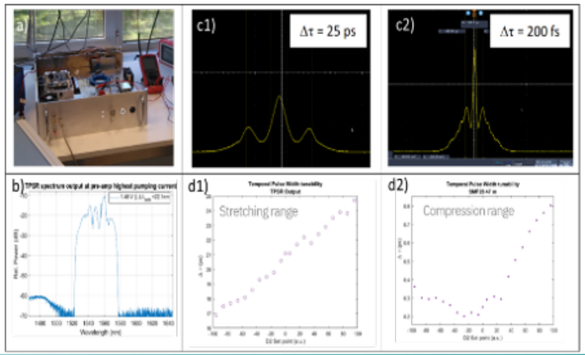
Some highlights - WP4

- **FYLA has been involved in Task 4.4** for development a new TPA-TCT System: **:**

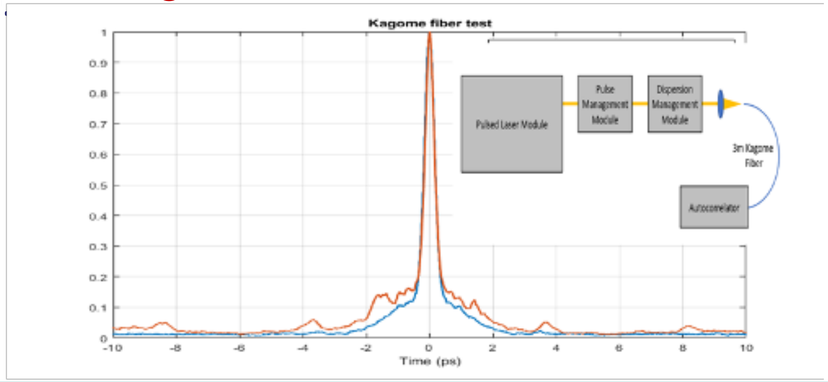


- FYLA has developed and tested new components and features for the commercial TPA-TCT system
- We have a **close and good collaboration with FYLA**.
- FYLA's availability and interest in solving project problems has been high.
- There were some **difficulties in two areas**:
  - **Technical** : We set very ambitious specifications for a commercial product.
  - **Intellectual property rights**: Administrative and technical
- These difficulties can be minimised with detailed discussions with companies at the beginning of the project.
- Fyla's collaboration in the project has been on a tendering basis.
  - A collaboration agreement (or contract) based common activity would be more effective.

Basic design of the laser time stretching stage and evaluation test results.



Kagome fiber evaluation test results



Some highlights - WP5

Industrial partners are CMOS IC vendors: LFoundry (150 nm & 110 nm)
Tower (180 nm & 65 nm)

What does work well:

- Ordering process and communication
- Both companies are attentive to small technical adaptations and fault searches requested by the customer for the mutual benefit:
- for HEP: better detector performance
- for industry: widening and improvement of portfolio
- Tower has tighter working relations with CERN and accepted a modification that enables full charge collection by drifting (rather than diffusing) charges
- Tower now offers this process modification also to other clients.

What does not work so well:

- Ownership of companies often changes and creates a constant fear that HEP research cannot be continued.
- Submissions are expensive and not much room for price negotiations exists.

I.FAST in a nutshell

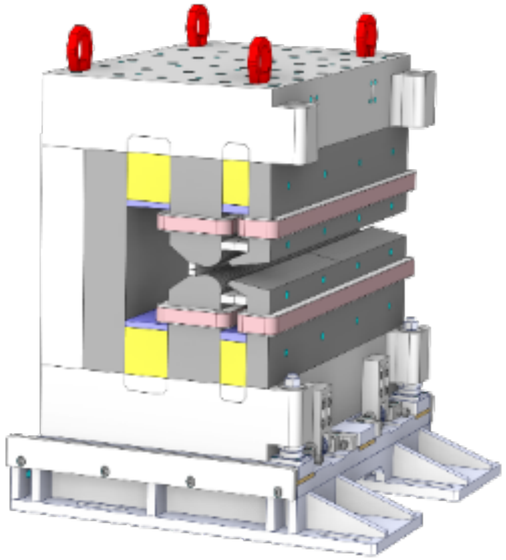
Innovation Fostering in Accelerator Science and Technology

Innovation Pilot, A new pilot instrument to demonstrate 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€.**

With 15 industrial partners, industry makes up 1/3 of the consortium.

