



ESPADON Project in Heritage Science

Dynamic Analysis of Ancient and Digital Objects



Vincent Detalle

Prof. CY Paris Cergy Université



IT-FR cooperation in heritage science - Vth edition

Human-centered approach for cultural heritage in digital transition: disciplines talking to each other

Naples, Suor Orsola Benincasa University

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Heritage science

The work carried out within this framework **ranges from fundamental to applied research** and aims to improve our **understanding of cultural heritage** and to develop new ways of ensuring its conservation, transmission and enhancement, while taking into account **sustainable development**.

Their results are used by heritage professionals in the framework of their missions

Objects of study



From the excavation



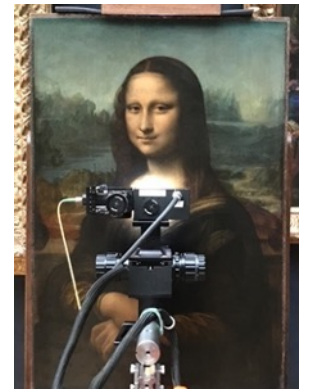
Building Heritage
Musée de Picardie, Amiens



Maison de l'armateur, Le
Havre



Salle Piette, les collections
musée d'archéologie nationale



Mona Lisa
OCT analysis
@V.Detaille,c2rmf



Exhibition "The art of appearing in
the 18th century", Nantes art
museum



BNF



Exhib. Vasarely, national museum of modern art



Pont-Aven Museum
storage

Heritage science

The research themes developed by the Ministry of Culture in the field of **heritage sciences** are **transversal**, as they concern several, or even all, of the heritage sectors.

They are at the **forefront** of **research and innovation**

About cultural objects : transdisciplinary questions ...



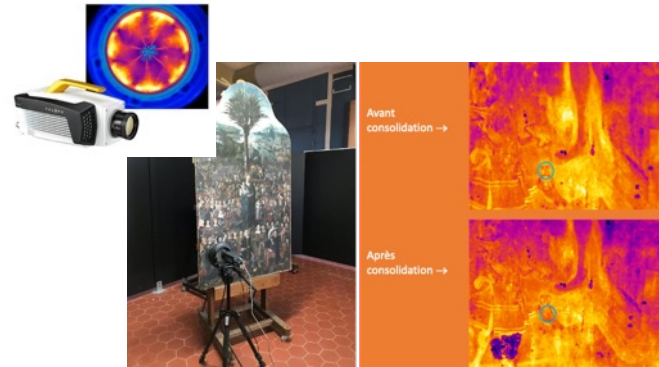
1-« Conservation - Restoration »

Issues



Cultural Heritage and environment

In progress



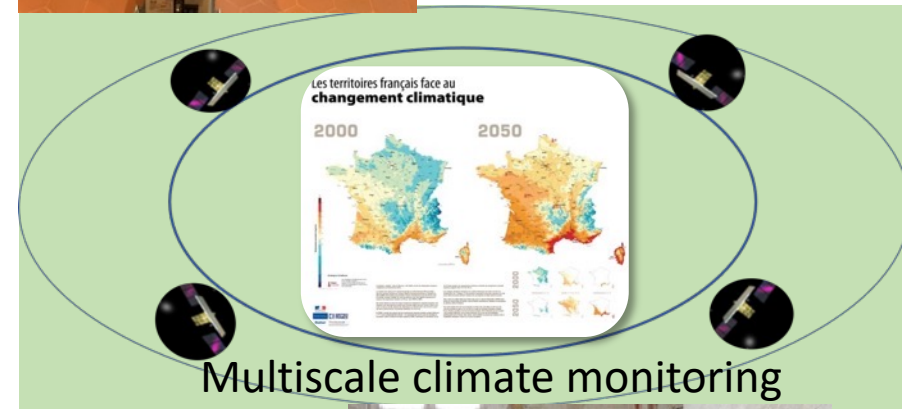
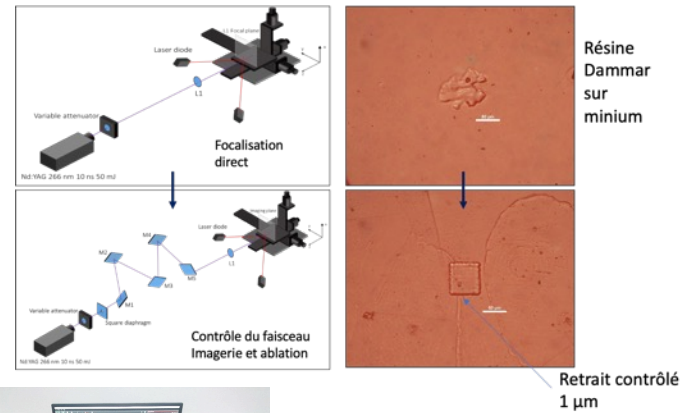
To be developed



New ways of restoration



Conservation - restauration



Multiscale climate monitoring


New tools for Preventive conservation



« Conservation - Restoration »



