COLOR & SPACE IN CULTURAL HERITAGE

Training School

Hyperspectral imaging – Techniques applied to the investigation of 2D polychrome surfaces

CRISTINA

Hyperspectral data access, management and visualization

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National Research Council

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Polo Fiorentino Museale

Soprintendenza Speciale per il Patrimonio Storico, Artistico ed Etnoantropologico e per il Polo Museale della città di Firenze

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This presentation can be found at:
www.filippomicheletti.it/teach/

Outline

- Hyperspectral data overview
- Hyperspectral imaging softwares *vs* data users: where is the problem?
- A new approach to hyperspectral data: CRISTINA
- CRISTINA features
    - Administration side
    - Data sharing
    - User side
- Developements, perspectives and conclusions

–- Coffee break---

- Practical demonstration

Your credentials

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You can use a temporary account to CRISTINA with the following credentials:

URL: cristina.ifac.cnr.it

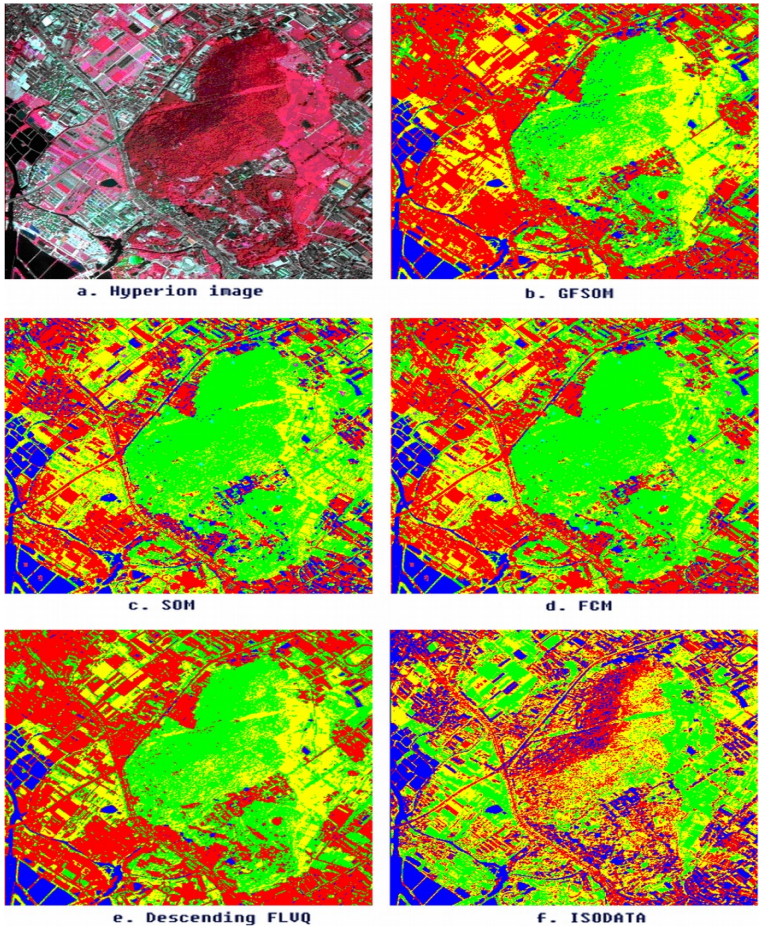
Username: trainingschool
Password: hyperspectral

Expiration date: Friday, December, 12 2014
(end of the Training School)

*** ASK for a permanent account if you like our work! ***

Hyperspectral data overview

From sky to museums...



From sky to museums...

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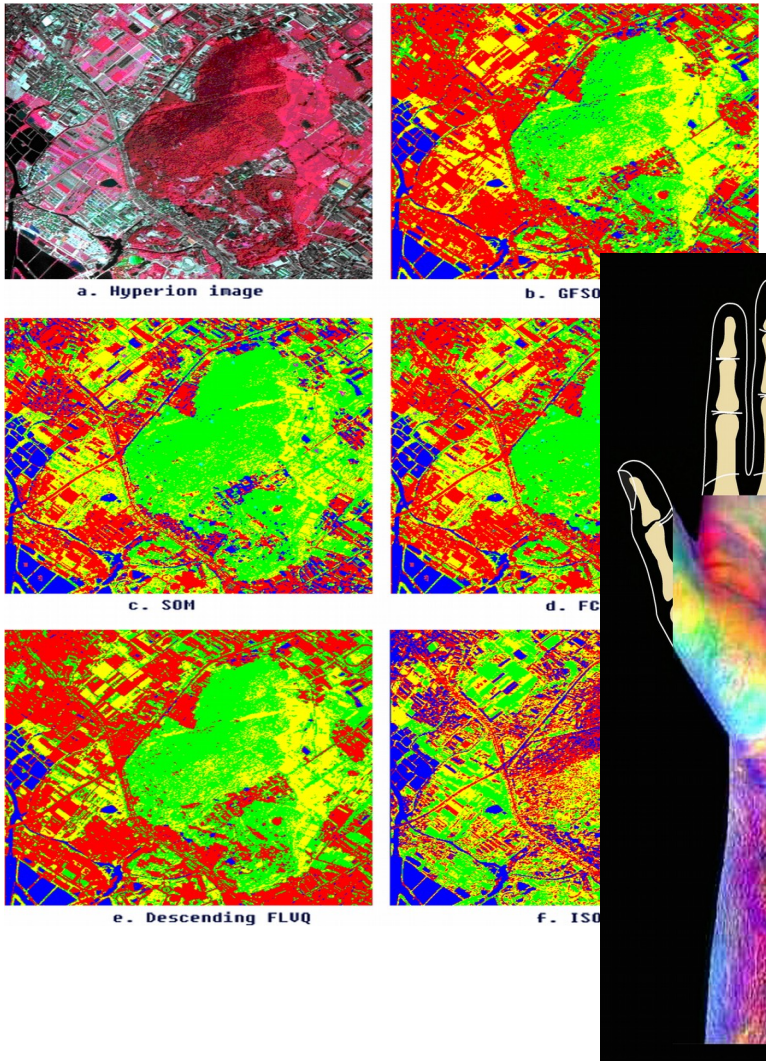