Challenges and opportunities for particle accelerator R&D: the need for industry

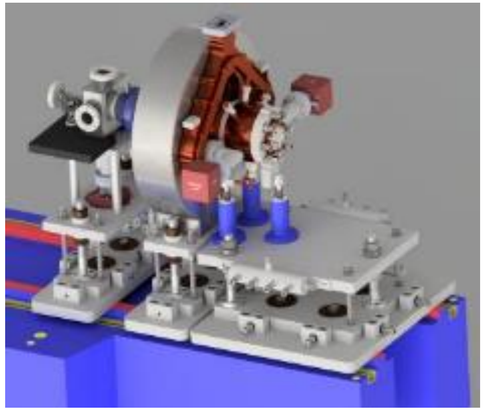


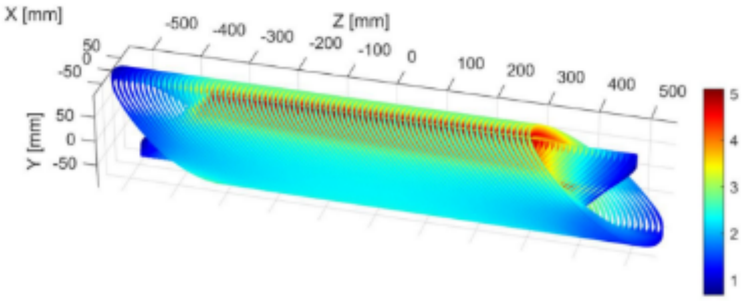
Opportunities:

- Strong demand for R&D: accelerators are crucial tools in the progress of modern science and technology (physics, biology, medicine, material science, etc.).
- Mature technology, with large industry involvement.
- Supported by a wide, motivated, and rapidly expanding scientific and technological community, spanning across continents.

Challenges:

- Presence of many actors, many projects, many technologies, with different priorities and time-scales.
- Long time scale and high cost of accelerator R&D, well beyond the capabilities of single EU projects.
- Strong dependence on post-ww2 technologies increasingly faraway from modern industry's focus.
- Needs coordination and sharing resources.

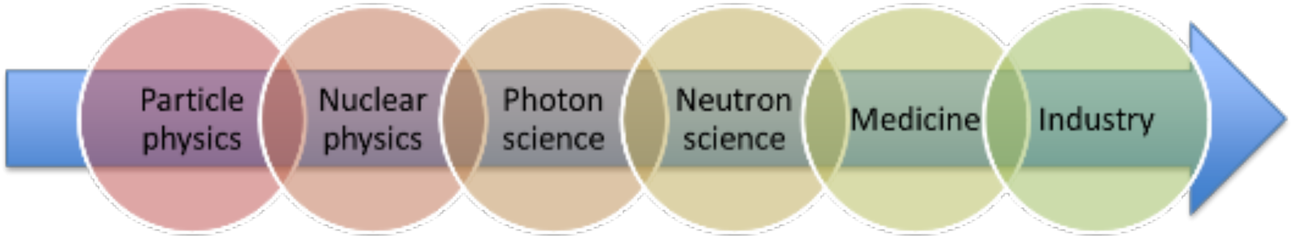




iFAST

I.FAST Priorities

- A project largely made of "**co-innovation**" R&D activities (prototyping) with industry, at different Technology Readiness Levels (TRL) – 15 Tasks / 40.
- On three priority lines:
  1. **Transversality,** exploiting synergies between accelerators for different users: particle and nuclear physics, photon and neutron science, medicine and industry.
  2. **Collaborative schemes** involving laboratories, university and industry.
  3. Priority to **long-term R&D** topics, beyond the specific needs of approved projects and developments.



The I.FAST vision of industry's role: times have changed

We observe that over the last years around particle accelerators has grown a network of companies, most of them SME's, often created and operated by scientists or by people with a scientific background, that are creative, flexible, innovative, continuously looking for new markets and new applications.

We believe that our scientific laboratories should help these companies to grow and to compete in the global market, to:

a) sustain the virtuous circle of scientific innovation, and

b) demonstrate the social and economical impact of accelerator-based research.

The virtuous circle of scientific innovation

A long term vision

Programmes like I.FAST have to help industry to grow by expanding the particle accelerator market, in three main directions:

1. Production by industry of increasingly standardized **components for accelerators**, possibly developed in co-innovation with academia.
2. Access with components made for accelerators to **other industrial or “Big Science” markets**.
3. Production by industry of complete accelerator set-ups for **applications in industry, medicine, environment, etc.**

I.FAST Industry participation

Beneficiaries (15):

RHP Technologies (Austria)
Bergoz Instrumentation, Thales (France)
BNG, Barthel HF-Technik, ILK (Germany),
COMEB, KYMA (Italy)
VDL-ETG (Netherlands)
CYCLOMED, Elytt, Nanoker (Spain)
GEMS, Scanditronix (Sweden)
TMD Technologies (UK)

Partners (2):

Amplitude (France)
INEUSTAR (Spain science industry association)

Industry Advisory Board (11)

