[EPS EDITORIAL]

# Physics and Cultural Heritage

DOI: https://doi.org/10.1051/2025401

For some time, museum curators have used scientific knowledge from physics and chemistry, to analyse, restore, and preserve all sorts of artistic and architectural pieces. As early as the end of the 19th century Louis Pasteur wrote a note entitled « Notes pour les leçons de physique et de chimie appliquées aux Beaux Arts (Notes on the lessons of physics and chemistry applied to the fine arts). The major museums now have dedicated services able to operate all kinds of scientific devices, from X-ray radiography, X-ray fluorescence, UV and IR spectrometry, thermal imaging, to gamma rays induced by particle accelerators. These tools were often originally conceived for fundamental physics research.

The first step in the analysis of a work of art is to identify the elements it contains. This can tell us where, how, and when it was made, by inferring precise information on the fabrication technique.

The basic requirement for the methods of analysis is their non-invasive nature. For example, the use of microscope (optical or electron) may require that a sample of material is removed from the object and is then often excluded.

Techniques like spectroscopy can reveal the chemical makeup of ancient paints without damaging them. X-ray fluorescence (XRF) can peer through layers of history to uncover hidden images or inscriptions. Thermal imaging detects weaknesses in walls and frescoes before they become visible to the naked eye. This means that these methods provide useful information for art history, preservation, and even restoration if needed.

The scope of the analysis covers a wide range of areas: archaeology, architecture, fine arts, and a time range running from paleolithic era to modern times.

One interesting example is provided by the Antikythera Mechanism: fragments of a corroded bronze mechanism were retrieved from a shipwreck off the coast of the Greek island Antikythera in 1901. X-ray, Gamma-ray images, and then X-ray computerised tomography have been used to explore – in a non-invasive way – the structure of the mechanism. Some of the fragments contains gearwheels, and some bear inscriptions. The mechanism is understood to be describing the motions of the Sun, the Moon and all five planets known in antiquity, including complex planetary periods. It can be considered as the first known analogue computer, constructed in ancient Greece back in the late second century BC or the early first century BC.

Another interest of the use of the various methods mentioned above is to determine the authenticity of a piece of art. An art scientist may use mass spectroscopy to identify which pigments were used, X-rays to determine whether a possible forgery is painted on a re-used canvas, and infrared reflectography to reveal underlying layers. There is a market for art, and this may attract forgers. By a careful analysis can help to detect frauds.

Beyond analysis, there is the possibility of « rebuilding the irreplaceable ». There are unfortunately cases where the cultural heritage is destroyed, intentionally or not, during conflicts or by natural disasters and physics helps rebuilding first digitally, and then physically. Art historians used laser scanners to create an extremely accurate digital copy of the cathedral Notre-Dame de Paris, which was essential for its recent restoration.

The use of modern tools of physics is a way to preserve what we inherited from the past and bequeath it to the future generations. ■

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