From sky to museums...

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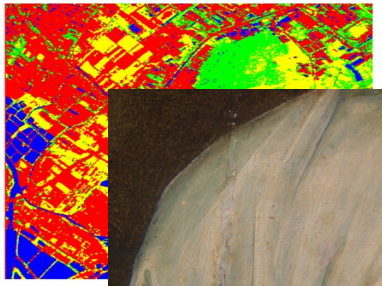
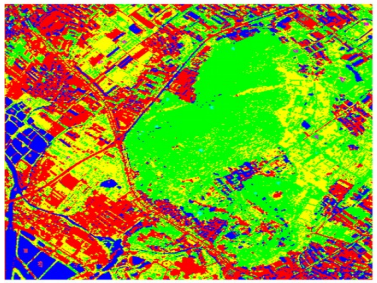
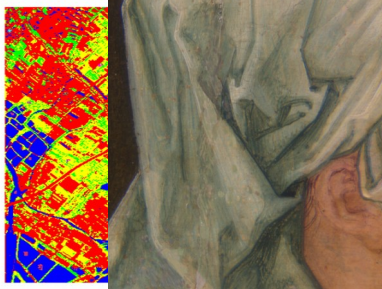
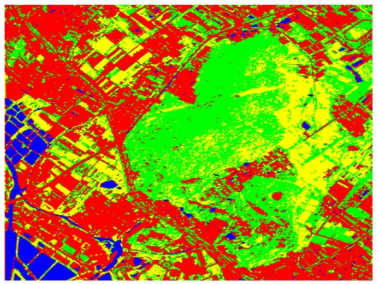
a. Hyperion image



