





Supporting Heritage Science Research with E-RIHS

Vision and Strategy

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Head of E-RIHS Coordination Office

Odessa, 2019 December 6th

Opportunities for the Use of Research Infrastructures
for Ukrainian Scientists and Entrepreneurs



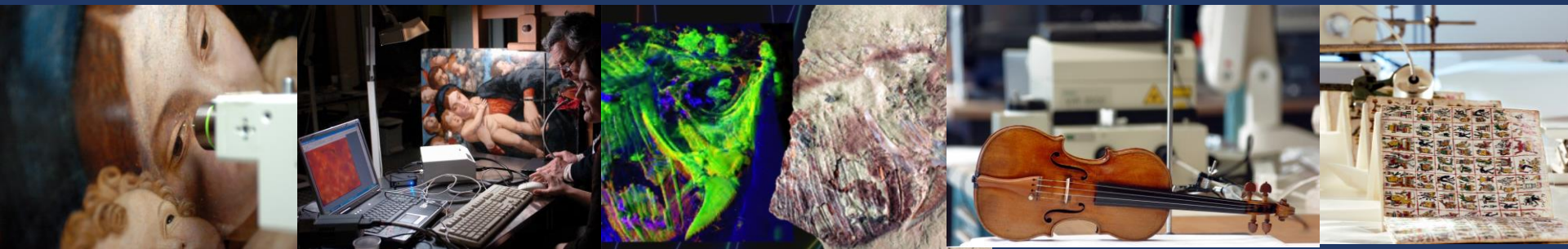
E-RIHS vision

a RI for heritage science



E-RIHS core mission

- ❑ provide **access to cutting-edge instruments and services** fostering advancements in heritage science
- ❑ operate at **global level**
- ❑ targeting **interdisciplinary communities** of users





E-RIHS [ˈɪrɪs] European Research Infrastructure for Heritage Science

- a collection of **advanced tools** and **services** for (and by) interdisciplinary communities of researchers
- a **distributed** research infrastructure – about 100 facilities – currently involving **29** countries (and counting...)
- a Project in the **ESFRI Roadmap** since 2016 (GSO since 2015)
- coordinated by CNR, **IT**





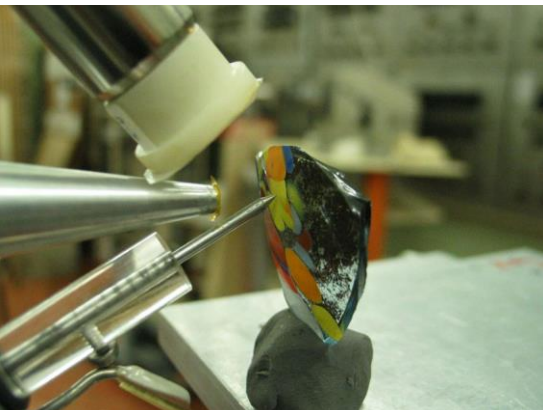
E-RIHS heritage science definition

heritage science is an interdisciplinary domain of scientific study of heritage

heritage science draws on diverse **humanities**, **sciences** and **engineering** disciplines

it focuses on enhancing the **understanding**, **care** and **sustainable use** of heritage so it can enrich people's lives, both today and in the future

heritage science is an umbrella term encompassing all forms of scientific enquiry into human works and the combined works of nature and humans, of value to people



access strategies
the E-RIHS platforms



E-RIHS access platforms



ARCHLAB

access heritage archives and collections



DIGILAB

data and tools for heritage research



FIXLAB

access LSF and advanced laboratories



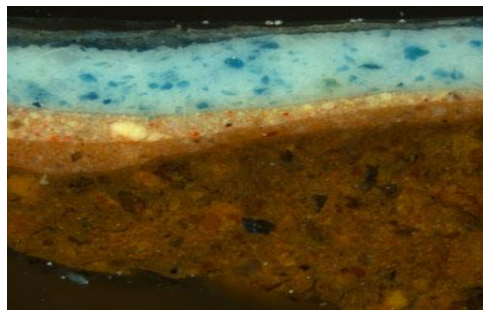
MOLAB

mobile instruments for in-situ diagnostics

*E-RIHS is committed to provide excellence-driven access
i.e. free access to its services via periodic peer-reviewed calls*

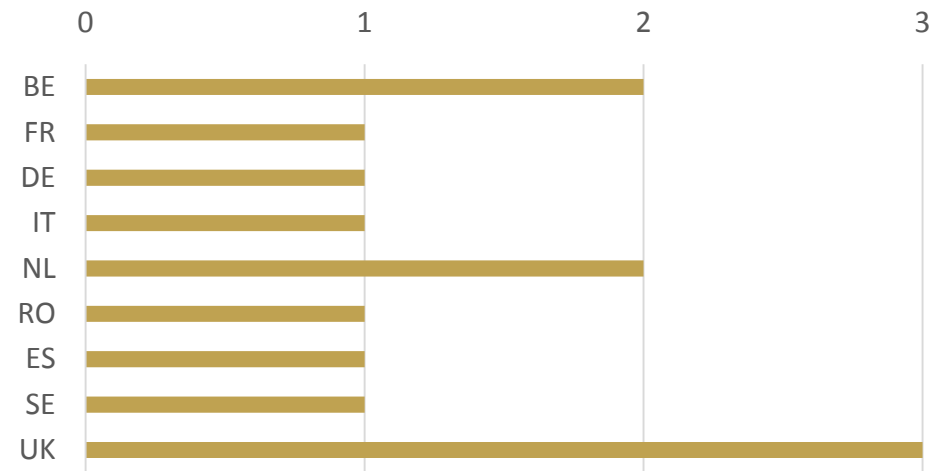


ARCHLAB scientific archives for heritage science





IPERION HS ARCHLAB providers/country

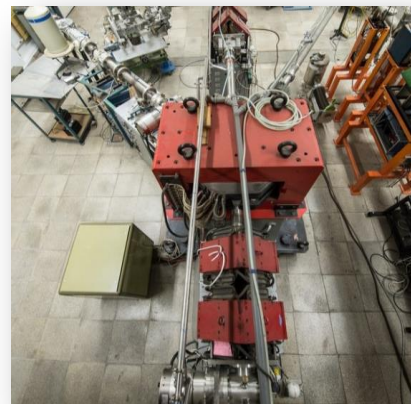


enable access to combined knowledge in repositories in **9 countries** (Belgium, France, Germany, Italy, The Netherlands, Romania, Spain, Sweden and the UK) through **13 provides**

