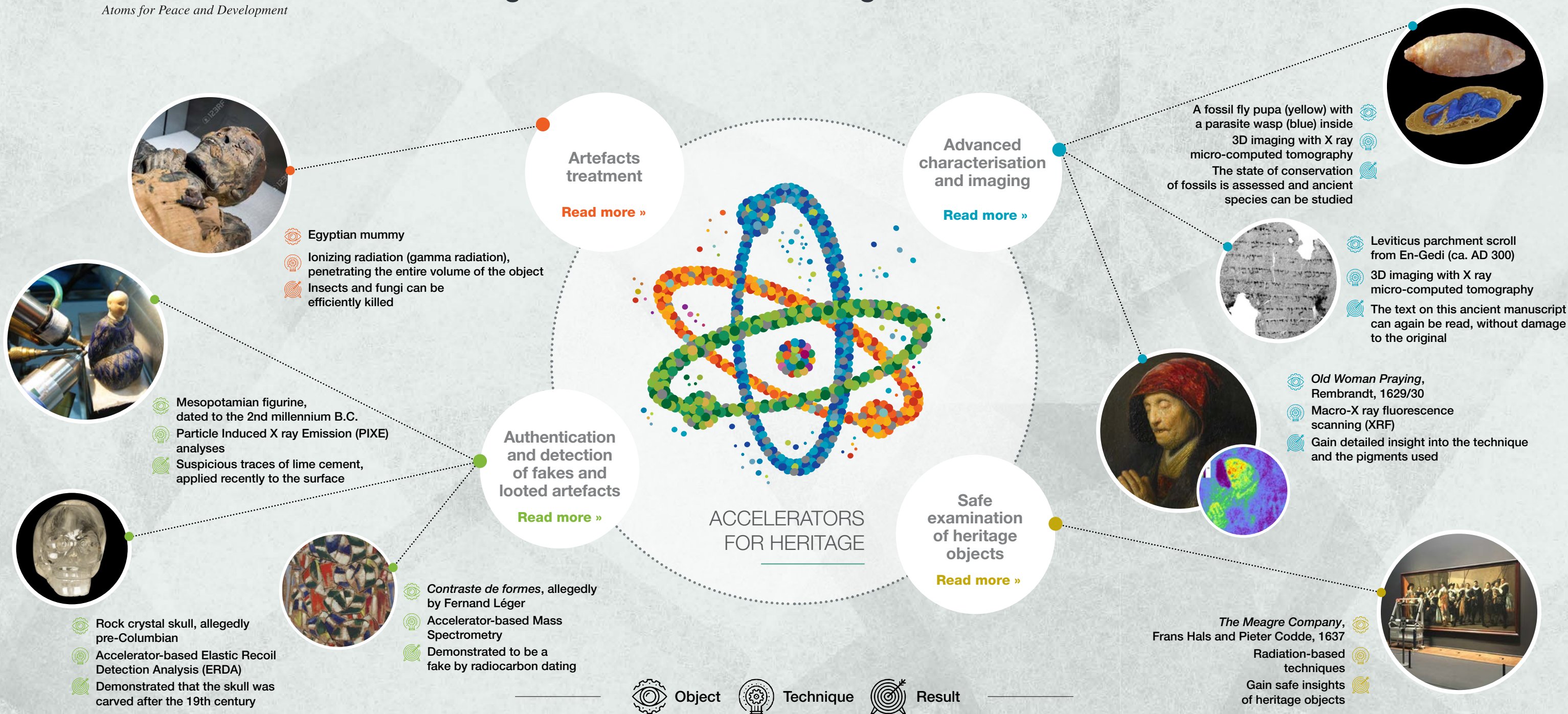


# Revealing secrets of our heritage with nuclear science





## Artefacts treatment

Main contributor:  
Laurent Cortella (ARC-Nucléart).