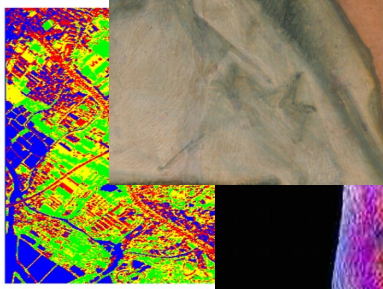


c. SOM

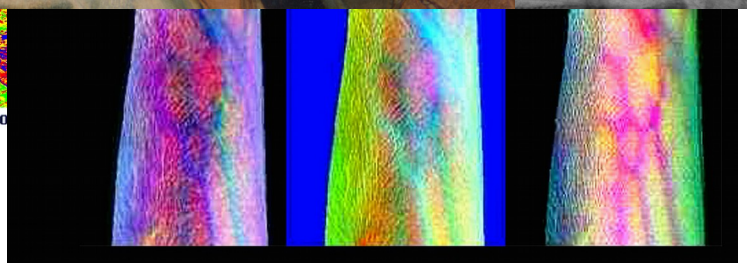




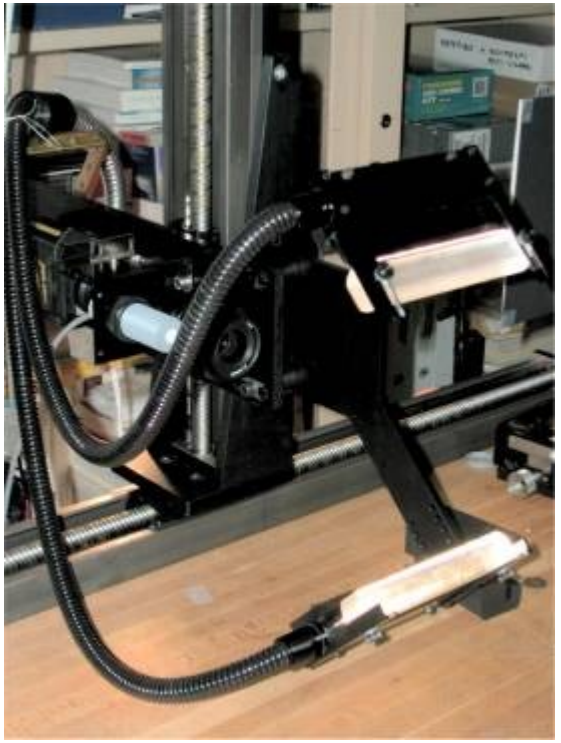
e. Descending FLUQ



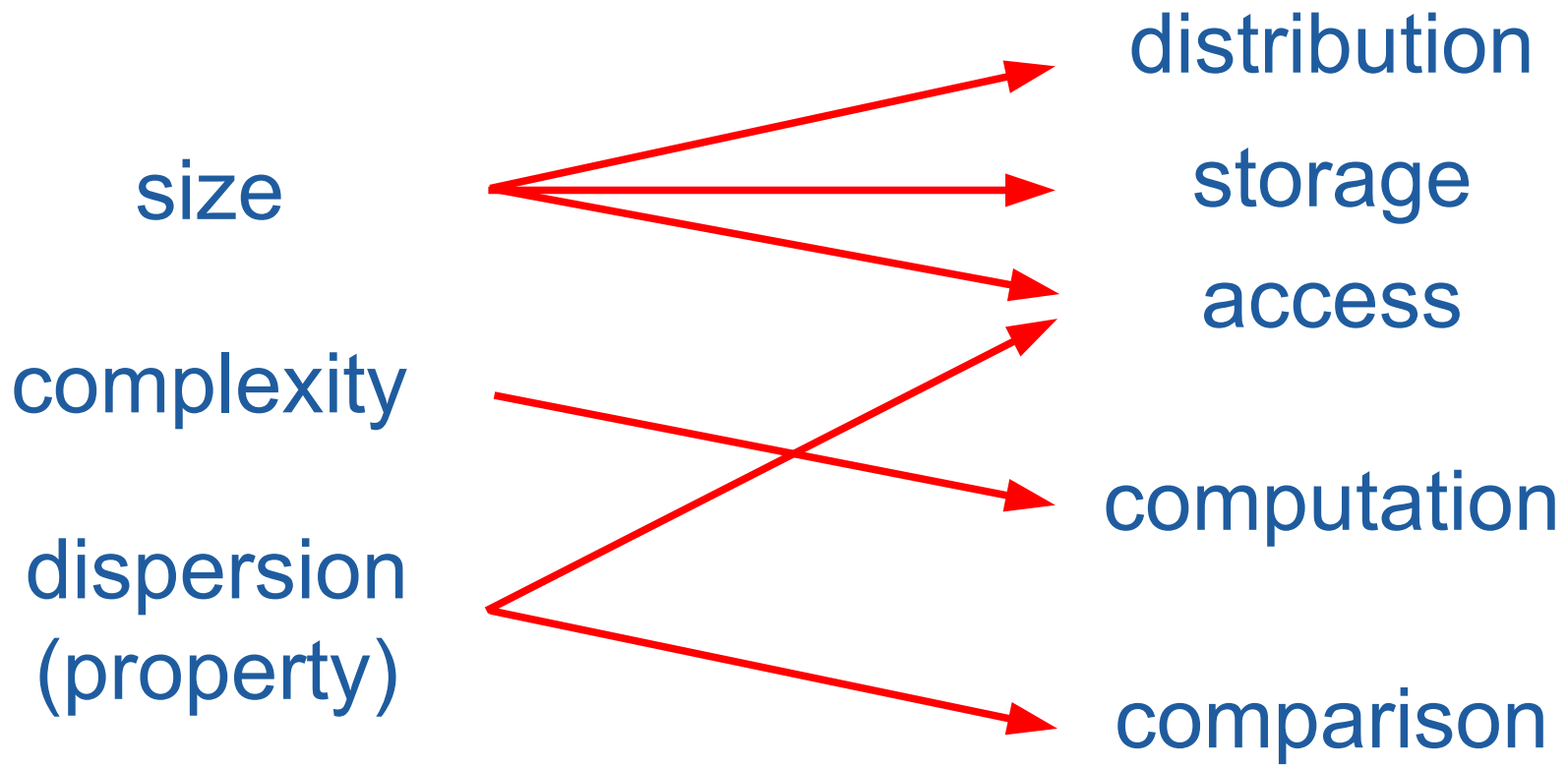
f. ISO



… and labs



Hyperspectral data issues



Distribution and access

Data distribution is one of the biggest problems, due to the huge size of data produced by hyperspectral surveys.

This problem is related also to available media supports.

Different ways of access are possible but still really difficult to be implemented.

Often the adopted solutions are not efficient.

Storage and organization

Storage requires a lot of space.

Organization is a challenge.

Computation and Comparison

Computation is needed on raw data also for very simple operations (like viewing an image taken at a single frequency)

Most of the more interesting operations require some computations (false-color images, sub-bands, spectra, etc.)

Comparison with other measurements on the same subject is usually not possible.

Hyperspectral imaging software

Hyperspectral data users

Hyperpectral data users are:

- Physicians
- Engineers
- Data-processing experts

But also:

- Restorers
- Architects
- Conservators

And a lot of other people who do not have (and should not need to have) particular computer science knowledge

Hyperspectral imaging softwares

Hyperspectral softwares are usually targetized to data-acquisition and elaborations

They are:

- Designed for specific applications
- Very heavy
- Platform-specific
- Propertary (expensive)
- Complicated

A lack of softwares supply

This often leads labs to use self-built tools or to build someone to use some specific features of commercial softwares (like ENVI).

What is really needed is a software designed specifically for who needs to have access in a simple and intuitive way, principally for viewing data and spectra, comparing images and different sets of data, and doing some simple elaborations.

