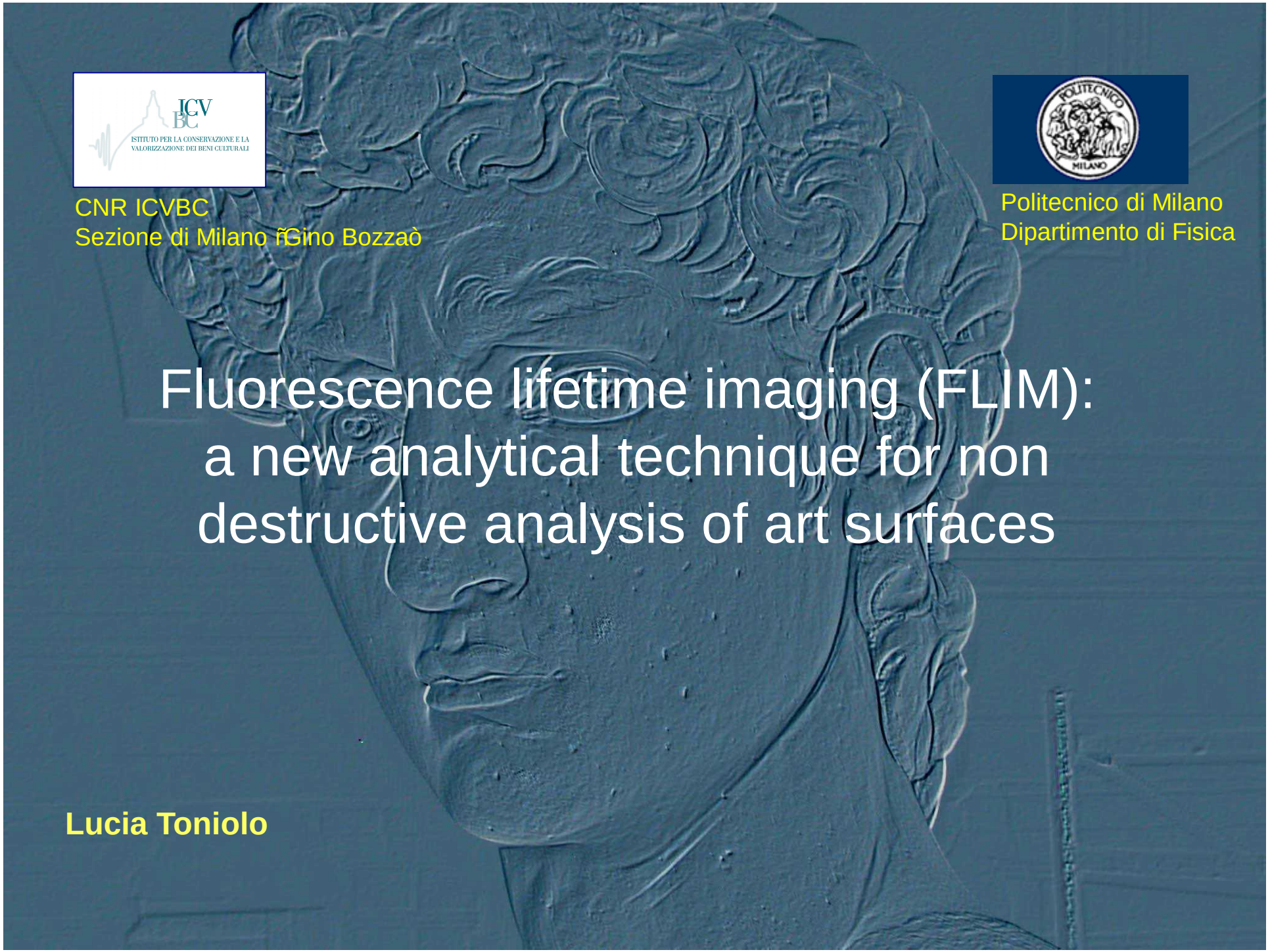

CNR ICVBC
Sezione di Milano ñGino Bozzaò

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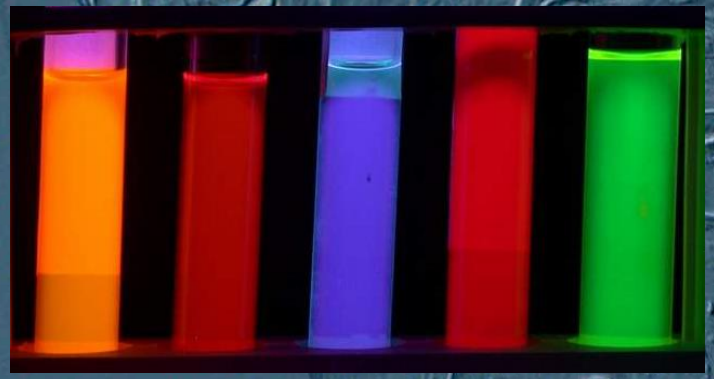
Dipartimento di Fisica