Koninklijk Inst. voor het Kunstpatrimonium, **BE**; Centre de Recherche et des Restauration des Musées de France, **FR**; Rathgen Forschungslabor Staatliche Museen zu Berlin, **DE**; Opificio delle Pietre Dure, Firenze, **IT**; Rijksdienst voor het Cultureel Erfgoed and Groningen Institute of Archaeology, **NL**; National Institute of Heritage, **RO**; Instituto del Patrimonio Cultural de España, **ES**; The Craft Laboratory, **SE**; The British Museum and the National Gallery and Historic England Lab, **UK**



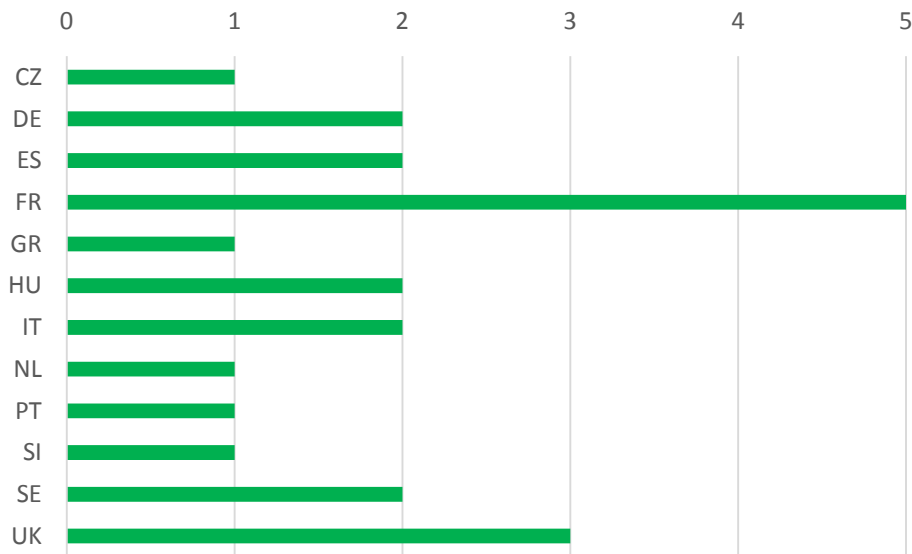
FIXLAB access to LSF and advanced laboratory facilities



particle accelerators, neutron and laser sources and other essentially non-transportable research facilities



IPERION HS FIXLAB providers/country



consists of **23 key research facilities** distributed in **12 countries**

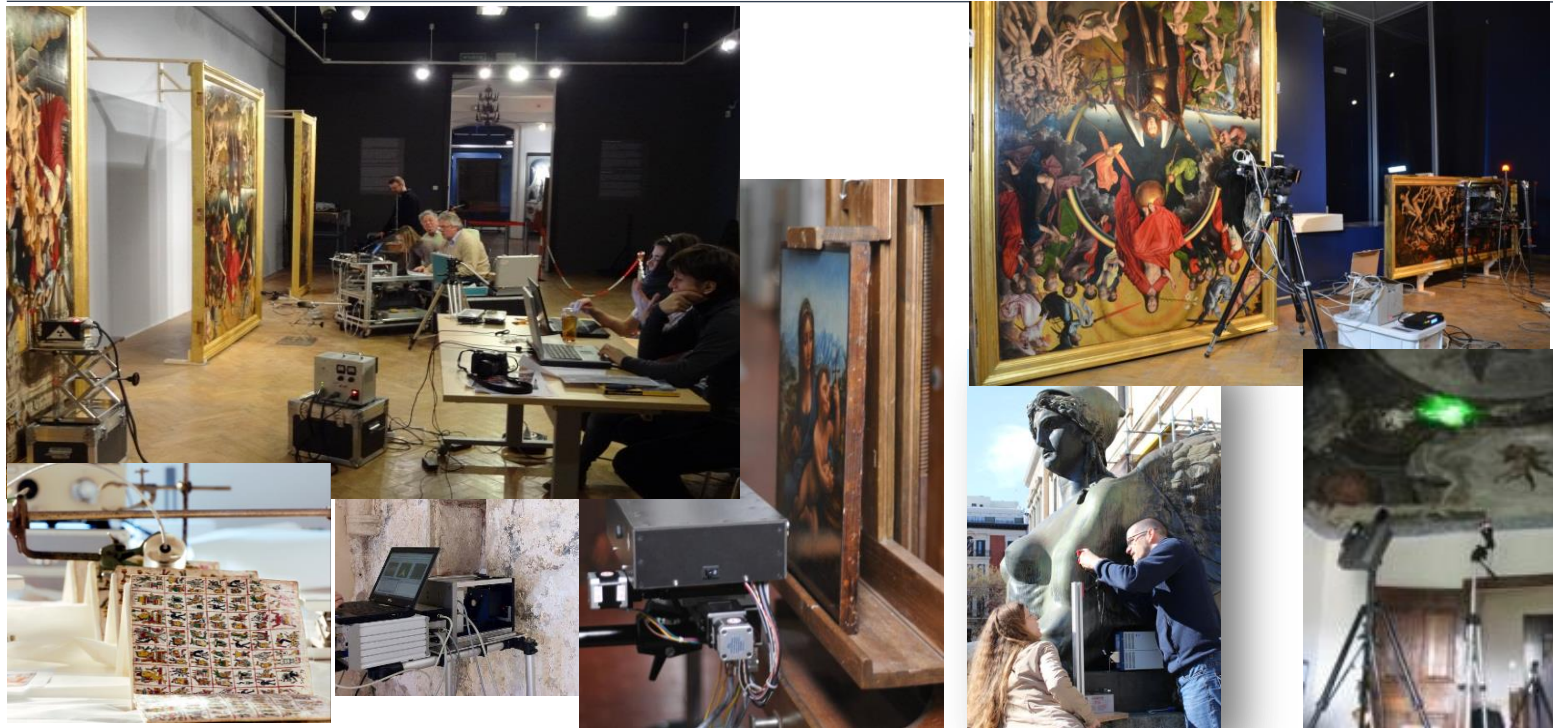
- large scientific instruments (Synchrotron, IBA, Neutrons, proteomics, C14, etc.);
- specialised scientific platforms for cultural heritage (laser platform, tomography, etc.);
- specialised scientific platforms for archaeology and palaeontology/palaeoanthropology;
- specialised scientific platforms for restoration and preventive conservation