CRISTINA, a new approach on hyperspectral data usage

CRISTINA intro

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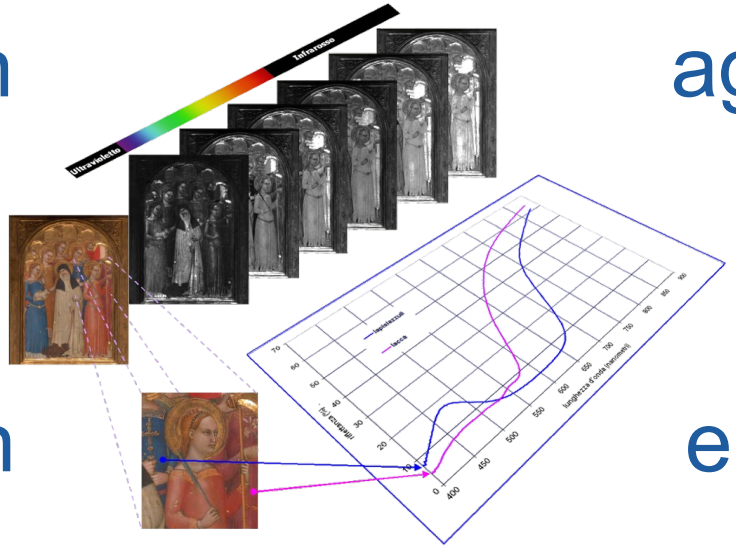
storage

organization

aggregation



presentation

elaboration

access

Principal characteristics

- Web-based (HTML - JavaScript - PHP)
  - No installation
  - OS independent
  - Usable from all kind of platforms, especially designed from mobiles with slow connections and low computational resources
- Smart works assignment (FCGI vs JS)
  - Main processing to the server, adjustments to the client
  - Significant, computationally hard results storage
- Data transfer optimization (AJAX + IIP)
  - Dynamic resources, tools and content loading: FAST, perfect for mobiles

Principal characteristics

- Network data organization (MySQL + SQLite)
  - Centralized data tracking
  - Centralized user access
  - Distributed data access with smart work assignment to servers
- Differentiated data sharing
  - Owners can decide what to share

Data organization: central

- **Artworks**
  classical meaning of "*work of art*"
- **Elements**
  parts of the same artwork
- **Measurements groups**
  groups of *spatially synchronized* measurements

Data organization: local

- Measurements
  - Hyperspectral images (cubes VIS-NIR)
  - Extracted images
  - Point measurements (FORS)
  - Other data

Admin interface

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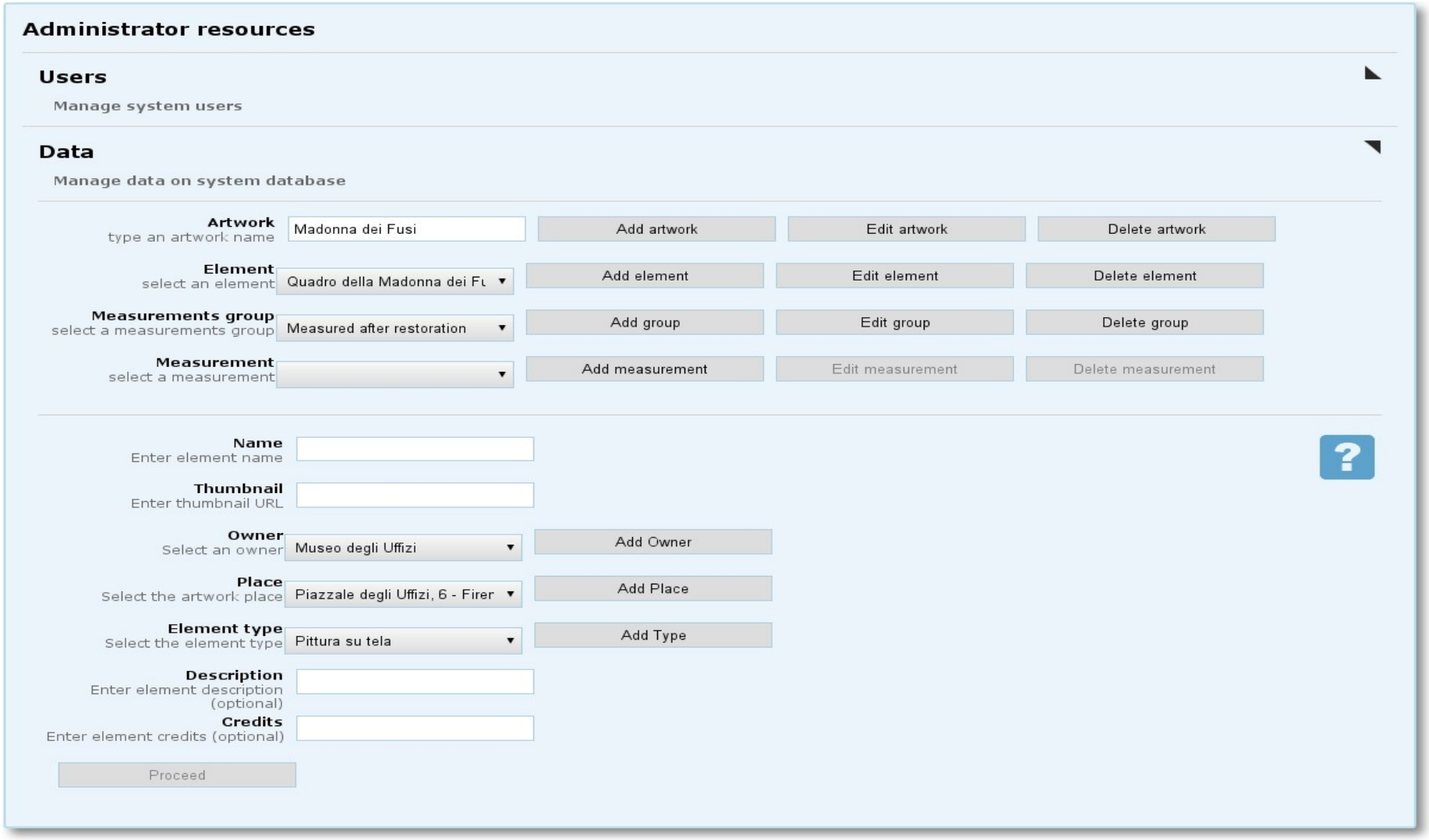

