

EXECUTIVE SUMMARY 2024

ISIS@MACH ITALIA (IM@IT¹), the Italian Multidisciplinary Research Infrastructure for Complex Materials and Interfaces

Name of Research Infrastructure	ISIS@MACH ITALIA (IM@IT) – the Italian Multidisciplinary Research Infrastructure (RI) for Complex Materials and Interfaces, Hub of ISIS Facility (UK)
Type of Research infrastructure	The Hybrid RI combines “distributed Small Research Facilities (SRF)”, single-sited “Medium Range Facilities (MRF)”, with User -Hub to single-sited Large Scale Facilities (LSF)”
Lead Contacts	Professor Silvia Licoccia, licoccia@uniroma2.it Professor Carla Andreani, carla.andreani@uniroma2.it , useroffice@isismachitalia.eu
Stage of development	Phase 2: Operation Phase– <i>ad interim</i> ²

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¹ IM@IT is the short acronym for ISIS@MACH ITALIA, the hub of ISIS Neutron and Muon Source (UK), Registered in the MUR official registry U. 0008642.28-05-2020 - 16th April 2020. IM@IT is listed in the Italian Ministry of University and Research’s Piano Nazionale delle Infrastrutture di Ricerca (PNIR 2021-2027) “in the broader notion of ISIS”, and ISIS Facility and IM@IT are jointly listed in high priority RI’s (see Table 6 page 30, note 38, PNIR in 2021-2027).

² The Executive Summary (ExS) is a ‘living document’ which is updated yearly on regular basis as new ideas come along and others become lower priorities. The present document is the year 2024 update of the ExS sent to the Ministry for University and Research (MUR) in December 2021 and 2022.

IM@IT Summary 2024

1. Introduction

ISIS@MACH Italia (IM@IT), a multidisciplinary research infrastructure (RI) at national level, is a distributed network of 7 different laboratories in Italy, and one in the UK. It is a rather unique organisation providing access to an extensive catalogue of over 100 small research facilities (SRF – of which many universities will have some, but not all), to forty-two medium range facilities (MRF – which are more specialised collections of equipment), and to large scale facilities (LSF – highly specialised infrastructures operated nationally or internationally) and the corresponding expertise, for the benefit of many different areas of scientific research, from materials, life sciences and cultural heritage to engineering and including industry. Although individual techniques may be available elsewhere, the IM@IT combination is unique in the national landscape as well as is its unique feature in providing a research pipeline from MRF to LSF.

The precursor to IM@IT was first established in 2019³ as a small-scale collaboration between the University of Rome Tor Vergata and ISIS⁴, based on funding from Regione Lazio and building on a collaboration between ISIS and CNR that started in 1985. Since 2019, IM@IT has developed rapidly, and especially considering the constraints imposed by the pandemic in 2020 and 2021, exceeding many of its original goals.

IM@IT has already attracted well over four hundred users, about 40% of whom are external, most of them unfamiliar with the MRF equipment. There has been a significant and steady growth in the number of users supported, with participants constantly increasing. Over this period 550 proposals have been allocated, with 1300 days of experimental and training time. The demand is constantly growing, but the access that can be delivered is limited by the available funding. Currently IM@IT is mostly supported on in-kind basis by the participating institutions.

With sustainable funding, IM@IT has the potential to develop a new generation of collaborative researchers from both academia and industry and to be a game-changer in transforming the research ecosystem in Italy and in the European landscape.

³ ISIS@MACH, the first Hub of ISIS Facility (UK), was funded in 2019, following an independent scientific and technical review panel, for with 4.83 M € within the programme POR FESR 2014-2020 (with 75% shares by Region Lazio and 25% by Univ Rome Tor Vergata.

⁴ <https://www.isis.stfc.ac.uk/Pages/A-new-partnership-between-ISIS-and-f.aspx>

2. Vision

The multidisciplinary IM@IT (website: <https://isismachitalia.eu/>) has catalysed the creation of a multi-site collaboration of MRF – (see document Annex - MRF) - and SRF, of which many universities will have some, but not all (see document Annex - SRF).

Research carried out at the European RI needs to be constantly nourished with new users, new research, and innovative ideas. However, for the many researchers who have little or no prior experience in the use of the analytical tools required to exploit MRF and LSF, there is a steep learning curve to develop proficiency in their use, and these users find that the highly competitive access to LSF is a high barrier even if it could be very beneficial to their research. This hierarchy applies not only to a given research question, but also to training and education of novice users in accessing the more advanced and more expensive methods at LSF. A key point is that IM@IT aims to reduce this barrier, which not only benefits the research but also enables Italy to get better value from those LSF that it contributes to financially such as ISIS Neutron and Muon Source (UK), the Institute Laue Langevin (France), ELETTRA (Italy) and the European Synchrotron Radiation Facility (France).

Currently IM@IT's pools of expertise offers the multidisciplinary user community, from both academia and industry, a multi-level Transnational Access program (TA) to SRF-MRF and LSF, which enabling users to take advantage of the very significant investments made by European Countries in LSF, which are not always fully geared to support national priorities (see for example document Annex - MRF All Submitted Proposals - Calls Direct Access 2024).

A particularly unique feature of IM@IT is that it provides users with a research pipeline from SRF to MRF and then to LSF, and greatly enhances the deployment of user's multi-disciplinary research ideas which will then have better access to the European LSF and in turn enrich their impact.

3. Mission (how do we get there?)

MRF (and SRF) are usually located at universities or research centres, used by few small groups, and not necessarily operating for user TA programs. In most cases, instruments and their operational costs are financed by universities and research institutions by in kind or through different projects. Projects do not generally include provisions for

external users access to unused machine time, which would require funding for external user support and training.

Therefore, two significant opportunities are missed under the current system:

- i. to exploit the initial capital investment to the fullest by maximising high-payoff machine use
- ii. to allow a wider section of the scientific community to make a qualitative leap, moving from SRFs to MRF and to LSF.

IM@IT realised a combination of highly specialised MRF which is unique in the national landscape where IM@IT pool of experts is not just a community of experts doing research but conducts research in partnership with users.

