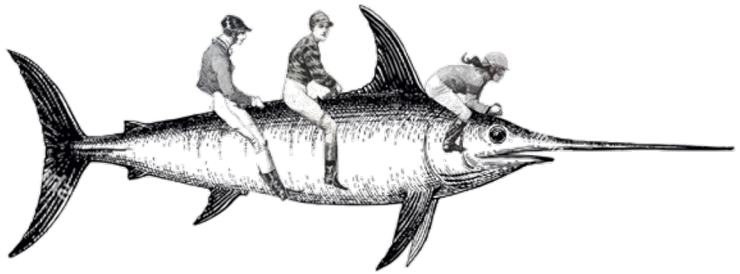
Fondation des Sciences du Patrimoine

eosc Journées EOSC-France 13 - 14 Juin 2023

RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

Advances in Heritage Science

The ESPADON Project: Creating a dynamic multidimensional cultural heritage atlas ecosystem



ESPADON

Romain Thomas (Adj.)
Emmanuel Poirault (Adj.)

2023/06/13

Vincent Detalle

Prof. CY Paris Cergy Université

cnrs

CY CERGY PARIS UNIVERSITÉ

CENTRE DE RECHERCHE ET DE RESTAURATION DES MUSÉES DE FRANCE

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

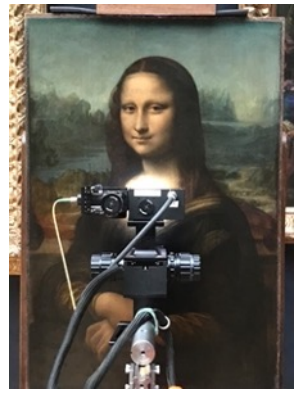
Objects of study

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.Detalle,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

CENTRE DE RECHERCHE ET DE RESTAURATION DES MUSÉES DE FRANCE

Heritage science

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

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 …

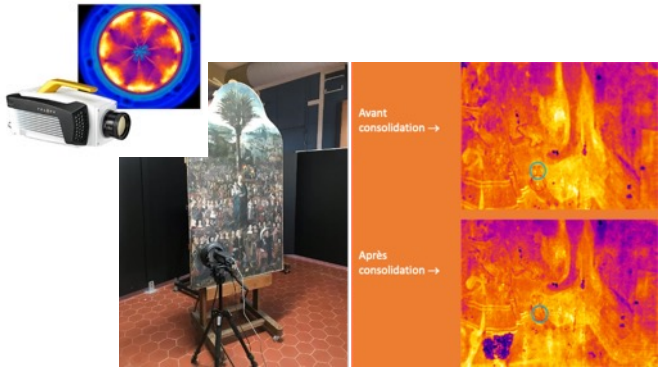
1-« Conservation - Restoration »