X-ray microCT device, **CZ**; Curt-Engelhorn-Zentrum Archäometrie and Neutron Lab, **DE**; Laser and Geochronology lab, **ES**; Aglae, synchrotron SOLEIL, proteomics, **FR**; Photonics for HS, **GR**; IBA and Neutron Lab, **HU**; Mass-spec. Isotopic and Radiocarbon lab, **IT**; Geological and geochemical, **NL**; Mater. Lab, **PT**; Ancient DNA Lab, **SE**; Heritage macromolecular Lab, **SI**; BioArch, Proteomics, Genomics, Preventive Conservation Lab, **UK**



MOLAB mobile instruments for *in-situ* diagnostics

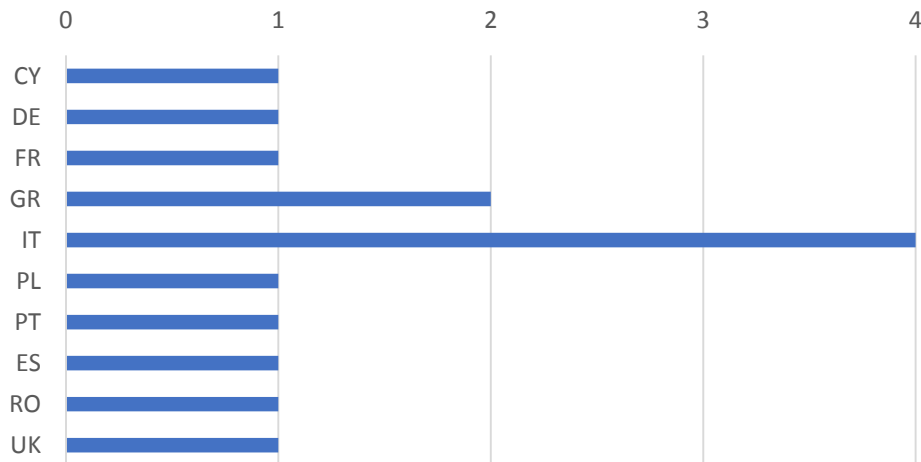
the facility
moves to
the user



a comprehensive selection of **mobile analytical instrumentation** for in-situ measurements (**close-range and remote sensing**) on **objects, collections, buildings, and sites**, allowing non-invasive investigations for complex multi-technique diagnostic projects



IPERION HS MOLAB providers/country



a toolbox of **38** different high-performance and well-integrated portable experimental techniques (ranging from point analysis, 2D/3D and multispectral/hyperspectral imaging and remote sensing)

provided in **10 countries** through **14 providers**

Dendrochronology/3D documentation, **CY**; Nuclear magnetic resonance, **DE**; Imaging/optical methods/X-ray diffraction, **FR**; Geophysical and 3D/2D optical/acoustic methods, **GR**; Molecular spectroscopies, hyperspectral imaging, 3D/2D optical methods, X-ray imaging, Aerial remote sensing, **IT**; Optical Coherence Tomography, **PL**; Biochemistry, **PT**; Electrochemistry, **ES**; Aerial remote sensing; **RO**; Ground remote sensing, **UK**

Excellence

Supporting outstanding projects

Integrating access procedures (centrally managed)

- Improve and facilitate user experience in designing proposals to apply for **multi-instrument and multi-facility** research projects
- **A single entry point** for short- and long-term and exploratory projects (expert and new users)
- **Building catalogue of services**
- A transparent, quick and efficient selection process that centrally integrates heritage criteria

