X-ray or neutron imaging?

A. Fedrigo[1]

[1]STFC, United Kingdom, **anna.fedrigo@stfc.ac.uk**

X-rays imaging is generally the first choice for examination of museum objects for their availability and easy application. But where X-rays fail or cannot deliver specific information, such in case of dense materials like bulky metals, neutron imaging methods will be successful at most times, delivering contrasts and penetration data that are not accessible for X-rays. Neutrons also deliver contrast between many neighbouring elements in the periodic system, often rendering contrast between very similar materials. In addition, neutron imaging provides high contrast for hydrogen containing phases, which can be easily located even in the presence of heavy atoms.

Neutron tomography can also be applied in combination with X-ray tomography in a bi-modal approach [1]. The different interactions of X-rays and neutrons with matter allow us to exploit the complementary information of both modalities: X-rays interact mainly with the electrons of an atom (the more electrons an atom has the higher the probability of interaction), whereas neutrons are electrically neutral particles that interact with the atomic nuclei.
Bi-modal imaging can provide a wealth of information on multi-phase objects. A bi-modal imaging approach can provide a more detailed and quantitative understanding of the structural and chemical composition compared to standard single mode imaging methods, as X-ray and neutron interaction with matter results in different attenuation coefficients with a non-linear relation.

The work covers various examples of neutron imaging and bi-modal imaging investigations of museum objects [2–4].

References

[1] - A.Fedrigo *et al*., Investigation of a Monturaqui Impactite by Means of Bi-Modal X-ray and Neutron Tomography, *J. Imaging* **4**(5), 72 (2018)
[2] - A. Fedrigo *et al.*, Neutron imaging study of ‘pattern-welded’ swords from the Viking Age. *Archaeol. Anthropol. Sci.* **10**(6), 1249–1263b (2018)
[3] - F.Salvemini *et al*., Reveals the Secrets of Composite Helmets of Japanese Tradition, The *European Physical Journal Plus* **128**(8), 87 (2013)
[4] - A. Fedrigo *et al.*, Integrated approach between neutron diffraction and elemental imaging through Neutron Resonance Transmission Imaging, preliminary results on Chinese bimetallic sword fragments, *J. Anal. At. Spectrom.* (2019)