

THz Science and Technology

Panels inspection behind gilded finishes through Terahertz Time-Domain Imaging (THz-TDI)

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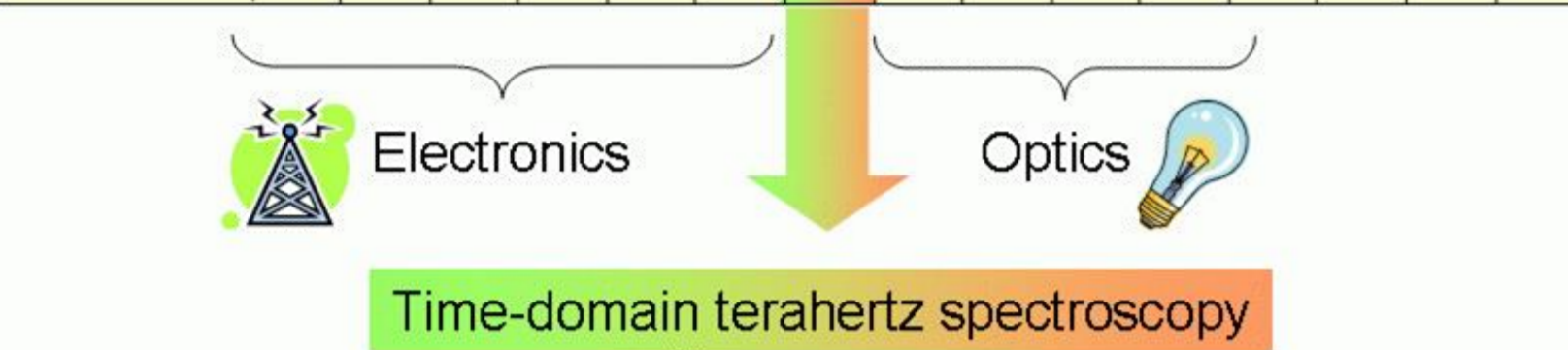