Research

 Framework for Preserving Heritage Collections Strategies for Avoiding or Reducing Damage				
AGENTS OF DETERIORATION	CLIMATE CHANGE AND SUSTAINABILITY ISSUES	BUILDING FEATURES	PORTABLE FITTINGS	PROCEDURES
Physical Forces - Seismicity - Wind - Rain - Snow - Ice - Salt crystallization - Acid rain - Air pollution - Light - Vibration - Theft - Vandalism - Fire - Water - Pests	Sustainable practices - Use of sustainable materials - Energy efficiency - Water conservation - Waste management - Green building - Sustainable procurement - Life cycle assessment - Carbon footprint - Environmental impact - Social responsibility - Governance	Building Features - Structure - Materials - Finishes - Details - Elements - Systems - Services - Equipment - Furniture - Fixtures - Fittings - Accessories - Components - Parts - Pieces - Items - Objects - Things - Stuff - Goods - Commodities - Products - Services - Experiences - Activities - Events - Programs - Initiatives - Campaigns - Projects - Enterprises - Organizations - Institutions - Organizations - Institutions	Portable Fittings - Storage - Display - Transport - Handling - Maintenance - Conservation - Restoration - Reproduction - Replacement - Repair - Conservation - Restoration - Reproduction - Replacement - Repair - Conservation - Restoration - Reproduction - Replacement - Repair	Procedures - Planning - Design - Construction - Installation - Operation - Maintenance - Conservation - Restoration - Reproduction - Replacement - Repair - Conservation - Restoration - Reproduction - Replacement - Repair

Challenges

Material characterization

Alteration mechanism

State of conservation

Preventive conservation strategies

Educational tools



Treatment and restoration methodologies

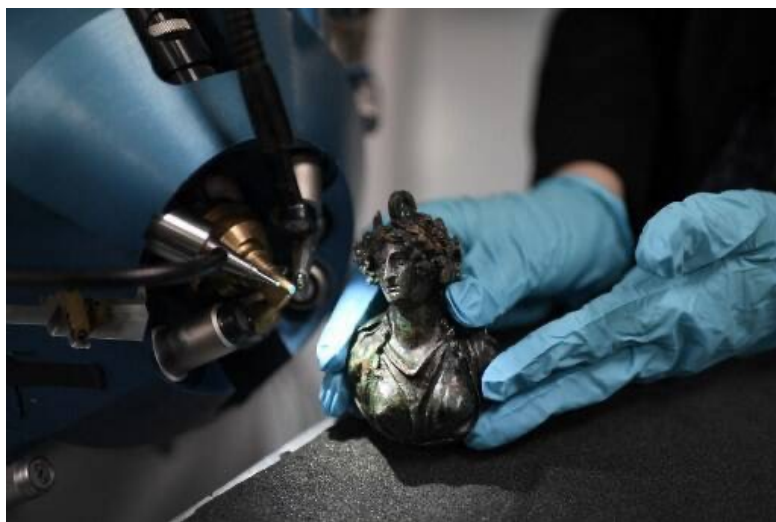


2-«Knowledge of materials, techniques and skills »