Files formats requirements

- Hyperspectral cube files must be in the BIP (band interleaved by pixel) format
- FORS and other point measurements must be in csv format

Login interface

Welcome to CRISTINA

Cnr Retrieval of Images from hyper-Spectral data Through Interactive Network Access

Username

Password

Login

ask for an account - disclaimer - © 2012 CNR-IFAC

Browser

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Welcome to CRISTINA browser

here you can display all available data in our database.

u

Madonna dei Fusi

Tavole Pinocchio Mussino





Blu di Prussia

Available artworks list

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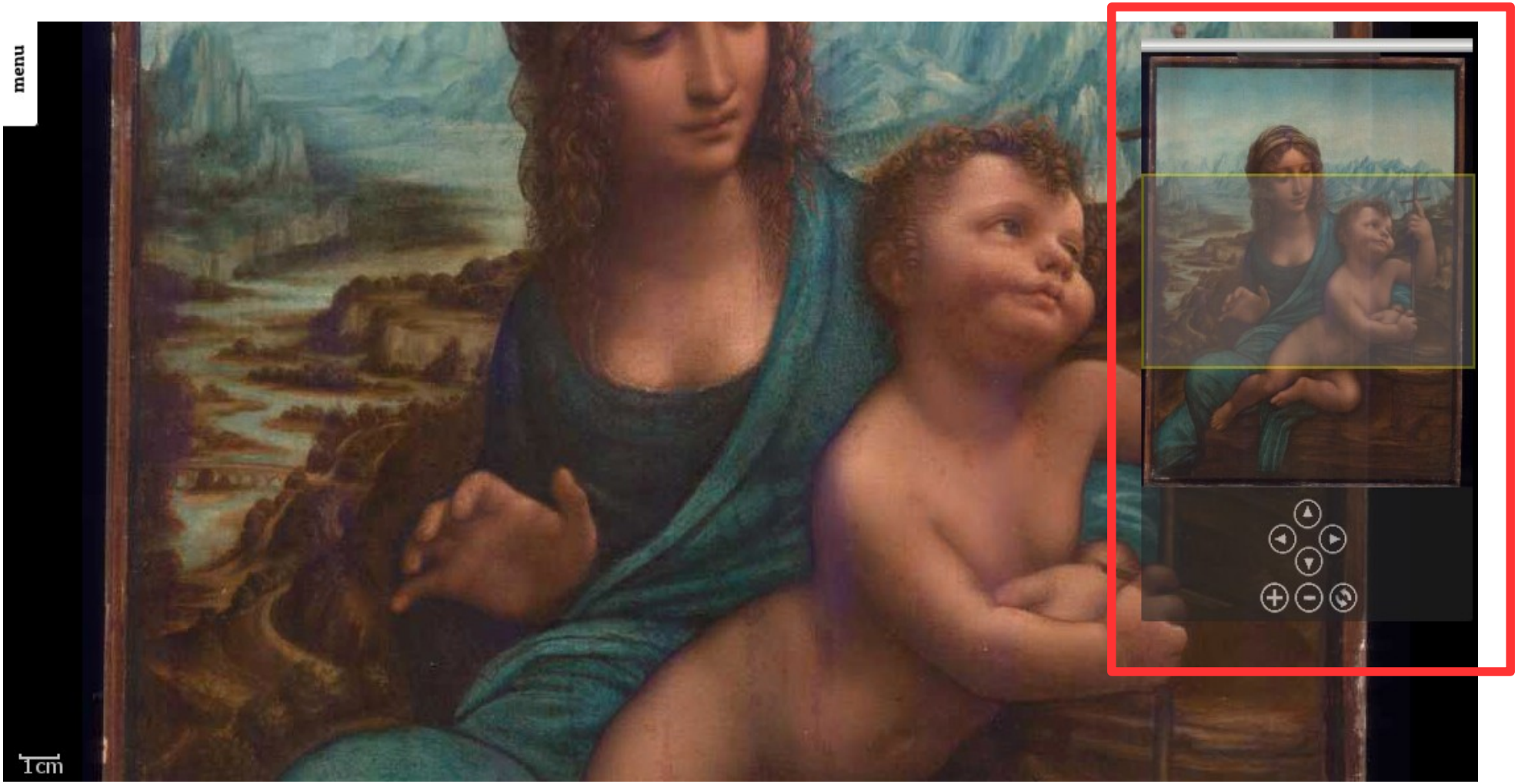
Available artworks and elements