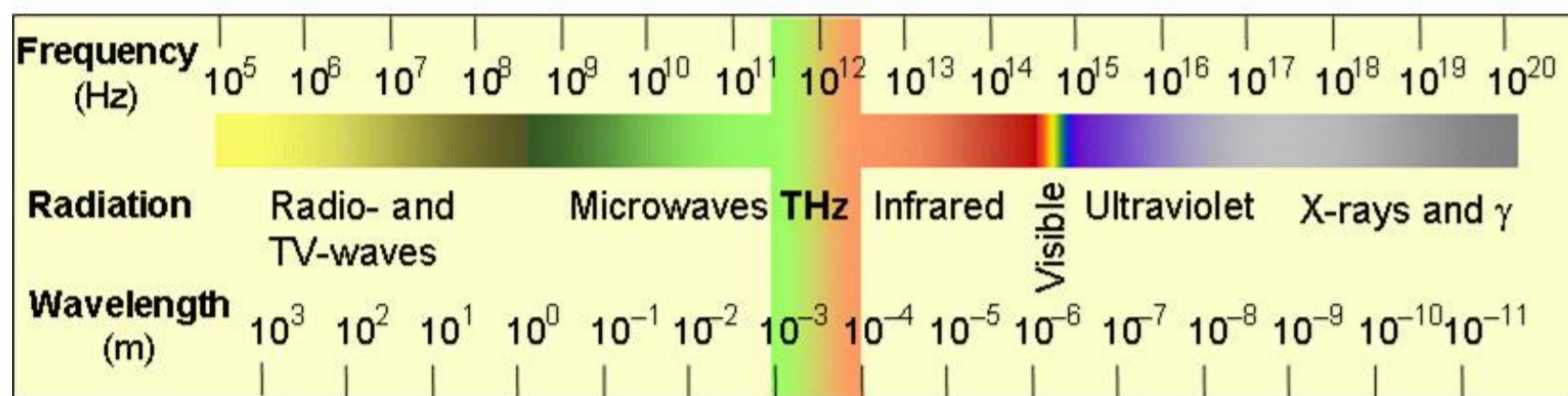
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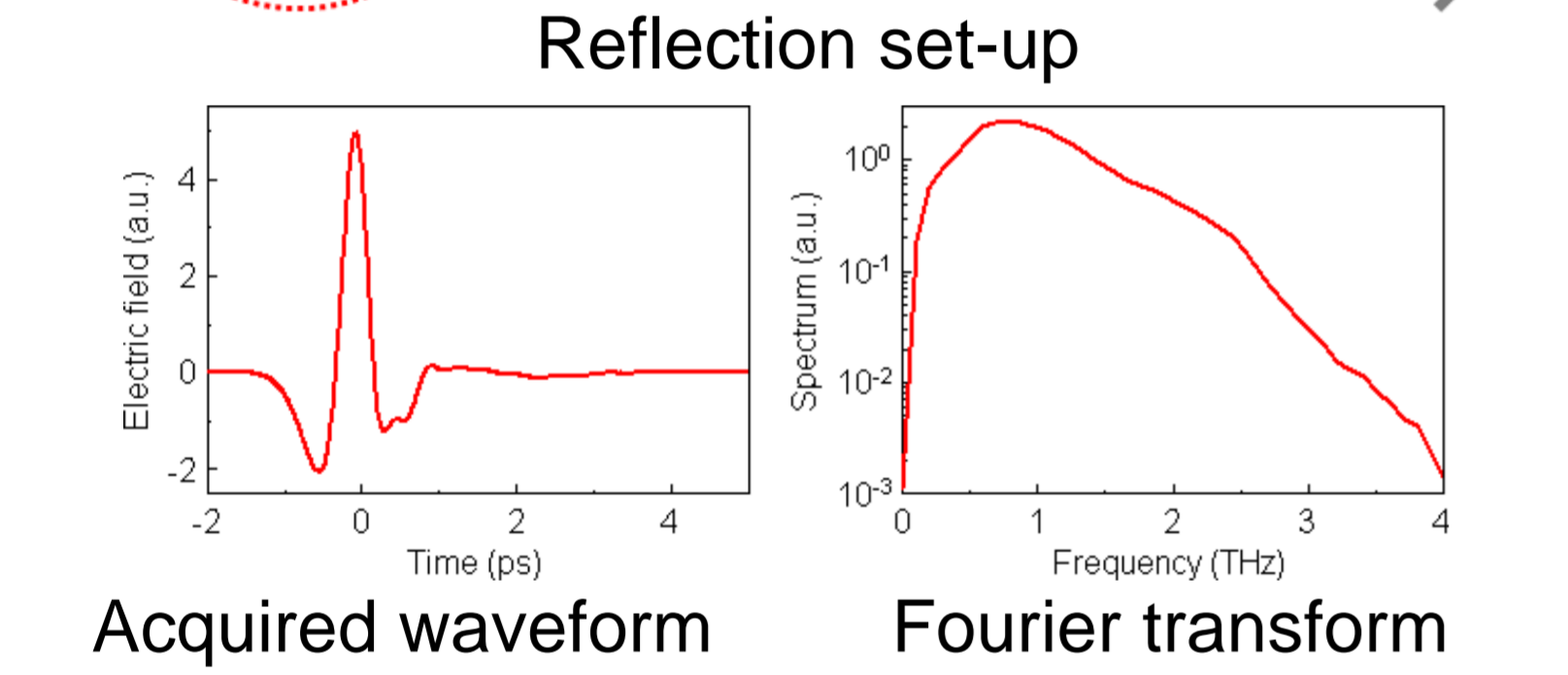
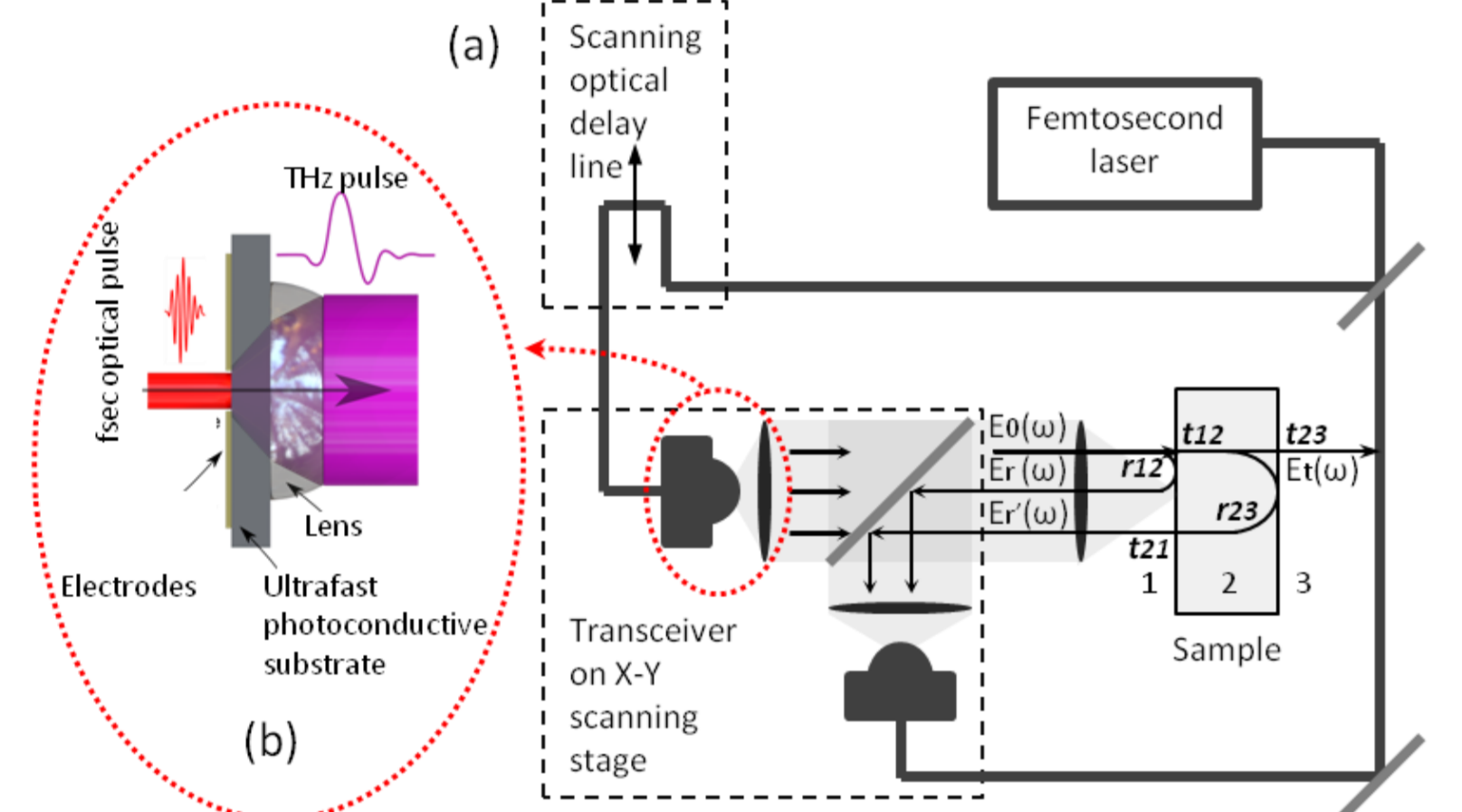
Abstract