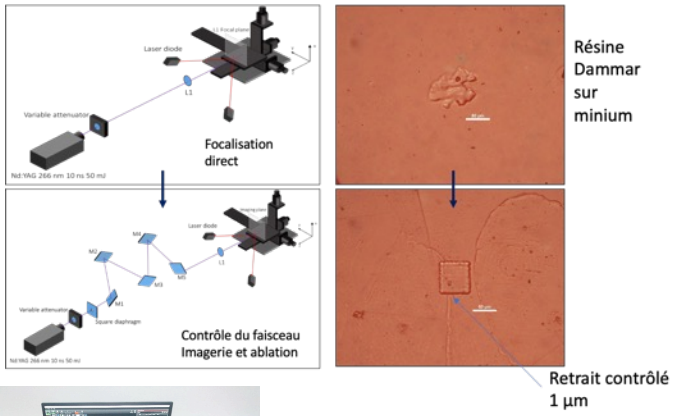
Issues

Cultural Heritage and environment

Conservation - restauration

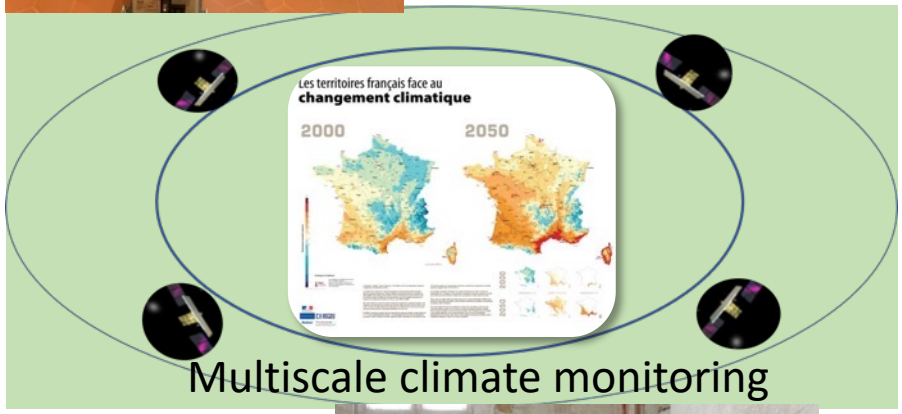
In progress





To be developed

New ways of restoration

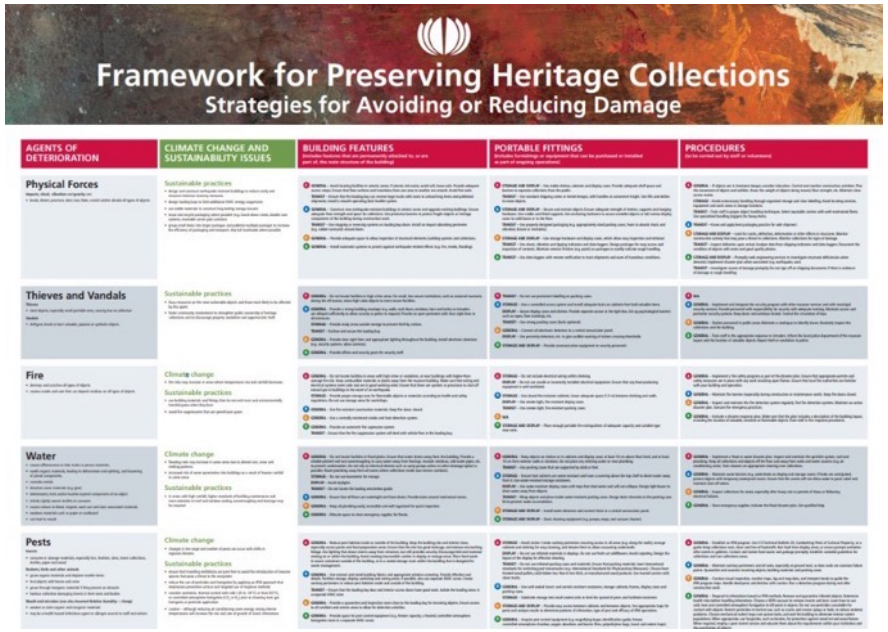


Multiscale climate monitoring

New tools for
Preventive conservation

« Conservation - Restoration »

Research



Challenges → Material characterization → Alteration mecanism → State of conservation → Preventive conservation strategies

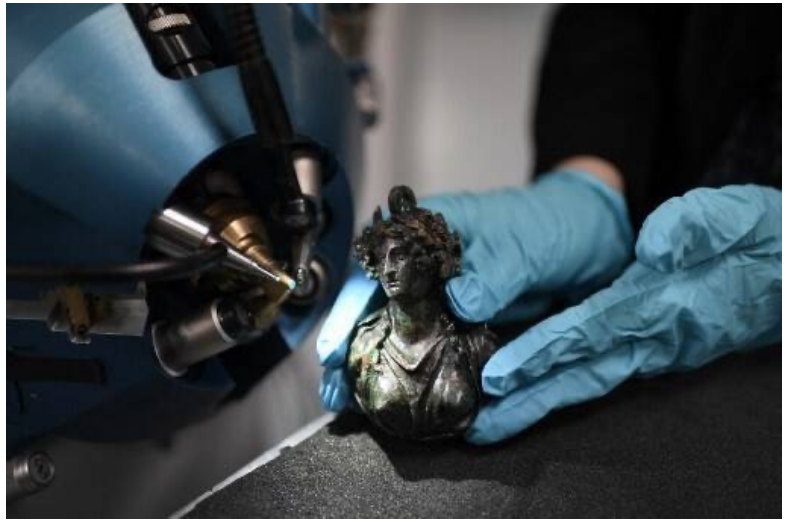
Educational tools

Treatment and restoration methodologies

2-«Knowledge of materials, techniques and skills »