What is the IM@IT added value compared to what is already financed?

The IM@IT added value consists in selecting research centres with state-of-the-art instrumentation and providing targeted funds to make instrument time available for external groups (or other Italian university departments and research centres) that do not have such instrumentation at their own institutions. This would allow *significant leveraging of public investment in small- and medium-scale instrumentation*: a realistic goal is 80% usage, up from a typical 50% under the current model (see Figure 1).

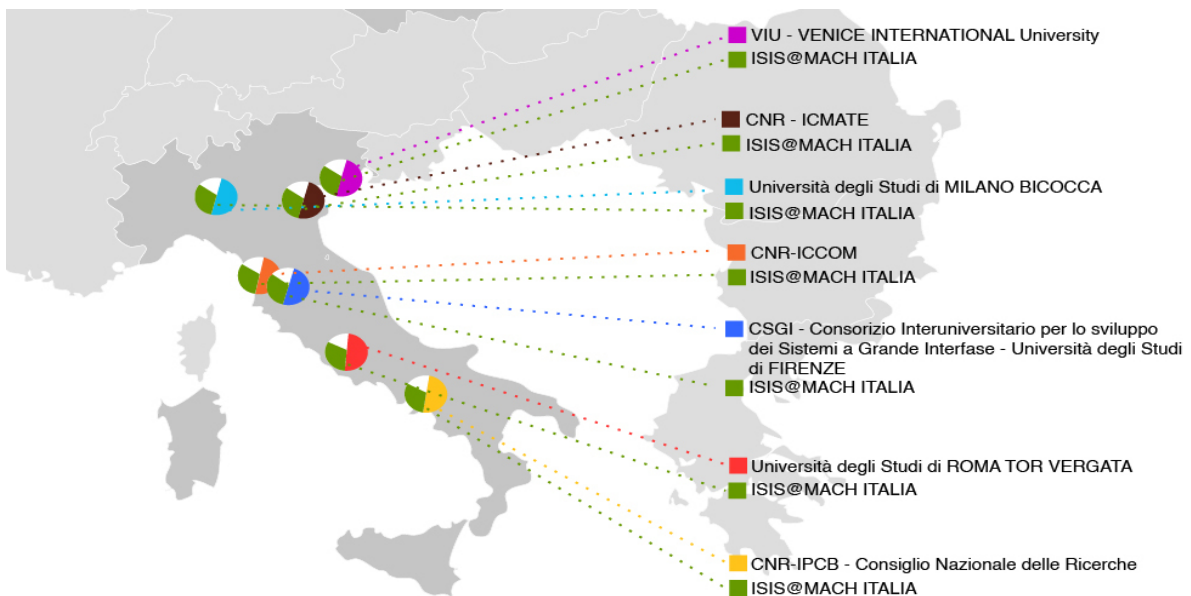


Figure 1. IM@IT nodes in Italy

IM@IT:

- o is challenge driven – i.e. it is not an RI focussed on a particular technique, or on a particular research area, but provides researchers with a portfolio of techniques to deploy to address a challenge

- provides a simple, easy mechanism to access a European wide set of advanced (and sometimes unique) analytical instruments
- provides access, expert advice, and training to researchers, through a single digital User-Hub (see document Annex - User-Hub and User Guide for Proposals) to support and enable them to expand their use of advanced techniques within their research.

Through IM@IT, users can access a diverse suite of analytical facilities with diverse diagnostic techniques using optical, X-Ray, and particle probes. Thus IM@IT provides a pipeline of aware and trained researchers in advanced analytical techniques who are confident to exploit these at both medium and large-scale facilities. This mirrors the experience at Large Scale Facilities where users are increasingly using a wider portfolio of advanced techniques rather than focusing on one or two. This model allows users to learn how to progress and climb the pipeline from MRF to LSF more rapidly at the same time this ensuring an additional and significant leveraging of public investment in national and international facilities.

3.1 The need to finance IM@IT as a single entity

Funding to provide user access, either as part of regular projects or with ad-hoc calls, might be achieved by individual institutions. Financing **IM@IT as a single entity represents a much more effective alternative in hence:**

- a) individual institutions do not have experience and tools for user access, whereas IM@IT in its five-year-of operation has accumulated significant expertise in promoting access to new public and industrial (mainly SME), thus responding to the growing need of the Italian production system. Unlike large corporations, SME usually have limited resources and skills to access and exploit the most advanced tools, which are nonetheless essential for understanding, developing, and improving their "productive fabric".
- b) There is a benefit in providing a single access costing model, which can be both transparent and uniform, and a single approach to peer-review: IM@IT panels of reviewers MAP (**M**edium **R**ange **F**acility **A**dvisory **P**anel) are of very high calibre (something that would be difficult to achieve at small institutions) and evaluate a broad range of science, including 'transversal' science.
- c) IM@IT can be used by the funders as a tool to target specific science areas of high societal value, without distorting the general spirit of open peer review.

3.2 IM@IT – a tool for target specific science areas

IM@IT has developed a new approach to access LSF, incorporating targeted funding specifically designed for specific types of access tailored to specific Case Studies addressing societal challenges within the Italian national science priorities. The thematic areas have been shaped in collaboration with IM@IT stakeholders (academic & industrial user).

In addition to 'generic TA', IM@IT has developed for its users an innovative approach for TA for Target-Specific Case Studies to MRF and to LSF via the IM@IT User - Hub (see document Annex – TA for Target-Specific Case Studies), which were tailored for specific areas of societal challenges and thematic areas (see document Annex – Case Studies). These have been designed precisely to provide successful exemplars of this journey in the LSF international landscape.

The industrial and academic users who are not LSF experts are accompanied by IM@IT' pool of expertise (PE) and led to become independent and able to propose their own experiments or, in the case of industry, to buy machine time for 'proprietary research', thus favouring the transition 'from research to business'.

4. 2024 Activities and Strategic Actions

Since 2020, IM@IT is ramping up its services (through SRF) and *peer reviewed* TA open access to MRF, International MRF and LSF. The number and range of multidisciplinary users accessing IM@IT is continuously and significantly growing (see Section 4.2).