Pulsed Terahertz Time-Domain Imaging (THz-TDI) in reflection mode has been applied to the investigation of gilded tempera panels, for the study of their internal structure and as an aid to understand the applied execution techniques. The knowledge of the inner structure, stratigraphy and condition of the subsurface layers of multi-layer objects is highly relevant in conservation when stability problems such as delamination, internal cracking or defects are considered. Unlike infrared reflectography and X-ray radiography, THz-TDI provides not only 2-D images but also subsurface 3-D images. Furthermore, unlike cross-sectioned samples it provides stratigraphic images (b-scans) contactless and non-invasively.

Spectrum of the electromagnetic radiation



$$1 \text{ THz} \leftrightarrow 1 \text{ ps} \leftrightarrow 33 \text{ cm}^{-1} \leftrightarrow 0.3 \text{ mm} \leftrightarrow 48 \text{ K} \leftrightarrow 4.1 \text{ meV}$$



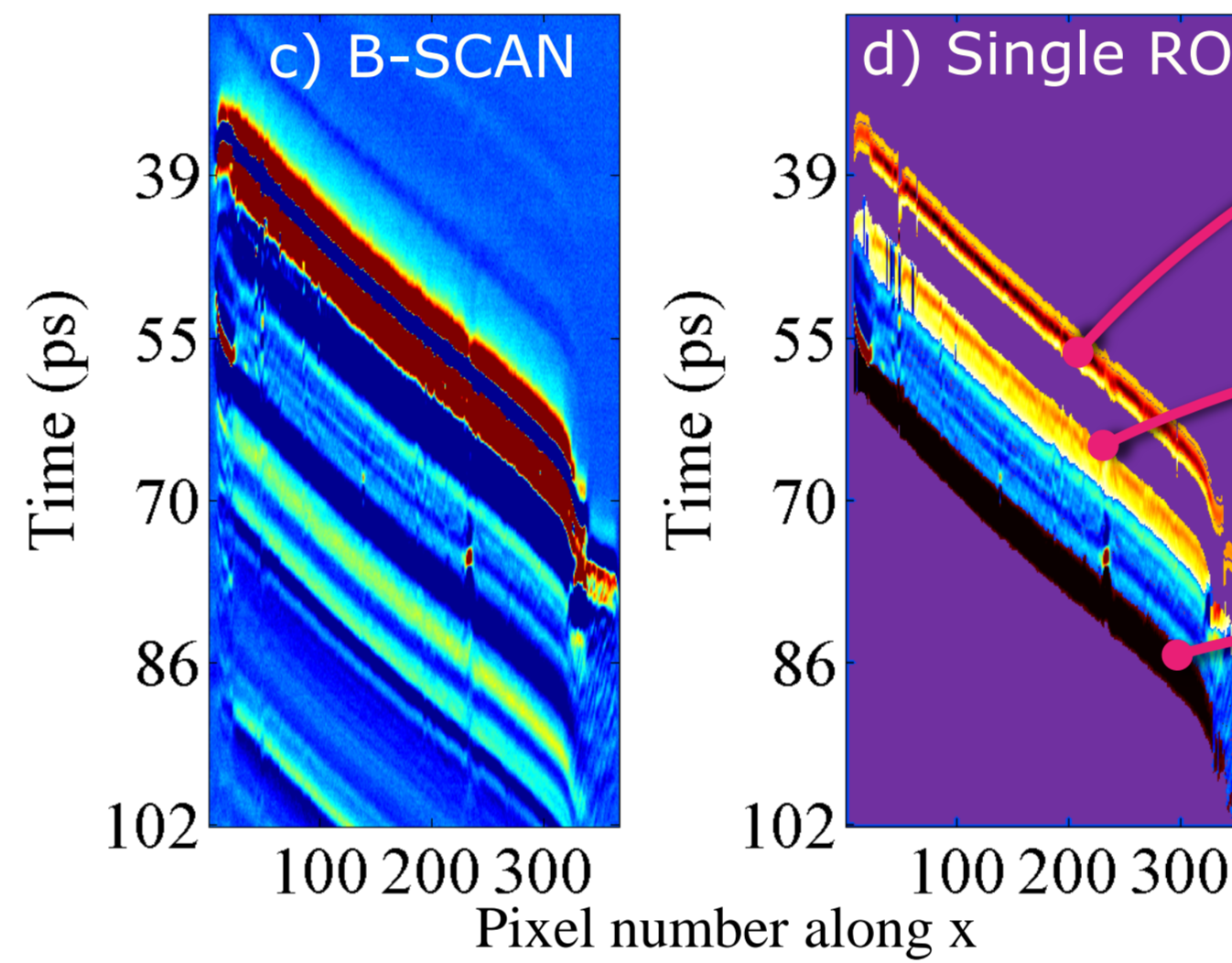
THz reflectometric imaging of the gilded panel replica n. 1