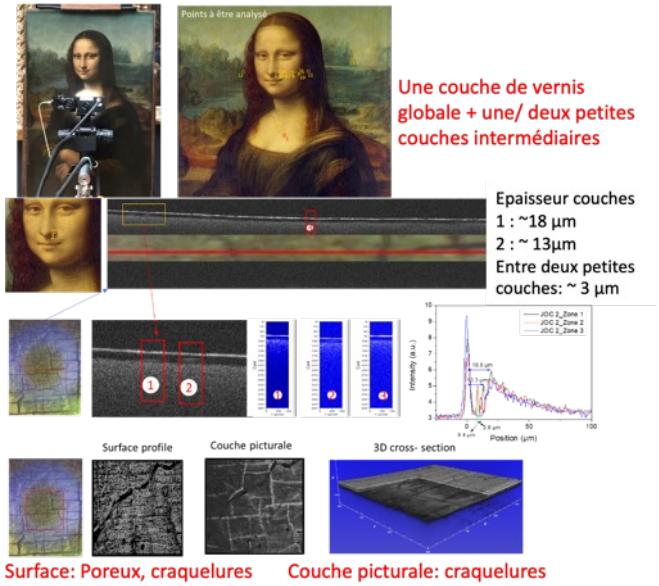
Issues

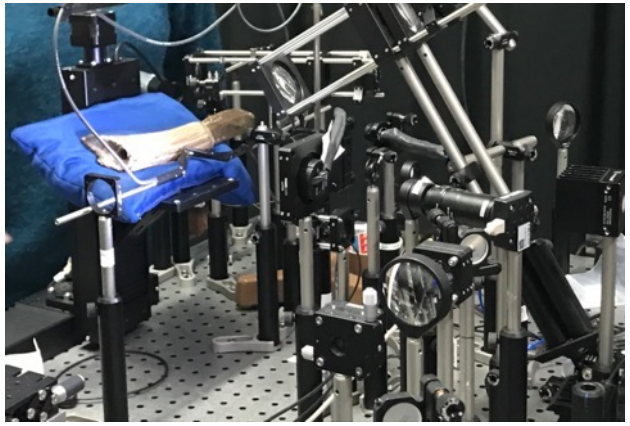
Ethnology and its cultural heritage



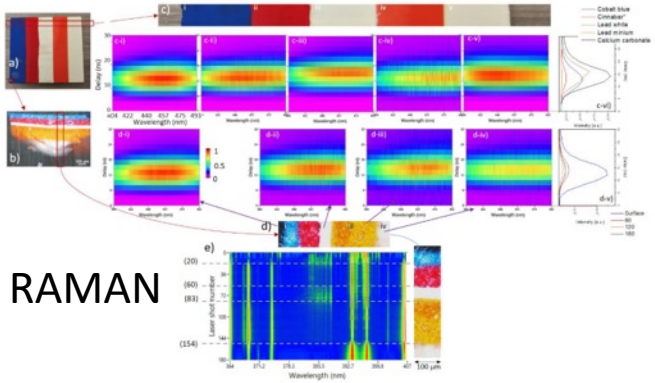
Study of material

In progress



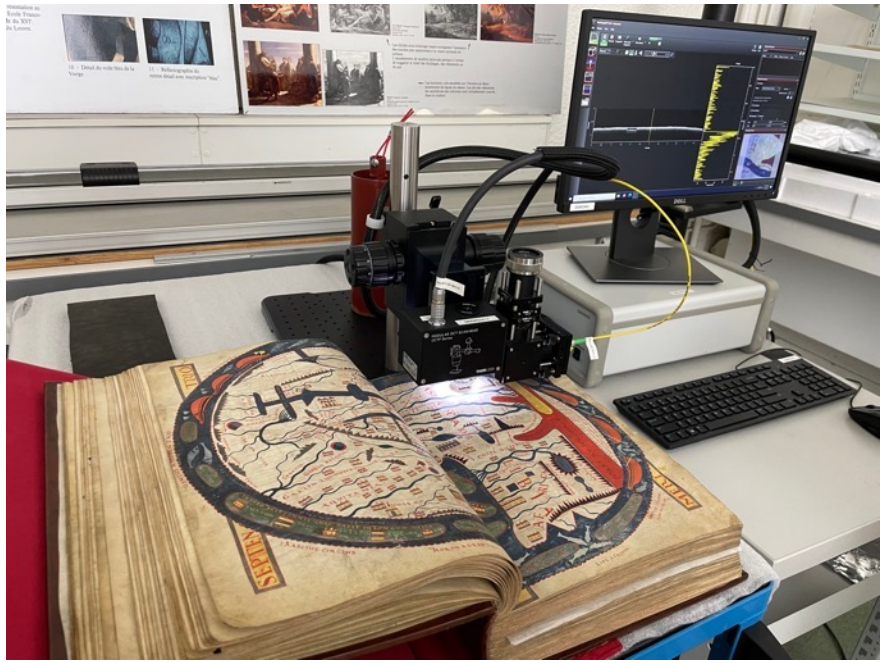


To be developed

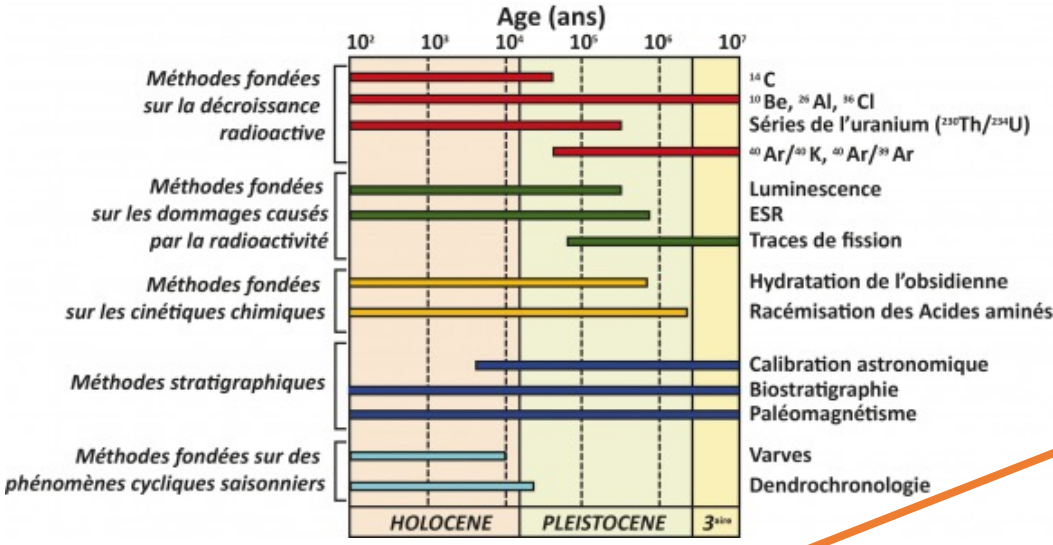


LIBS LIF RAMAN

«Knowledge of materials, techniques and skills »