4.1 Transnational access (TA)

IM@IT operates TA tailored to the needs of new users (academic & Industrial) for service to SRF, experimental and training access to MRF and to International LSF, through a single-point digital access – the digital User - Hub.

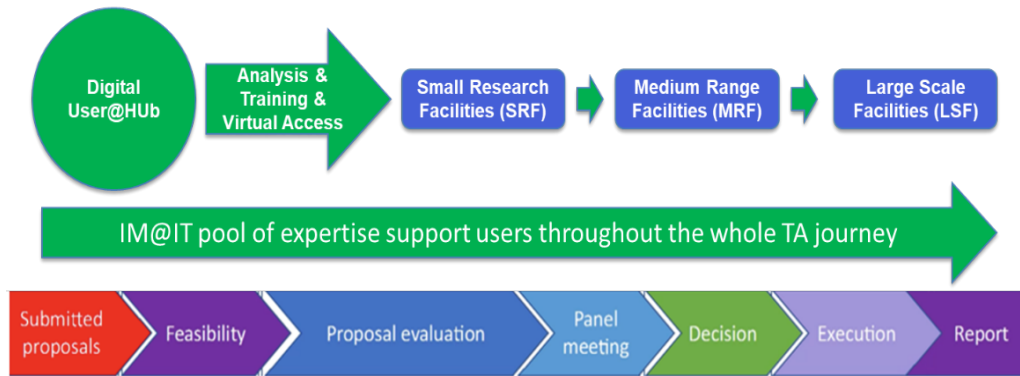
4.2 The digital User -Hub

The digital User - Hub is instrumental:

- To manage interaction with users (and MAP' panel members)
- To manage user access to MRF and to LSF (see Figure 2)

- To coordinate and schedule experimental time access routes
- To organise BoD’ be meeting, roadshows, SAC and MAP meetings
- For user virtual access to experimental and training TA.

**Figure 2. Transnational Activities
Analysis & Training & Virtual Access**



MRF are free at the point of use for researchers, provided the results from experiments are published in the public domain. IM@IT operates one MRFs Access Panel (MAP) to peer review all MRF proposals. MAP is an external independent peer review panel responsible for the selection and scientific evaluation of the proposals submitted by all potential users. It is composed of 9 to 13 independent experts with a collective scientific knowledge of complex materials and interphases and atomic-to-micro analysis, covering the science areas supported by the IM@IT Research Infrastructure. More information on the MAP process, including the Panel Guidelines, is available in the MAP PACK (see Annex MAP PACK DA 24-2), made available to all MAP members before each DA Call.

In 2024 IM@IT operated two Calls for Direct Access (DA) with a total of 170 proposals

submitted. These are listed in documents Annex – MRF and Annex MRF All Submitted Proposals Call Direct Access 2024 and documents Annex MAP PACK DA 24-2.

Figure 3 summarizes the number of IM@IT users registered on the digital User - Hub. In 2024 the number of unique users registered is 156, from eleven countries; in the period 2020-2024 the total number of users is ~ 425. The latter include frequent & unique users.

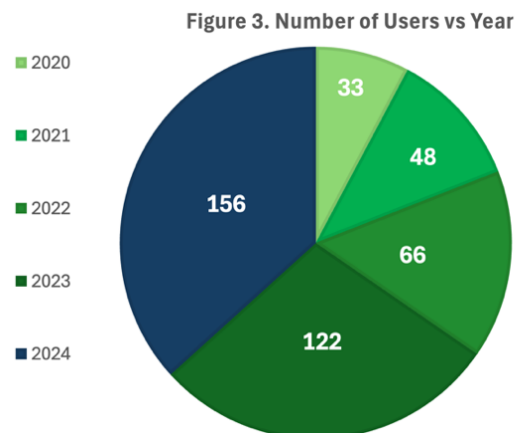
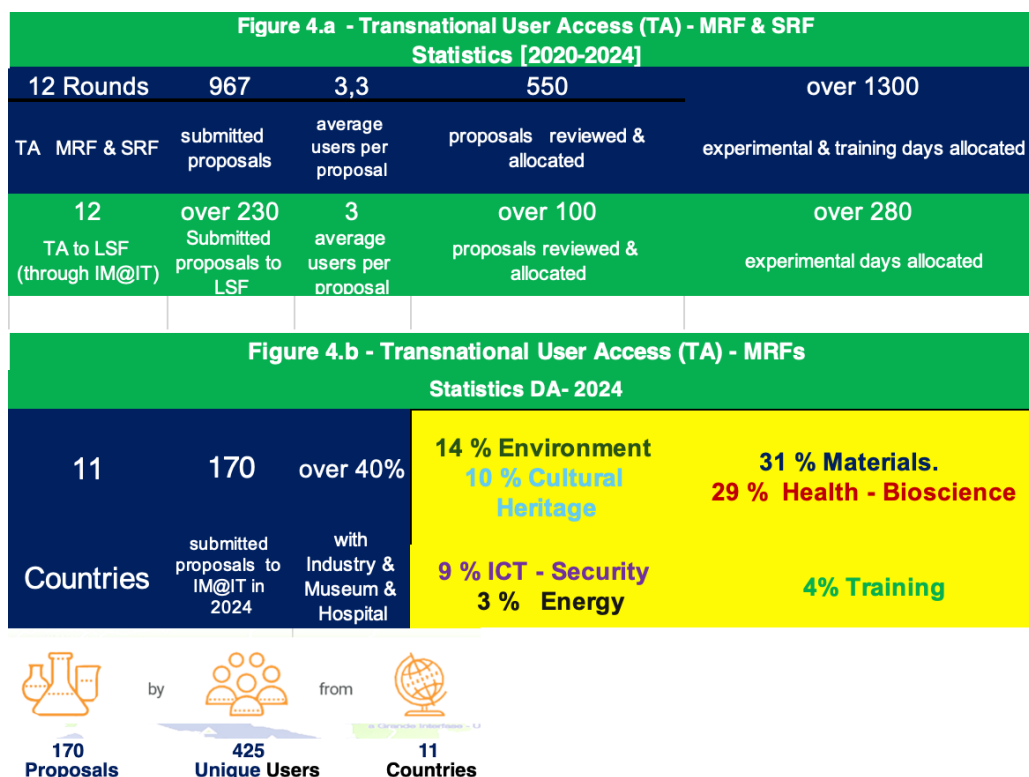


Figure 4.a and 4.b. report the statistics of TA to MRFs in 2020-2024 and in 2024, proposals submitted, proposals reviewed & allocated, total experimental days allocated to SRF/MRF and to LSF.