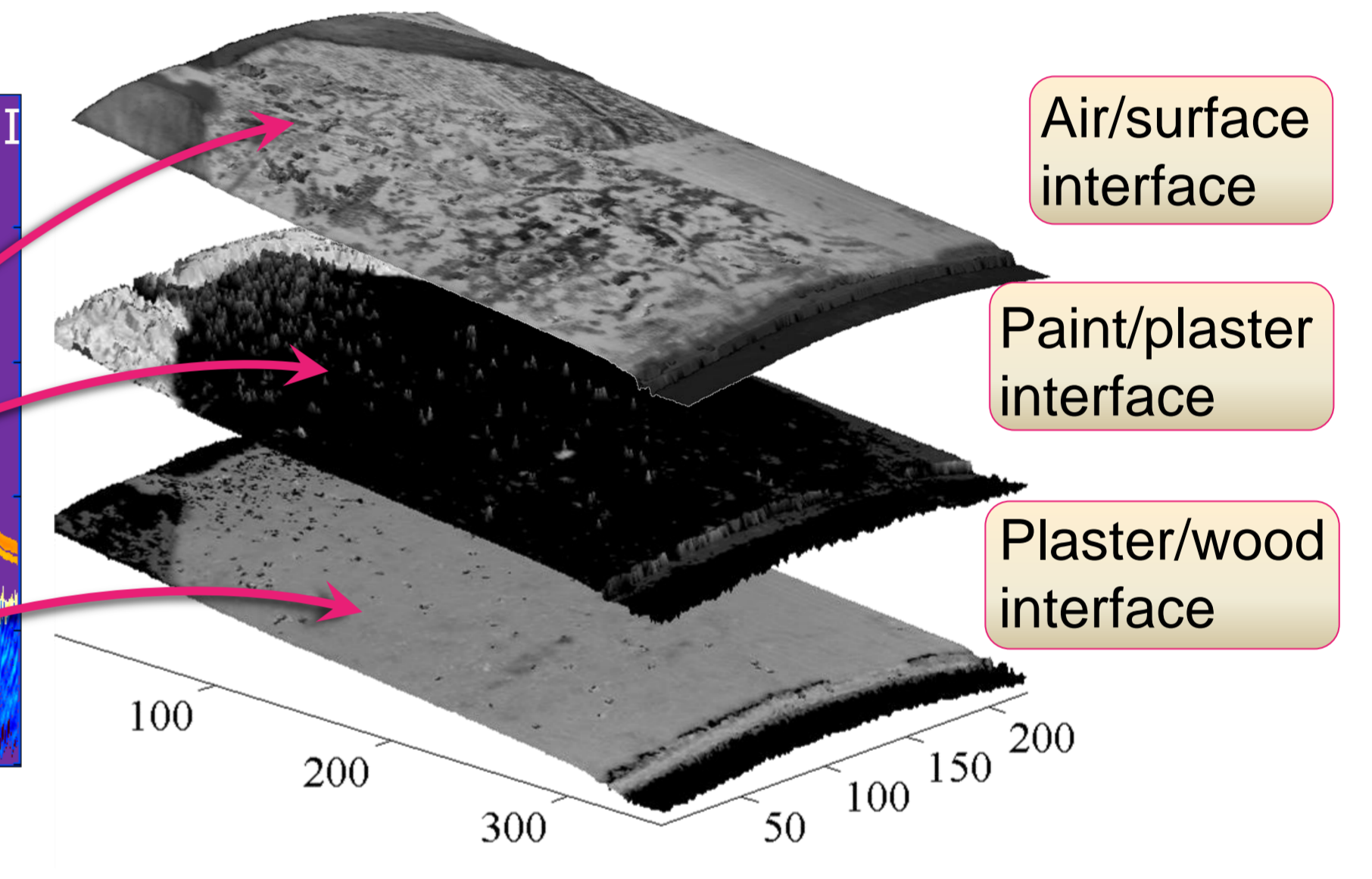
The investigated panel replica n.1 is realized on a wooden support covered by the primer layer. The pictorial scene is complex. The gilding has been used extensively as decorative theme together with the painting material to represent textile. Engravings on the gilding are used to represent geometrical and floral motives.

Thanks to the high reflectivity of gold, terahertz images of the second panel (fig. b) reveal that the majority of the paint layer has been applied on top of the gilding, except for some details, where the paint layer has been applied directly on the primer.