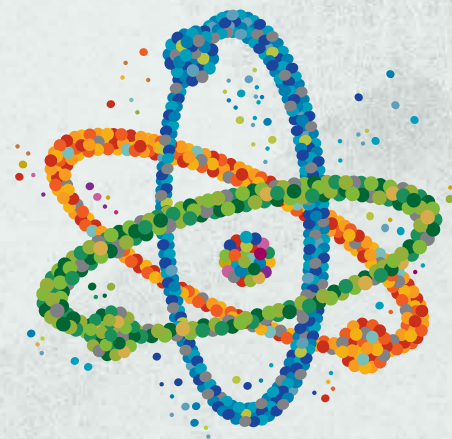
Other contributors:  
John Havermans † (formerly TNO, Netherlands), Ineke Joosten (RCE, Netherlands), Maartje Stols-Witlox (AHM, UvA, Netherlands), Pablo Vasquez (Nuclear and Energy Institute IPEN, São Paulo, Brazil)



## Authentication and detection of fakes and looted artefacts

Main contributor:  
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Other contributors (alphabetical order):  
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## Advanced characterisation and imaging

Contributors:  
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Main contributor:  
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## Safe examination of heritage objects

Main contributors:  
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Other contributors (alphabetical order):  
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## ACCELERATORS FOR HERITAGE

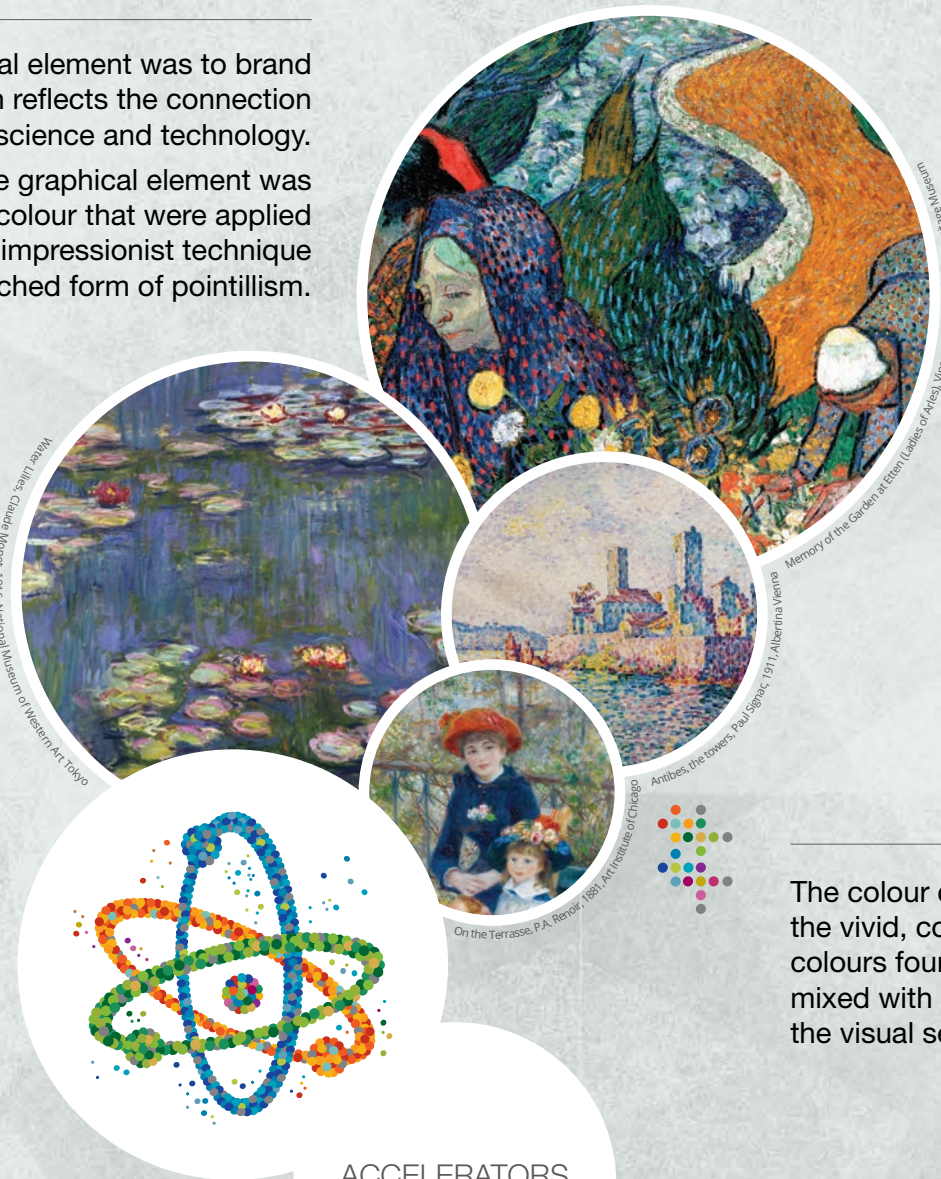
# The story behind the IAEA graphical element

The main objective to introduce this IAEA graphical element was to brand the IAEA heritage science projects. Its design reflects the connection between heritage science and nuclear science and technology.