4.3 Case studies: toward targeted access to tackle societal challenges

IM@IT has implemented the existing Case Studies and developed new ones in specific areas of societal challenges, which address national's science priorities in relevant thematic areas. Most of the time these Cases Studies envisaged for its stakeholders a 'TA generic' to SRF (service), to MRF (peer reviewed) and to LSF (peer reviewed) through a single point of access (User -Hub). The 'TA generic' approach goes hand in hand with new typologies of access to LSF. The unique feature of IM@IT envisages the deployment of specific fundings for targeted Case Studies (see document Annex – TA for target-specific Case Studies), i.e. a multi-level research pipeline from SRF to MRF and, when necessary, to LSF. Science Cases listed below envisage a 'TA generic' to SRF (service), to MRF (peer reviewed) and to LSF (peer reviewed) through the single-entry point (the digital User -Hub). The 'TA generic' approach goes hand in hand with new typologies of access to LSF (see Section 6. and Annex -TA for target-specific user access), and the deployment of specific fundings for targeted Science Cases tailored to the needs of stakeholders.

The IM@IT multi-level research pipeline greatly enhances the deployment of user’s multi-disciplinary research ideas and capabilities in the use of analytical instrumentation.

Figures 5.a and 5.b show the Areas of impact 2024 (%).

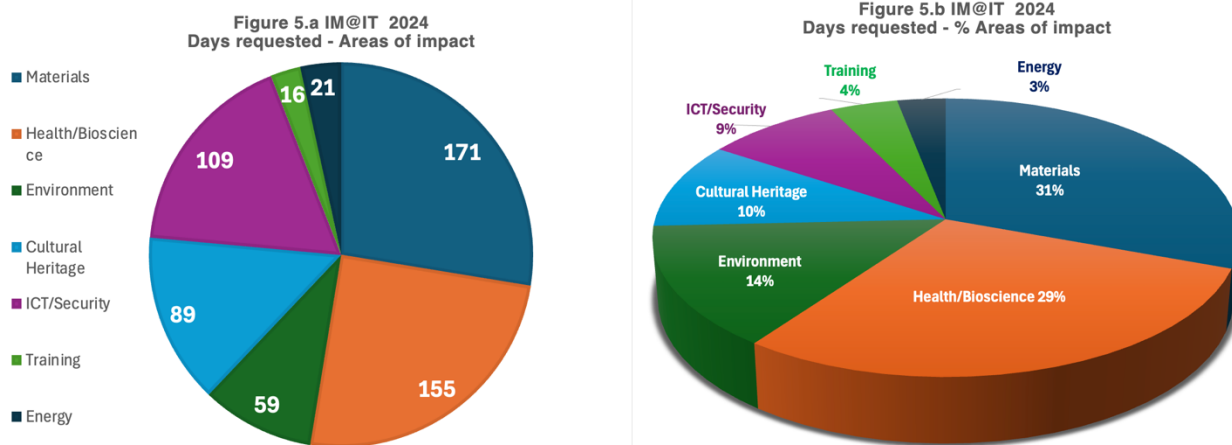
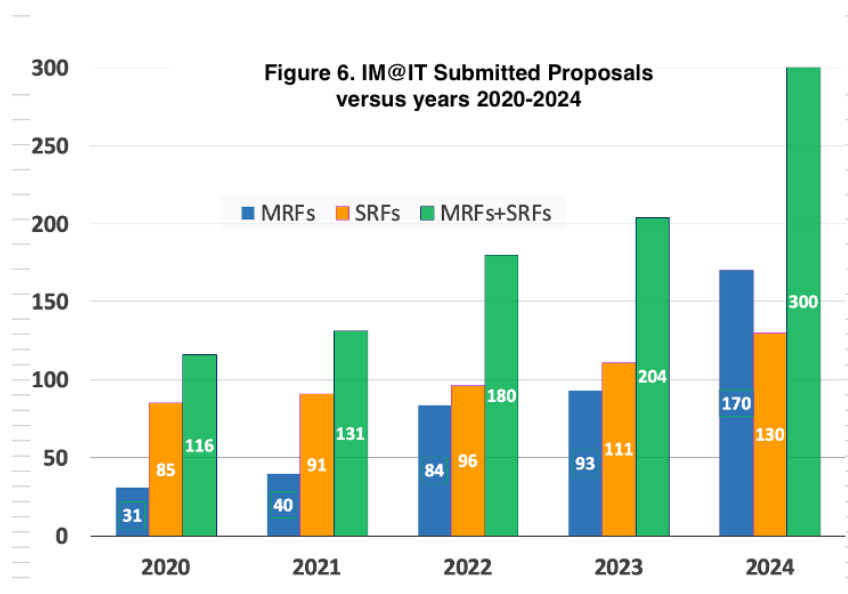


Figure 6 shows the yearly trend of the number of proposals submitted to the different facilities between 2020 - 2024.

TA Access is either through special grant agreement with IM@IT- ISIS (Agreement 2023-2027), or through the normal open access proposal system (Agreement CNR-SFTC 2021-2027).



In the former case, priority will be given to proposals within “long term projects” and exploiting the instrumentation available at IM@IT to fully prepare and support the need for neutron and muon beamtimes and the implementation of ISIS. These ‘long term projects’,

will prioritise the participation of pools of industry, including SME as detailed in document Annex – TA for target-specific Case Studies.