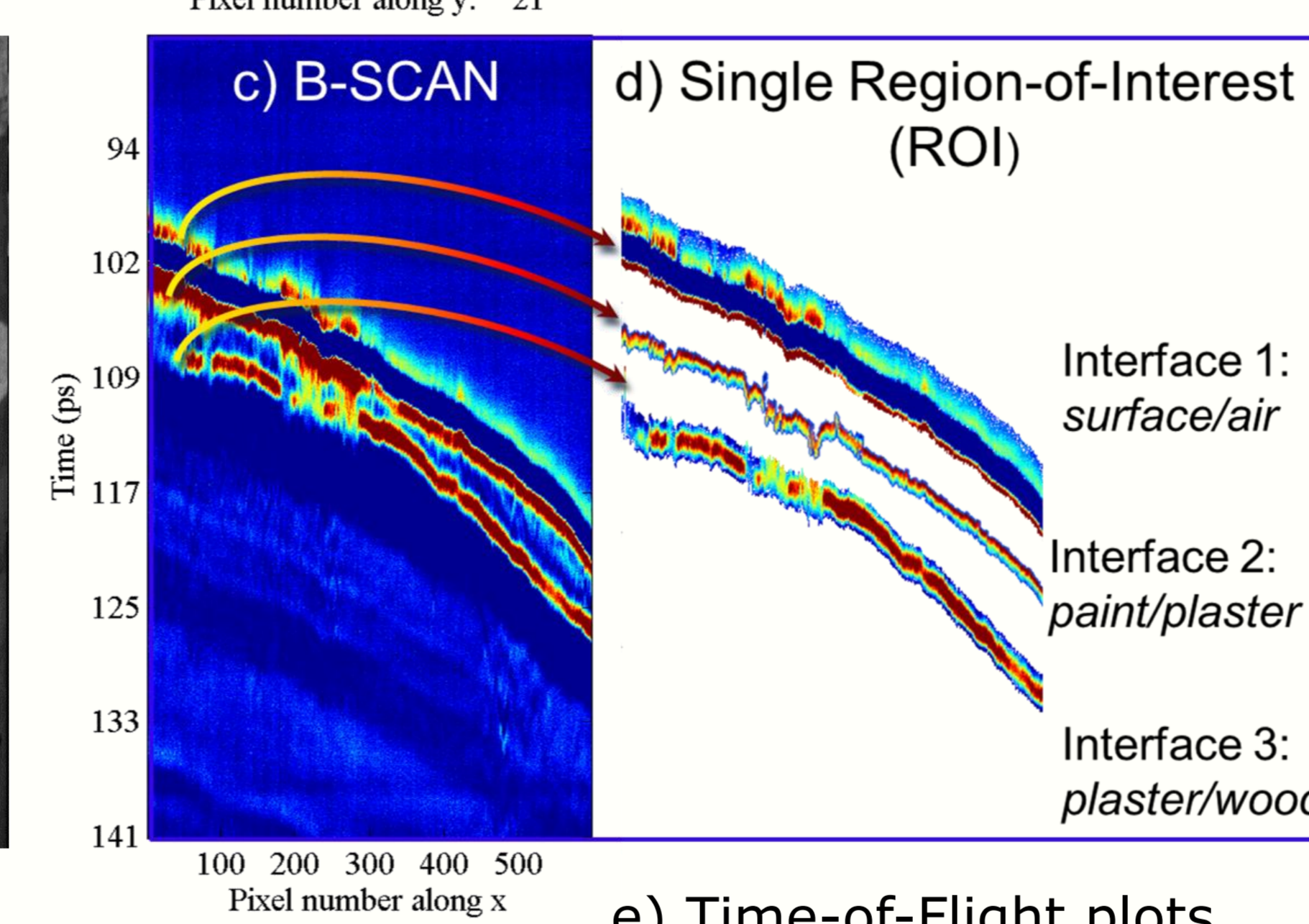
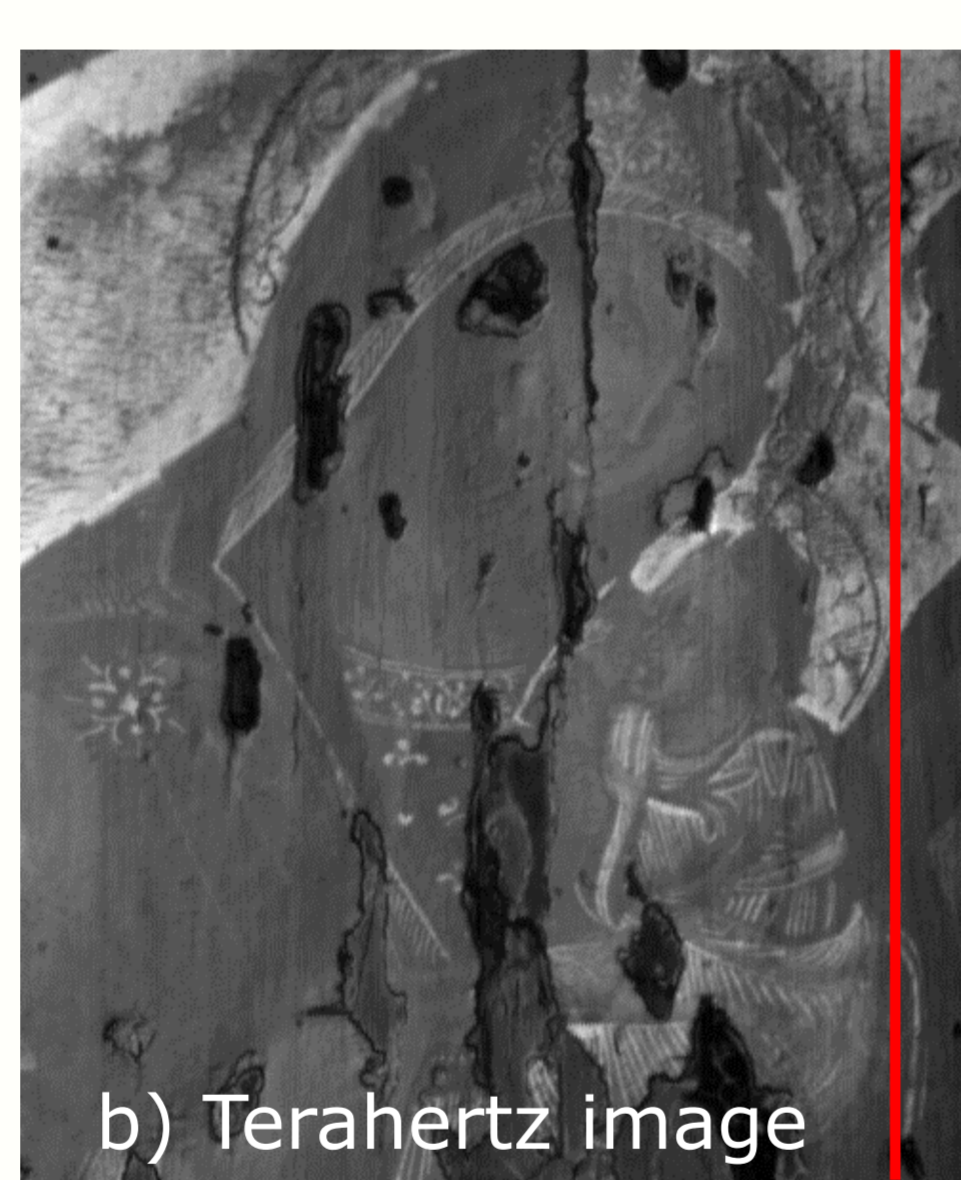
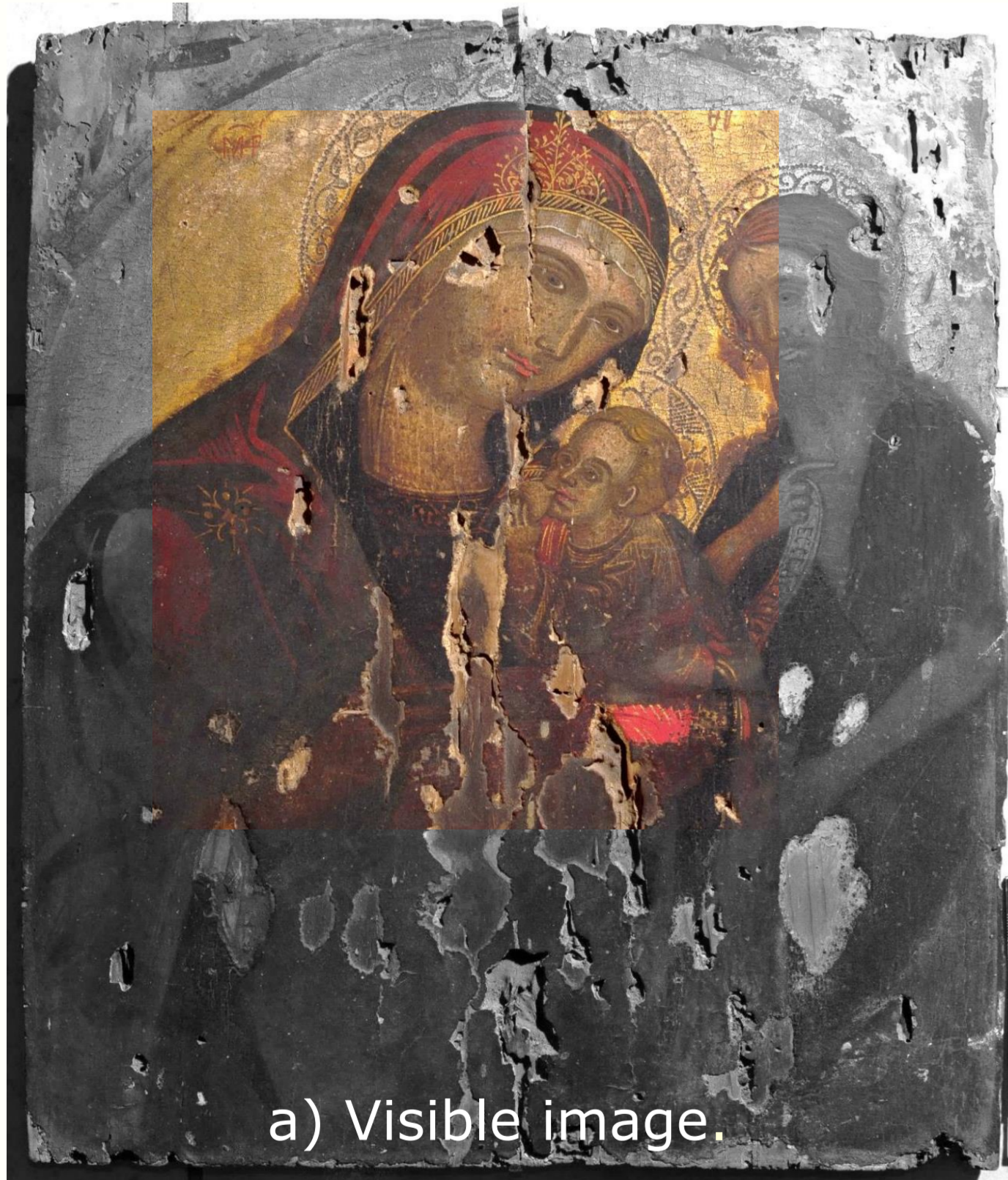
Defects inside the buried plaster layer behind the gilding have been imaged through B-SCANS (fig. c) and d). Single interfaces have been imaged through Time-of-Flight plots (fig. e).