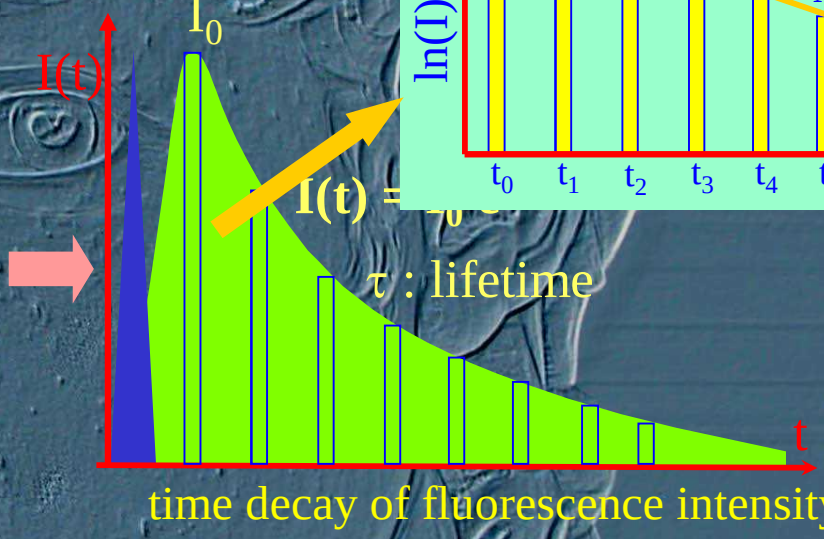
Fluorescence lifetime imaging (FLIM): a new analytical technique for non destructive analysis of art surfaces

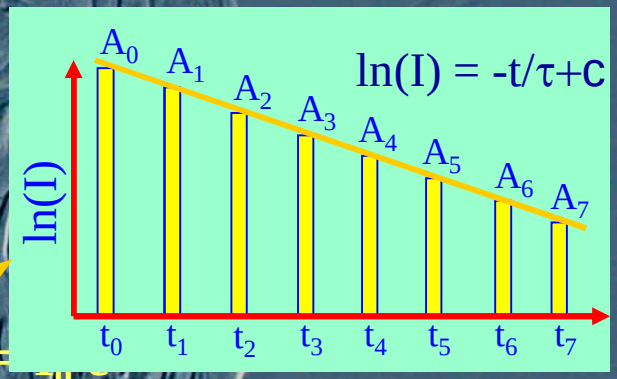
Lucia Toniolo

Fluorescence

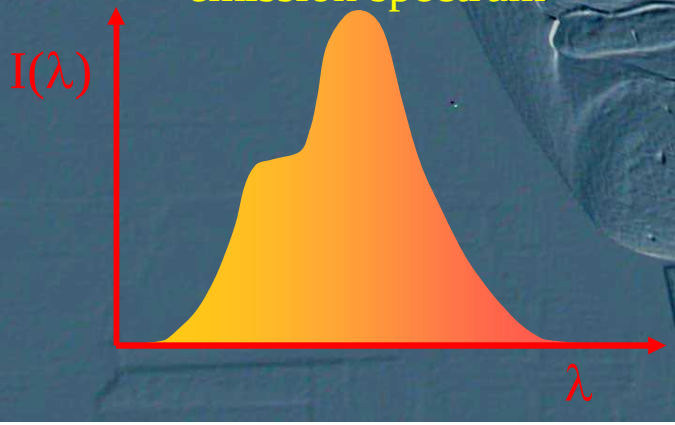
Fluorescence spectrum and lifetime are characteristic parameters of a molecule or set of molecules







emission spectrum



ÅComplex molecular systems often have similar spectral behavior but they can be identified on the basis of different lifetime values

UV Fluorescence

A portable fluorescence system that allowed to measure:

a) **fluorescence lifetime maps** of surfaces

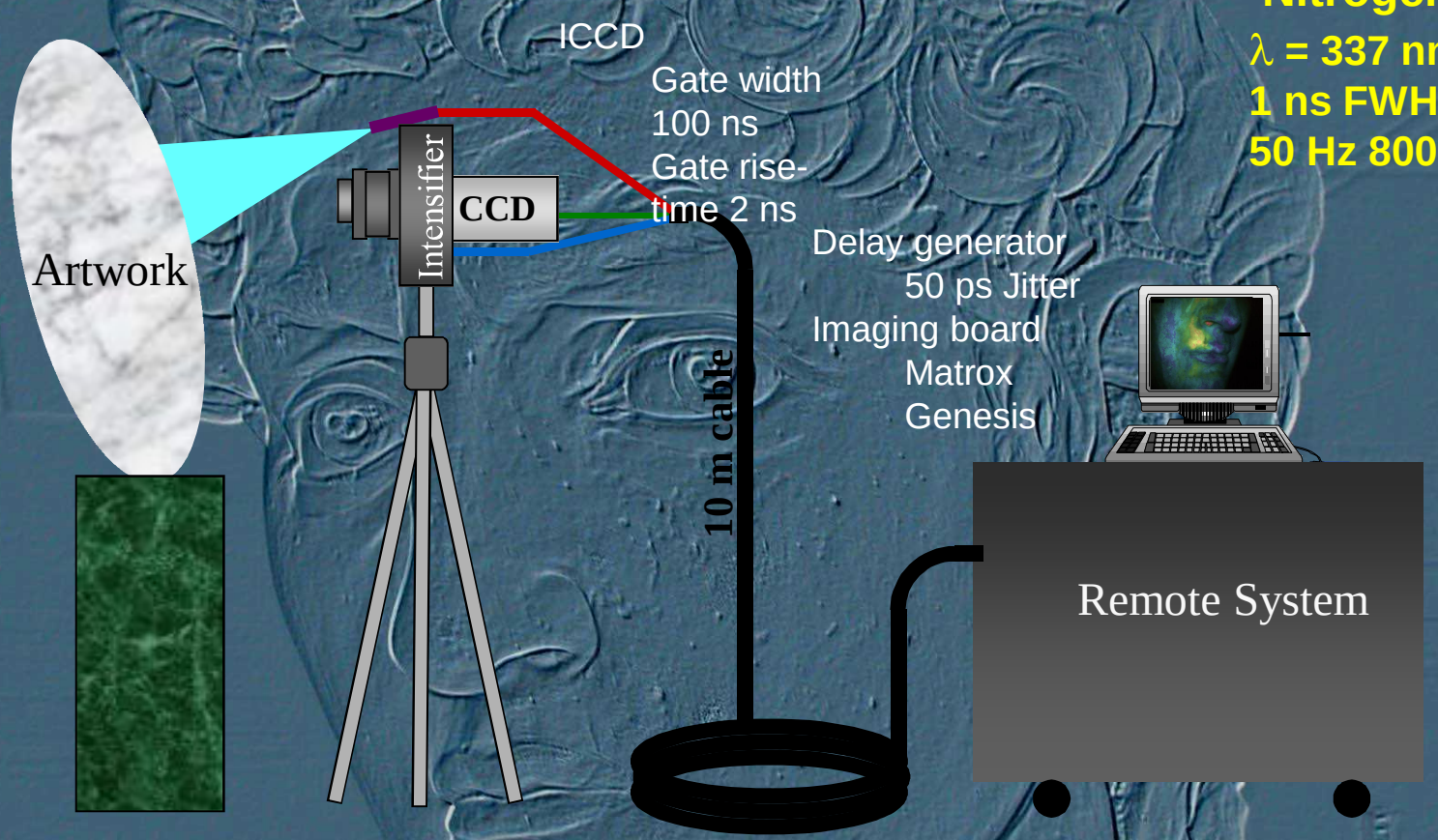
b) **fluorescence spectra** of points of interest