- Beato Angelico - Madonna della Stella
  - Angeli
  - Angeli di destra
  - Angeli di sinistra
  - Colori di riferimento
  - Dio
  - Madonna
  - Santi
- Beato Angelico - Armadio degli Argenti
  - Anta Sinistra
  - Anta Destra
- Leonardo Da Vinci - Madonna dei Fusi
  - Madonna
- Lopez
  - Vari
- Pigments tests
  - Prussian blue

Logout

The viewer

The viewer



The viewer

The viewer

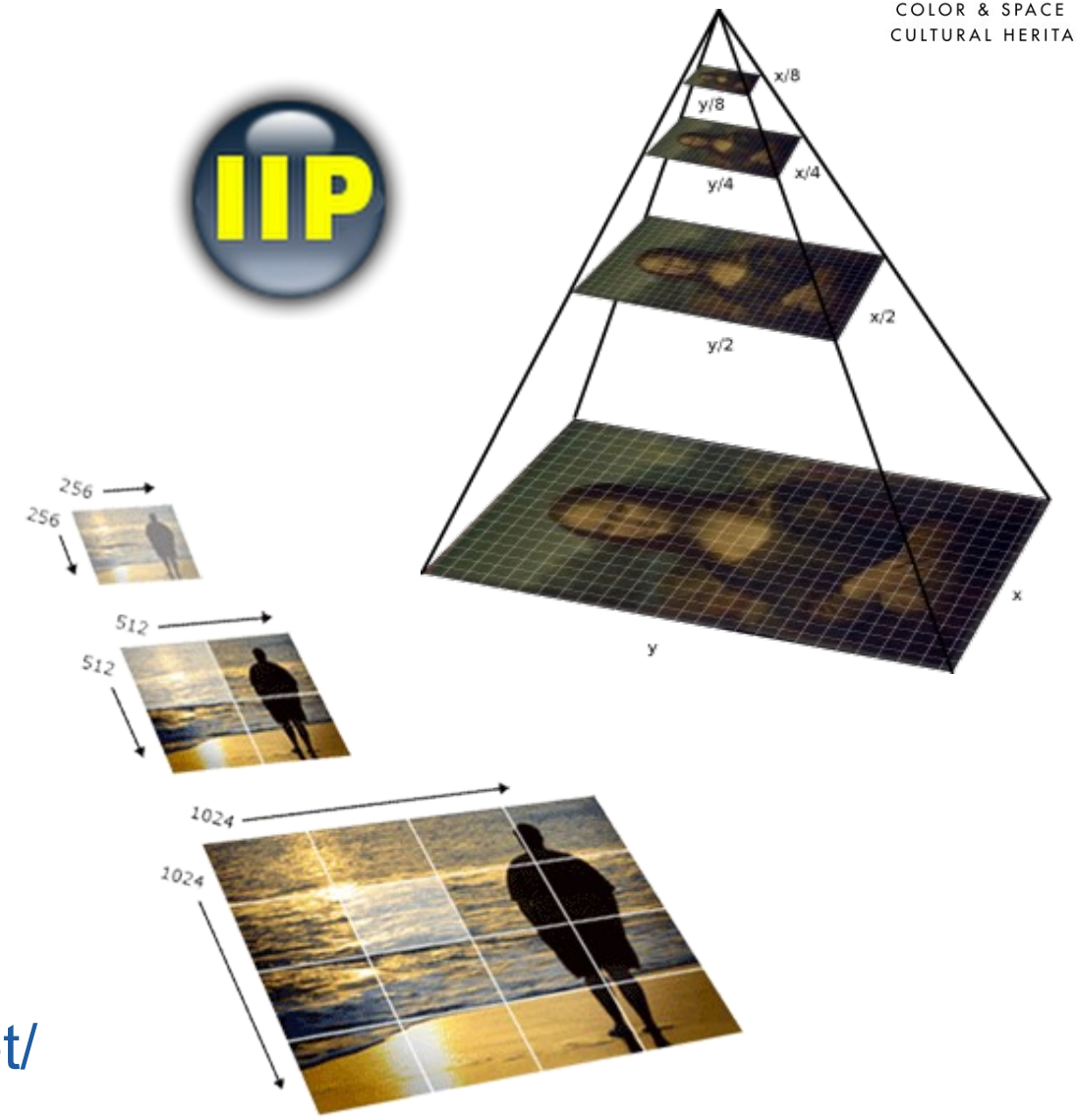
Viewer working principles

The viewer is based on an open source project called *IIPImage*

Pyramidal images & tiles

Only the needed portions of full images at the needed resolution for current zoom level are transfered

http://iipimage.sourceforge.net/



Performances of the viewer

Madonna dei Fusi:

Cube size: 22 GB

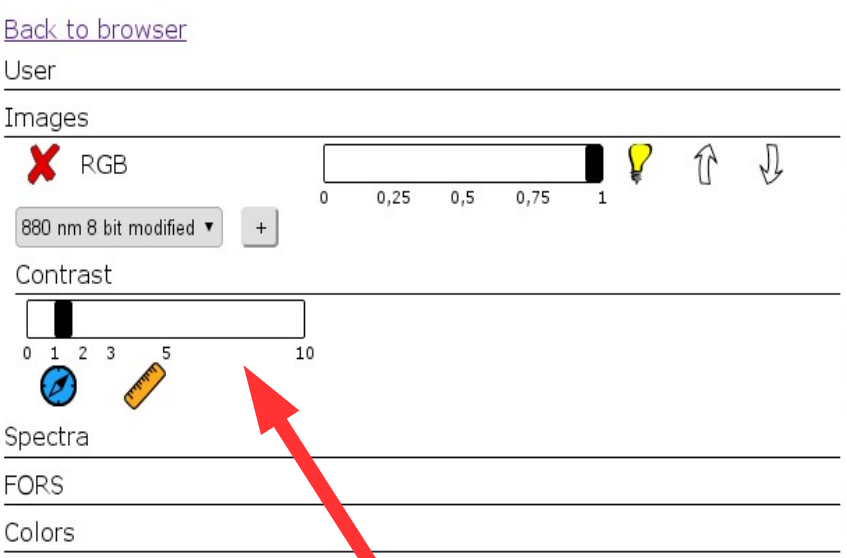
Load time: about 100 ms with an ADSL connection, about 1 s with a mobile connection.

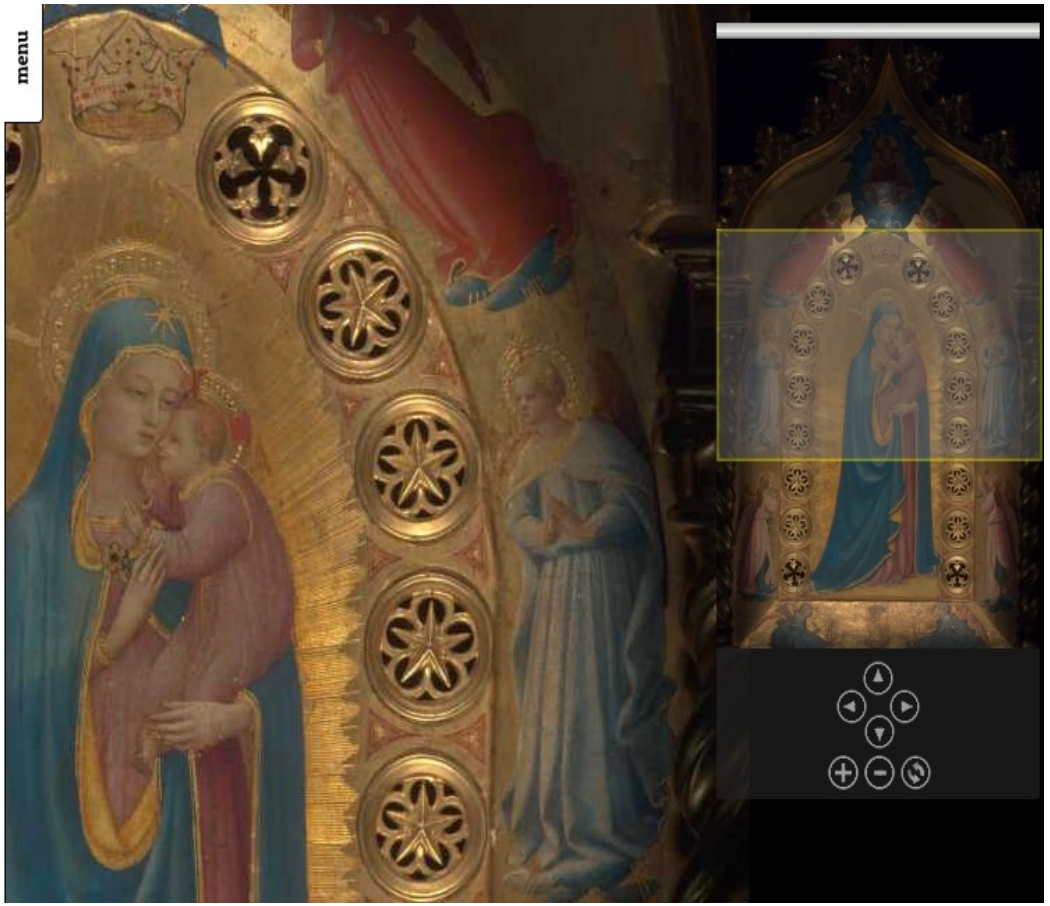
Armadio degli argenti (anta Dx):