e) Time-of-flight plots



Gilded XIV C. tempera panel - the Virgin with Child and Saint

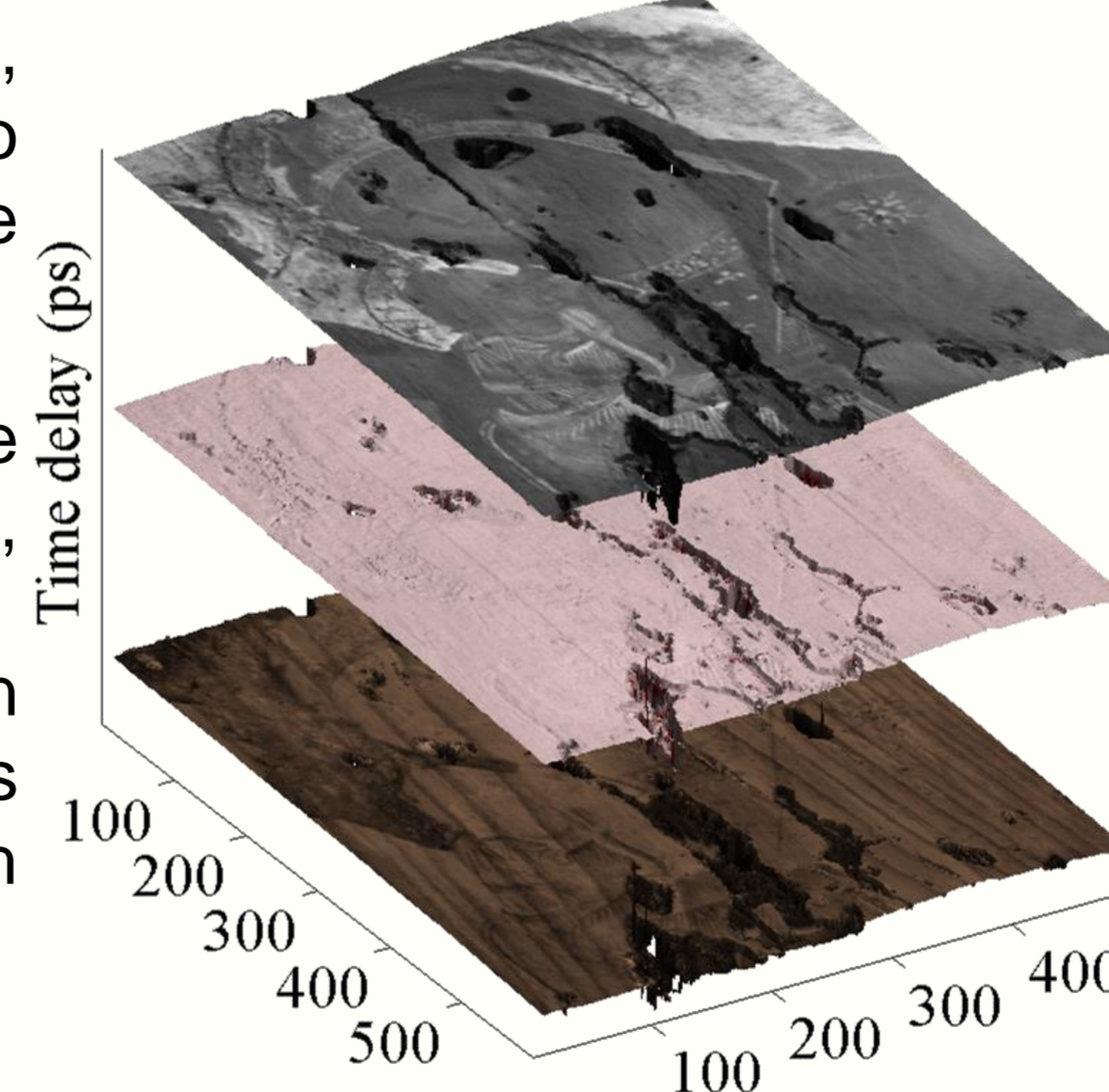


The investigated gilded tempera panel (fig. a)), has been provided by the conservator Angelo Cristaudo (Acireale, Sicily, Italy). It is a unique example of gilded icons of the XIV C. .