Issues

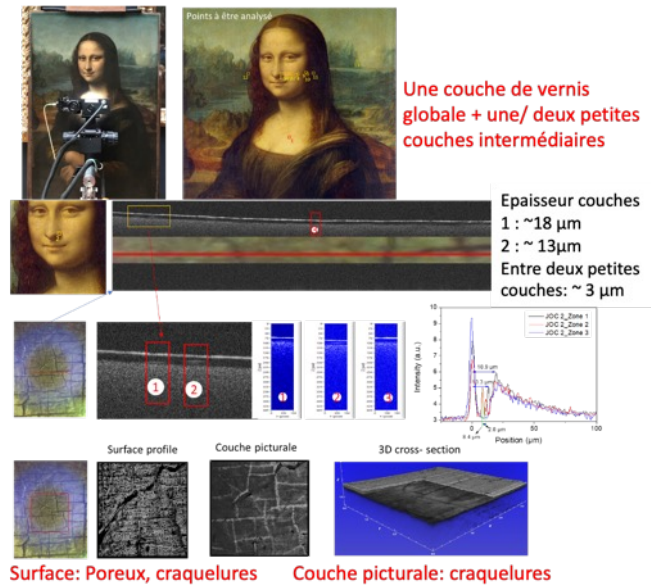


Ethnology and its cultural heritage

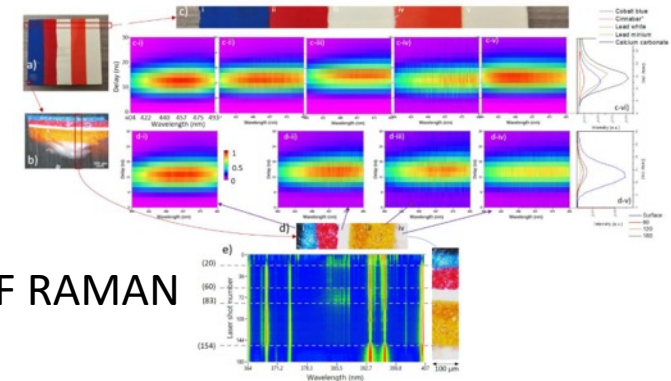


Study of material

In progress



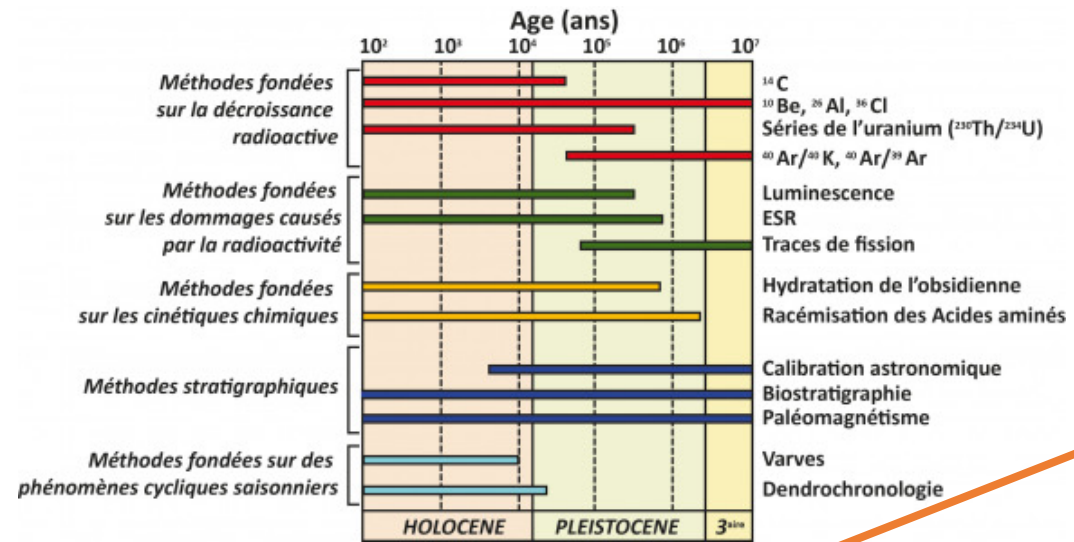
To be developed



« Knowledge of materials, techniques and skills »



Beatus de St Sever
OCT analysis



Historical approach

Material studies

Origin, trade routes

Dating



Challenges

Issues



Digital cultural heritage

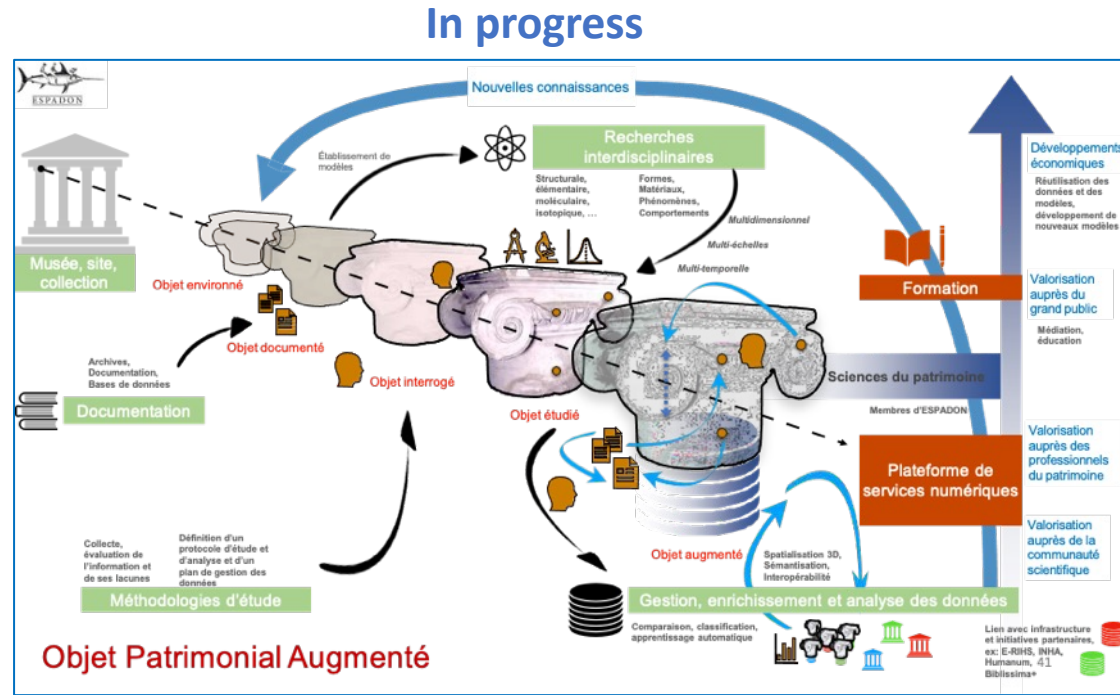


The restoration of Notre-Dame de Paris



Cultural heritage and society

3-« Digital integration, ecosystem and know-how »



To be developed



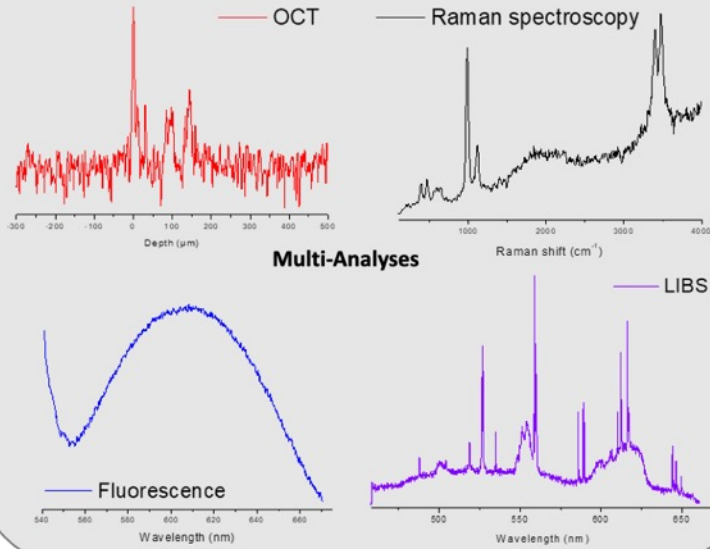
- DIGILAB
- E-RIHS IP
- European Collaborative Cloud Platform for Museum and other Cultural Heritage institution (ECCCH)
- New ways of spatial representation of information ensuring data exchange and interoperability