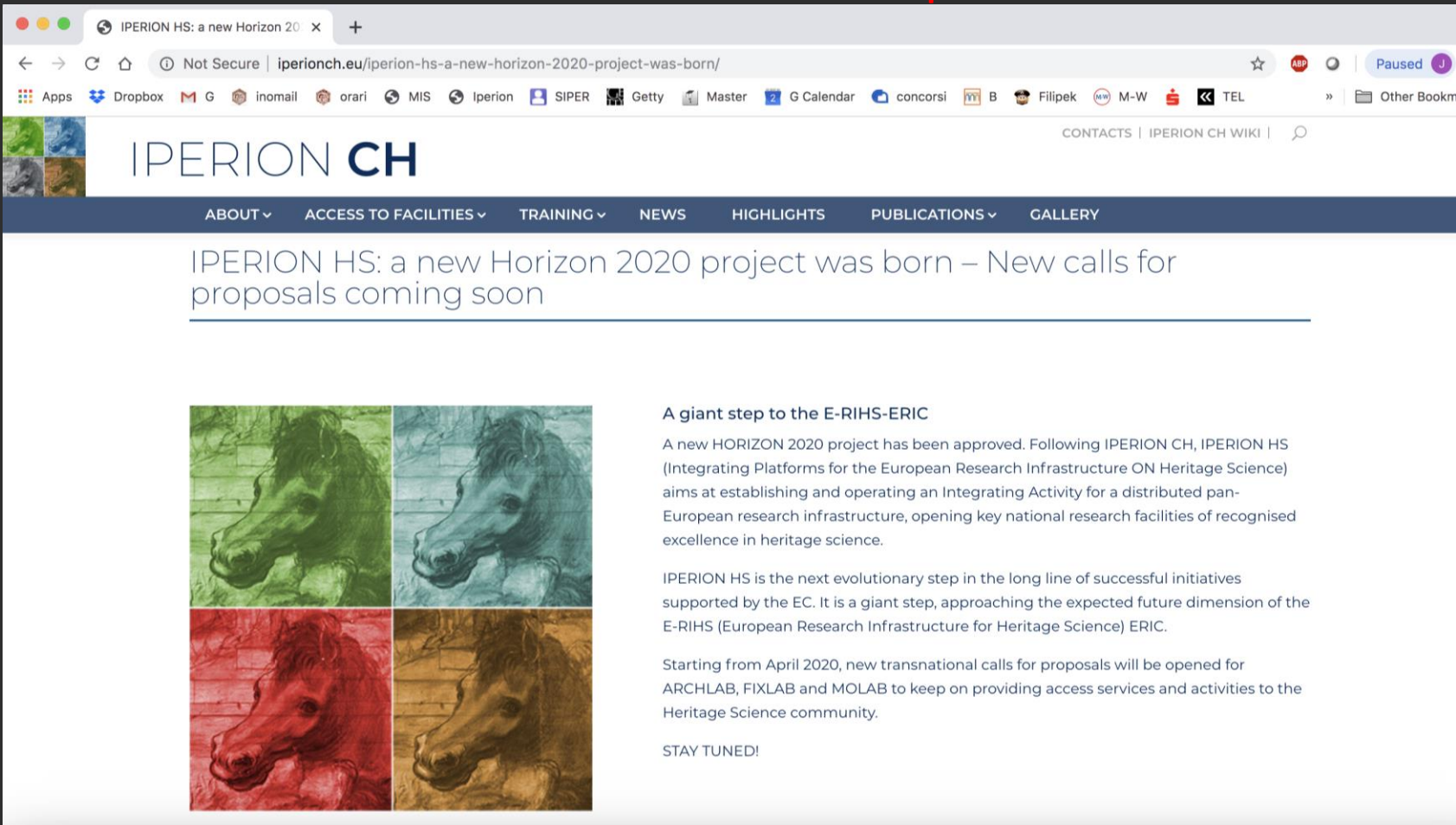


E-RIHS

EUROPEAN RESEARCH INFRASTRUCTURE
FOR HERITAGE SCIENCE



IPERION HS



The screenshot shows a web browser displaying the IPERION CH website. The browser's address bar shows the URL `iperionch.eu/iperion-hs-a-new-horizon-2020-project-was-born/`. The website header includes the IPERION CH logo and navigation links for CONTACTS and IPERION CH WIKI. A dark blue navigation bar contains the following menu items: ABOUT, ACCESS TO FACILITIES, TRAINING, NEWS, HIGHLIGHTS, PUBLICATIONS, and GALLERY. The main content area features a large heading: "IPERION HS: a new Horizon 2020 project was born – New calls for proposals coming soon". Below this heading is a 2x2 grid of images showing a horse's head in different colors: green (top-left), blue (top-right), red (bottom-left), and brown (bottom-right). To the right of the images is a text block with the following content:

A giant step to the E-RIHS-ERIC

A new HORIZON 2020 project has been approved. Following IPERION CH, IPERION HS (Integrating Platforms for the European Research Infrastructure ON Heritage Science) aims at establishing and operating an Integrating Activity for a distributed pan-European research infrastructure, opening key national research facilities of recognised excellence in heritage science.

IPERION HS is the next evolutionary step in the long line of successful initiatives supported by the EC. It is a giant step, approaching the expected future dimension of the E-RIHS (European Research Infrastructure for Heritage Science) ERIC.

Starting from April 2020, new transnational calls for proposals will be opened for ARCHLAB, FIXLAB and MOLAB to keep on providing access services and activities to the Heritage Science community.

STAY TUNED!

Trans-national access: procedures

- Access provision managed through the Access Board (internal advisory body)
- User applies through a single digital entry point (www.iperionhs.eu)
 - Submission always opened (2 cut-off deadlines/year)
 - Proposal elaborated by interacting with Access officer at Central hub and help-desks operating at each platform
- Evaluation of proposals:
 - Technical feasibility (internal check by the providers)
 - Scientific excellence and originality (external peer-review panels)
 - winning projects get free access to the infrastructure
 - cost of the access provided to users is covered by the European Commission (ca. 50% of the project budget)
- Project Summary/User Report
- User Satisfaction Survey



Potential KPIs evaluating TNA quality

KPI	Applies to...	Unit of measure
Access provision efficiency	ARCHLAB, FIXLAB, MOLAB	% of accesses provided vs. planned
User support quality	ARCHLAB, FIXLAB, MOLAB	% of proposals accepted by PRP vs. available access slots
Efficiency of TNA user outreach	ARCHLAB, FIXLAB, MOLAB	% of submitted projects vs. available access slots
Access quality	ARCHLAB, FIXLAB, MOLAB	% of users rating satisfaction for services in the two top categories
Training event quality	WP7	% of attendees rating usefulness of a course in the top category
Scientific quality	Publications referring to IPERION HS as a source of financing	Number of peer-reviewed publications at conferences or in open-access international scientific journals
Scientific interest	invitations related to the project or its results	Number of invitations as speakers at international conferences



supporting research
in heritage science



E-RIHS access highlights



ARCHLAB

access heritage archives and collections



DIGILAB

data and tools for heritage research



FIXLAB

access LSF and advanced laboratories



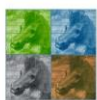
MOLAB

mobile instruments for in-situ diagnostics



E-RIHS access highlights

- ✓ materials and execution techniques of ancient and modern paintings (by Giotto, Leonardo, Rubens, Van Gogh, Munch, Picasso etc.)
- ✓ conservation state of buildings and archaeological sites (e.g. Merida, Alcázar of Seville, both UNESCO World Heritage Sites)
- ✓ writing, decoration techniques and illuminations of ancient manuscripts (e.g. Islamic codices and opisthographic and multilayered papyri from Herculaneum) and of other types of heritage objects such as wall paintings, sculptures, violins, stained glass window



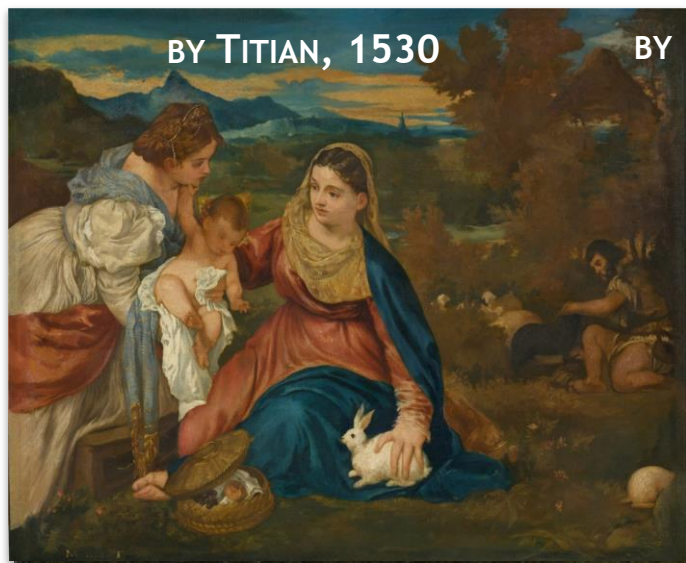
Scope of the access: shedding light on technical decisions taken by Manet in 1856 when copying the Titian's original painting

Major research activities:

Exploring IR imaging and XRF datasets on Manet from the CNR, INFN (IT) and from the C2RMF (FR) archives

Heritage objects:

The two Madonna of the Rabbit
Titian ~ 1525 and Manet ~ 1856
@Musée du Louvre



Research outcomes:

Manet was no fan “of virtual restoration”...