In order to establish this link, the drawing of the graphical element was made by a composition of small, distinct dots of colour that were applied in patterns to form an image, aiming to remind the impressionist technique using its branched form of pointillism.

The base of the drawing is an abstract deconstruction of the stylized symbol of an atom. The dots around the main drawing support the idea that everything is made of atoms. The variety of colours may also be interpreted as diversity of heritage materials.

close

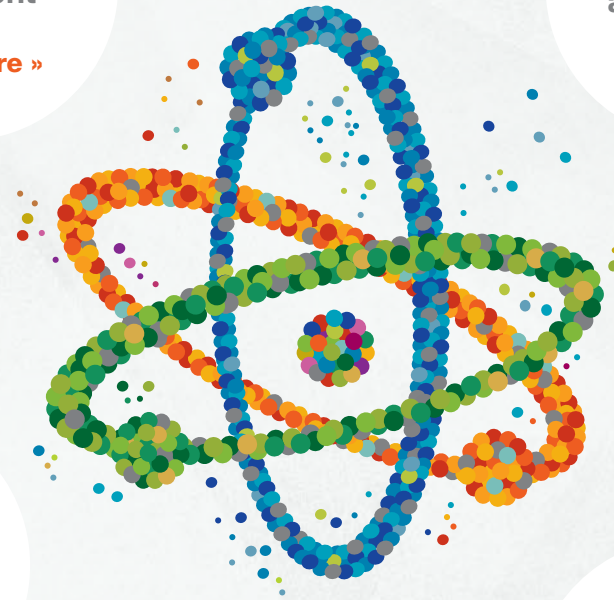


## ACCELERATORS FOR HERITAGE

The colour combinations are made out of the vivid, contrasting and complementary colours found in the impressionist paintings mixed with grey, in order to enhance the visual sensation of the image.




The typeface is a modern and clear font which stands for clarity, precision, integrity and technology. Its grey colour stands in high contrast to the coloured symbol.

# Revealing secrets of our heritage with nuclear science



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-  Egyptian mummy
-  Ionizing radiation (gamma radiation), penetrating the entire volume of the object
-  Insects and fungi can be efficiently killed

## Artefacts treatment

[Read more »](#)






-  Mesopotamian figurine, dated to the 2nd millennium B.C.
-  Particle Induced X ray Emission (PIXE) analyses
-  Suspicious traces of lime cement, applied recently to the surface




## Authentication and detection of fakes and looted artefacts

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-  Rock crystal skull, allegedly pre-Columbian
-  Accelerator-based Elastic Recoil Detection Analysis (ERDA)
-  Demonstrated that the skull was carved after the 19th century



-  *Contraste de formes*, allegedly by Fernand Léger
-  Accelerator-based Mass Spectrometry
-  Demonstrated to be a fake by radiocarbon dating

## Advanced characterization and imaging

[Read](#)

X-ray micro-computed tomography allows for the detailed study of fossils in the collections of natural history museums around the world. This technique is widely used to study ancient species and to assess the state of conservation of fossils.

Here, a visualization of a fossil fly pupa (yellow) with a parasite wasp (blue) inside, allows researchers to study the biology of parasitism at an unprecedented resolution in 3d imaging.

3D X-ray microtomography allows researchers to virtually unwrap and enhance the contrast of the ink on this fragile archaeological find, the Leviticus parchment scroll from En-Gedi (ca. AD 300). For the first time since it was found in 1970, buried in an arch, the text on this ancient manuscript can again be read, without damage to the original.

Rembrandt's "Old Woman Praying", 1629/30, is the most valuable and exceptional work of art of the Residenzgalerie Salzburg (RGS), Salzburg, Austria. It is painted on a gilded copper plate with dimensions of only app. 15 x 12 cm. The painting probably belongs to a series of three small-scaled tronies (the others are in The Hague and Stockholm), all painted on gilded copper plates. The gilded copper support, which represents a special feature in Rembrandt's work, is quite unusual in the entire history of art.