Collaborative behaviour

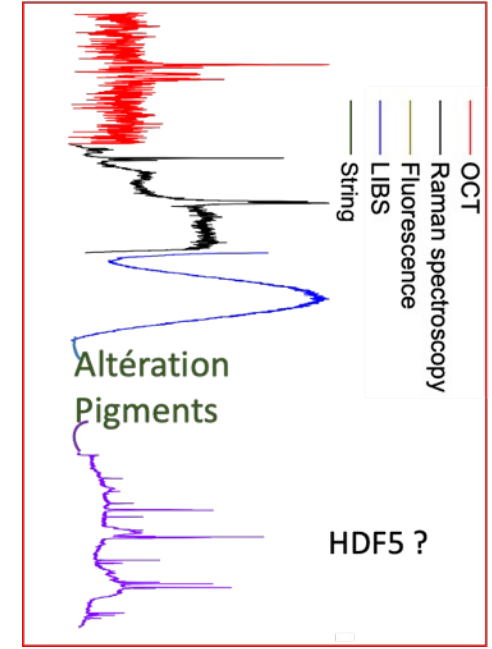


Description

Pigments alteration

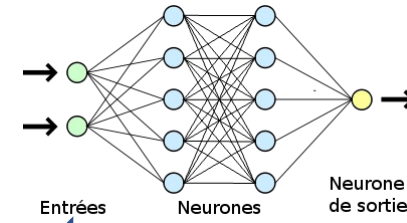
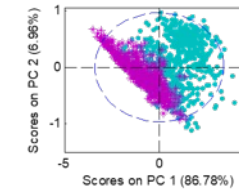
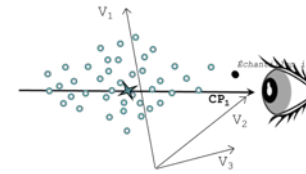


Integrated approach information / multimodality



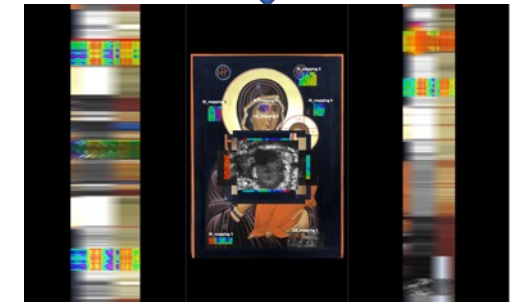
Chemimetry

Neural network



Information extraction and new representations

- New fields for research



« Digital integration, ecosystem and know-how »

Information
organisation and
mediation



Dissemination
Teaching

Archiving
Conservation

Mediation
Museography



3D Model

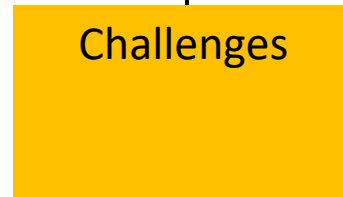


Identification
of virgin
research
areas

Creation of
databases



Challenges



Futur: Strategic objectives of the



Ecosystem

- Addressing **instrumental issues**

- 2D/3D Spatialization, Multidimensional (multi-scale, multi-temporal)
- Multimodal

- Responding to **the challenge of massive data management**

- Storage
- Processing and treatment
- Data exchange

- Managing **the digital transition**

- Federating and training the scientific and professional communities in France
- Integrating new practices ("best practices"), FAIR principle