Beatus de St Sever
OCT analysis



Historical approach

Material studies

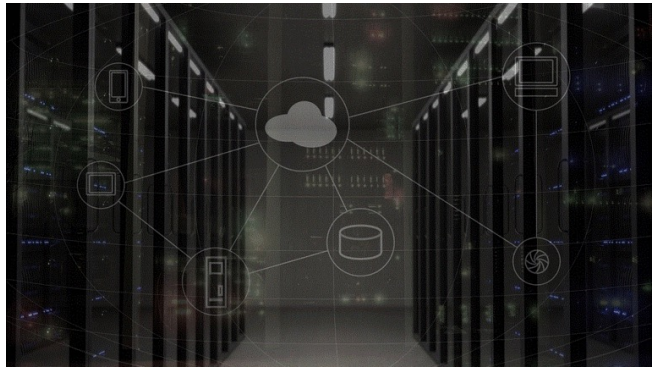
Origin, trade routes

Dating

Challenges

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

Issues

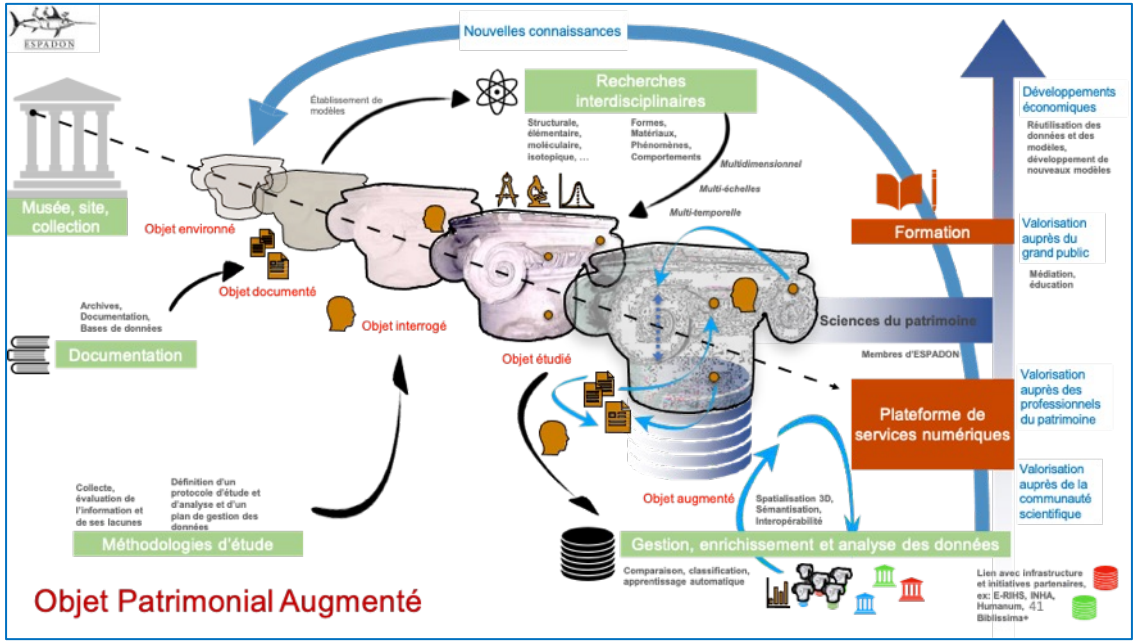


Digital cultural heritage

The restoration of Notre-Dame de Paris

Cultural heritage and society

In progress



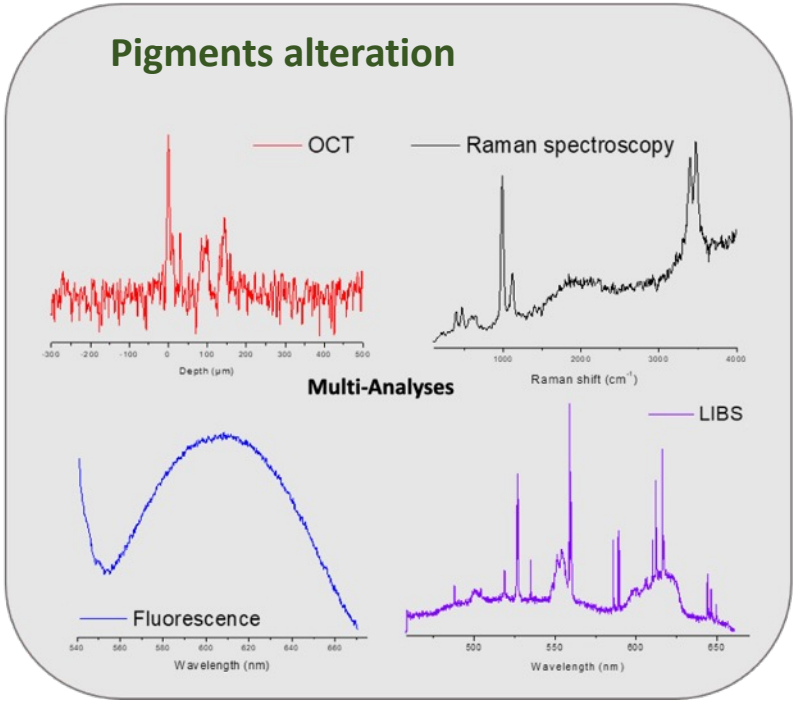
ESPADON

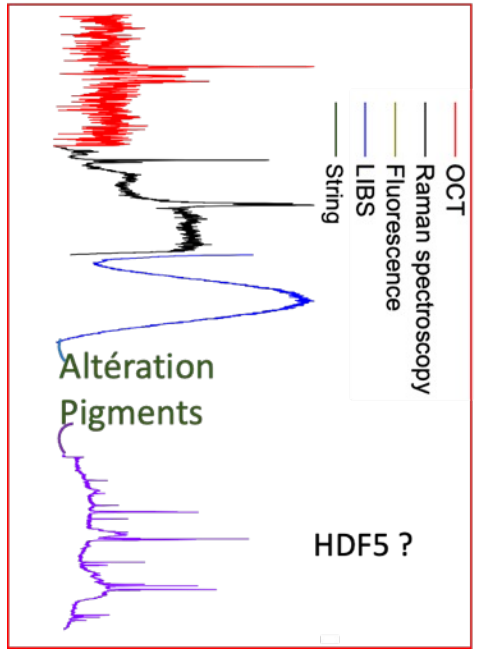
To be developed

- **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

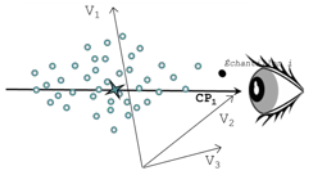
Description

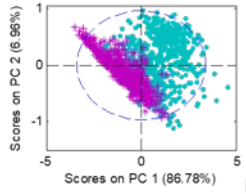




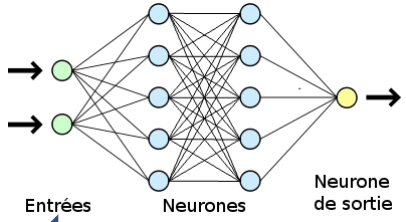
Integrated approach information / multimodality

Chemiometry

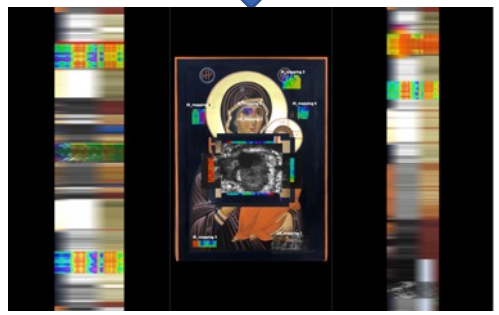




Neural network



Information extraction and new representations



- New fields for research

« Digital integration, ecosystem and know-how»