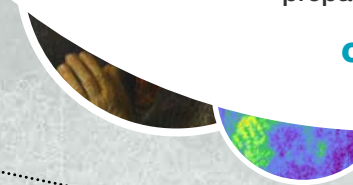
For the examination of the lead (Pb) distribution, the Pb M $\alpha$  line signal, originating mostly from the surface layers, and the Pb L $\alpha$  line signal, originating additionally from underlying layers, can be considered. The use of lead white in the top layers and underlying layers can thus be distinguished. Lead distributions also indicate the gilding technique: the gold was applied directly on the copper plate (oil gilding) without a lead white preparation layer.




Technique

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## Safe examination of heritage objects

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-  *The Meagre Company*, Frans Hals and Pieter Codde, 1637
-  Radiation-based techniques
-  Gain safe insights of heritage objects



Object

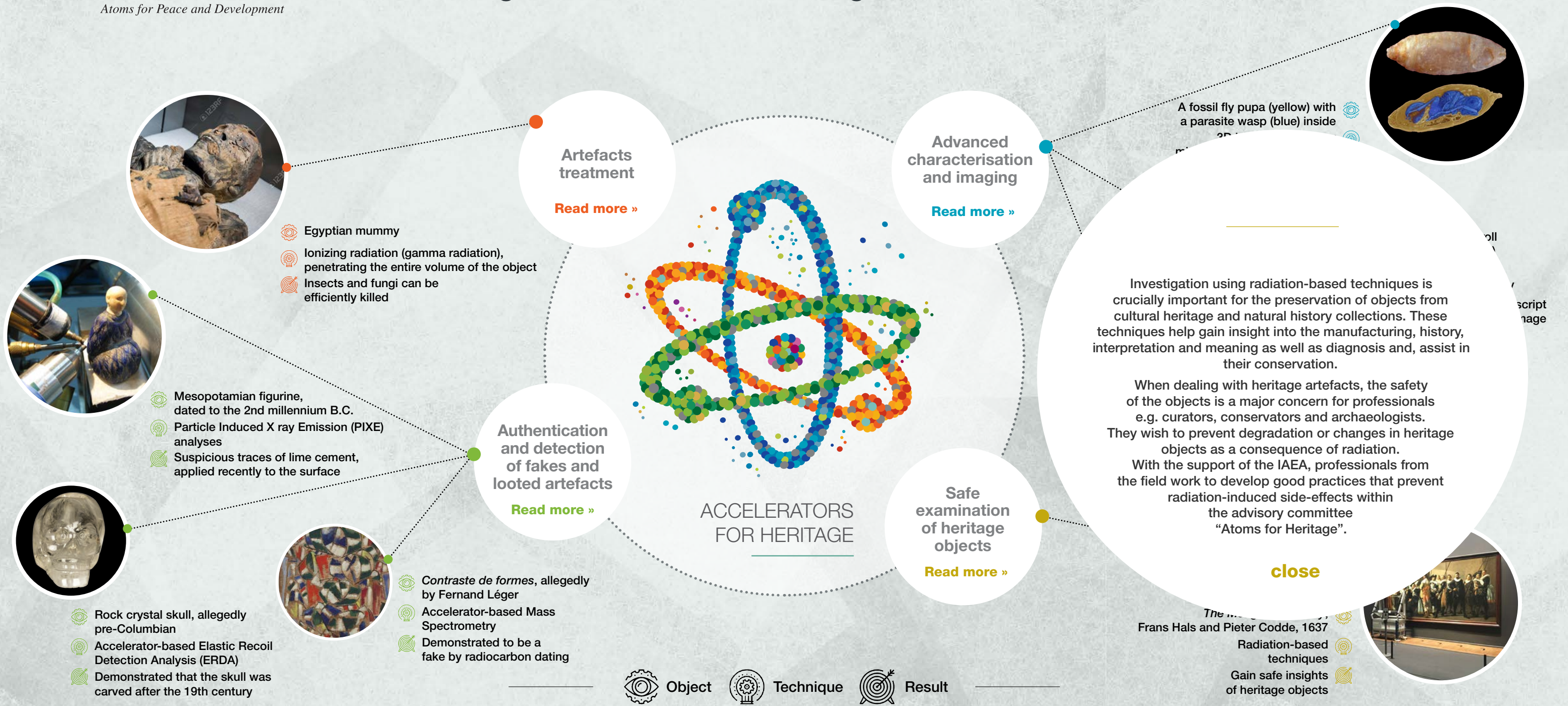


Technique



Result

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## Artefacts treatment

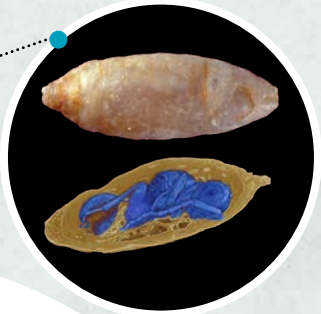
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- Egyptian mummy
- Ionizing radiation (gamma radiation), penetrating the entire volume of the object
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A fossil fly pupa (yellow) with a parasite wasp (blue) inside



## Authentication and detection of fakes and looted artefacts

[Read more »](#)

- Mesopotamian figurine, dated to the 2nd millennium B.C.
- Particle Induced X ray Emission (PIXE) analyses
- Suspicious traces of lime cement, applied recently to the surface

## Safe examination of heritage objects

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Investigation using radiation-based techniques is crucially important for the preservation of objects from cultural heritage and natural history collections. These techniques help gain insight into the manufacturing, history, interpretation and meaning as well as diagnosis and, assist in their conservation.