The portable set-up, developed in the Department of Physics of Politecnico di Milano, is made of:

a) a **FLIM** apparatus

b) a fluorescence spectrometer, **OMA**

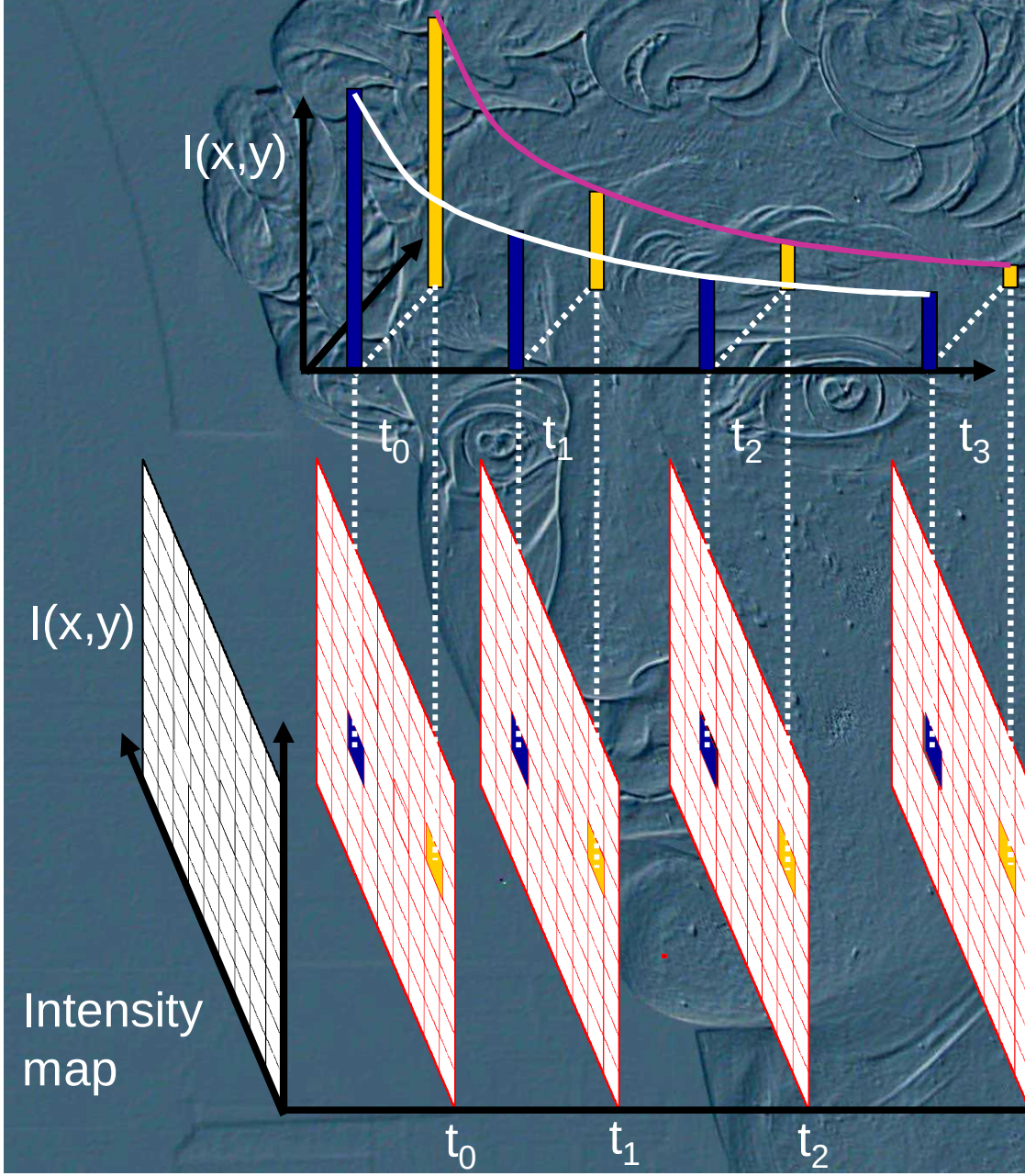
FLIM ï lifetime measurements



Nitrogen laser
λ = 337 nm
1 ns FWHM
50 Hz 800 mW

fluorescence lifetime is reconstructed for each point in the field of view ⇒ discrimination between different organic compounds

FLIM Technique



For each UV laser pulse the camera acquires an image; the camera is synchronized with the pulse and acquires the images with increasing delay.