Information organisation and mediation

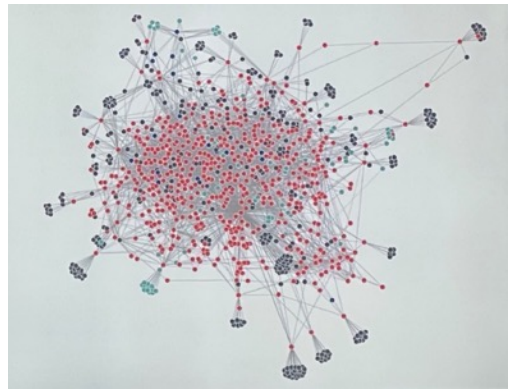
Dissemination
Teaching

Mediation
Museography

Archiving
Conservation

Creation of databases

3D Model



Identification of virgin research areas

Challenges

Futur: Strategic objectives of the ESPADON Ecosystem

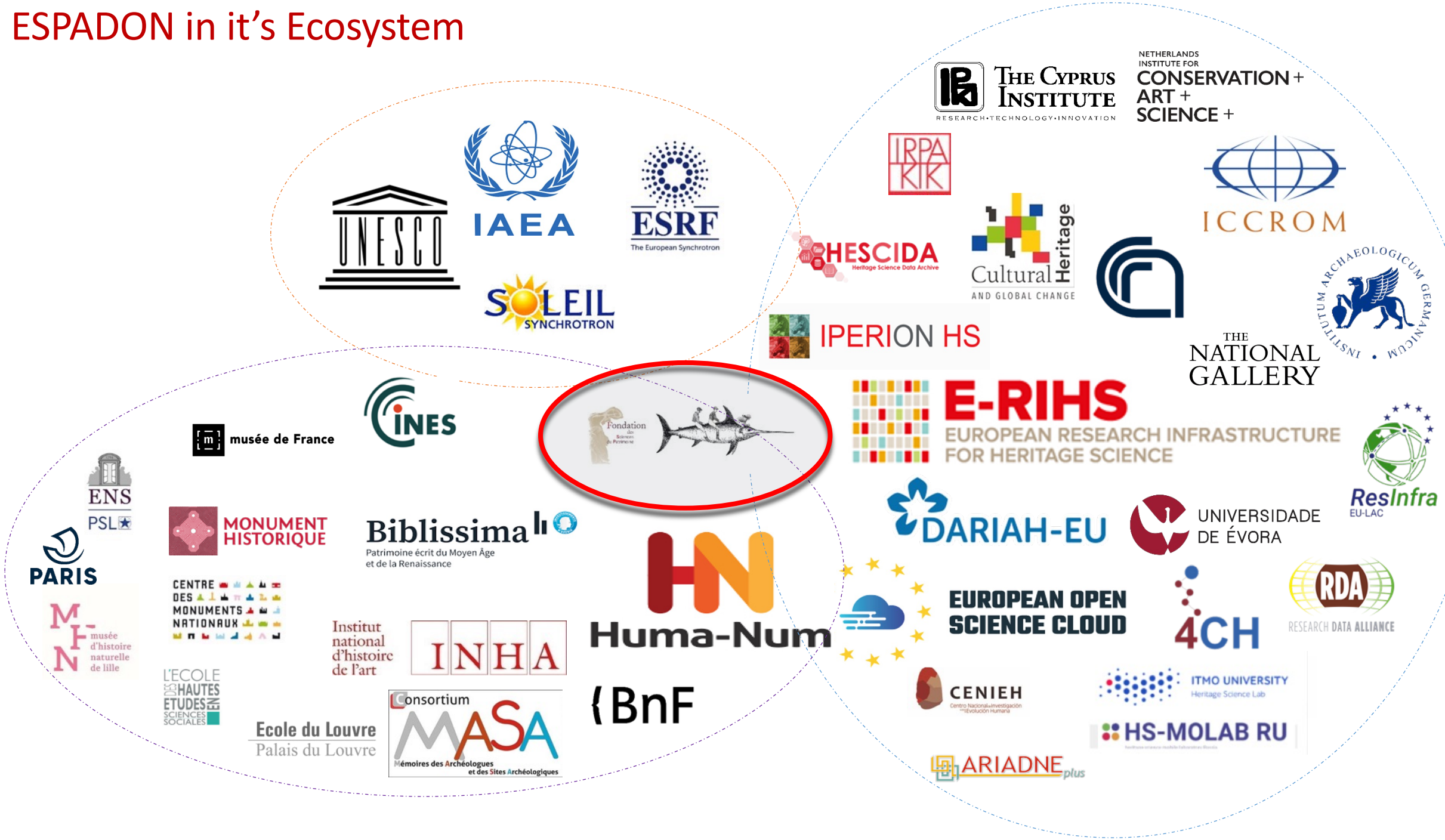
- Addressing instrumental issues
  - 2D/3D Spatialization, Multidimensional (multi-scale, multi-temporal)
  - Multimodal
- Responding to the challenge of massive data management
  - Storage
  - Processing and treatment
  - Data exchange
- Managing the digital transition
  - Federating and training the scientific and professional communities in France
  - Integrating new practices ("best practices"),FAIR principle