When dealing with heritage artefacts, the safety of the objects is a major concern for professionals e.g. curators, conservators and archaeologists. They wish to prevent degradation or changes in heritage objects as a consequence of radiation.

With the support of the IAEA, professionals from the field work to develop good practices that prevent radiation-induced side-effects within the advisory committee "Atoms for Heritage".

[close](#)

The ...  
Frans Hals and Pieter Codde, 1637

Radiation-based techniques

Gain safe insights of heritage objects

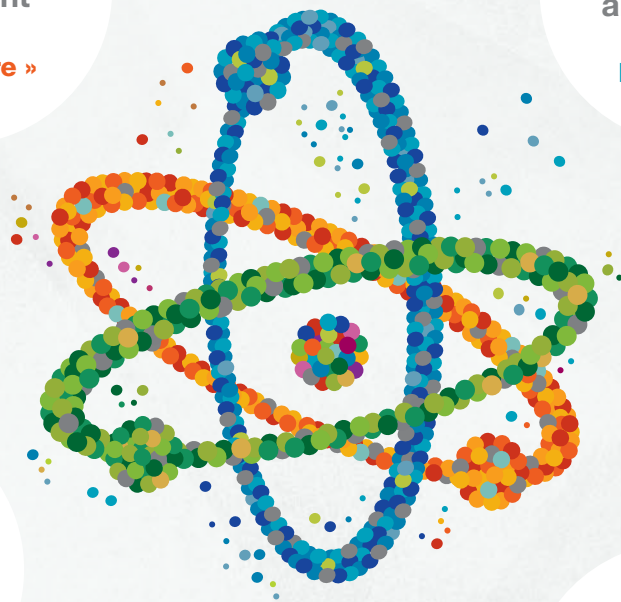


- Rock crystal skull, allegedly pre-Columbian
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## Artefacts treatment

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## Advanced characterisation and imaging

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## Safe examination of heritage objects

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## Authentication of objects and artefacts

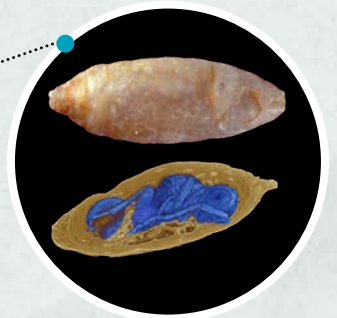
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Accelerator-based Mass Spectrometry plays an important role in the detection of fakes. This painting, *Contraste de formes*, allegedly by Fernand Léger, was demonstrated to be a fake by radiocarbon dating at the INFN-Labec laboratory in Florence. The radiocarbon concentration in the atmosphere increased for a short period after c. 1950 due to tests with atomic weapons. This so-called 'Bomb peak' was found in the analytical data, showing that the canvas could not have been produced before 1959, four years after Fernand Léger's death.