The intensity values of a same pixel for different images allow one to determine the fluorescence lifetime and relative intensity for the considered pixel.
In this way it is possible to obtain a map of lifetime and relative intensity.

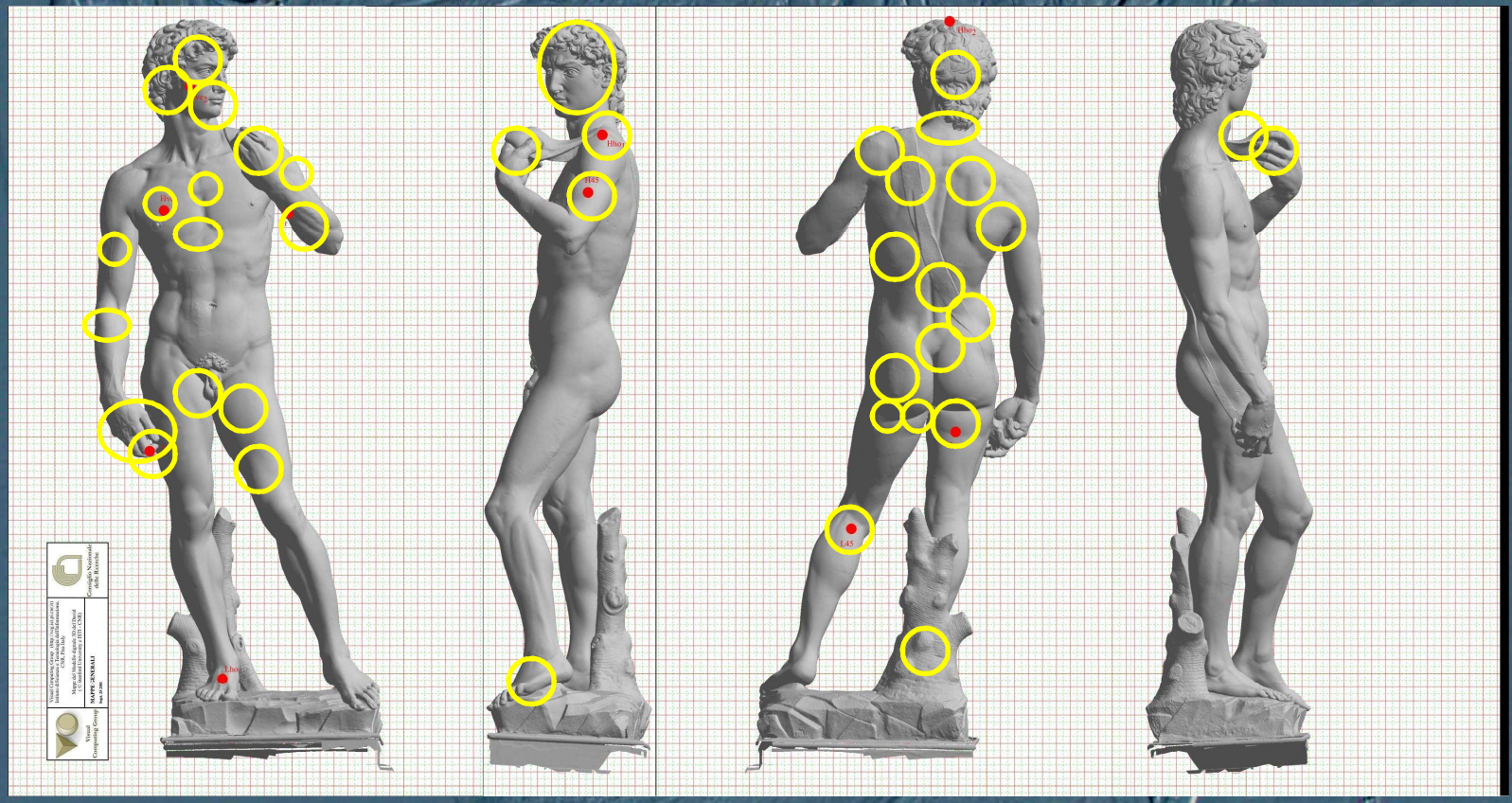
Michelangeloôs David

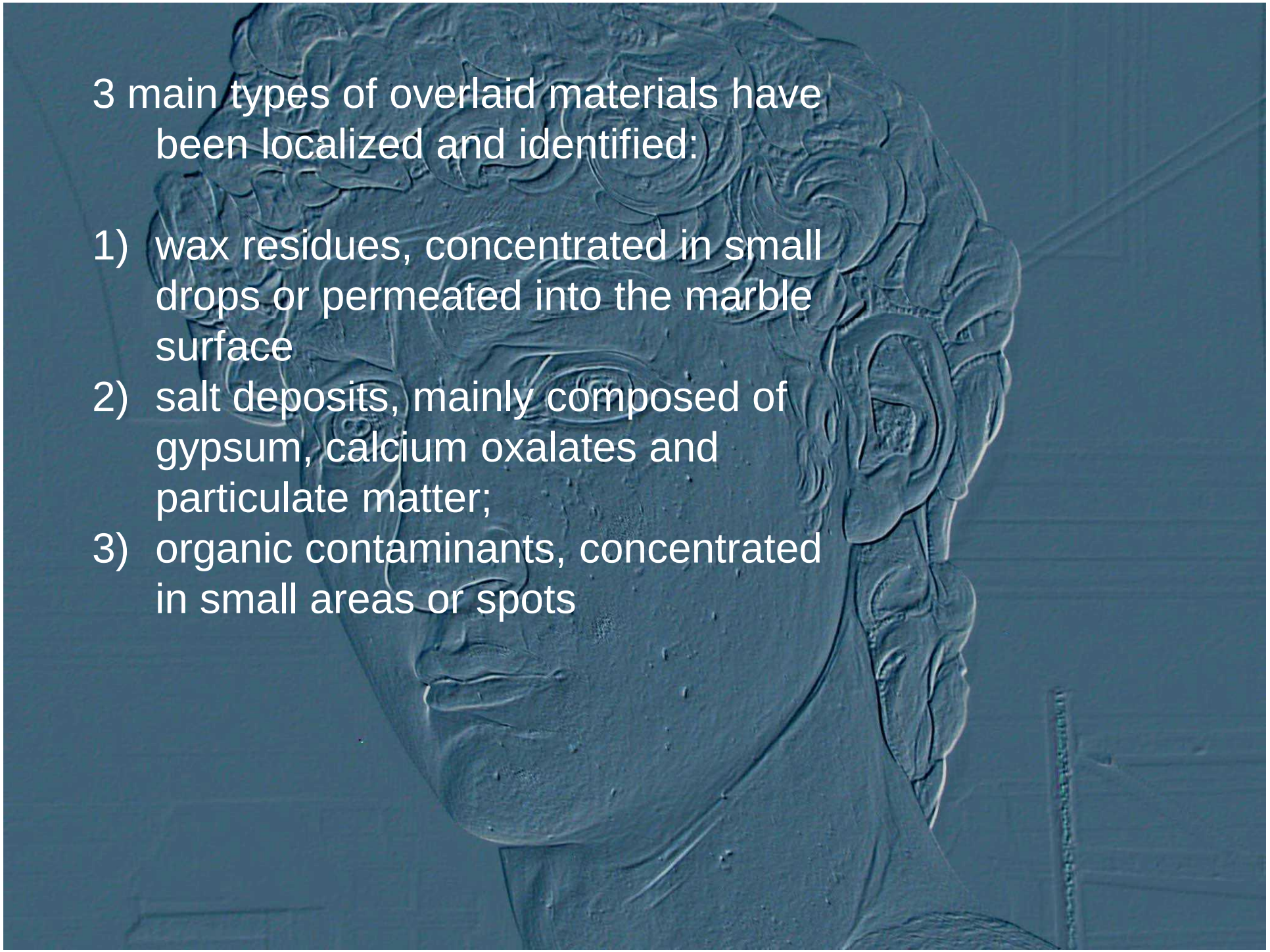
- In September 2002 Davidôs conservation work started
- A coordinated diagnostic intervention
  - 3D laser scanning and reconstruction
  - In-situ measurements of FTIR, XRF, XPS, UV Fluorescence, Roughness, Color, etc.
  - Monitoring of environmental conditions for one year

The FLIM equipment working at Michelangeloôs David

Italian Patent MI2002A001361 20, 2002;
patent pending PCT EP03063433.

FLIM and OMA measurements on Davidôs surface

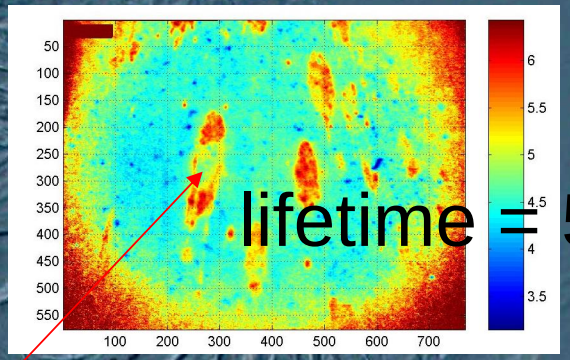




3 main types of overlaid materials have been localized and identified:

1) wax residues, concentrated in small drops or permeated into the marble surface
2) salt deposits, mainly composed of gypsum, calcium oxalates and particulate matter;
3) organic contaminants, concentrated in small areas or spots