The artist did not try to match the supposed original appearance of the painting. The study demonstrates that its palette for the copy was chosen to the “current” conservation state of Titian's work. This is even more clear after the recent restoration. “Hot paper” in *Angewandte Chemie*, 2018, vol. 57

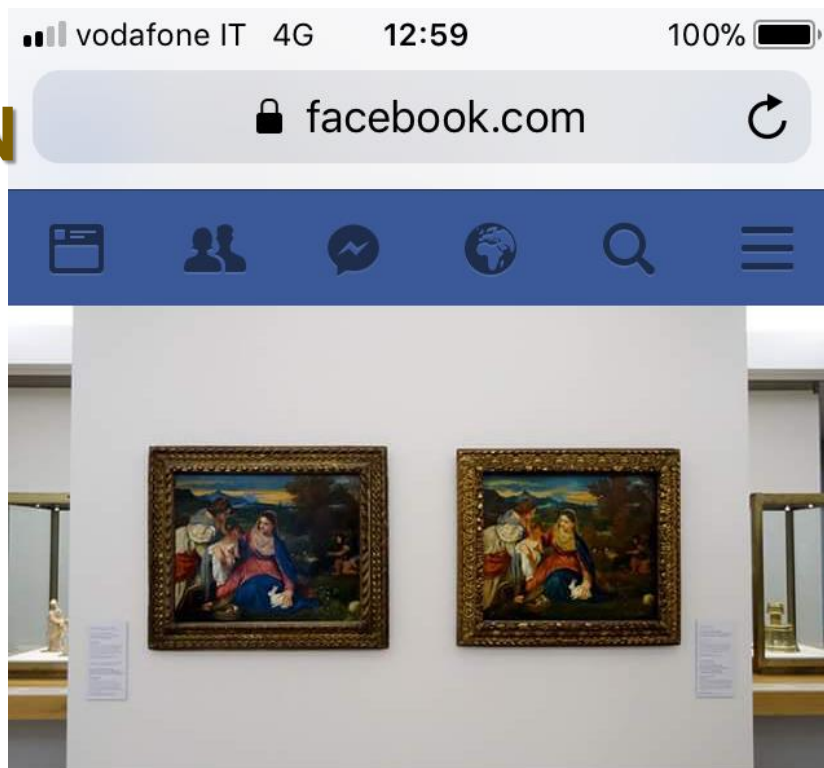


**FROM ITS ORIGIN
(1856)**

**BACK TO ITS
ORIGIN**

FROM 2017

**At LOUVRE
Next to Titian**

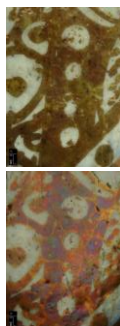
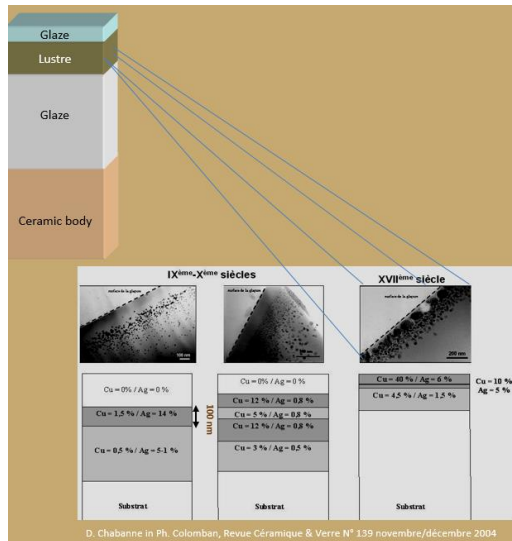


Musée du Louvre

Nouvel accrochage de la salle des actualités du Pavillon de l'Horloge ©
2017 Musée du Louvre / Arnaud de Coninck

Scope of the access:

Understanding the lustre optical properties in relation to their composition – the observed dichroic behaviour is due to Ag/Cu nano-particles in the glaze



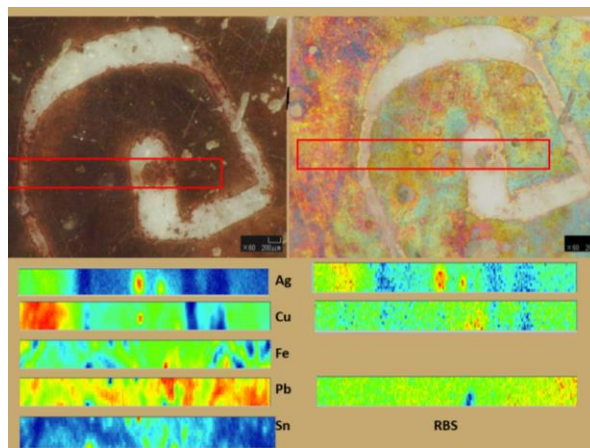
Heritage objects:

Unique Iranian lustre tiles from the British Museum
XIV century



Major research activities:

PIXE and RBS at AGLAE



Research outcomes:

Towards a “lustre cookbook”

Enrichment of the database of lustre recipes (>150 pieces measured).

New protocol and data treatment for this type of analyses – PIXE and RBS mapping – at AGLAE.

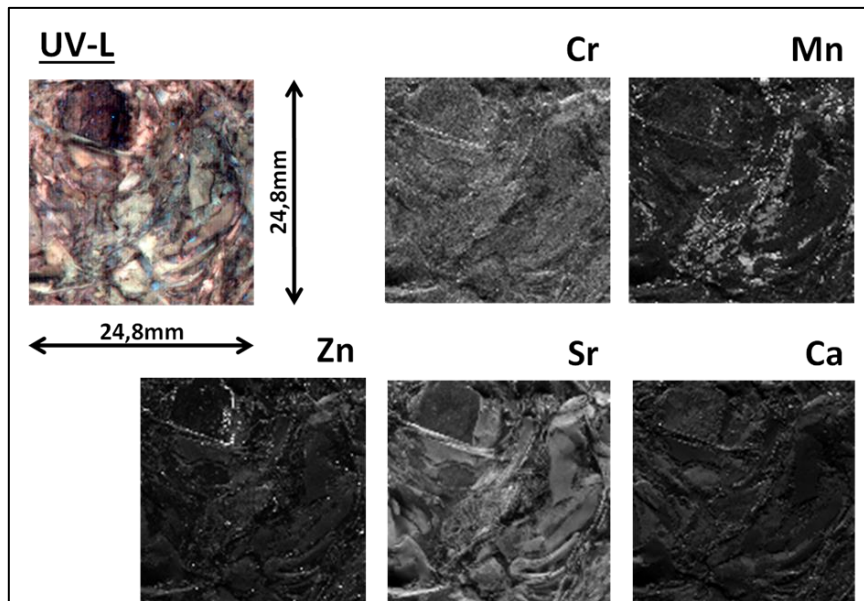
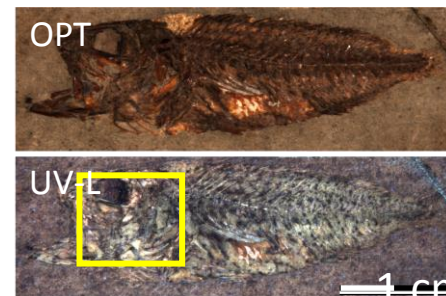