Total of 28 companies represented in I.FAST

LEAPS
since 2017

LEAPS is the largest consortium of analytical facilities world-wide and further expanding its service to an interdisciplinary European user community

19 synchrotrons and FELs - **16** institutions - **10** countries

> 300 operating end stations

> 1.000.000 h beamtime /year

> 5.000 publications/year

> 15 spin off companies

> 35.000 users from all of EU & beyond
researchers from all research areas

https://leaps-initiative.eu/about/leaps-documents/

SESAME LENS Canadian Light Source Centre canadien de rayonnement synchrotron ESUO EUROPEAN SYNCHROTRON AND FEL USER ORGANISATION

LEAPS INNOVATION

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement no. 101004728

The LEAPS-INNOV pilot project

- New strategies and activities are on the horizon for long-term partnership between industry and the European accelerator-based light sources – synchrotron radiation facilities and free-electron lasers – with their tens of thousands of users. This is the focus of the EU-funded LEAPS-INNOV pilot project (www.leaps-innov.eu), which aims to solve key technological challenges for these light sources.

- The overall aim is to build partnerships between industry and the photon science community, setting the stage for long-term industry engagement for the League of European Accelerator-Based Photon Sources (LEAPS). LEAPS was established in 2017 to realise synergies across Europe's accelerator-based light sources.

- The project has a dedicated work package that concerns coordination, support and networking activities with the objective to facilitate the transfer of LEAPS skills, technology and know-how towards industry and the economy.

Project Information

LEAPS-INNOV

Grant agreement ID: 101004728

DOI

10.3030/101004728

Start date 1 April 2021

End date 31 March 2025

Funded under

EXCELLENT SCIENCE - Research Infrastructures

Total cost

€ 10 000 000,00

EU contribution

€ 9 999 991,28

Coordinated by

DEUTSCHES ELEKTRONEN-SYNCHROTRON DESY

Germany

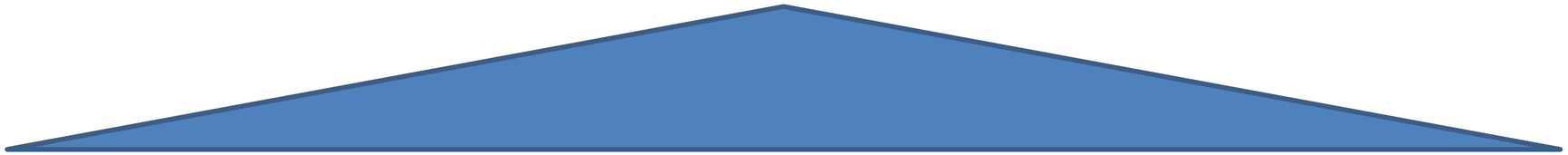
LEAPS INNOVATION

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement no. 101004728

Technologies under development (Technology Work Packages)

1. Detectors: Novel prototype detectors for X-ray spectroscopy
2. Optics: High-performance X-ray mirrors and diffraction gratings
3. Sample Environment and Handling: sample delivery with higher spatial and time resolution
4. Photon sources: insertion devices for high brilliance
5. Information Technology: data reduction and compression

The technology work packages (WP) form the heart of LEAPS-INNOV, based on their potential for co-innovation and their ability to enhance European leadership of both, LEAPS facilities and industry.



LEAPS INNOVATION

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement no. 101004728

Co-developments started with industrial partners

Companies involved

- More than 50 companies, 41% are SME
- Sectors: Optics, Electronic Instruments, Scientific Instruments, Diagnostics, Accelerators, Detectors, Electron-beam lithography equipment, Digital and “deep tech”, Nanotechnologies
- Types of collaboration includes: joint developments, subcontracting, commercialization and licensing

Common Objectives

- Developing the interaction and partnership of the LEAPS facilities with industry as a collaborator in technological developments
- Exchanging best practices, including IPR rules, and building collaborative and joint approaches towards industry
- Increase capabilities of European companies to supply research infrastructures

The integration of the 50-some companies, is supported by an industry networking WP and complemented by pilot activities towards co-creation with the Horizon Europe clusters.