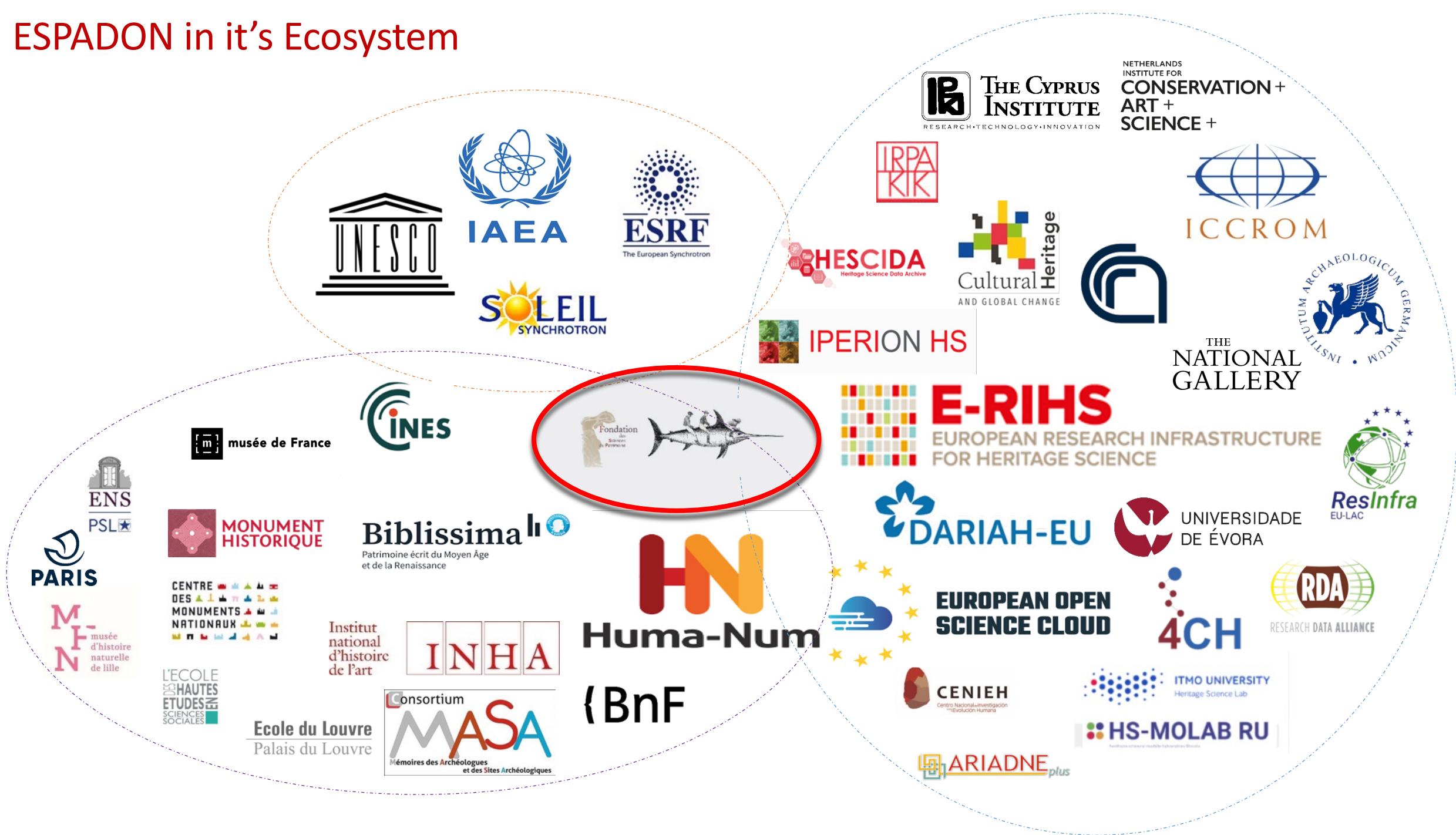


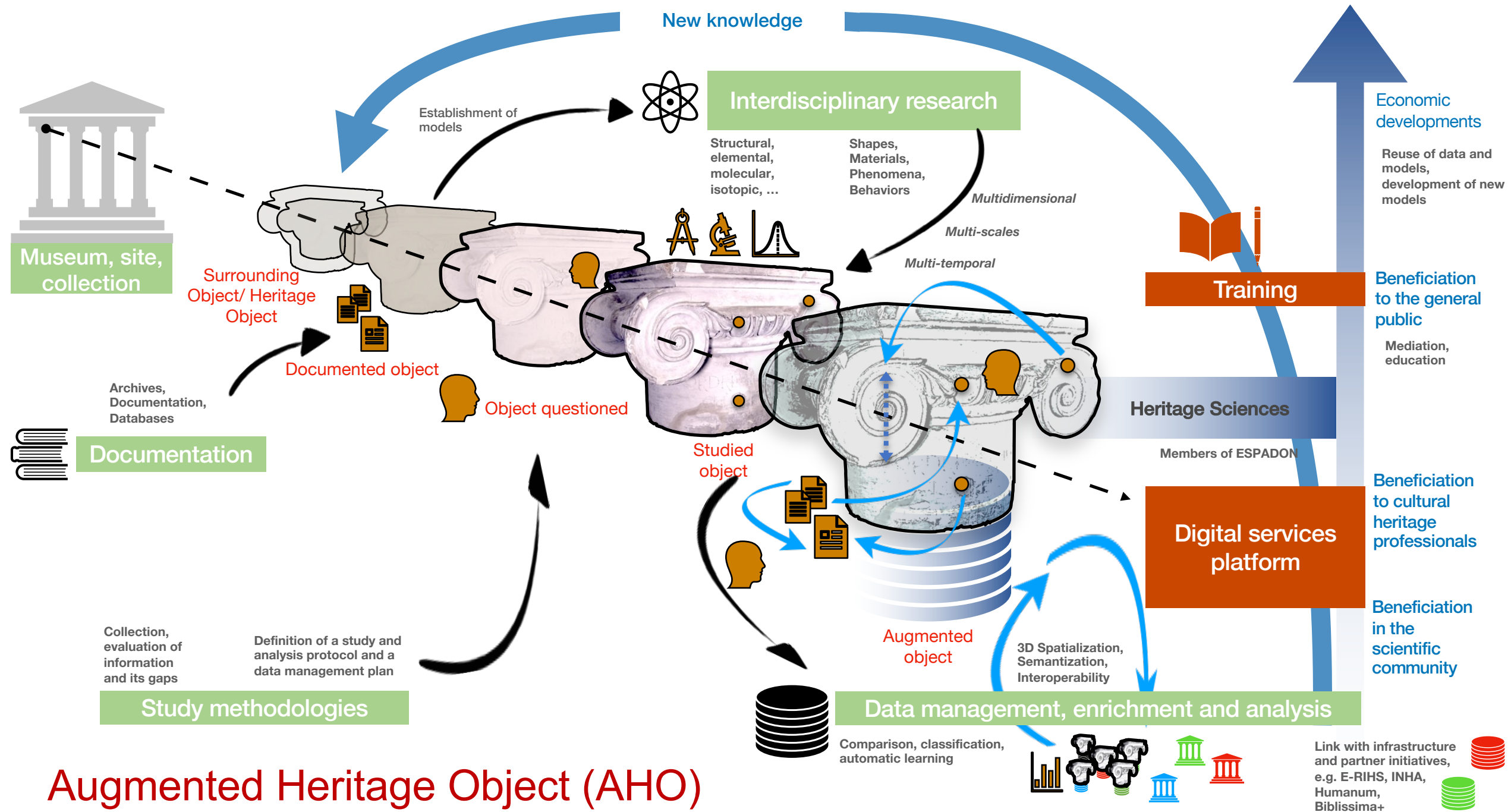
- Enriching the possibilities of **access to artworks**