Proposal applications of TA for target specific Case Studies will continue to be assessed scientifically and technically within the framework of the IM@IT MAP and ISIS Facility Access Panels (FAPs): users can open access to the national MRFs facilities for which the individual or long term experimental proposals would then be assessed (peer-reviewed): proposals submitted to MRF are first checked for technical feasibility; those assessed as feasible will be then sent for evaluation of scientific merit by an independent, external ISIS FAP's which if the response is positive determine the assignment of experimental time and neutron beamtime to the applicant team. Where access to ISIS or other LSF is needed this could either be through the digital User @ Hub, but with IM@IT staff providing support and the proposal success rate being much improved because of the previous work using other IM@IT instrumentation.

In 2024, several proposals for “TA for Target-Specific Case Studies”, for specific areas of societal challenges and thematic areas, have been allocated (see document Annex - Case Studies and Annex - MRF All Submitted Proposals Calls Direct Access 2024). A selected list of TA Target-Specific Case Studies is reported in Table 1:

Table 1 – List TA for target-specific Case Studies						
GP Number	MRF and ISIS beamline	Days	Proposal Title	Institution	Case Study-societal challenges	
2024003	XRD TOMOGRAPHY	5	<i>Characterisation of the degree of damage by neutron induced single-event effects on Heartmate 3 Ventricular Assist Device by means of X-Ray tomography</i>	Università Rome Tor Vergata and Niguarda Hospital	CS 4, 5 / Health, wellness, biomaterials	
2024004	SEM with correlative AFM	5	<i>Characterisation of the degree of damage by neutron induced single-event effects on Heartmate 3 Ventricular Assist Device by means of SEM measurements</i>	Università Rome Tor Vergata and Niguarda Hospital	CS 4, 5 / Health, wellness, biomaterials	
2024006	SEM with correlative AFM	3	<i>Morphological characterisation and compositional analysis of SiCa based Bioglasses using SEM- EDX</i>	Università Campus Bio-Medico di Roma	CS 5 / Health, wellness, biomaterials	
2024008	SEM with correlative AFM	3	<i>Characterisation of surgically removed vitreous humor samples by SEM measurements</i>	IRCCS Fondazione G.B. Bietti	CS 5 / Health, wellness, biomaterials	
2024010	AFM Raman	4	<i>Understanding ritual practices in Neolithic Saudi Arabia on horn sheaths from Mustatils using Raman spectroscopy</i>	Institut Català de Arqueologia Clàssica	CS 2 / Cultural, and Education	
2024011	Fluorescence Microscopy	1	<i>Understanding ritual practices in Neolithic Saudi Arabia on horn sheaths from Mustatils using Fluorescence Microscopy</i>	Institut Català de Arqueologia Clàssica	CS 5 / Health, wellness, biomaterials	
2024018	Fluorescence Microscopy	2	<i>Characterisation of surgically removed human vitreous samples by second harmonic generation microscopy measurements</i>	IRCCS Fondazione G.B. Bietti	CS 5 / Health, wellness, biomaterials	

2024020	Confocal Microscope 3	4	<i>Investigating Thermal Stability and Cellular Internalization Pathways of SARS-CoV-2 mRNA Vaccine</i>	IRCCS Mario Negri	CS 5 / Health, wellness, biomaterials
2024025	Raman Confocal Microscope	3	<i>Investigating the Source of Imperfections in Forged Brass Items Using Raman Confocal Microscopy</i>	CONSORZIO PHYSIS SRL SB	CS 2 / Cultural, and Education
2024026	SEM ZEISS SIGMA	3	<i>Investigating the Source of Imperfections in Forged Brass Items Using Scanning Electron Microscopy</i>	CONSORZIO PHYSIS SRL SB	CS 2 / Cultural, and Education
2024029	SEM FEI	3	<i>Morphological characterization of sustainable coatings containing antimicrobial nanoparticles applied on different kind of textiles for personal protective equipment (PPE)</i>	Next Technology Tecnotessile	CS 1 / Materials for Energy & Env & Climate
2024033	XRD TOMOGRAPHY	3	<i>Characterisation of the degree of damage by neutron induced single-event burnout failure in SiC MOSFET by means of X-Ray tomography</i>	STMicroelectronics	CS 4 / Neutron Space weather – ICT - Security
2024045	AFM Raman with Optical Profiler	3	<i>Investigating the Corrosive Impact of Chrome-Tanned Semi aniline Calf Leather using RAMAN Spectroscopy and Profilometry</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024046	ESCALB QXi	4	<i>Investigating the Corrosive Impact of Chrome-Tanned Semi aniline Calf Leather using X-ray Photoelectron Spectroscopy (XPS) and Ion Scattering Spectroscopy</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024047	FT-IR Nexus	1	<i>Investigating the Corrosive Impact of Chrome-Tanned Semi aniline Calf Leather using FT-IR Spectroscopy</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024048	SEM&C-AFM with Optical Profiler	3	<i>Investigating the Corrosive Impact of Chrome-Tanned Semi aniline Calf Leather using SEM with correlative EDX</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024049	XRD TOMOGRAPHY	1	<i>Ancient DNA analysis of a Neolithic human tooth from eastern Sicily XRD TOMOGRAPHY: insights and implications</i>	Museo e Istituto Fiorentino di Preistoria	CS 2 / Cultural, and Education
2024050	SAXS GISAXS	1	<i>Ancient DNA analysis of a Neolithic human tooth from eastern Sicily with SAXS GISAXS: insights and implications</i>	Museo e Istituto Fiorentino di Preistoria	CS 2 / Cultural, and Education
2024051	DNA Sequencing NGS	5	<i>Ancient DNA analysis of a Neolithic human tooth from eastern Sicily using NGS: insights and implications</i>	Museo e Istituto Fiorentino di Preistoria	CS 2 / Cultural, and Education
2024054	ESCALB QXi	1	<i>Training on X-ray Photoelectron Spectroscopy (XPS) with ESCALAB QXi X-Ray Photoelectron Spectrometer</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024055	SEM&C-AFM with Optical Profiler	3	<i>Silver diffusion in Glydco grain boundaries for ultra high vacuum applications</i>	Cecom Srl,	CS 1 / Materials for Energy & Env & Climate
2024059	RETINA	2	<i>Investigating the Corrosive Impact of Chrome-Tanned Semi aniline Calf Leather using XRF</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024065	SEM ZEISS SIGMA	2	<i>Training on Scanning electron Microscopy with SEM ZEISS SIGMA</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate

2024066	SEM&C-AFM with Optical Profiler	3	<i>Advanced Analysis of Surface and Composition Variations in Treated Brass Samples with Scanning Electron microscopy (SEM) and Profilometry</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024067	ESCALB QXi	3	<i>Advanced Analysis of Surface and Composition Variations in Treated Brass Samples with ESCALAB QXi (XPS)</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024068	SEM FEI	2	<i>SEM characterization of EoL fibers, and recycled non-wovens and compounds</i>	Next Technology Tecnotessile	CS 1 / Materials for Energy & Env & Climate
2024069	SAXS WAXD	3	<i>SAXS/WAXD characterization of EoL fibers, and recycled non-wovens and compounds</i>	Next Technology Tecnotessile	CS 1 / Materials for Energy & Env & Climate
2024076	RETINA	1	<i>A multidisciplinary proteomic study of the unique ancient Homo cepranensis petrous bone using RETINA</i>	Sovraintendenza	CS 2 / Cultural, and Education
2024077	Mass Spectrometer 2	2	<i>A multidisciplinary proteomic study of the unique ancient Homo cepranensis petrous bone using Mass Spectrometer instrument</i>	Sovraintendenza	CS 2 / Cultural, and Education
2024078	DNA Sequencing NGS	7	<i>A multidisciplinary aDNA study of the unique ancient Homo cepranensis petrous bone</i>	Sovraintendenza	CS 2 / Cultural, and Education
2024081	XRD TOMOGRAPHY	1	<i>Training on XRD TOMOGRAPHY (CNR-IPCB)</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024082	XRD TOMOGRAPHY	4	<i>Wire bending and adhesion investigation with XRD TOMOGRAPHY (CNR-IPCB)</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024086	Raman Confocal Microscope	3	<i>Advanced Analysis of Surface and Composition Variations in Treated Brass Samples with Raman Confocal Microscope</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024090	SEM&C-AFM with Optical Profiler	4	<i>SEM-EDX characterization of polymeric dosimeters for fast neutrons</i>	L.B. Servizi per le Aziende S.r.l.	CS 1 / Health, wellness, biomaterials
2024091	DNA Sequencing NGS	5	<i>Exploring the presence of aurochs from the prehistoric period to medieval times using ancient DNA</i>	Royal Belgian Institute of Natural Sciences	CS 2 / Cultural, and Education
2024094	MONeutron	90	<i>A power transistor monitor to record high energy neutrons</i>	STMicroelectronics	CS 3 / Digital, Industry, Space, Security, chip irradiation
2024096	TEM FEI	5	<i>TEM characterization of water dispersed fluorine-free polymer based nanoparticles</i>	CROMOGENIA UNIT	CS 2 and CS 3 / Environment and Climate
2024097	XRD TOMOGRAPHY	5	<i>Analysis of the distribution and morphology of hydrophobic/oleophobic coatings onto textiles by XRD tomography</i>	CROMOGENIA UNIT	CS 1 / Materials for Energy & Env & Climate e
2024098	SAXS WAXD	3	<i>Structural characterization of hydrophobic/oleophobic coatings by SAXS WAXD</i>	CROMOGENIA UNIT	CS 1 / Materials for Energy & Env & Climate
2024099	SEM&C-AFM with Optical Profiler	3	<i>Morphological characterization of hydrophobic/oleophobic nanoparticles and coatings by SEM@C-AFM</i>	CROMOGENIA UNIT	CS 1 / Materials for Energy & Env & Climate

2024101	FT-IR Nexus	1	<i>Stripping of surface treatments from ABS/metal composites: an FT-IR investigation</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024102	SEM ZEISS SIGMA	2	<i>Steel alloys behaviours to corrosion testing for metal accessories quality control with SEM ZEISS SIGMA</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024103	SEM ZEISS SIGMA	2	<i>Stripping of surface treatment from ABS articles investigation with SEM ZEISS SIGMA</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024104	SEM ZEISS SIGMA	2	<i>Wire bending and adhesion investigation with SEM ZEISS (Scanning Electron Microscopy)</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024113	DNA Sequencing NGS	5	<i>Genetic characterization of the Medieval community of Santa Severa</i>	Polo Museale Civico di Santa Marinella	CS 5 / Health, wellness, biomaterials
2024115	AFM	3	<i>Stiffness characterization of pancreatic ductal adenocarcinoma tissue</i>	San Raffaele Scientific Institute	CS 5 / Health, wellness, biomaterials
2024116	TEM FEI	3	<i>TEM characterization of innovative graphene-based inks for multifunctional applications</i>	GrapheneUP SE	CS 1 / Materials for Energy & Env & Climate
2024117	SEM FEI	2	<i>SEM characterization of innovative graphene-based inks for multifunctional applications</i>	GrapheneUP SE	CS 1 / Materials for Energy & Env & Climate
2024118	SAXS WAXD	3	<i>SAXS WAXD characterization of innovative graphene-based inks for multifunctional applications</i>	GrapheneUP SE	CS 1 / Materials for Energy & Env & Climate
2024119	Raman Confocal Microscope	3	<i>RAMAN confocal microscopy characterization of innovative graphene-based inks for multifunctional applications</i>	GrapheneUP SE	CS 1 / Materials for Energy & Env & Climate
2024121	SEM ZEISS GEMINI	3	<i>Identification and characterization of the size and shape of biodegradable microplastics in contaminated honey bees through SEM/EDX</i>	Università Cattolica del Sacro Cuore	CS 1 / Materials for Energy & Env & Climate
2024122	AFM	3	<i>Nanomechanical characterization of healthy and pathological lymphoid tissue</i>	Università Vita-Salute San Raffaele	CS 5 / Health, wellness, biomaterials
2024123	FIB-SEM GAIA 3	4	<i>Ca-Mg-Fe carbonates alteration of basalts at Sverrefjellet Volcano (Svalbard, Norway)</i>	Trinity College Dublin	CS 1 / Materials for Energy & Env & Climate
2024127	Mass Spectrometer 2	10	<i>Self-assembling peptidonucleic acids as novel biomaterials for tissue engineering</i>	Fondazione IRCCS Casa Sollievo della Sofferenza	CS 5 / Health, wellness, biomaterials
2024131	NMR 600 MHz	3	<i>Study of the chemical and structural characteristics of biodegradable microplastics in contaminated honey bees through NMR spectroscopy</i>	Università Cattolica del Sacro Cuore	CS 2 and CS 3 / Environment and Climate
2024132	Raman Confocal Microscope	1	<i>Stripping of surface treatment from ABS articles investigation with confocal RAMAN microscopy</i>	CONSORZIO PHYSIS SRL SB	CS 1 / Materials for Energy & Env & Climate
2024133	RETINA	3	<i>Characterization of Silicon Avalanche Photon Detectors (APD) for X-ray Fluorescence analysis</i>	RAYLAB	CS 1 / Materials for