LEAPS INNOVATION

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement no. 101004728

Findings of the collaborations

- In the co-development of new technologies, an in-depth interaction with industry from the start has been very useful to avoid mismatching specifications and to find the best possible and most cost-effective solutions
- The support of scientists and engineers by technology transfer staff of the facilities has been important in defining and teaching the rules of engagement in working with industry
- The use of new public tender procedures, such as pre-commercial procurement (PCP), was challenging for both sides. However, the experience gained will serve both the industrial and the research community
- The "competitive dialogue" procurement framework allows refinement of the specifications in an open dialog with several providers during the procurement process. This procurement tool is highly advantageous to reach the best technological solutions for the task
- Dissemination activities allow companies to express interest in the possibilities of commercialisation and fruitful collaboration with the RIs and present their activities to the community

LEAPS INNOVATION

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement no. 101004728

EURO-LABS project

- First European project that brings together Nuclear Physics, Accelerators and Detectors for HEP
- Offers **TA** to **44 Research Infrastructures** (RIs): https://web.infn.it/EURO-LABS/
  - **Economic support** to participate to test beams, irradiation facilities, nuclear physics experiments, etc.
- The various Research Infrastructures (RI) are distributed according to these scientific areas:
  - **WP2: Nuclear Physics**
  - **WP3: Accelerators for HEP**
  - **WP4: Detectors for HEP**
- Also Service Improvements to several of the RIs
- Total budget **~15 Meuro** (**14.2** from **EU**, 0.7 from **UK** and **CH**)
- Start of the project: **September 1st, 2022**
- End of the Project: **August 31st, 2026**

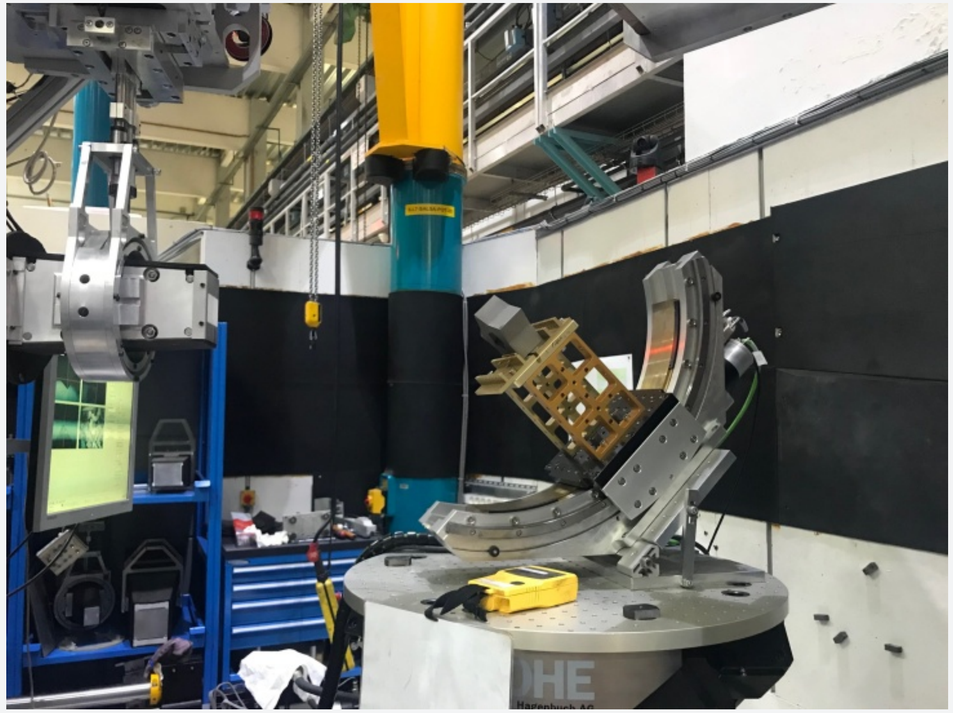
EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

EURO-LABS ecosystem

THE EASI-STRESS PROJECT

European Activity for Standardisation of Industrial residual STRESS characterisation

The EASI-STRESS project has the overall aim to strengthen industrial access and uptake of non-destructive synchrotron x-ray and neutron diffraction-based residual stress characterization tools by validation against accepted destructive techniques and development of protocols, in close collaboration with industry.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 953219.

1. EASI-STRESS: INDUSTRIAL PARTNERS

VOLUM-e 3DComplexProduction — Simulation

OHB — Samples

Nemak Innovative Lightweighting — Samples

SIEMENS Gamesa RENEWABLE ENERGY — Samples

eDF — Simulation, Samples

ROLLS ROYCE — Samples

ArcelorMittal — Samples

BENEFITS AND EXPERIENCE

- The benefits are to understand industrial needs in residual stress analysis, both in materials terms as well as in reliability and standardisation
- Once more we envisage the differences in language and lead times between academia and industry. Research strategies and routines are very different, as are time scales
- Improvement could be achieved through more and closer long term collaboration, e.g. in joint PhD projects, to educate "translators" between the two worlds

