



## I.FAST Period 2 Review – 15 July 2024

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## WP13 General context

- The European Technology Infrastructure (TI) for accelerators and magnets is the ensemble of Technological Facilities (TFs), encompassing large-scale Technical Platforms (TPs) for development, fabrication, assembly, integration and performance verification of accelerator and magnets components, together with large concentrations of dedicated, highly-skilled personnel.
- Follow-up of the H2020 **AMICI** (Accelerator and Magnet Infrastructure for Cooperation and Innovation) project (01/2017-10/2019), which investigated how to increase the visibility of the TI and ensure its the long term sustainability and how the TI could be reinforced, harmonized and made more efficient, and industry could benefit more from the possibilities offered by TPs (see <http://eu-amici.eu/>).
  - ↳ Proposed actions, some of which implemented in **IFAST WP13, also WP2 and WP3** and support to transnational access to some of AMICI TPs in **EUROLABS Task 3.2.**

# IFAST WP13 - Technology Infrastructure for Accelerators and Magnets

Partners:CEA,CIEMAT,CNRS,DESY,IFJ-PAN,INFN,KIT,UKRI,UU

## WP13 General objectives:

- Propose a strategic approach ensuring the long-term sustainability of the TI and the development of its capabilities in view of the construction of future accelerator-based RIs.
- Extend and strengthen the cooperation with industry to exploit opportunities of fostering innovation in related technologies.
- Develop and promote services, within a common approach, for the benefit of RIs, future scientific projects and high-tech industry.

# WP13 structure

- **Task 13.1:** Strategy for the development of the AMICI TI Partners: **CEA**, CIEMAT, CNRS, DESY, IFJ-PAN, INFN, KIT, UKRI, UU
- **Task 13.2:** Developing and promoting services to industry in AMICI TFs Partners: **DESY**, CEA, CIEMAT, CNRS, IFJ-PAN, INFN, KIT, UKRI, UU
- **Task 13.3:** New RF amplifiers based on GaN semiconductors Partners: **UU**, CERN

An example of an upgrade of a TP allowing to keep the TF at the forefront of the technology in a Key Technical Area

## Task 13.1: Strategy for the development of the AMICI TI (CEA)

- Analysis of the landscape of the different scientific fields that could need the AMICI Technical Platforms (TPs) (based as much as possible on roadmaps or reports prepared by the concerned communities)
  - *particle physics,*
  - *nuclear physics,*
  - *energy,*
  - *material and biological science,*
  - *medicine and other applications.*
- Adoption of a classification of TPs according to pre-defined categories and sub-categories.

## Task 13.1: Strategy for the development of the AMICI TI (CEA)

- Extensive inventory of the available accelerator and magnet TPs in each category within the different laboratories
  - Characteristics and functionalities
  - Activities
  - Plan for the future

(available on the [AMICI website](#))

- Recommendations to guide the future exploitation of technological platforms in key technological areas, with the aim of enhancing collaboration, efficiency, and innovation

## Task 13.2: Developing and promoting services to industry in AMICI TFs

- **Sub-Task 13.2.1 (CEA):** Organization and operation of a central information and contact point for industry and other external partners to access TPs → [AMICI Web site](#)
- **Sub-Task 13.2.2 (DESY):** Analyzing the existing rules and procedures across different TFs that host external partners, with a particular emphasis on industry collaborators in view of possibly harmonizing the diverse approaches and developing a set of standardized rules.
  - Rules such as access procedures, safety and radiation protection, and IP management are specific to each laboratory and reflect national legislation, making it very difficult to harmonize them.
  - Feedback from the IAB suggests that the lack of non-unified access rules is actually not an issue for industrial users.