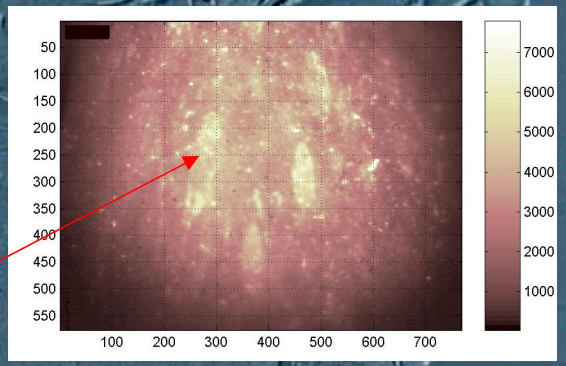
The right forearm



lifetime = 5,5-6,0 ns

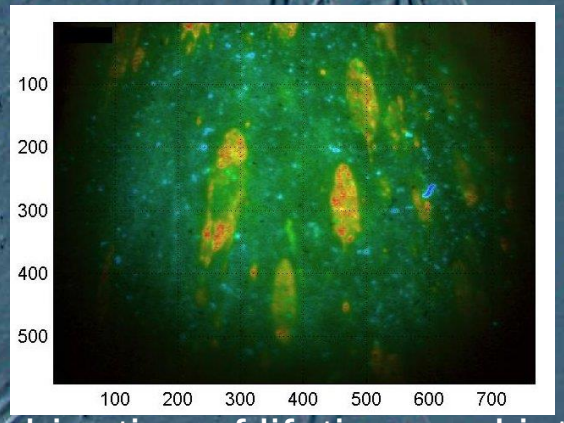
τ

VIS



Amp

UV

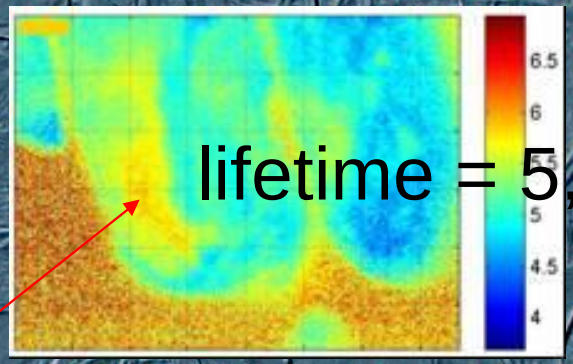


HSV

combination of lifetime and intensity map

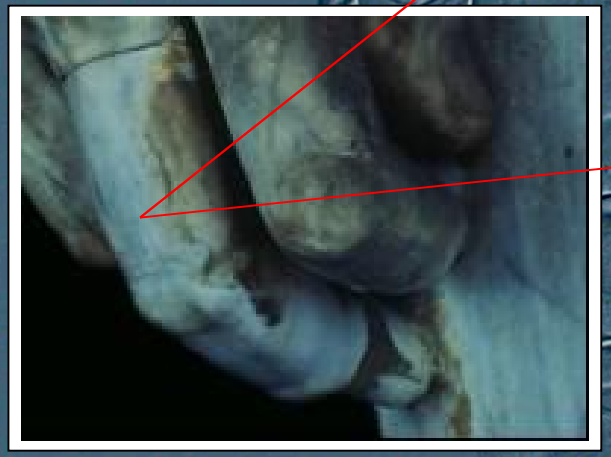
The right hand

VIS



lifetime = 5,5-6,0 ns

τ

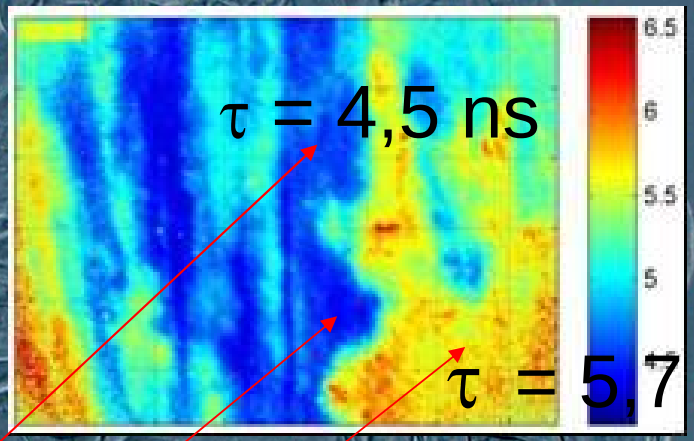


UV

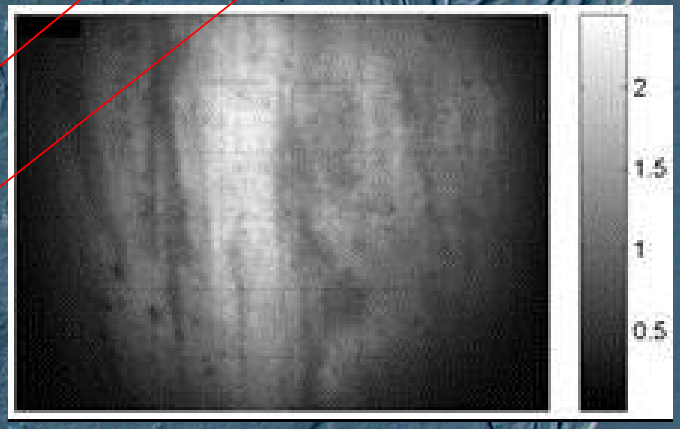
Amp

The back