Conclusions

- **Co-development between Academia & Industry is key** to us and to the EC:
  - > 100 industrial partners involved in these EC projects;
  - Looking to increase portfolio of industrial partners;
  - Clear benefits to both parties.
- **Technology transfer is crucial** to maximise the technological and knowledge return to society:
  - It is important to demonstrate the impact of fundamental research.
- **Mind the gap: in language, ‘clockspeed’ and culture** which sometimes can be a challenge for the co-development with industry.
  - It would be useful to work together on a strategy to mitigate common challenges: **align on incentives and expectations.**

Backup

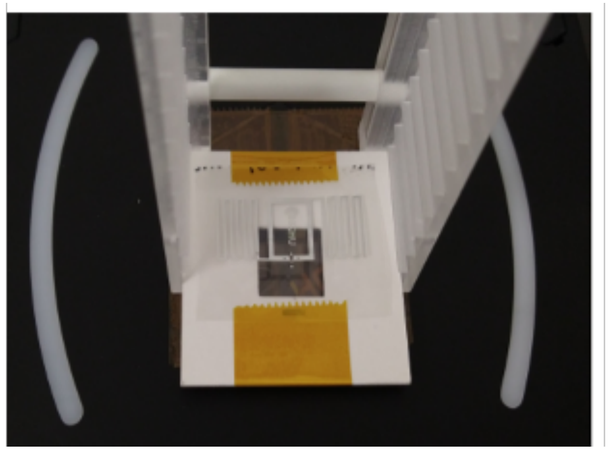
These projects have received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreements No. 101057511 (AIDAinnova), 101004728 (LEAPS-INNOV), 101004730 (I.FAST), 101057511 (EURO-LABS), Horizon 2020 RI programme under Grant Agreement no. 953219 (EASI-STRESS).

Outline

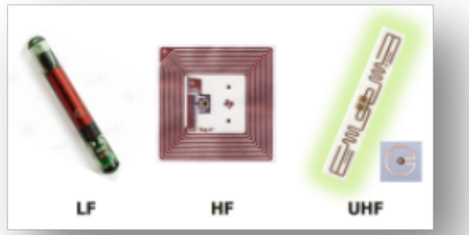
- Introduce a few large EU-funded projects
  - AIDAinnova
  - I.FAST
  - LEAPS-INNOV
  - EURO-LABS
  - EASI-STRESS
- Provide some of the best examples of co-development with Industry
- Explain a few of the issues that could be improved and/or simplified
- Conclusions

Some highlights - WP4

- The activities will be covered by different partners, two of which are **industrial companies**.
  - CAEN (Italy)- Task 4.3 & FYLA (Spain) – Task 4.4
- **CAEN has been involved in Task 4.3** for building an integrated system for induced activation due to radiation
  - CAEN has collaborated to the development and integration of RadBASE REST API with IRRAD Data Manager & CAEN-RFIDs radiation-hardness assessment (protons&neutrons)
  - It participates actively in both tasks (meetings, material,..)
  - Very **good and close collaboration:**

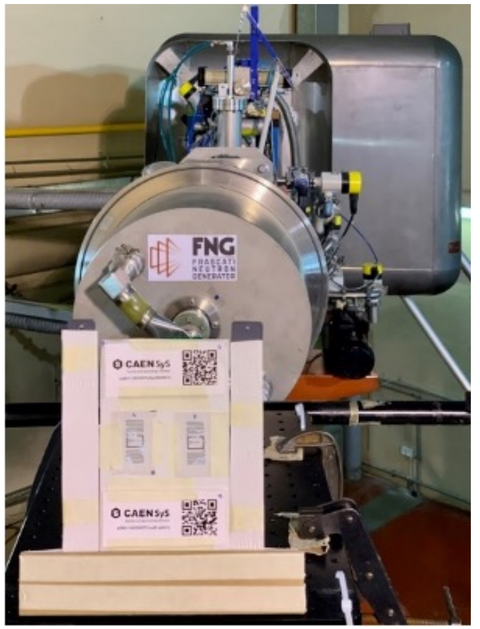


CAEN RFID Sample, testing platform and reader at CERN



RFID tags

R1290I, Hex, Multipurpose RAIN RFID Reader with PoE (CAEN RFID) at CERN



CAEN RFID testing at ENEA-FNG

Industrial partners - WP8

- WP 8 has several industrial partners (full beneficiaries and associated partners)
  - ✦ Crytur (CZ) and Glass2Power (I) for material R&D and production
  - ✦ Foton (CZ) for adaptation of SiPM operation
  - ✦ FBK (I) for SiPM R&D including production runs (with AIDAinnova funding)
  - ✦ CAEN (I) for electronics development
- Partners are long standing collaborators within HEP and neighbouring disciplines (e.g. Crytur, CAEN)
- The cooperation goes on smoothly
  - ✦ Some partners were present at Face-to-Face Meeting
  - ✦ Results will become visible in 2nd half of project
- Ongoing work may foster new contacts with industry