- Access to researchers and the cultural world
- Socio-economic opening
- Dissemination to civil society and public actors

- Proactive participation to **E-RIHS / DIGILAB/ECCCH**

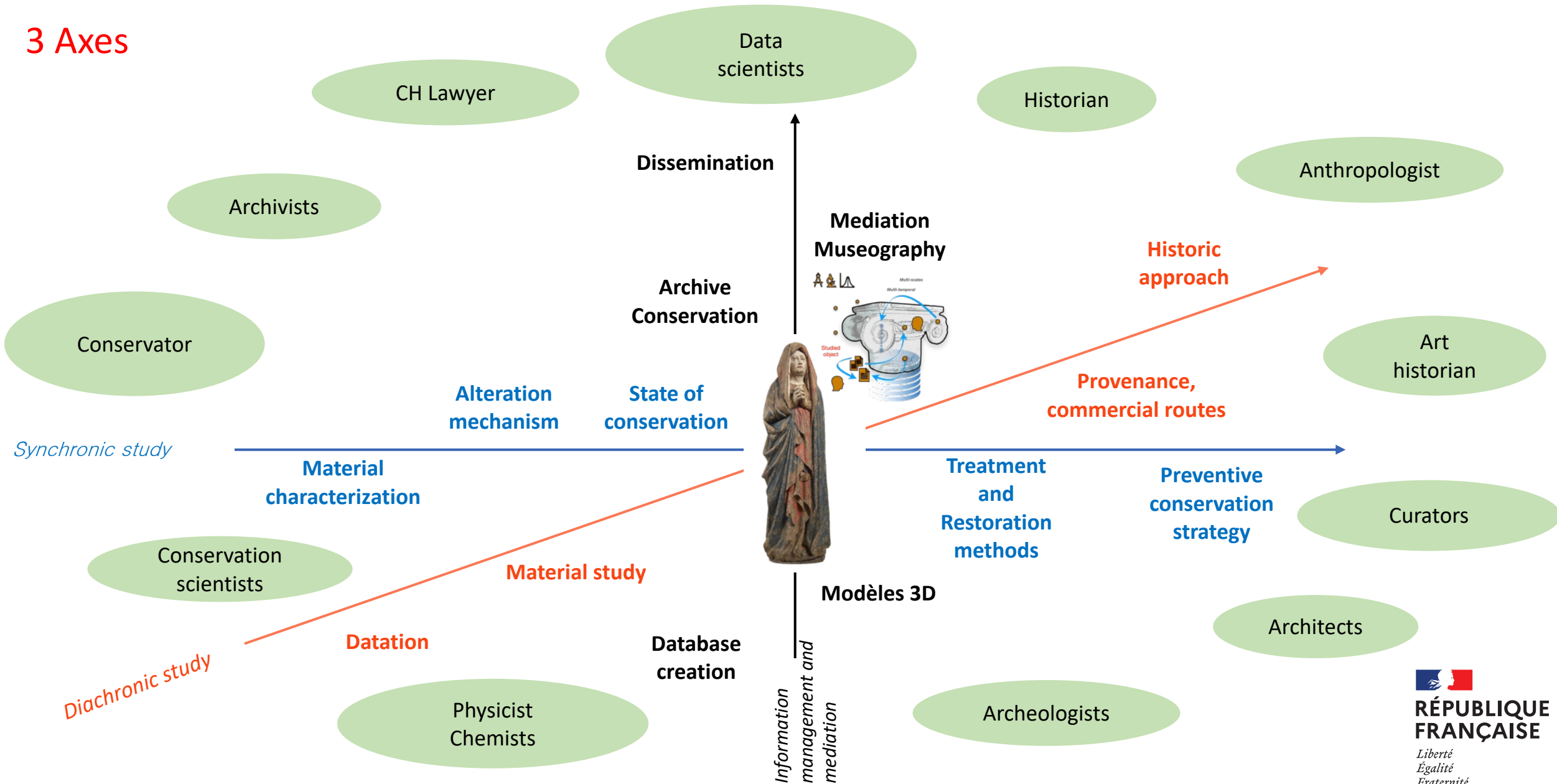
ESPADON in it's Ecosystem





Heritage Science : Toward Collaborative Transdisciplinary Science

3 Axes



PIXXL : triple innovation

- XL line 20 AGLAE beams at the same time \varnothing 200 μm beam to distinguish the smallest details visible to the naked eye
Ultra-fast detection system for mapping with photographic sharpness
- Robotised Support for large objects (2 m x 2 m) 3D vision of the surface of objects by an integrated optical scanner
motorised movement in X/Y/Z to map a large surface ($< 1 \text{ m}^2$)
- Secure optical and chemical sensors to prevent in real time any risk of modification under beam