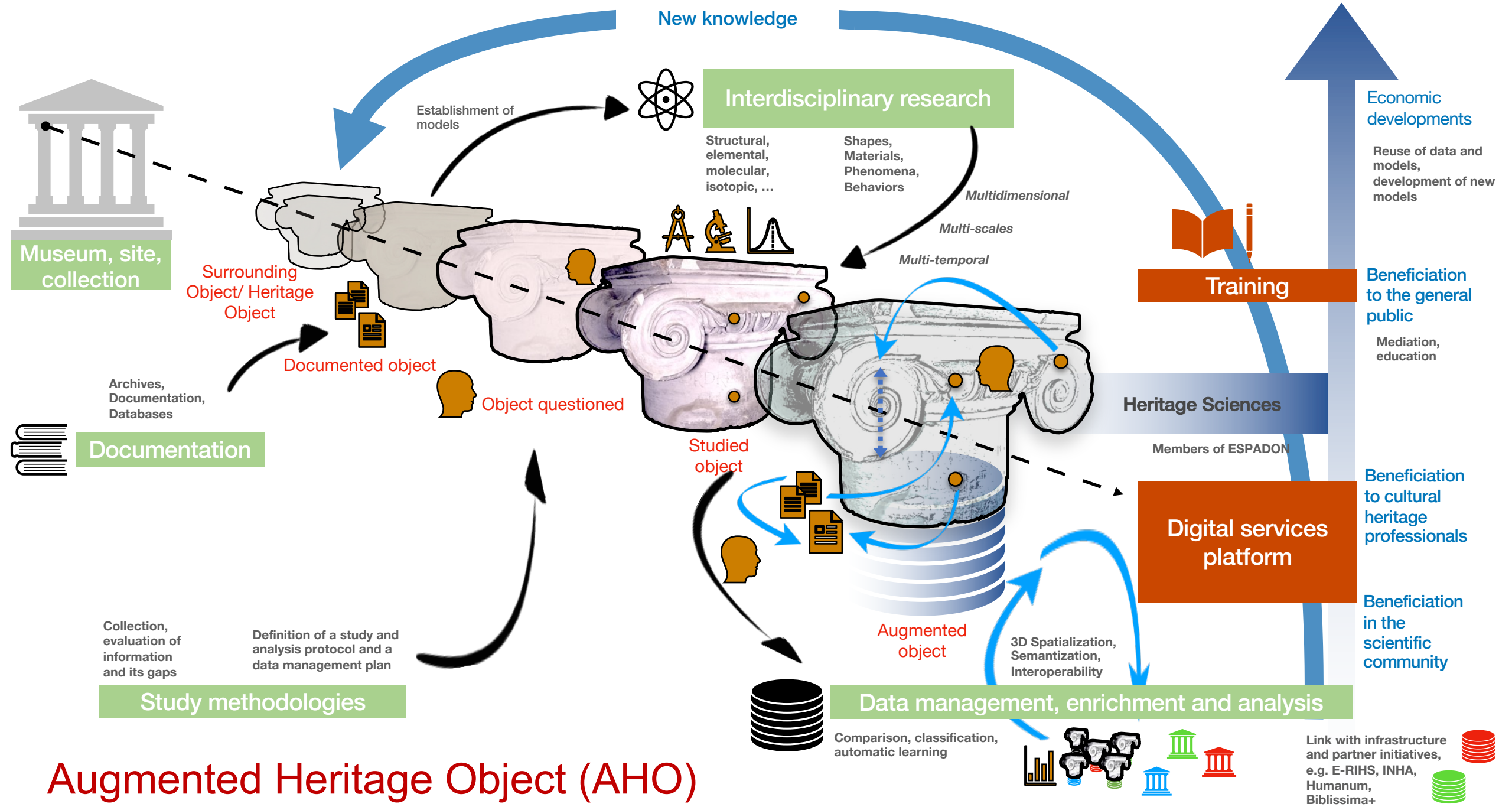
- Enriching the possibilities of access to artworks
  - Access to researchers and the cultural world
  - Socio-economic opening
  - Dissemination to civil society and public actors
- Proactive participation to E-RIHS / DIGILAB

Who is ESPADON ?

13 mandatory institutions
31 partner units

ESPADON in it's Ecosystem





Augmented Heritage Object (AHO)

• Heritage Science : Toward Collaborative Transdisciplinary Science

3 Axes

Data scientists

CH Lawyer

Historian

Anthropologist

Archivists

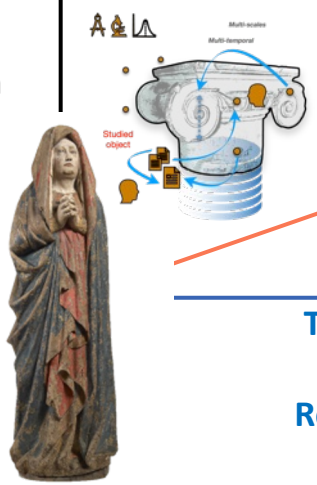
Dissemination

Mediation
Museography

Archive
Conservation

Historic approach

Conservator



Art historian

Alteration mechanism

State of conservation

Provenance, commercial routes

Synchronic study

Material characterization

Treatment and Restoration methods

Preventive conservation strategy

Curators

Conservation scientists

Material study

Modèles 3D

Architects

Datation

Database creation

Diachronic study

Physicist Chemists

Information management and mediation

Archeologists

RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

PIXXL : triple innovation

XL line	20 AGLAE beams at the same time Ø 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 m²)
Secure	optical and chemical sensors to prevent in real time any risk of modification under beam

WORK PACKAGE 3:

UV-VIS-IR Light imaging

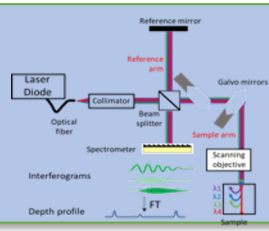
Corpus
Objets, prélèvements, échantillons de synthèse



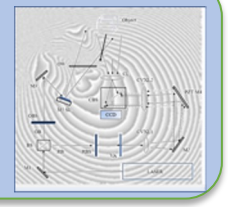

Christine Andraud
Nicolas Wilkie-Chancellier

HSI UV-VIS-NIR - CRC
Echelle: macro-meso
2D/"3D vol" , Car/HT/C/R
Moléculaire , Transportable

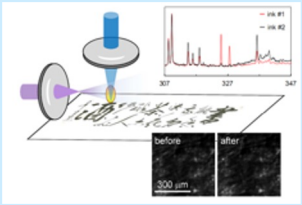
OCT multi λ - C2RMF
Echelle: meso-micro
3D vol , Car/C/R/HT
Structure , Transportable



Holo. Interf. - C2RMF/SATIE/CEA
Echelle: macro-meso
3D surf , C/R/HT
Structure , Transportable



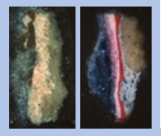
P-LEAF - C2RMF
Echelle: micro
Ponctuel+carto , Car
Elementaire , T?