					Energy & Env & Climate
2024147	AFM	6	<i>Exploring surface-induced mechanical forces and macrophage behaviour for microscale interactions with substrate topography</i>	Humanitas university	CS 5 / Health, wellness, biomaterials
2024151	AFM	5	<i>Investigating microbial colonization and removal on bioinspired wrinkled surfaces</i>	Humanitas university	CS 5 / Health, wellness, biomaterials
2024138	SAXS GISAXS	3	<i>Biogeochemical Multi-Instrumental Study of Rocks and Microbial Biomass in Zechstein Salt Deposits of Boulby Laboratory</i>	University of Edinburgh	CS 1 / Materials for Energy & Env & Climate
2024165	SAXS GISAXS	3	<i>Probing Structural Dynamics of Deep Eutectic Solvents Confined within the Pores of Bio-Metal- Organic Frameworks Using SAXS under Extreme Conditions</i>	S V NATIONAL INSTITUTE OF TECHNOLOGY	CS 7. / Energy Storage and Conversion Energy

5. Core funding, Research Projects and Daughter projects

Income is predominately from FOE. MUR has continuously allocated to IM@IT funds on FOE from 2002 to 2024. In addition to such core funding, IM@IT has operated and pursued various strategies, adopting a flexible approach to construct a collection of ‘Daughter’ projects (DP), with corresponding fundings. Each of these DP is related to one or more IM@IT Case Studies. The projects were submitted in response to public and/or private calls (see document Annex – IM@IT ‘Daughter’ projects).

The successful projects were mainly in the area of ICT-Space, so we are reallocating core funding to other areas, particularly in TA and personnel, to prevent them from over-dominating the programme."

5.1 Core funding

FOE 2022 (MUR) (550.000 € transferred to IM@IT)

FOE 2023 (MUR) (600.000 € transferred to IM@IT)

FOE 2024 (MUR) (1.050.000 € to be transferred by end of 2024)

5.2 ‘Daughter’ funding projects

1. **HARDEST** (*submitted 2023, approved August 2024*) – “HANE HARDENING FOR SATELLITE SYSTEMS”. Funded by Ministry of Defence. ‘Daughter’ project (TA for target-specific Case Study 4).
2. **HiCHIP** (*Approved 2024-2025*) – “Radiation hardness tests of hard Si/SiC/GaAs/GaN based chips and chip components of pacing-based devices for biomedical

applications". Funded by Ministry of Defence. 'Daughter' project (TA for target-specific Case Study 4 and Case Study 5).

3. **SMACH- EU-SEE Forum for intercultural exchange on Sustainable Management of Cultural Heritage (Approved 2023-2024)**. Funded by CEI-KEP CALL KEP 2023. 'Daughter' project (TA for target-specific Case Study 1).
4. **FRUIPAD (Approved 2024-2025)**, "Exploitation of Fruit by-products of Mediterranean countries for developing compatible, biodegradable, and sustainable active pads, intended for food packaging applications". Funded by MUR. 'Daughter' project (TA for target-specific Case Study 1).
5. **CHARMANT (2023 submitted and funded 2024-2025)** – Extreme space weather events and their impact on the ageing of human body, biological systems, and electronic systems. Program strengthening RI' (civil building for MRF, for target-specific Case Study 4, Case Study 5)
6. **euMATERIA**. In August 2023, IM@IT promoted an initiative for a new research infrastructure which mirrors the structure and operating mode of IM@IT prototype aiming to make it sustainable in the long term. Meanwhile in view of the call ESFRI Roadmap 2026 we started a strong coordinated action to constitute a European team which, in February 2024, jointly signed for euMATERIA Science case - Concept and Feasibility Report. If the ESFRI project were successful, through euMATERIA project IM@IT will start the transition to become sustainable from 2027.

More details on 'Daughter' projects are in document Annex – 'Daughter' projects.

6. Key Milestones

During 2024, IM@IT has achieved several key milestones:

- **Expansion of research activities (challenge driven)**: The organisation has significantly broadened the scope of its research efforts, with a scientific agenda challenge driven – i.e. it is not focussed on a particular technique, or on a particular research area, but provides researchers with a portfolio of techniques to deploy to address a challenge.
- **Significant increase in the number of users**: IM@IT has attracted a growing community of users, demonstrating the increasing demand for its resources, analytical

facilities and training. This growth highlights the value and impact of the infrastructure and support IM@IT provides to the research community.

- **Expansion of available MRF and SFR:** IM@IT has made substantial investments in expanding the number of MRF and SFR accessible to its users. This has enhanced the organization's capacity to accommodate a wider range of scientific projects and fostered more collaborative research opportunities.
- **Strengthening of organizational structure:** In response to its expanding activities, IM@IT has bolstered its internal structure by hiring key leadership positions, including a Science Director (12th March 2023), Program Manager, and a member of User Office (1st October 2024). Positions are funded within the core funding FOE 2023. By the end of 2024, we will complete the recruitment of first group of researchers in the role of Instrument scientists for MRF (see section 7.). These strategic hires have ensured that IM@IT remains well-positioned to manage its growth, support its users effectively, and sustain high standards of scientific excellence.
- **Demonstration of leadership at the national and European levels.** IM@IT has showcased its foresight by recognizing that its innovative operational model could be scaled and shared beyond national borders, i.e. at European level. In a significant leadership move, the organization has successfully engaged high-level institutions across Europe and coordinated the design of the euMATERIA project (see document euMATERIA. This initiative leverages IM@IT team expertise and scientific agenda driven by challenges making the euMATERIA project unique in the European landscape.