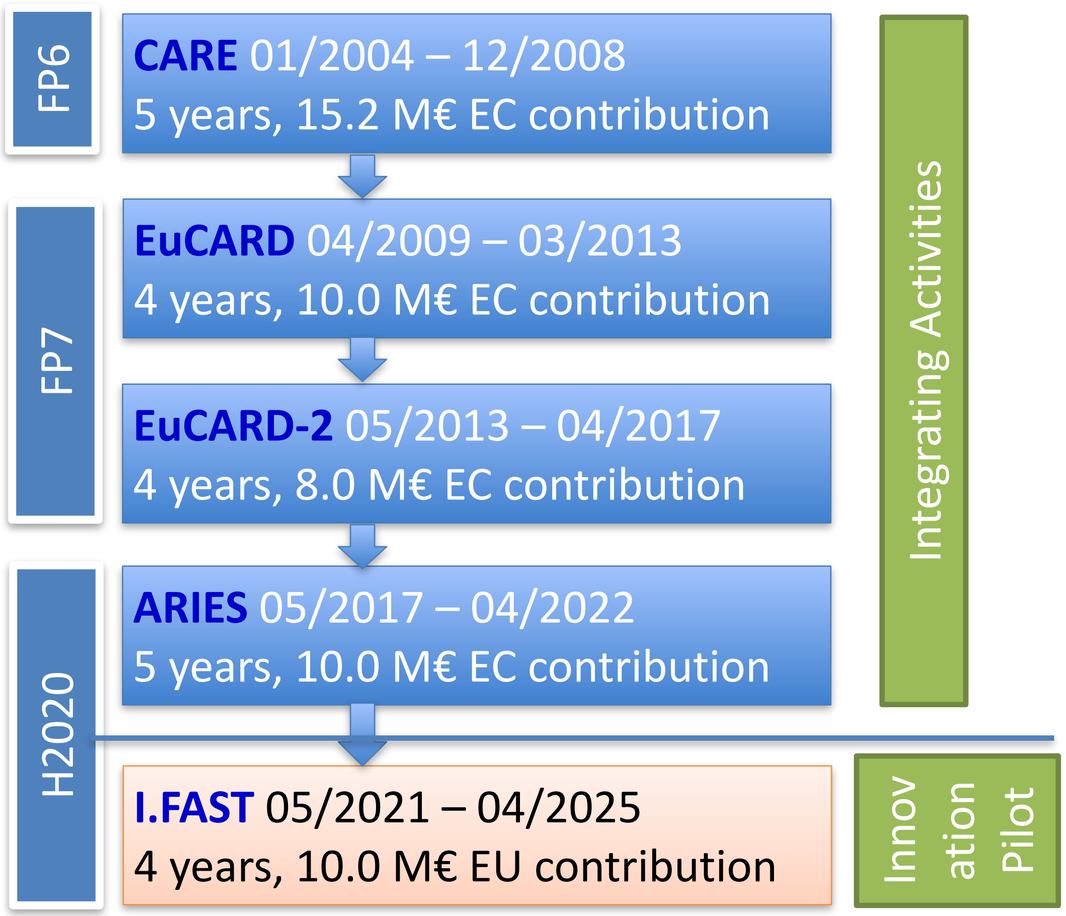
  e.g. Discussion with companies specialised for gluing to consolidate gluing of Si sensors in Task 8.2

Industrial partners - WP12

WP 12 Innovative software

- Offline software aims at Commodity-Off-The-Shelf hardware (COTS)
- Growing interest in many areas in exploring the use of non-CPU devices for offline software tasks
  - Mainly GPUs, although some interest in FPGAs for software triggers
- We have an active collaboration with IBM in the Machine Learning Simulation task
  - This is an area of huge industrial investment and innovation (e.g., ChatGPT)
- What works?
  - Scientific cooperation with technical experts in industry: our problems are often new and interesting use cases for them
- What can be improved?
  - Getting access to industry resources (e.g., for ML training) involves difficult and protracted negotiations between the lab and industrial legal departments
  - Sometimes non-negligible financial costs, which were not budgeted for