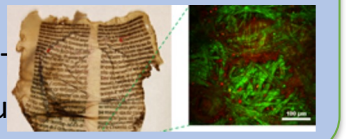
LIBS/RAMAN- C2RMF /CEA
Echelle: meso
2D/3D surf , Car/C/R
Elémentaire/moléculaire, Transpo

Source UV multi λ–IPANEMA
Echelle: macro-meso?
2D? , Car/C
Moléculaire , OL?P?

Confocal CARS - SATIE
Echelle: micro
3D vol , Car/C
Anal. Moléc. , P/O




µscopie NL/OCT - CRC/LOB
Echelle: micro
3D vol , C/Car/HT
Moléculaire/stru



AFM
Echelle: micro
3D vol , C/Car/HT/R
Moléculaire/structure , OL/P

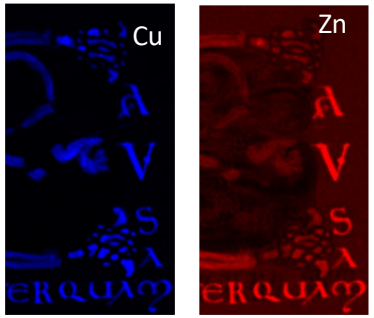
THE EXAMPLE OF MANUSCRIPTS

Multiscale / Interdisciplinary

2D Imaging

Hyperspectral Imaging
UV-VIS-NIR

Full field elemental analysis (PIXE, XRF)



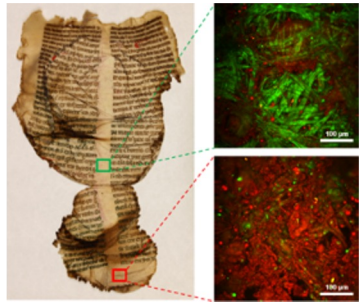
Recover illegible or underlying writings
Materials identification (inks, coloring materials)

Materials analysis

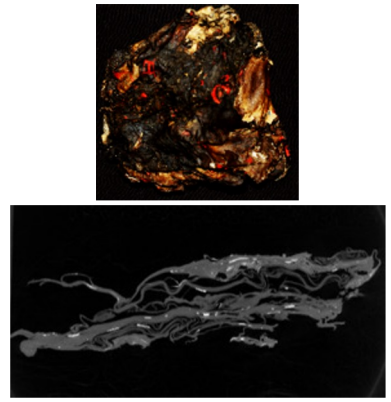
Multitemporal/Dynamic

3D Imaging

Non Linear Optical Microscopy
OCT
correlation of the 2 techniques



X-ray Tomography



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

Data

Biblissima+ / Huma Num

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

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

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

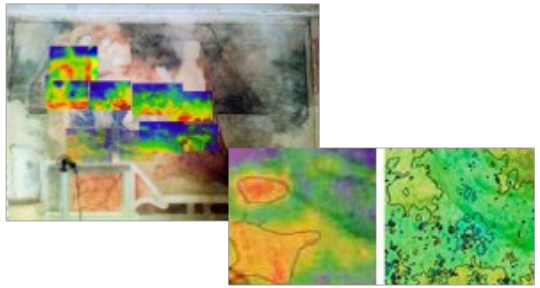
Structure and **manufacturing** techniques
Conservation state monitoring
Decision on **restauration/conservation** treatments

The example of Built Heritage

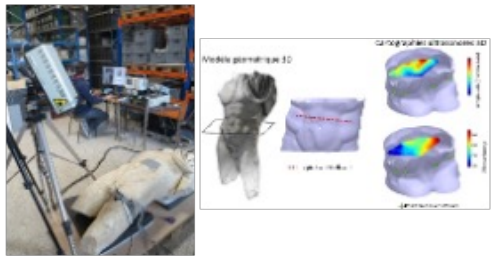
Dynamic analysis,

3D Imaging of (sub)-surface

SIRT highspeed + 3D imaging systems



Photoacoustic platform



In field materials analysis

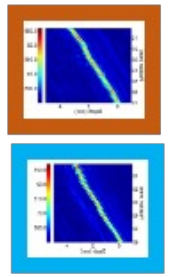
Track and identify the degradation causes in their first steps before the start of an irreversible degradation process
Porosity study of the first surface layers and in depth