VIS



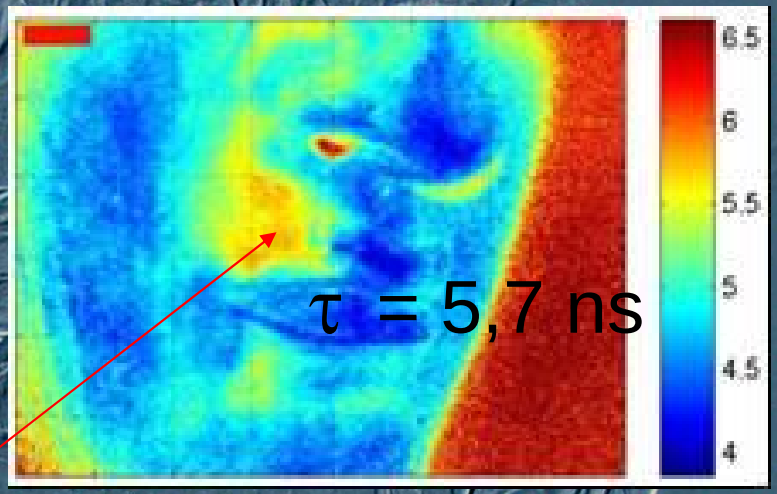
UV

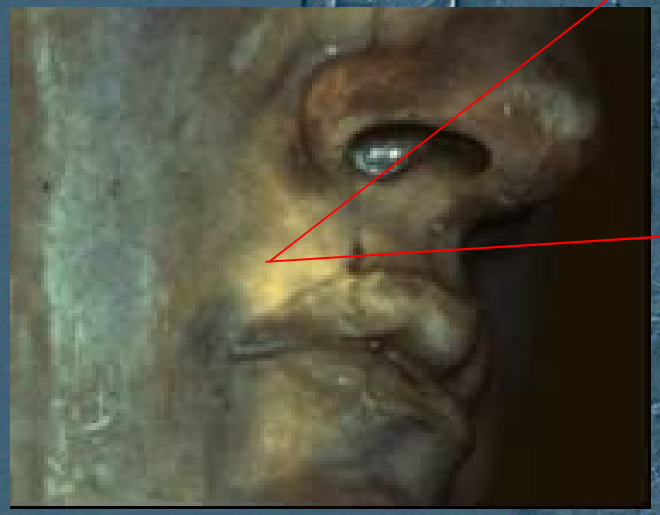


Amp

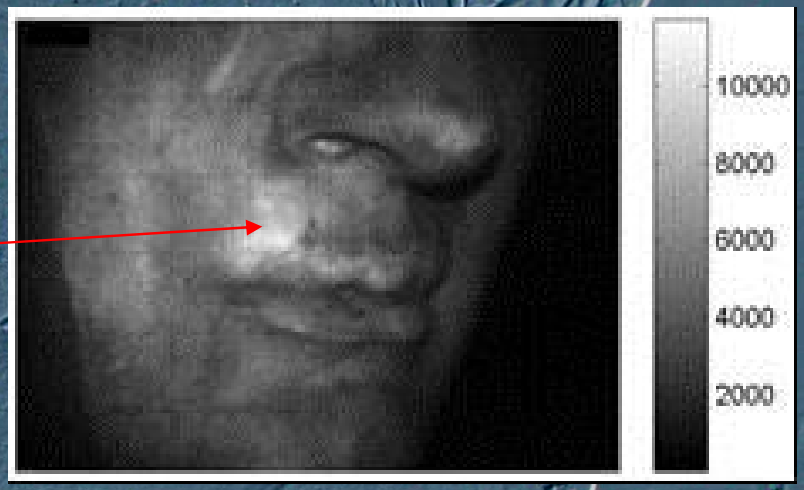
Immagini FLIM

VIS



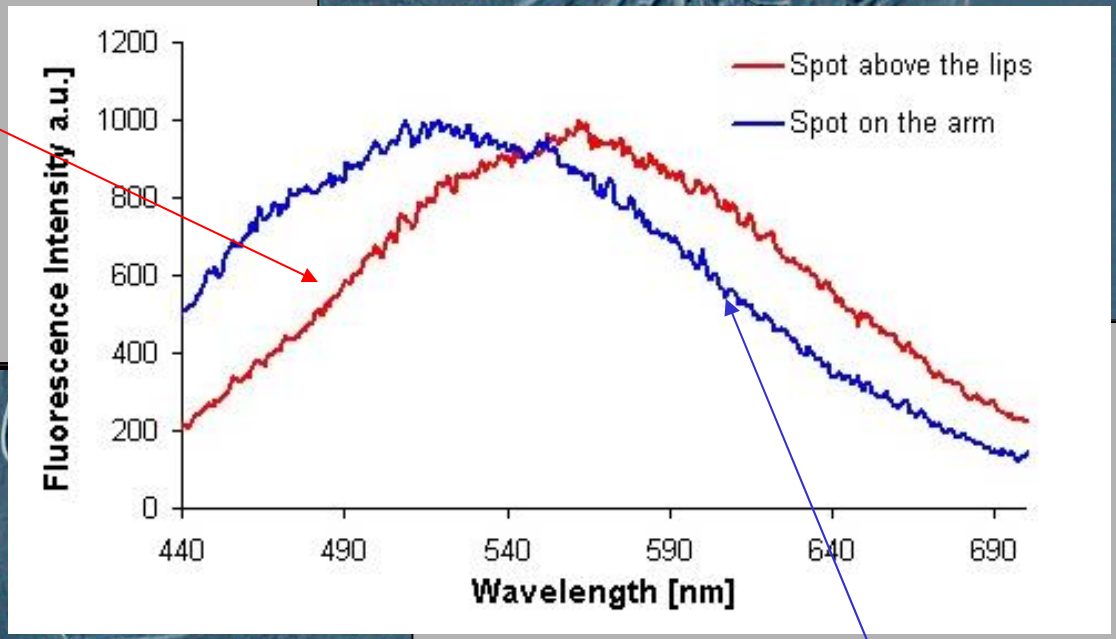


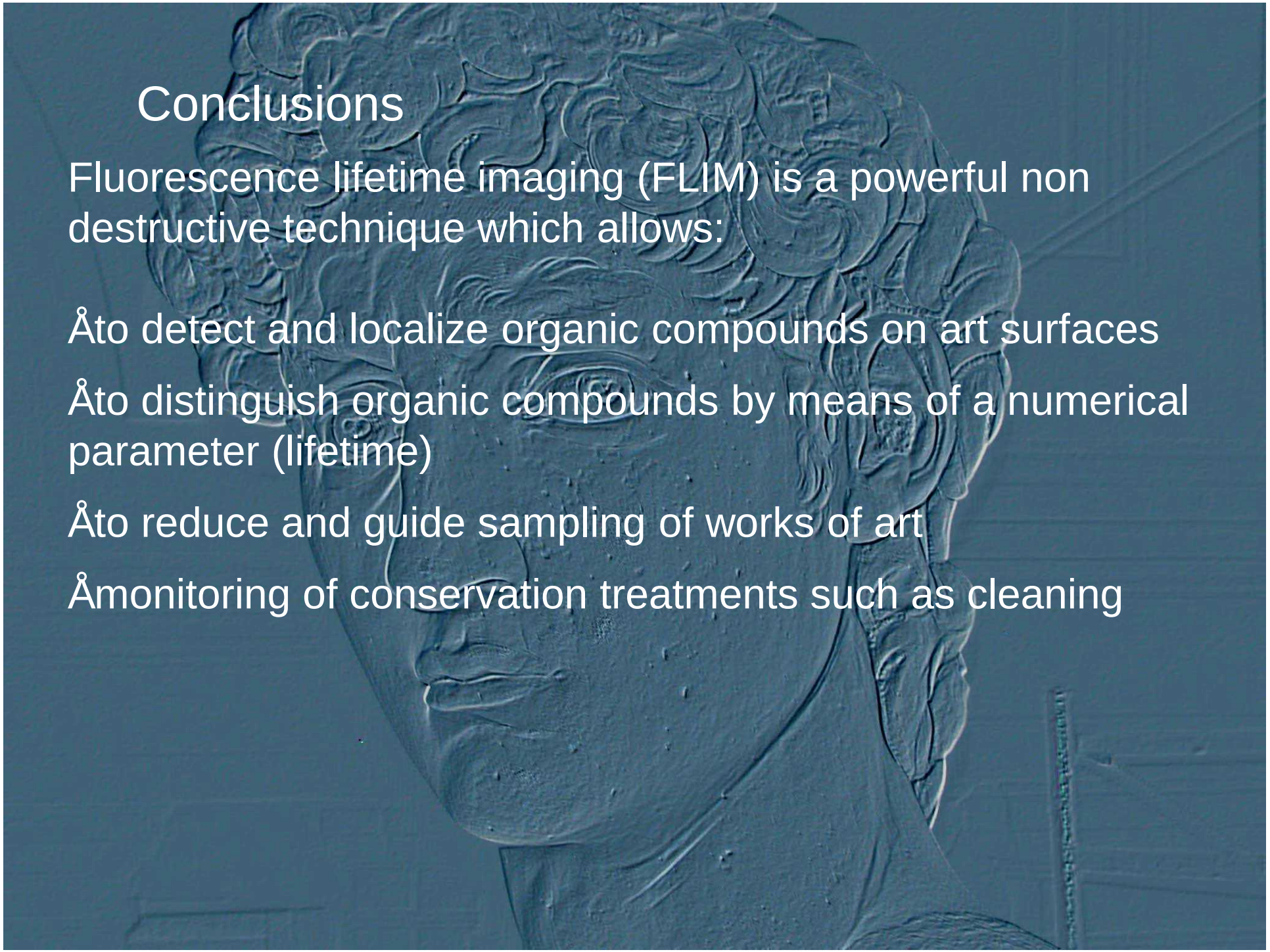
UV



Amp

Analizzatore Ottico Multicanale (OMA)





Conclusions

Fluorescence lifetime imaging (FLIM) is a powerful non destructive technique which allows:

Åto detect and localize organic compounds on art surfaces

Åto distinguish organic compounds by means of a numerical parameter (lifetime)

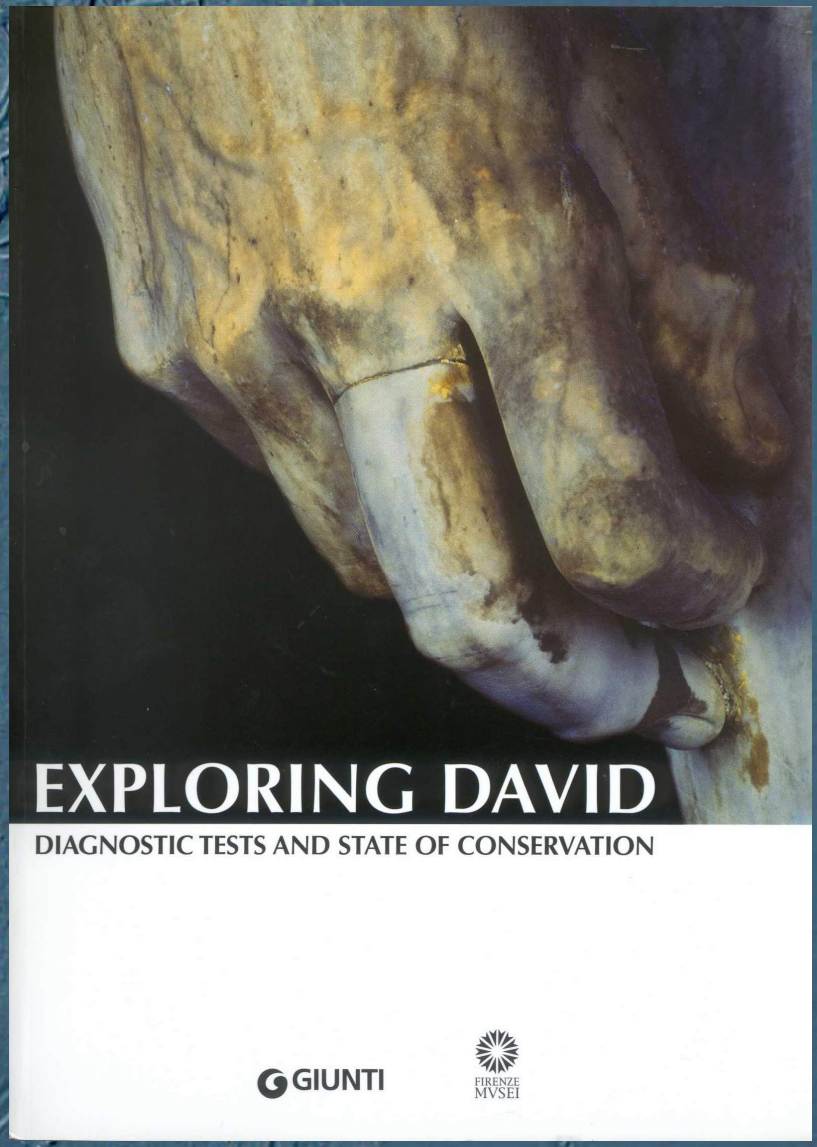
Åto reduce and guide sampling of works of art

Åmonitoring of conservation treatments such as cleaning

2004: Technical investigation on Michelangelo's David

To propose any investigation please contact me

lucia.toniolo@polimi.it



Thank you for your kind attention