Scope of the access:

Deciphering exceptional fossilization process of 50 Myrs fossils from Italy

Heritage object:

Fossil actinopterygians from the Eocene ~50 Myrs BC



Major research activities:

Coupled synchrotron-X-ray fluorescence imaging and UV luminescence imaging at SOLEIL

Research outcome:

Trace elements to get the story told

Revealed the spatial distribution of trace elements within mineralized soft tissues and bones.



Scope of the access:

Revealing a hidden underdrawing
previously discovered by low-
resolution instruments



Photo © The National Gallery, London.

Heritage object:

Virgin of the Rocks by Leonardo ~1484
@The National Gallery of London



Major research activities:

Scanning Infrared and RGB imaging of the painting

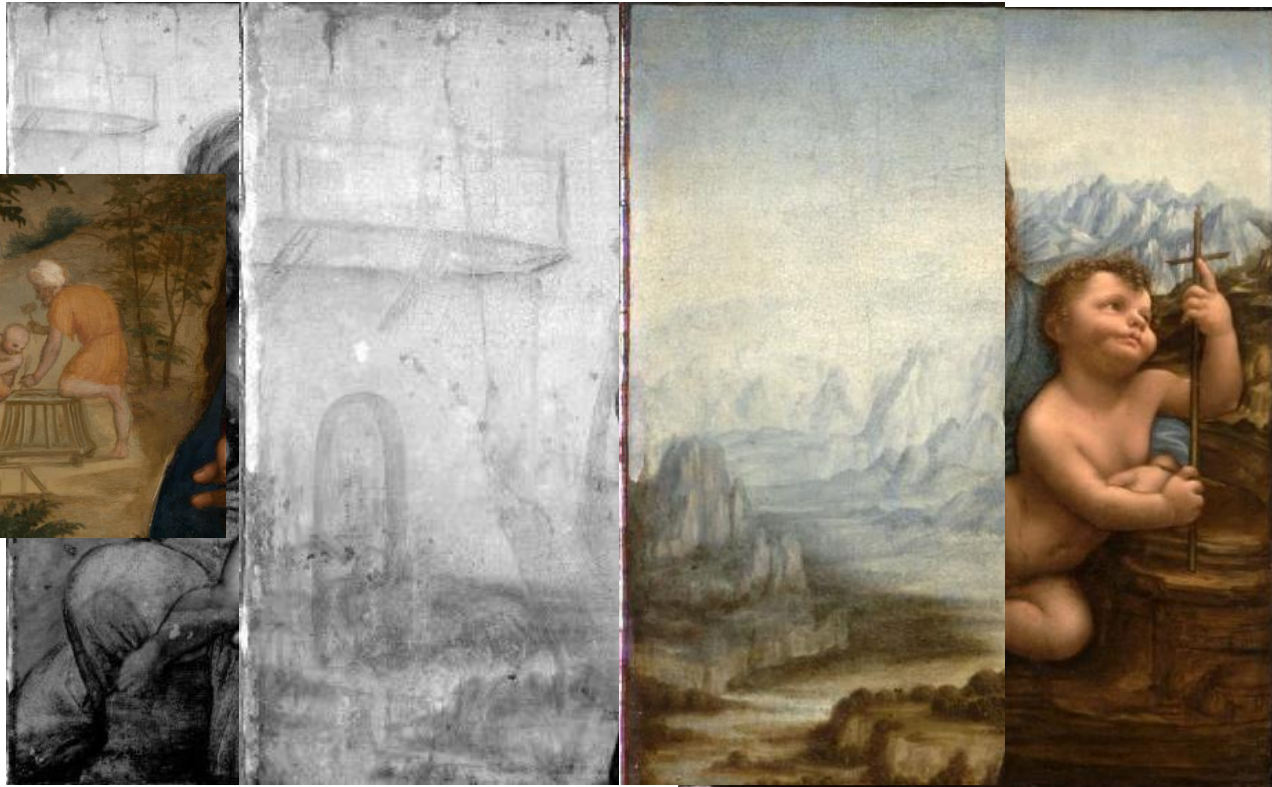
Research outcomes:

A new Leonardo revealed

A fully sketched original Leonardo
underdrawing was revealed thanks to the
higher resolution of the MOLAB instrument.
Resonance in international media was huge.



COLAB



hidden
underdr
and hist

Heritag object:

Virgin of
Yarnwin
to Leonardo

Major research activities:

Scanning Infrared
and RGB imaging
of the painting

Research outcomes:

New elements
shed light on
the genesis of
the motif by
comparing its
materials and
techniques
with three
contemporary
copies.



Exhibition Leonardo da Vinci

from October 24, 2019 to February 24, 2020; Louvre, Paris

A screenshot of the Louvre Museum's website. The browser address bar shows 'r/en/expositions/leonardo-da-vinci'. The page features a dark navigation bar with the Louvre logo and menu items: 'PLAN YOUR VISIT', 'ACTIVITIES & TOURS', 'EXHIBITIONS & EVENTS', 'COLLECTION & LOUVRE PALACE', and 'LEARNING ABOUT ART'. A red 'BUY YOUR TICKET' button is on the right. Below the navigation bar, an orange banner contains 'Exhibitions & Events', 'Exhibitions', and 'Leonardo da Vinci'. The main content area has a white background with a 'Previous Exhibition' link on the left and a 'Next Exhibition' link on the right. The central text reads 'Exhibition Leonardo da Vinci from October 24, 2019 to February 24, 2020'. Below this is a large image of a portrait of a woman, identified as 'Léonard de Vinci, Portrait de femme'. The caption at the bottom left of the image reads: 'Léonard de Vinci, Portrait de femme © RMN-Grand Palais (musée du Louvre) / Michel Urtado'. The bottom of the page shows a dark blue footer with the E-RIHS logo and the website URL 'www.e-rihs.eu'.