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

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

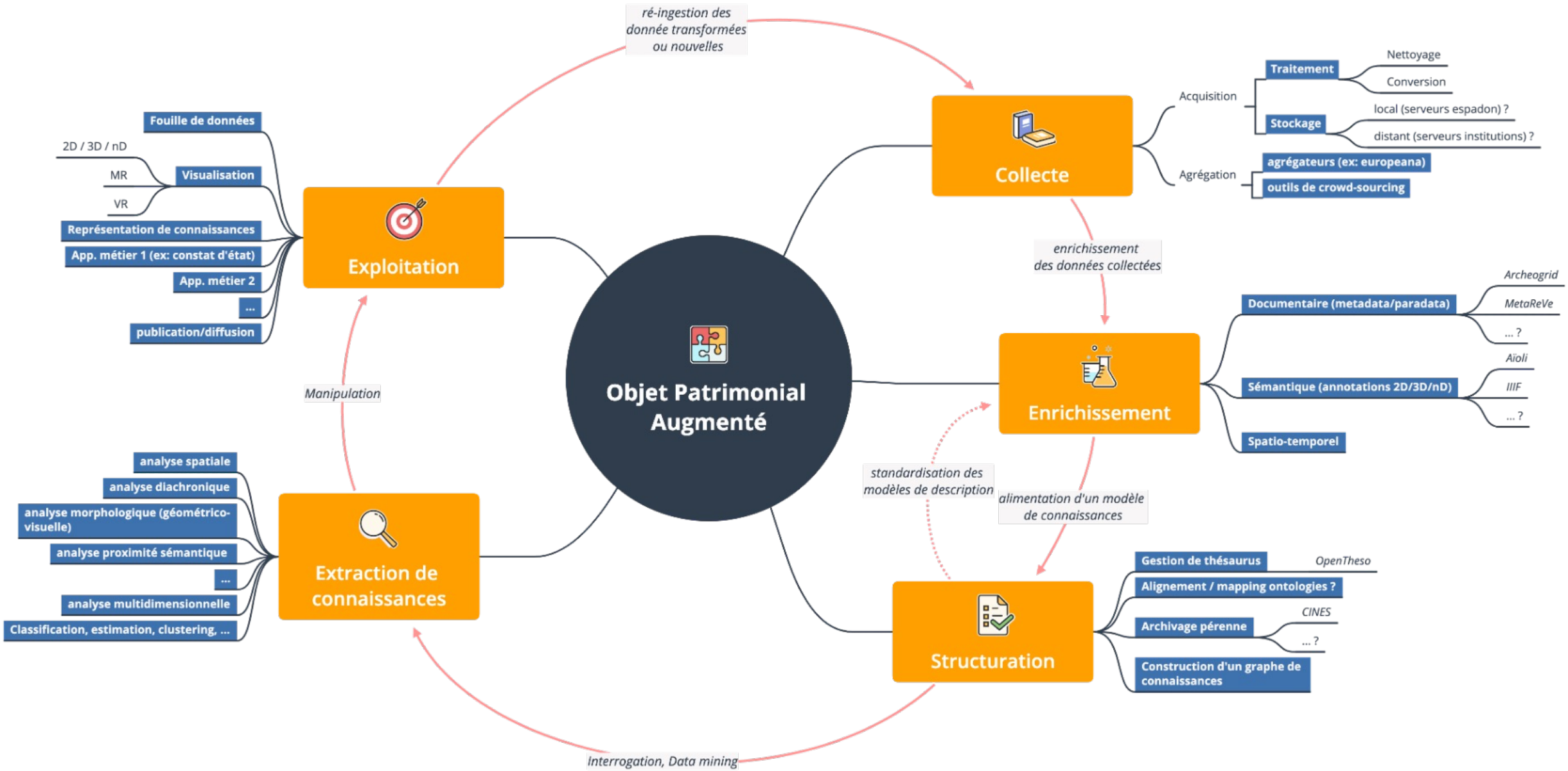
Data
Aïoli, Huma Num

Development of dedicated **data treatments**
Semantic annotation, propagation of annotations, information **correlation**

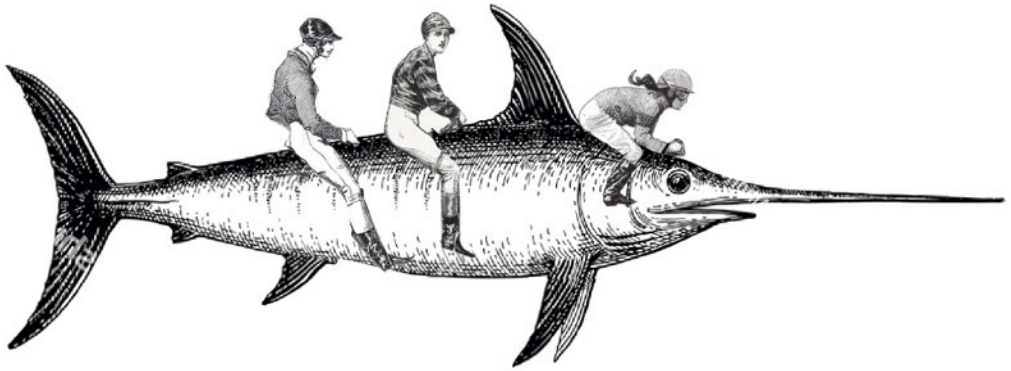
Conservation state monitoring, decision on **restauration/conservation** treatments, **structure** and **manufacturing** techniques

General asssembly 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 definir)	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 definir) Valérie Toureille (à definir)	AHMUF, SHMESP + contemporanéistes


Objet Patrimonial Augmenté
Collecte
Acquisition
Traitement
Nettoyage
Conversion
Stockage
local (serveurs espadon) ?
distant (serveurs institutions) ?
Agrégation
agrégateurs (ex: europeana)
outils de crowd-sourcing
Enrichissement
Documentaire (metadata/paradata)
Archeogrid
MetaReVe
... ?
Sémantique (annotations 2D/3D/nD)
Aioli
IIIF
... ?
Spatio-temporel
Structuration
Gestion de thésaurus
OpenTheso
Alignement / mapping ontologies ?
Archivage pérenne
CINES
... ?
Construction d'un graphe de connaissances
Extraction de connaissances
analyse spatiale
analyse diachronique
analyse morphologique (géométrico-visuelle)
analyse proximité sémantique
...
analyse multidimensionnelle
Classification, estimation, clustering, ...
Exploitation
Fouille de données
Visualisation
2D / 3D / nD
MR
VR
Représentation de connaissances
App. métier 1 (ex: constat d'état)
App. métier 2
...
publication/diffusion
ré-ingestion des donnée transformées ou nouvelles
enrichissement des données collectées
alimentation d'un modèle de connaissances
standardisation des modèles de description
Interrogation, Data mining
Manipulation

Fondation des Sciences du Patrimoine



eosc | Journées EOSC-France 13 - 14 Juin 2023

Thank you for your attention