7. Core Funding and Sustainability

FOE public funding ('core funding') from MUR should remain the 'bedrock' upon which IM@IT is built and sustained. A RI such as IM@IT, which provides TA and services to many and varied external users, cannot operate sustainably based only on short-term 'Daughter' projects for specific research projects, or contract services for industry, though such funding can complement and enhance the services offered by IM@IT. Since 2022 and until 2024 personnel of the universities and research centres operated the two DA Calls for user TA, i.e. this has been the unvaluable in-kind additional source of income for IM@IT.

A significant proportion of continuous ‘core funding’ from MUR is required to guarantee IM@IT sustainability.

Starting FOE 2024, the level of core funding allocated by MUR will enable the start of growth of IM@IT in terms of a pool of expertise (executive director, science director, program manager, user office, senior-expert-junior-technicians), which will be dedicated to run the complex and multilevel operation of the facility.

The level of core funding that should be allocated from MUR on FOE 2025 to FOE 2027 to maintain a constant grow of IM@IT operation is reported in Table 2. This must include support for the recruitment of a) core staff for the RI head office (website responsible & developer and user office to deliver the TA); b) core staff based at the IM@IT universities or research centres, to operate the suite of MRF, i.e., executive director, science director, user office members, beam/instrument senior researchers with expertise in the appropriate use for an individual research problem, and technicians with adequate technical capacity for the use of equipment [see Table 2]. Maintenance costs are not included.

By 2028 then IM@IT will operate in sustainable way, with core funding to support all the cost of the staff operating the IM@IT’ facility plus some additional cost for TA.

Table 2. – Level of core funding required to maintain small & constant grow of IM@IT operation

	2022 (€)	2023 (€)	2024 (€)	2025 (€)	2026 (€)	2027 (€)
FOE MUR	550.000	600.000	1.050.000	1.500.000	1.500.000	1.500.000

Once fully operational and sustainable, from 2028 IM@IT will became agile; beamline scientists will provide service to SRF and TA to MRF-LSF, manage peer reviews and do jointly research with users. MUR could refer to IM@IT, for example, to finance TA in specific target areas to boost research in certain thematic areas, related to societal challenges or other MUR strategic priorities.

Our vision is for IM@IT to become a widespread tool for the education and training of new generations of technical and scientific staff. This is a crucial aspect to secure adequate and sustainable funding for the proper operation, maintenance and development of IM@IT, as well as providing incentives for increased staff mobility between other PSE-Research Infrastructures to allow the exchange of skills and foster collaborations between teams, institutions, implementing and disseminating the initiatives.

8. The transition to ESFRI

During the past year, IM@IT has taken the leadership in exploring the possibility of joining forces with related capabilities elsewhere in Europe and operating as a European Strategic Forum on Research Infrastructures (ESFRI). A consortium of potential partners in 8 other countries has been formed under the name euMATERIA.

The euMATERIA proposal (see document Annex – euMATERIA SCFR and Annex - ESFRI Roadmap 2026 and Timeline) represents the groundbreaking project from 2027. euMATERIA is an initiative formed to promote a new ESFRI Research Infrastructure at European level that will offer researchers opportunities for collaborative research, training and transnational access to a diverse suite of advanced and highly specialised MRF. Although individual techniques may be available elsewhere the euMATERIA combination is unique in the European landscape.

euMATERIA aims to promote, enable and support new and innovative multidisciplinary research on such MRF to address emerging scientific problems and key societal challenges, particularly in the areas of materials, energy storage, environment, ICT and health. To address complex materials problems the infrastructure will bring together hubs of expertise located at university and national laboratories (research centres and industry) in the Czech Republic, France, Germany, Italy, Hungary, the Netherlands, Spain, Switzerland, Poland and the United Kingdom. Together they will provide a highly transversal portfolio of capabilities not currently covered by a single national laboratory or university. euMATERIA aims to be strongly challenge driven, providing European researchers open and free access to expertise and advanced analytical techniques they may not have previously used within their research. It aims to engage and train researchers within Europe to exploit the investment made in advanced instrumentation at MRF and to also provide a trained pipeline of researchers who can go on to further exploit the large-scale facilities within Europe.

The proposal mirrors the IM@IT structure and operation modes (feasibility of implementing within 10 years and lifetime for at least 30 years).

ESFRI Planning – New proposals

STEPS	TIMELINE
INFODAY	8 October 2024
OPEN CALL FOR PROPOSALS	8 October 2024
SUBMISSION OF PROPOSALS	8 April 2025
CRITICAL QUESTIONS & INVITATION TO HEARINGS	December 2025
HEARINGS	February 2026
ESFRI FORUM DECISION	June-September 2026
ESFRI ROADMAP LAUNCH	December 2026

The ESFRI project requires three eligibility Criteria:

- Proof of robust financial commitment by, at least, two Member States, Associated Countries or EuroForum members.
- Proof of political Support by Lead country plus at least 2 MS/AC or Euroforum members.
- Proof of an inter-institutional and multi-lateral agreement (MOUs).

The letters of commitment from the national authorities or institutes must cover the “usual, expected” running costs for the individual site’s infrastructures. If euMATERIA were selected, we can apply to a HEU EU-funded project..

Discussions are underway to obtain the necessary commitments to enable a formal proposal to ESFRI (April 2025) for inclusion in the 2026 ESFRI roadmap. Within Italy, this would open the possibility of further long-term funding, enabling the expansion of IM@IT activities as required by its internationalisation, but also making facilities in other countries available to Italian researchers.

For the euMATERIA initiative, we request SAC’s strong backing in engaging with public decision makers (MUR and CNR) to ensure that, by December 2024, they formally convey to ESFRI their financial and political commitment in support of euMATERIA project for a duration of 10 years from 2027.