Integrating Activities for accelerators and the new Innovation Pilot I.FAST

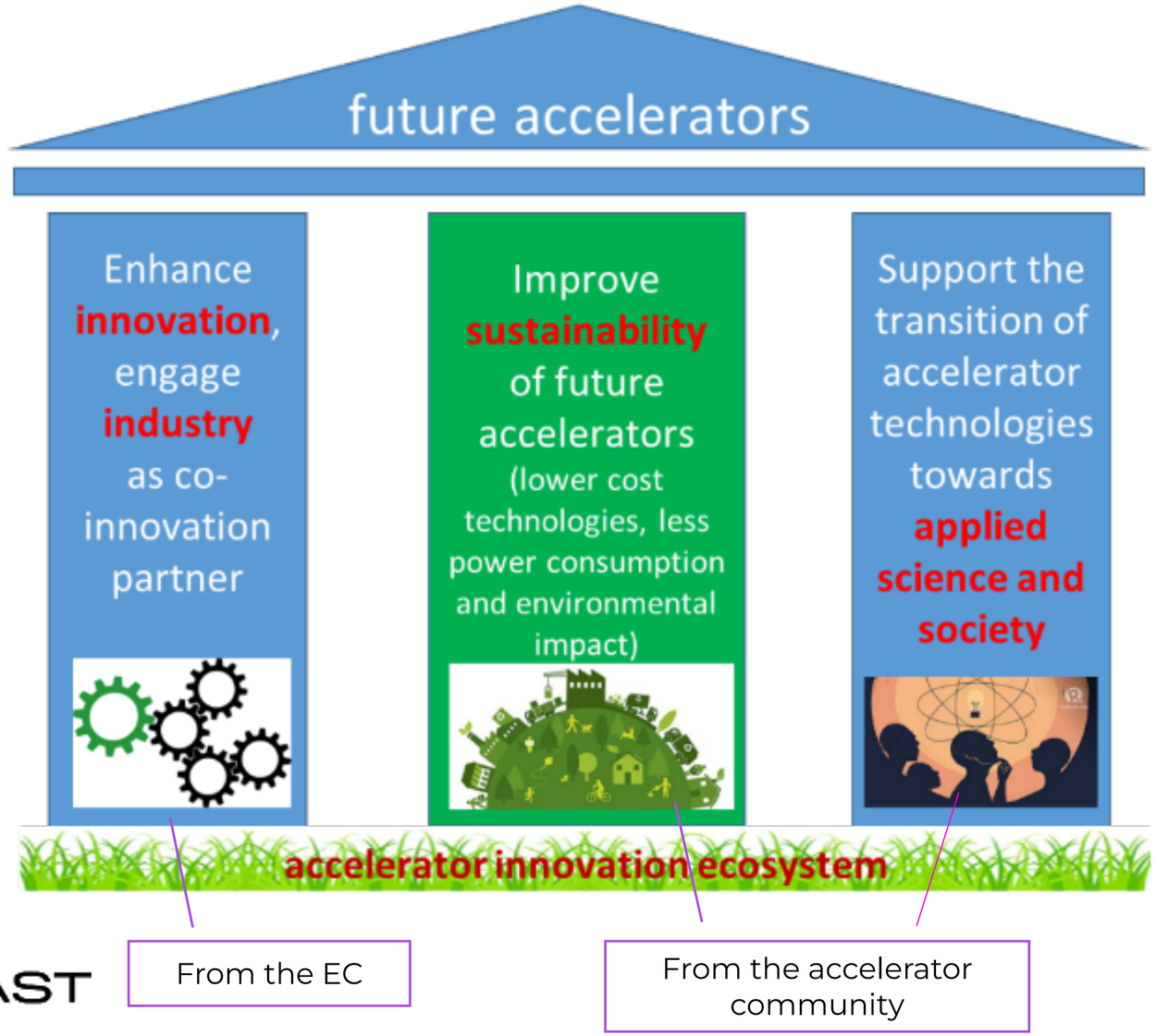


Long tradition of EC support to **particle accelerator R&D**: four successful Integrating Activities have raised 43 M€ EC funding over **16 years** (2.7 M€/yr).

Integrating Activities (and Innovation Pilot): Development of cross-boundary subjects, not directly followed by large laboratories, with added value coming from collaboration and sharing of resources.

I.FAST is a new step in this progress, including for the first time a large industry representation (1/3 of participants!)

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.

EURO-LABS project

EURO-LABS project

The EUROpean Laboratories for Accelerator Based Sciences (**EURO-LABS**) project aims to provide unified Transnational Access to leading research infrastructures across Europe. Taking over from previously running independent programmes (**ENSAR2**, **AIDAinnova**, **I.FAST**) it brings together the nuclear physics, the high-energy accelerator, and the high-energy detector R&D communities.

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With **33 partners** (**25 beneficiaries** and **8 associated partners**) from European and non-EU countries, EURO-LABS forms a large network of laboratories and institutes ranging from modest sized test infrastructures to large-scale ESFRI facilities such as SPIRAL2. Within this large network, EURO-LABS will **ensure diversity** and **actively support researchers** from **different nationalities, gender, age, grade,** and **variety** of **professional expertise**.

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At the **kick-off meeting**, held in **Bologna** from the **3rd to 5th October**, presentations offered a detailed overview of the research infrastructures and facilities providing particle and ion beams at energies from meV to GeV.