OCT scattering maps (12x 12 mm²) showing structures present at:

Scope of the access:

Revealing painting's and history

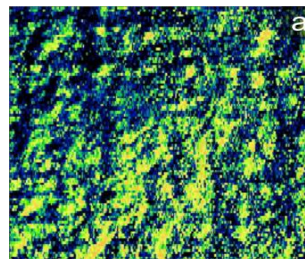
Revealing painting's and history

Heritage object:

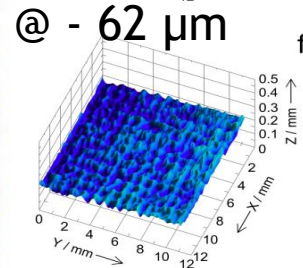
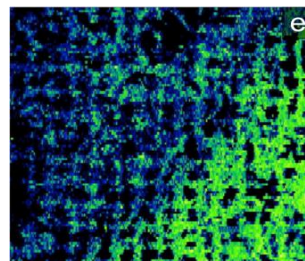
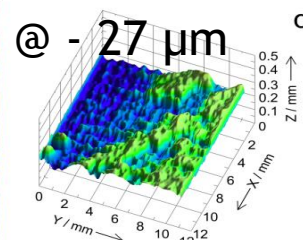
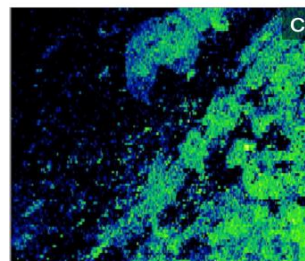
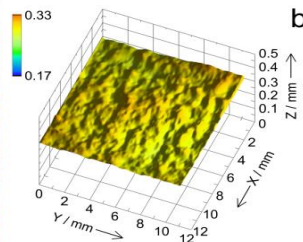
Virgin of the Yarnwinder by Leonardo ~1484

Major research activities:

OCT



the surface



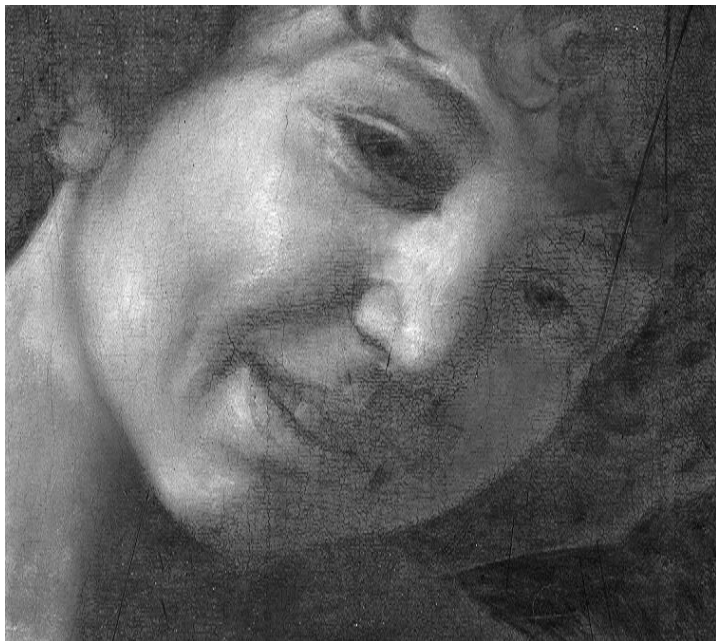
Research outcomes:

a criss-crossed pattern is a proof of a past renovation of the painting, when pictorial layers were transferred from wooden to canvas support.



Scope of the access:

Assessing the possible – and widely disputed
– use of the *underdrawing* by Caravaggio



Heritage object:

Amor vincit omnia by Caravaggio ~1602
@Gemäldegalerie Berlin

Major research activities:

Scanning Infrared and RGB imaging
of the painting

Research outcome:

Caravaggio was no exception
Experimental evidence of the use
of *underdrawing* by Caravaggio,
ending a 400-year-long dispute.





Scopes of the access:

Shedding light on the **darkening of yellow paint areas** coupled with signs of physical deterioration; **monitoring cleaning tests of the synthetic varnish.**



Heritage object:

Sunflowers by Van Gogh 1889

@ Van Gogh Museum, Amsterdam, The Netherlands

Major research activities:

Investigate pigments by non invasive multi-analytical techniques

Cleaning tests for varnish removal monitored by Optical Coherence Tomography (OCT) and Reflectance FTIR

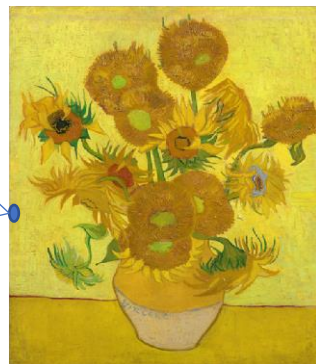
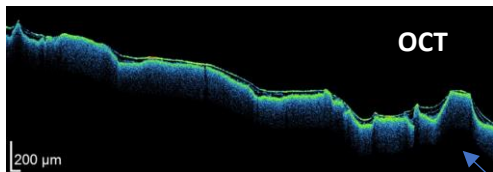
Research outcomes:

Sunflowers are not supposed to be green!

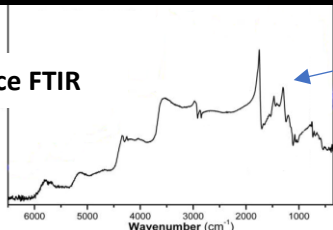
Understanding of color alteration processes.

Demonstration of feasibility of controlled varnish removal.

Of great interest to scholars and general public alike.