THE EXAMPLE OF MANUSCRIPTS

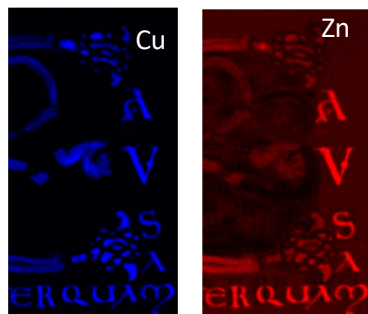
Multiscale / Interdisciplinary

2D Imaging

Hyperspectral Imaging
UV-VIS-NIR



Full field elemental analysis (PIXE, XRF)



Recover illegible or underlying writings
Materials identification (inks, coloring materials)

History, codicology and materials data
Structuration and standardisation
Storage, sharing and data searchability

Knowledge on scriptorium practices
→ **Provenance, datation, attribution**



Materials analysis

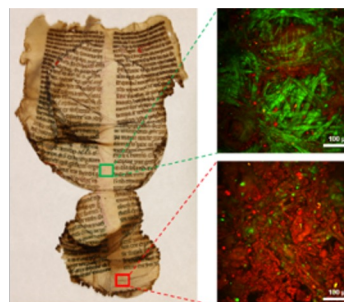
Data
Biblissima+ / Huma Num

Multitemporal/Dynamic

3D Imaging

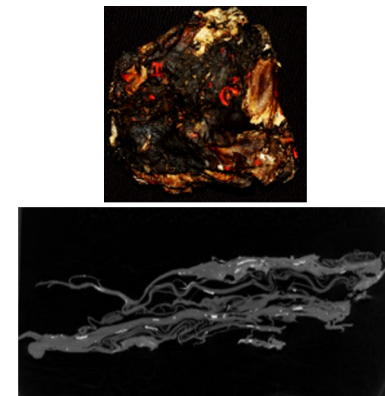
Non Linear Optical Microscopy
OCT

correlation of the 2 techniques



Morphological information at macro and micro scale
Chemical information and degradation state

X-ray Tomography



Development of dedicated **data treatments**
Information **correlation**

Structure and manufacturing techniques
Conservation state monitoring
Decision on **restoration/conservation treatments**

The example of Built Heritage

Dynamic analysis,

3D Imaging of (sub)-surface

SIRT highspeed + 3D imaging systems

Photoacoustic platform



In field materials analysis

multiscale and multitemporal data

3D ortho-imaging

LIBS-Raman-Drone + 3D photogrammetry VIS-IR

TeraHertz ToF



Continuum of morphological and structural information from macroscale to microscale
Identification and surface/internal location of original/restoration materials

Track and identify the degradation causes in their first steps before the start of an irreversible degradation process
Porosity study of the first surface layers and in depth

History and materials data

Multi-mapping, multimodal, structuration
Storage, sharing and data searchability

Data

Aïoli, Huma Num

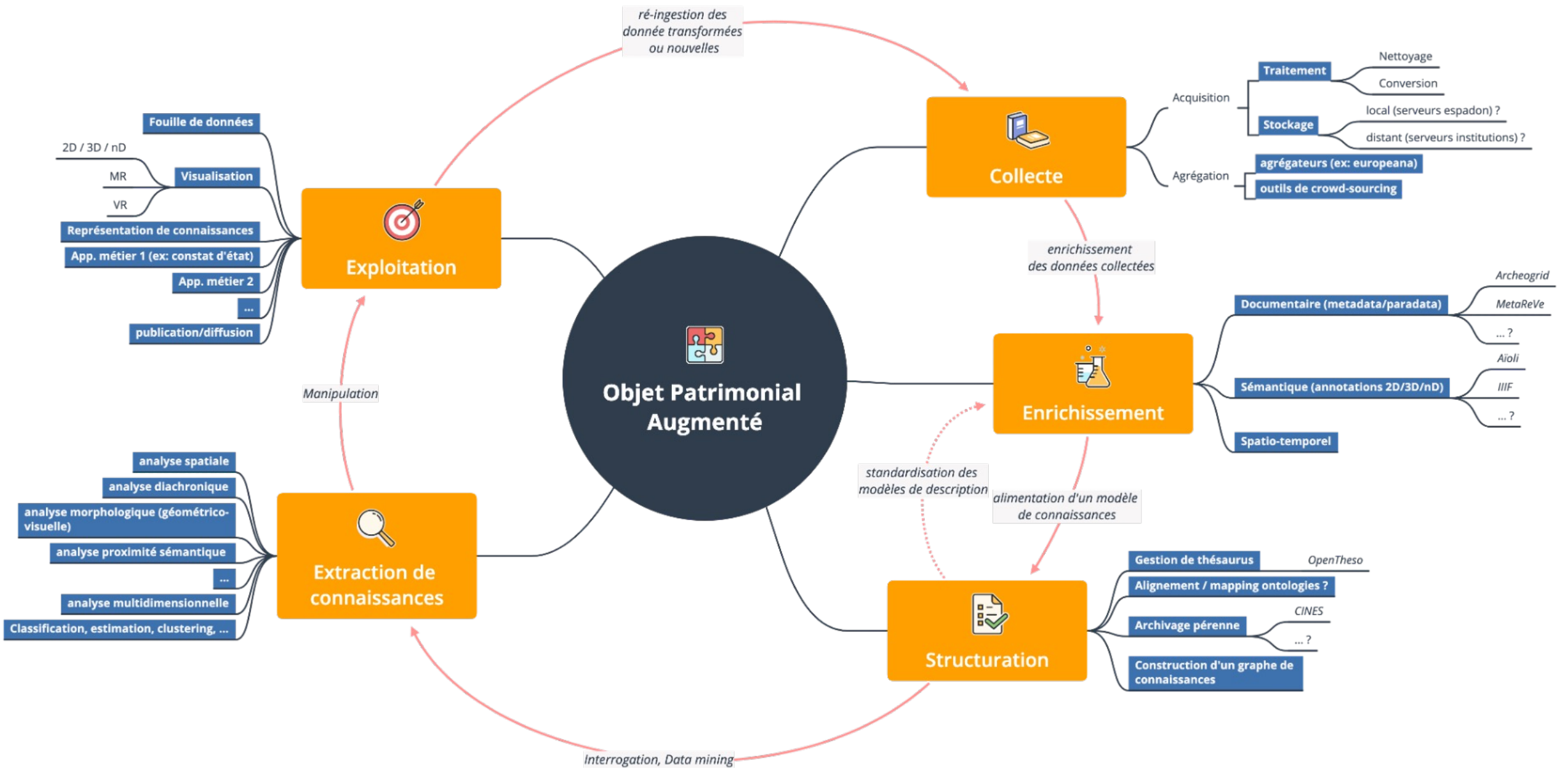
Development of dedicated data treatments