## Task 13.2: Developing and promoting services to industry in AMICI TFs

- **Sub-Task 13.2.3 (INFN):** Workshops dedicated to a particular type of TP, gathering personnel from the TPs and possible users from both research labs and industry.
  - *Superconducting RF cavity testing, DESY, Hamburg, 14-15 September 2022*  
<https://indico.desy.de/event/35316/>
  - *Test facilities for superconducting magnets, LASA Milano, 17-18 November 2022*  
<https://agenda.infn.it/event/32859/>
  - *Platforms for characterization, treatments and test of materials, IJCLab, Orsay, 22-23 June 2023*  
<https://indico.in2p3.fr/event/28703/>
  - *Facilities for beam test of accelerator components, IFJ PAN, Krakow, 12 October 2023 (combined with EUROLABS Annual Meeting)*  
<https://indico.ifj.edu.pl/event/1122/>



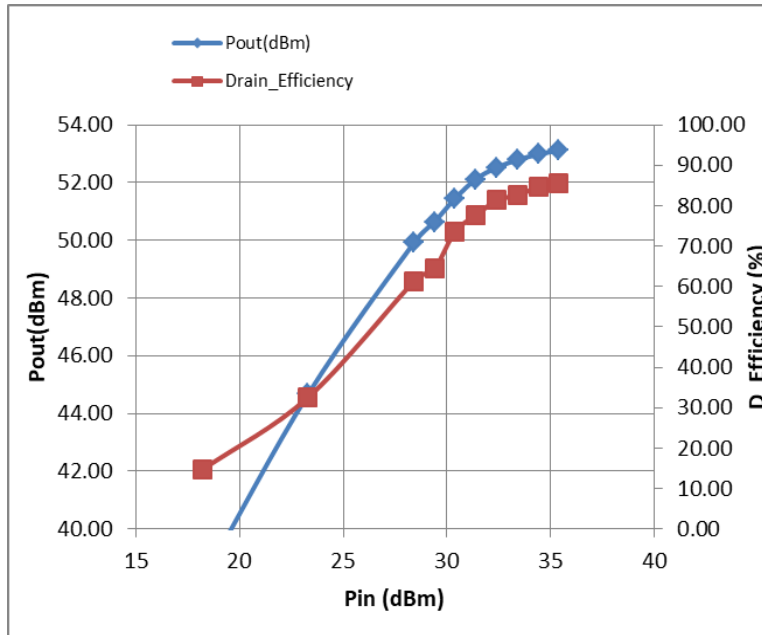
## Task 13.3: New RF amplifiers based on GaN semiconductors (UU)

- *Realization and evaluation of a new RF amplifier based on GaN semiconductors at kilowatt level. Identification of the advantages of GaN semiconductor technology for accelerator RF amplifiers.*

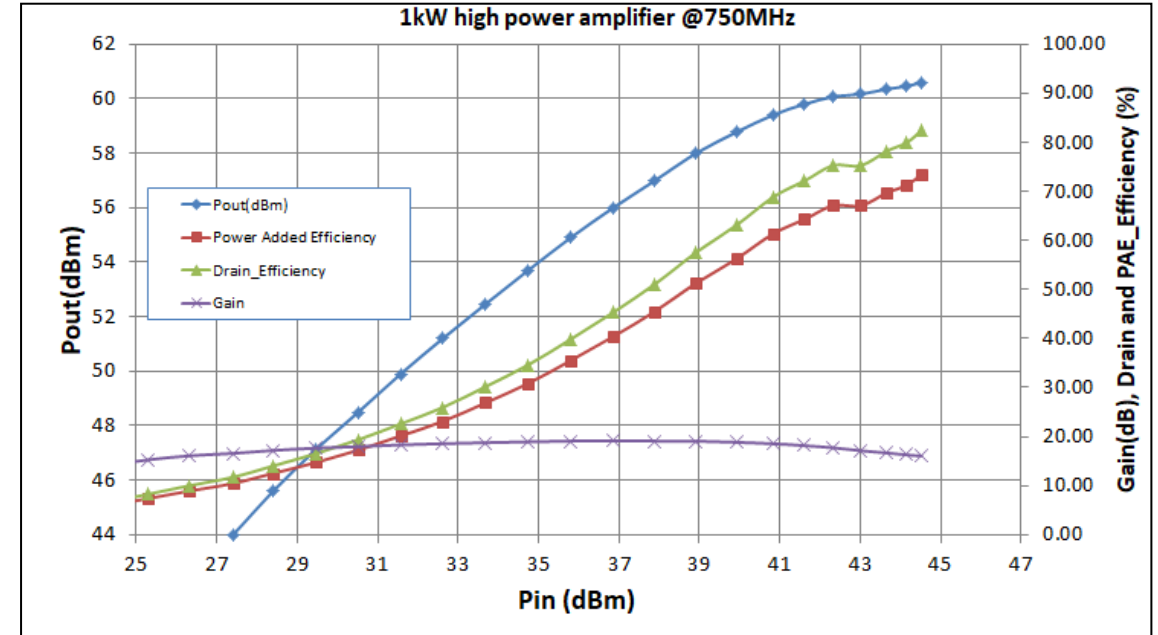
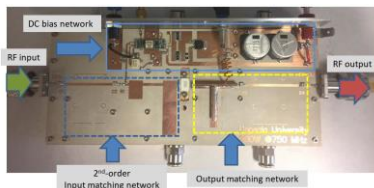
The task aims to investigate the use of Gallium Nitride (GaN) semiconductor technology for solid-state power amplifiers in the kilowatt level and radio frequencies (RF) range. GaN is expected to be widely used for next-generation power semiconductor devices due to its superior performance compared to silicon-based power transistors. The current nominal power level of single GaN transistors is 100 W. The University of Uppsala (UU) will develop a kilowatt-level GaN module at 750 MHz using the facilities at the UU Technological Platform, which are part of AMICI. In addition, UU will share their knowledge and advancements in the field with the other AMICI partners, I.FAST project members, and the wider community.