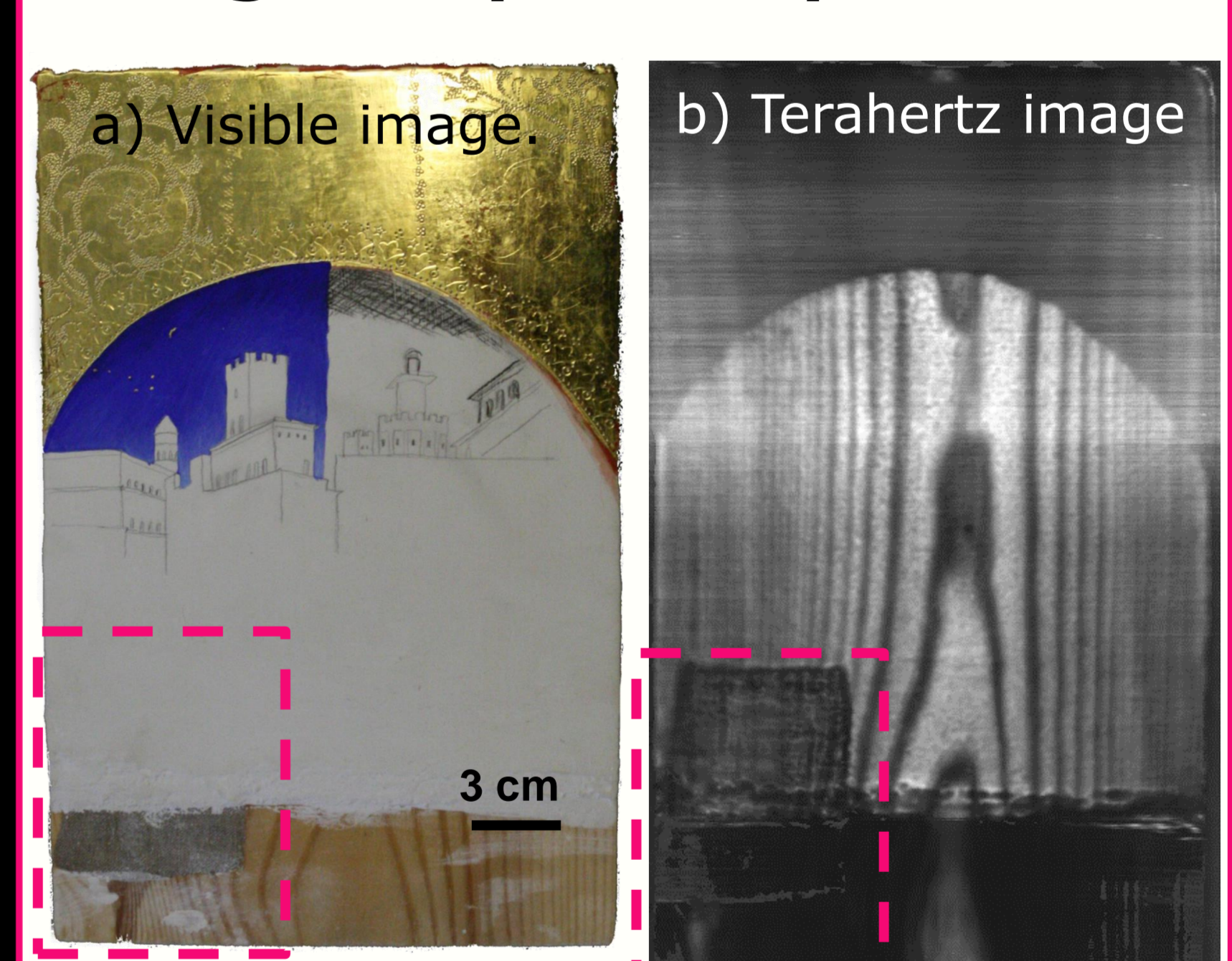
In the terahertz reflection image (fig. b)) the details of the figure made by gold are much more clearer. It is possible to see the borders of the gold leaves covered by the paint layers, especially in coincidence with the faces of the characters.

The details of the mantle of the Virgin realized by a red pigment show a high reflectance in the THz frequency range used, fact that induce to hypothesize that the used pigment is Cinnabar (HgS). The pigment used to shape the lights of the complexion shows also an high reflectivity in THz range, fact that suggests the use of a Pb-based pigment.

e) Time-of-Flight plots



THz reflectometric imaging of the gilded panel replica n. 2



A cloth piece was applied on the wooden support of the second panel replica, and then covered by the primer layer. A golden finish (gold leaves on a red bole layer), frames the pictorial scene. The terahertz reflection images show the grain of the wood located behind the primer layer and partially under the gilding. The part of the canvas hidden by the primer has been also localized through terahertz time parametric images.

Acknowledgments

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