Semantic annotation, propagation of annotations, information correlation

Conservation state monitoring, decision on restoration/conservation treatments, structure and manufacturing techniques

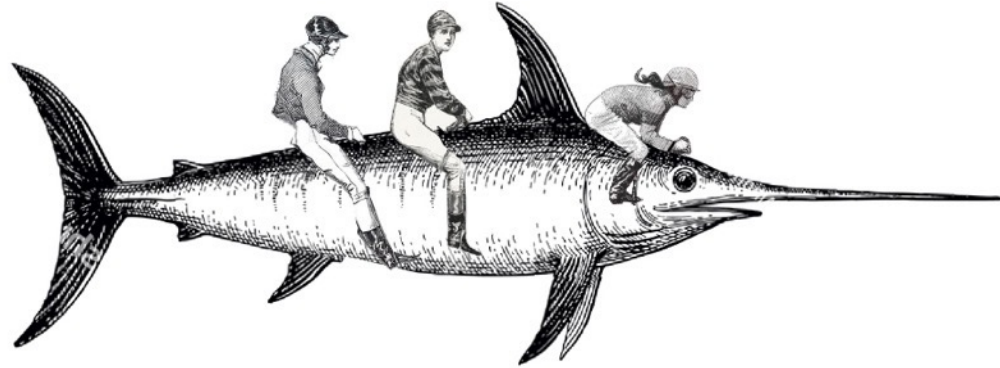
General assembly of heritage data

Regroupement	Domaine des sciences du patrimoine	Coordinateurs	Organismes représentatifs et experts
1	Restaurateurs	Dominique Martos, Cécile Aufaure et al.	FFCR, ARAAFU, restaurateurs fonctionnaires
2	Régie, conservation préventive, ...	Juliette Rémy et al.	AprévU, AFROA (régisseurs d'œuvres d'art), FFCR
3	Conservateurs	Isabelle Pallot Frossard et al.	AGCCPF, FEMS, AAF, OCIM,...
4	Documentalistes	Olivier Malavergne et al.	Sociétés des ingénieurs et scientifiques de France
5	Scientifiques de la conservation et Archéomètres	Vincent Detalle et al.	CaiRN, C2RMF, CRC, LRMH, CICRP...
6	Professionnels de la médiation, scénographes...	Marie-Claire Le Bourdellès et al.	Association professionnelle des muséographes, association nationale des guides conférenciers + experts EDL
7	Architectes + conservateurs MH + historiens de l'architecture	Stéphanie Celle et al.	Architectes du patrimoine, Collège des monuments historiques, ANABF
8	Anthropologues, sociologues, juristes... Question des recherches en provenance	Monica Heintz (à définir)	OCBC, ISP Saclay, ICOM France, SMF, SDMHEP
9	Historiens de l'art	Romain Thomas et al.	APAHAU, CFHA
10	Archéologues (universitaires, ...) + philosophes	Ph Jockey et al.	INRAP, APAHAU, MSH Mondes, conservateurs régionaux de l'archéologie, SDA, Anne LEHOERFF (CNRA)
11	Historiens	Pauline Lemaigre (à définir) Valérie Toureille (à définir)	AHMUF, SHMESP + contemporanéistes





Fondation
des
Sciences
du Patrimoine



IT-FR COOPERATION IN HERITAGE SCIENCE
COOPÉRATION IT-FR SUR LES SCIENCES DU PATRIMOINE
COOPERAZIONE IT-FR NELLE SCIENZE DEL PATRIMONIO CULTURALE



PROGRAMMA DELLE VISITE DELLA DELEGAZIONE ITALO-FRANCESE DEL BILATERALE SU SCIENZE DEL PATRIMONIO
Napoli, 28-30 giugno 2023

Thank you for your attention