EURO-LABS Transnational Access

EURO-LABS offers

- Reimbursement of travel expenses to many of the Research Infrastructures
- Reimbursement of lodging expenses at RIs
- Support at the laboratories hosting the RI
- Service improvements for future research and training of new users

Who can apply to EURO-LABS TA

- European research groups
- Non-EU research groups up to 20% of the overall budget
- Eligibility criteria: https://web.infn.it/EURO-LABS/eligibility-criteria/

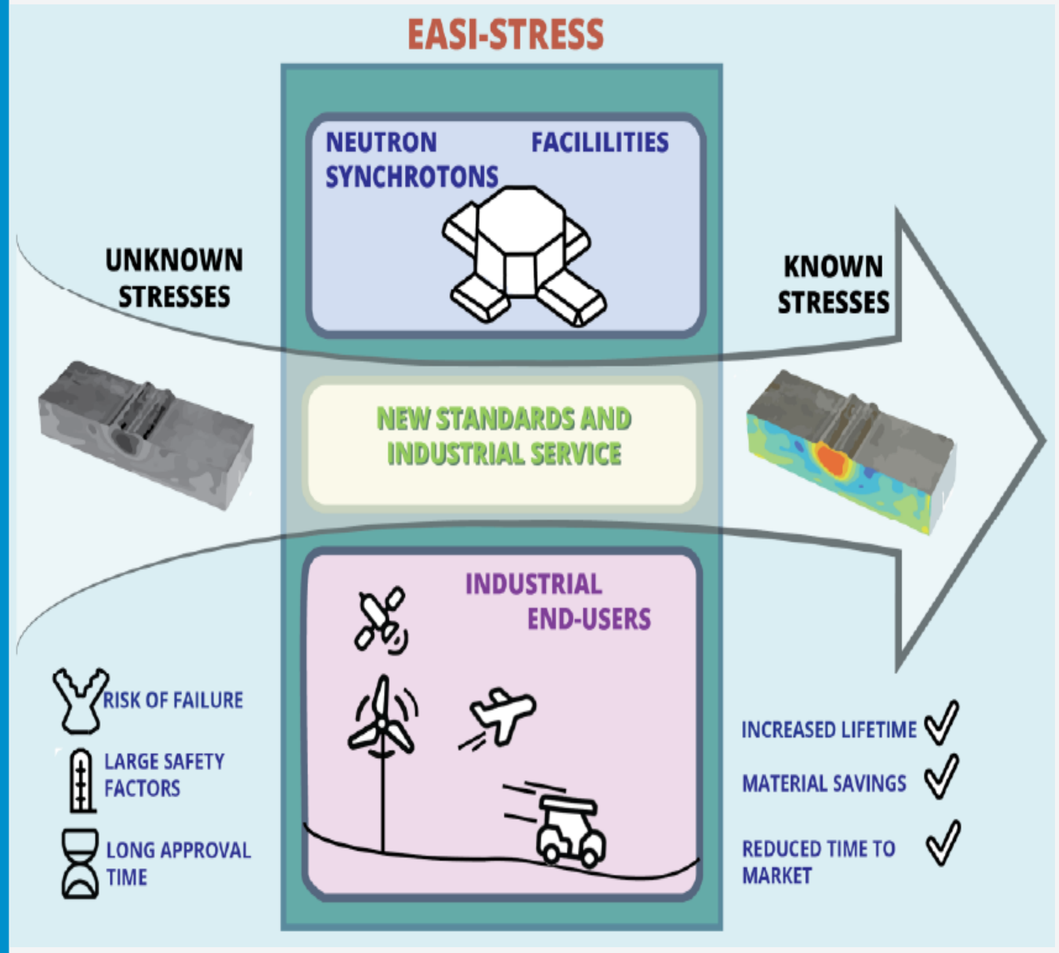
How to apply:

- Application Procedure: https://web.infn.it/EURO-LABS/how-to-apply-for-transnational-access/

WP's TA information:

- WP2: https://web.infn.it/EURO-LABS/wp2-ta/
- WP3: https://web.infn.it/EURO-LABS/wp3-ta/
- WP4: https://web.infn.it/EURO-LABS/wp4-ta/

THE EASI-STRESS PROJECT



- develop synchrotron x-ray and neutron diffraction-based residual stress characterization tools for industrial use
- develop European-wide characterization standards, protocols and data exchange procedures to facilitate the industrial use of the characterization tools, e.g. through traceability and comparability
- strengthen European industrial uptake of the characterization tools through open access to data and protocols, development of a test bed service and collaboration/synergy/standardization activities

- Components Lifetime optimization
- Material and time saving
- Reduced cost