The originality of the famous pre-Columbian rock crystal skull exposed in Musée du Quai Branly, Paris has long been questioned. By using an accelerator-based technique named Elastic Recoil Detection Analysis (ERDA), it was shown that the skull was carved after the 19th century; hence, the Paris quartz skull joins the group of forged archaeological rock crystals which used to make the headlines.

The figurine was auctioned in Paris as a Mesopotamian artefact dated to the 2nd millennium B.C., however, while Particle Induced X-ray Emission (PIXE) analyses showed that the lapis-lazuli of the body originates from the historical mines in Afghanistan; it also evidenced suspicious traces of lime cement, applied recently to the surface. Figurines like these appear in the red list of cultural objects exposed to trafficking, maintained by the International Council of Museums (ICOM). As a result, the acquisition by public collections was vetoed.

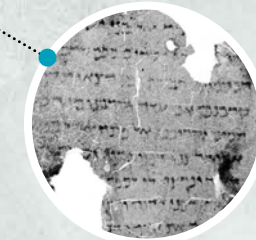
A fossil fly pupa (yellow) with a parasite wasp (blue) inside  
3D imaging with X ray micro-computed tomography  
The state of conservation of fossils is assessed and ancient species can be studied



Leviticus parchment scroll from En-Gedi (ca. AD 300)

3D imaging with X ray micro-computed tomography

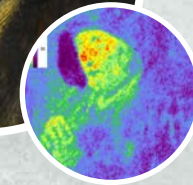
The text on this ancient manuscript can again be read, without damage to the original



*Old Woman Praying*, Rembrandt, 1629/30

Macro-X ray fluorescence scanning (XRF)

Gain detailed insight into the technique and the pigments used






*The Meagre Company*, Frans Hals and Pieter Codde, 1637




Radiation-based techniques

Gain safe insights of heritage objects



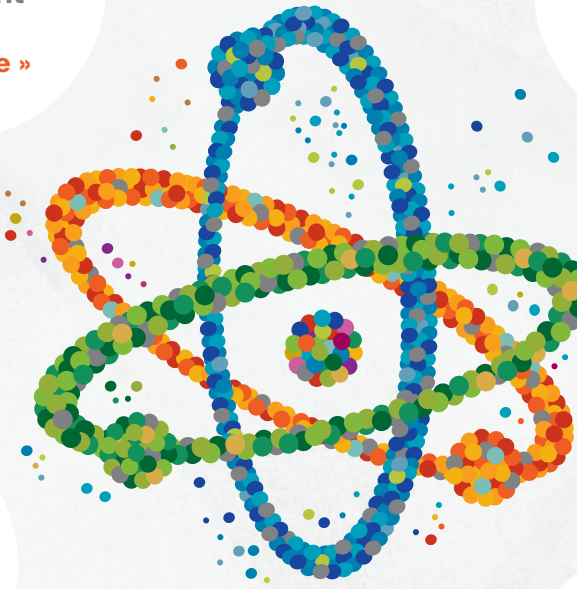
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Fungi or insects can be very damaging to organic materials, such as this Egyptian mummy. Taking advantage of the biological effects of ionizing radiation, insects and fungi can be efficiently killed by gamma radiation, for example in the ARC-Nucléart Irradiator in Grenoble, France. Gamma radiation penetrates the entire volume of the object, ensuring unparalleled reliability. The technique can be used for a very large range of materials. Ionizing radiation is also used to harden resins (radio-curable resins). When impregnated with the liquid resin, which is subsequently hardened in the irradiator, weakened porous materials can be strengthened. This technique is used as a last resort for wooden sculptures like this 18th century sculpture of Saint Vincent in Suzannecourt (France), which was too weak to stand. The method is particularly suitable to strengthen objects that need high mechanical strength, or to treat waterlogged archaeological wood.

close



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## Artefacts treatment

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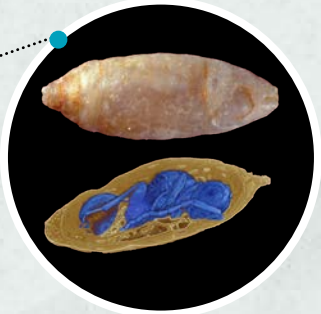
## Authentication and detection of fakes and looted artefacts

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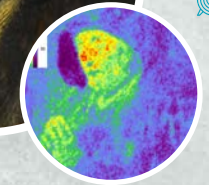
## Advanced characterisation and imaging

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