From D. Dancila, UU

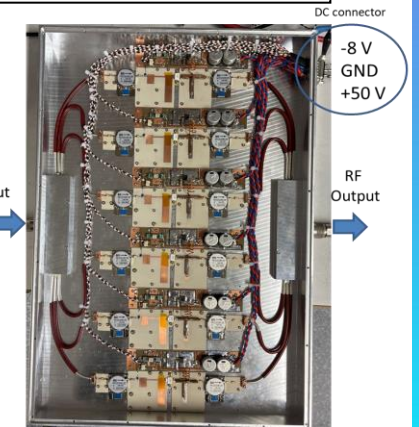
# Task 13.3: New RF amplifiers based on GaN semiconductors (UU)- Results



- MS63: Demonstration of operation with high efficiency and nominal power of the first GaN amplifier: measured output power of 205 W was possible, with a signal gain of 17 dB and an efficiency of 82% in compression.



- D13-3: GaN RF amplifier module at kW level
- 1148 W output power @750MHz
- 82.45% power efficiency (operated more in compression than at 200 W)



## Task 13.3: New RF amplifiers based on GaN semiconductors (UU)- Results

- The initial goals of Task 13.3 are fulfilled: A significant achievement was made with the demonstration of a GaN amplifier producing 205 W with 82% efficiency at 750 MHz. We have shown a combined six of these amplifiers demonstrating 1148 W output power with 82.45%.
- GaN semiconductor technology is anticipated to play a significant role in the development of future power semiconductor devices, due to its superior characteristics compared to silicon-based transistors. This research advances the field of kilowatt-level amplifiers at 750 MHz and has direct applications in industries, including as the RF power source for the RFQ developed at CERN.
- We have disseminated the knowledge made in this area among the other AMICI partners, project members and the wider community: we contributed actively to the Traineeship Programme initiated by I.FAST and provided a platform for the future generation of scientists and engineers, thereby facilitating the transfer of knowledge between laboratories and industry and fostering collaboration with industrial partners and other key players in the technology domain. We plan to publish our findings in prestigious journals and present them at high-profile conferences such as IMS, EUMW and IPAC.

## All Milestones and Deliverables completed

- **Milestone MS61** - Organization of a workshop to inform and consult the stakeholders among which industry: **M24** (at 2<sup>nd</sup> Annual Meeting)
- **Milestone MS62** - Central information and contact point operational (Web site): **M17**
- **Milestone MS63** - Demonstration of operation with high efficiency and nominal power of the first GaN amplifier: **M12**
- **Deliverable D13.1** - *Report on the key TPs that need to be sustained over the long term and possibly developed/upgraded in the future (CEA): **M30***
- **Deliverable D13.2** - *Report on the organization and operation of the contact point, on the organized workshops and proposition for standardized access rules (DESY): **M30***
- **Deliverable D13.3** - *Realization of an RF amplifier module based on GaN semiconductor technology and demonstration of combined power at kW level (UU): **M33***

# iFAST

**Thank you for your attention**



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