X-rays help to uncover who painted a centuries-old masterpiece in Albania

By Alejandra Silva

A portable X-ray fluorescence spectrometer helps scientists analyse a portrait of Saint George, one of Christianity's most famous saints.
(Photo: A. Silva/IAEA)

Albanian researchers have used X-rays to discover who painted a delicate, centuries-old masterpiece of Saint George, one of Christianity's most famous saints. Their methods included non-destructive testing (NDT) and non-destructive assay (NDA) involving X-rays, which are widely used to study materials and the quality of objects, from analysing cultural artefacts and biomedical samples like blood and hair, to finding cracks or cavities in oil pipes and aeroplane parts.

"Non-destructive testing and assay let us evaluate the integrity and physical properties of objects without damaging them, which is critical when dealing with old, often very fragile artefacts," said Elida Bylyku, Director of the Institute of Applied Nuclear Physics in Tirana, Albania. "X-rays also help us see the inner parts of an object and identify any cracks or flaws that may not otherwise be visible."

After recovering the portrait from an old church, researchers at the Institute of Applied Nuclear Physics worked with IAEA experts to study the portrait using NDT and NDA techniques. Their findings have helped conservationists at the National Museum of History in Tirana understand the painting's history and choose the right methods to restore the precious piece of art.

"Originally when we received the portrait, we thought it had been painted by an anonymous artist," said Bylyku. After checking the structural integrity of the piece using industrial radiography, the researchers used X-ray fluorescence analysis (XRF) to identify the materials used to create the icon (see The Science box). They compared these materials to those used by various artists during different time periods and their analysis led to a match.

"Thanks to X-ray fluorescence analysis we have now identified the colour pigments used in the portrait of Saint George, which helped us to discover that the icon was painted by the Çetiri brothers in the 18th century," said Bylyku. "This information is also key to restoring the piece in an authentic way."

The portrait of Saint George is one of thousands of cultural and archaeological treasures in the museum's collection. Many of the pieces have been recovered from historical sites and churches. They are often delicate and deteriorating, which makes them

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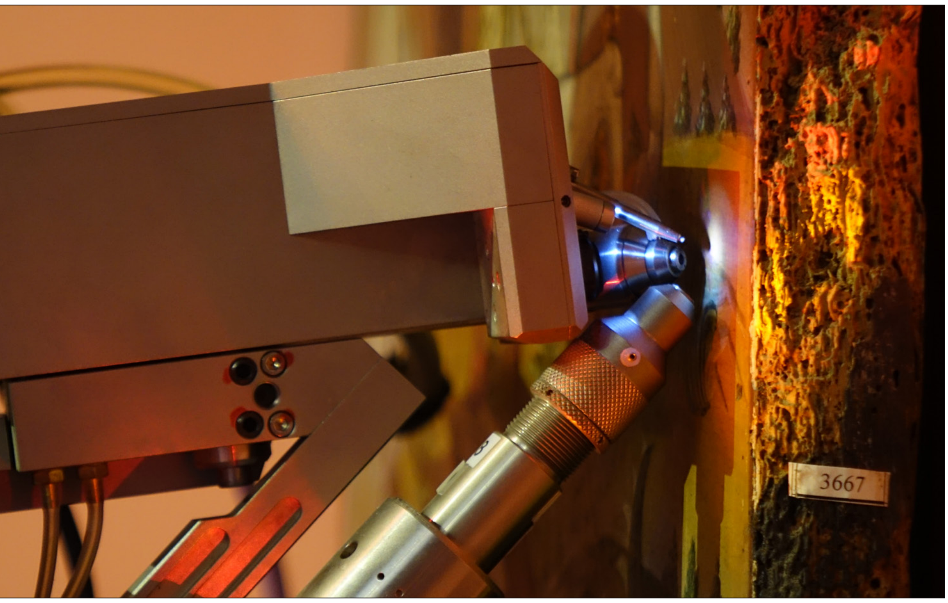
—Elida Bylyku, Director, Institute of Applied Nuclear Physics, Tirana, Albania



Beams of X-rays interact with the atoms in the portrait to reveal clues about its history and how it was created.

(Photo: A. Silva/IAEA)

precarious to handle. As NDT and NDA are both hands-off methods, they are often used by researchers to study such fragile objects.

Protecting cultural heritage worldwide

NDT and NDA can uncover valuable details in artwork and cultural artefacts that are undetectable to the naked eye. "Each piece contains a unique blend of elements and isotopes that carries information about the origin of the piece, from the techniques and materials used, to when and even where it was likely created," said Patrick Brisset, an industrial technologist at the IAEA. "While this information can be used to preserve pieces and discover the history surrounding their creation, it can also be used to identify forgeries."

Hundreds of specialists worldwide are working with the IAEA to use NDT and NDA to study and preserve cultural heritage and to identify forgeries. This can include receiving training and the necessary equipment and facilities to carry out these studies through IAEA coordinated research and technical cooperation projects. These projects are also an opportunity for specialists to share their expertise and knowledge, which helps to advance the field and preserve the history of human civilization.

"We are working together with the Institute of Applied Nuclear Physics because icons are one of the most important cultural heritage artefacts that we have. So, we are taking every possible step to make sure that they are being adequately analysed and preserved," said Arta Dollani, Director of the Institute of Cultural Monuments of Albania, which works closely with the National Museum of History to restore cultural artefacts.

THE SCIENCE

X-ray fluorescence and industrial radiography

X-ray fluorescence, or XRF, is a non-destructive assay method that detects the presence and measures the concentration of elements in virtually all types of material. Scientists normally use a small, portable device called an X-ray fluorescence spectrometer to bombard a sample of the test material with X-ray beams. The beams interact with the atoms in the sample, displacing the electrons from the inner shells of these atoms. When an electron is displaced, it leaves behind a vacancy that is then filled by an electron from the higher orbit. When an electron moves from a higher orbit to a lower one, a certain amount of energy is released as electromagnetic radiation. This radiation is in the form of X-rays, which can be detected by the spectrometer and is used to unequivocally identify the element they originated from. The method is accurate because the energy of the emitted X-rays is unique to each element. XRF is widely used in archaeometry to investigate the composition of pigments or metals used in manuscripts, paintings, coins, ceramics, and other artefacts.

Industrial radiography is a non-destructive testing method used to verify the internal structure and integrity of objects. It uses ionizing radiation, such as X-rays, to create an image of the internal structure of solid and hard materials. The radiation passes through the material, hitting an exposed film placed on the other side. The darkness of the film varies depending on the amount of radiation that reaches it through the object: materials with areas of reduced thickness, cracks or voids, or a lower material density, allow more radiation to pass through. These variations in the image can be used to find any flaws or cracks hidden inside the object.