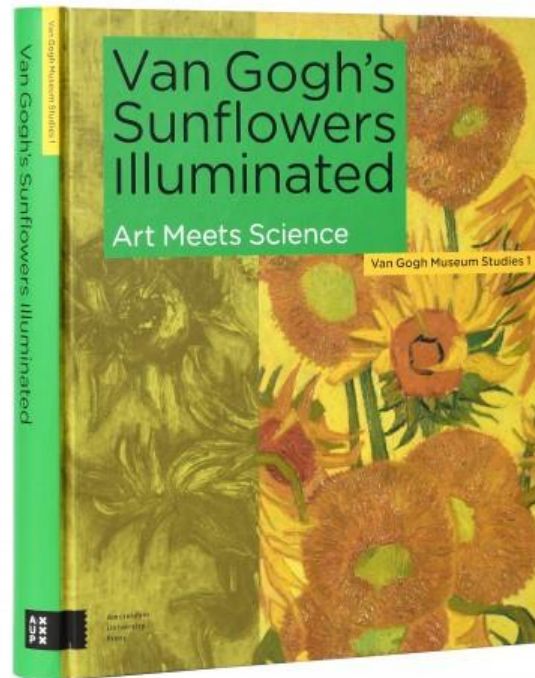


Reflectance FTIR





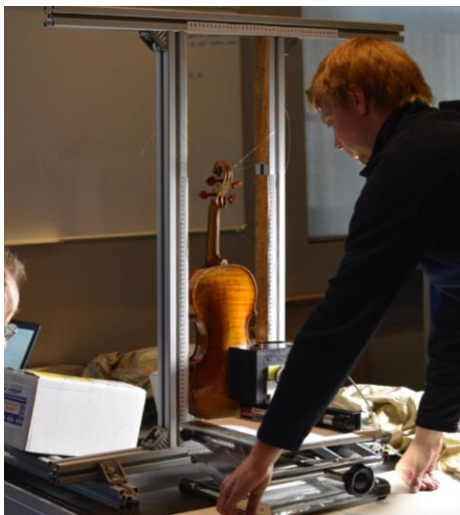
The book summarises the state of the knowledge of the structure of the painting and its state of preservation





Scopes of the access:

- evaluate the **modification of the elasticity** of the wood through surface treatment and age
- accurate **thickness measure** and appearance, condition and properties of **varnishes** in ancient violins



Heritage object:

violins by Antonio **Stradivari**, Giuseppe Guarneri 'del Gesu', Lorenzo Storioni in Museum of Violin in Cremona

Major research activities:

Non-invasive Examination of Stratigraphic System in violins by NMR Mouse and OCT

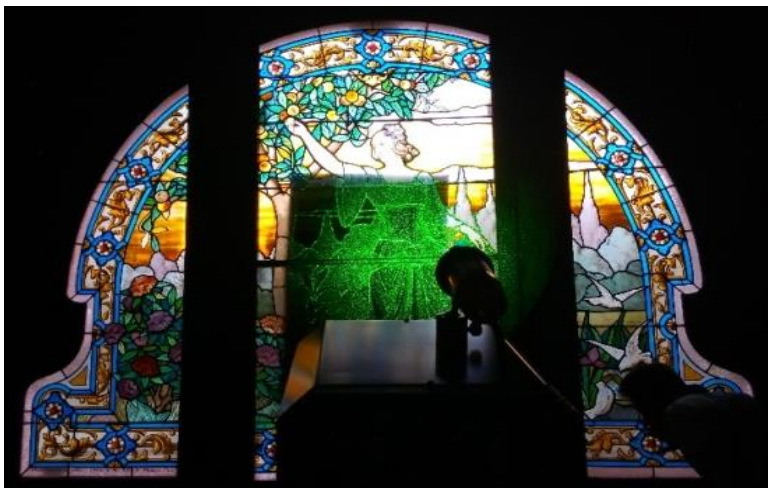
Research outcomes:

Developing analytical protocol.
Linking a wood structure with a fabrication technique, the marks of history, or some past restoration work



Scopes of the access:

- the scientific information about the execution technique, the presence of retouchings and the causes of degradation of the 20th century *Art Nouveau* glass windows



Heritage object:

glass window in the dining room of *Casa-Museu* Dr. Anastácio Gonçalves, Portugal

Major research activities:

Digital Holographic Speckle Pattern Interferometry, Thermography, VIS Hyperspectral Imaging, Optical Coherence Tomography

Research outcomes:

The results enabled developing the restoration protocol of the window panels that will have high impact in the Museum because it will promote the visitor flow through specialized visits



Development of new instrumentation/methodologies

- **NMR mouse** – e.g. measure of solvent uptake
- **Electrochemical cell** for in situ diagnostic of metallic cultural heritage – allows corrosion resistance evaluation of patinas
- **iTomography** multimodal system (UV/VIS/nIR/mIR spectroscopy and acoustic microscopy or a combination of Raman and laser spectroscopy)
- **Integrated unit for laser cleaning** of paintings with multi-modal in-situ diagnostics
- **Bimodal (neutron and X-ray) imaging** at the RAD neutron facility of BNC
- **Neutron imaging driven prompt gamma-ray activation analysis (PGAA)** at the NIPS-NORMA facility of the BNC





DIGILAB – opening data in heritage science

- ❑ heritage data are often closed...
- ❑ **open by definition** but actually **restricted by necessity**
- ❑ capillary IPR management very hard to handle, demanded to the user-provider relationship (the “last mile” approach)
- ❑ to overcome this situation, **DIGILAB** will start by creating registries of heritage data (opening the metadata)
- ❑ at the same time, registries of **tools** will be created



International cooperation through **DIGILAB**

- **DIGILAB** VRE will grow by linking more and more data and services/applications
- **DIGILAB** tools and data will be provided by contributors in the **E-RIHS** network
- non-EU **E-RIHS** providers will be able to contribute to **DIGILAB**
- **DIGILAB** is the **E-RIHS** platform with the capacity to establish a real international cooperation



What about **DIGILAB** ?...

- **E-RIHS** adopts the FAIR, Open Data and Open Science principles
- **DIGILAB** will be the heritage science **data and service** infrastructure provided by **E-RIHS** to the research community
- **DIGILAB** will be the **E-RIHS** contribute to the EOSC

- **DIGILAB**: *open data and tools for heritage science, and where to find them*

10 pillars of the E-RIHS Scientific Vision

1. **Competencies first** – Giving priority to skills
2. **Interdisciplinarity** – Optimising work for teams with complementary culture and practices
3. **Co-Creation** – Recognizing the contribution of each participant
4. **Communication** – Benefiting from the public dimension of heritage institutions
5. **Excellence** – Supporting outstanding projects
6. **Interoperability** – Connecting knowledge
7. **Innovation** – Developing E-RIHS and the study of heritage
8. **International** – Collaborating at the highest global level
9. **Ethics** – Encouraging responsible heritage research
10. **Quality** – Ensuring the best possible user experience



IPERION HS

www.e-rihs.eu



...thank you for your attention!



E-RIHS

EUROPEAN RESEARCH INFRASTRUCTURE
FOR HERITAGE SCIENCE



E-RIHS

EUROPEAN RESEARCH INFRASTRUCTURE
FOR HERITAGE SCIENCE

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E-RIHS is a Project in the ESFRI Roadmap 2016
www.esfri.eu