Cube size: 90 GB

Load time: about 1 s with ADSL, about 2 s with mobile

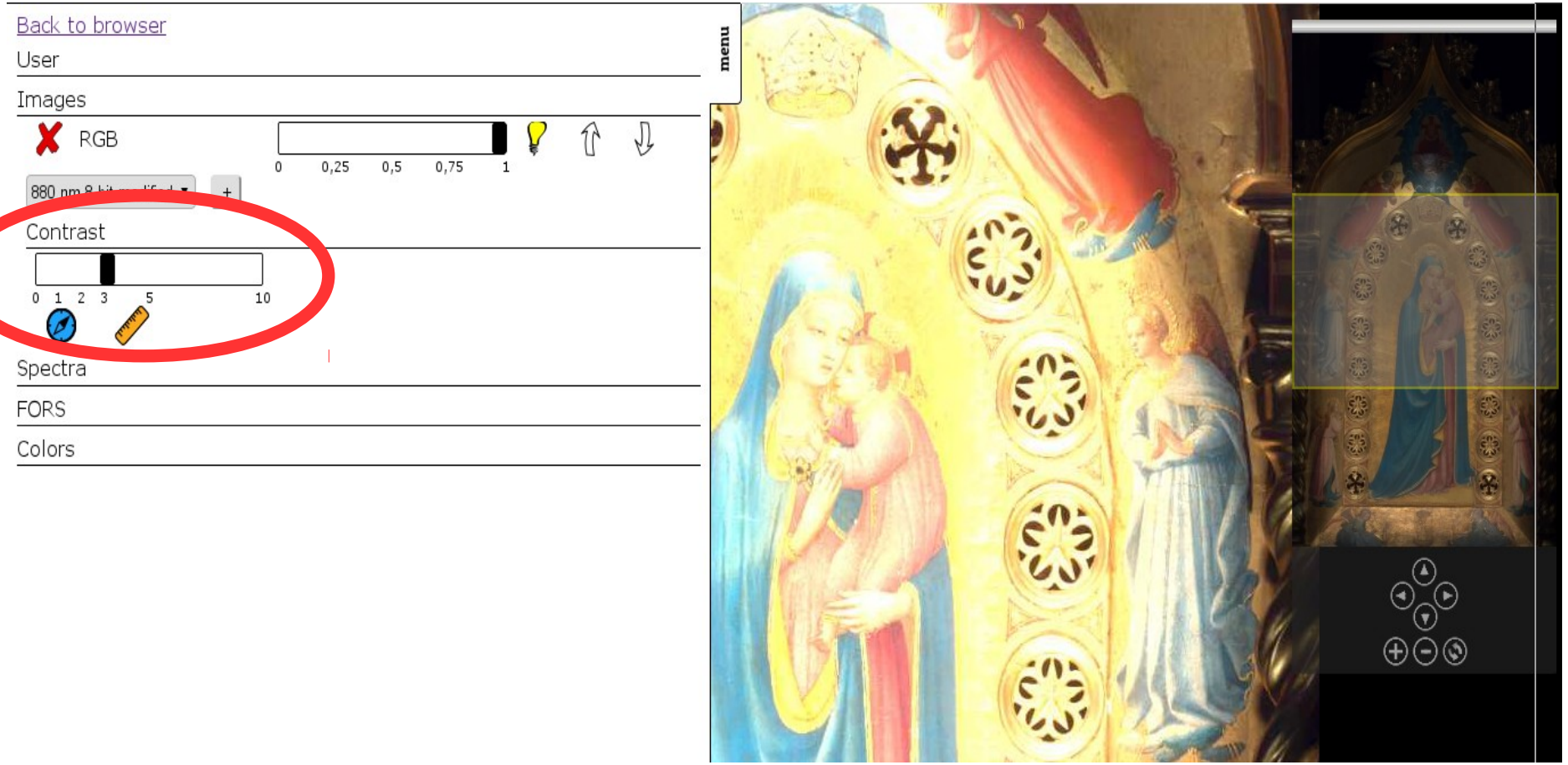
Viewer features: contrast





Contrast selector

Viewer features: contrast



Viewer features: navigator and scale

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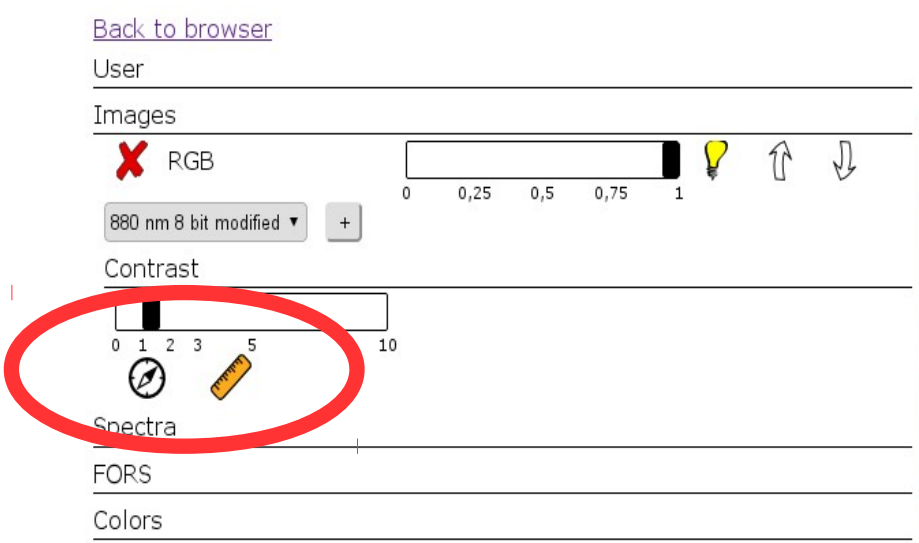
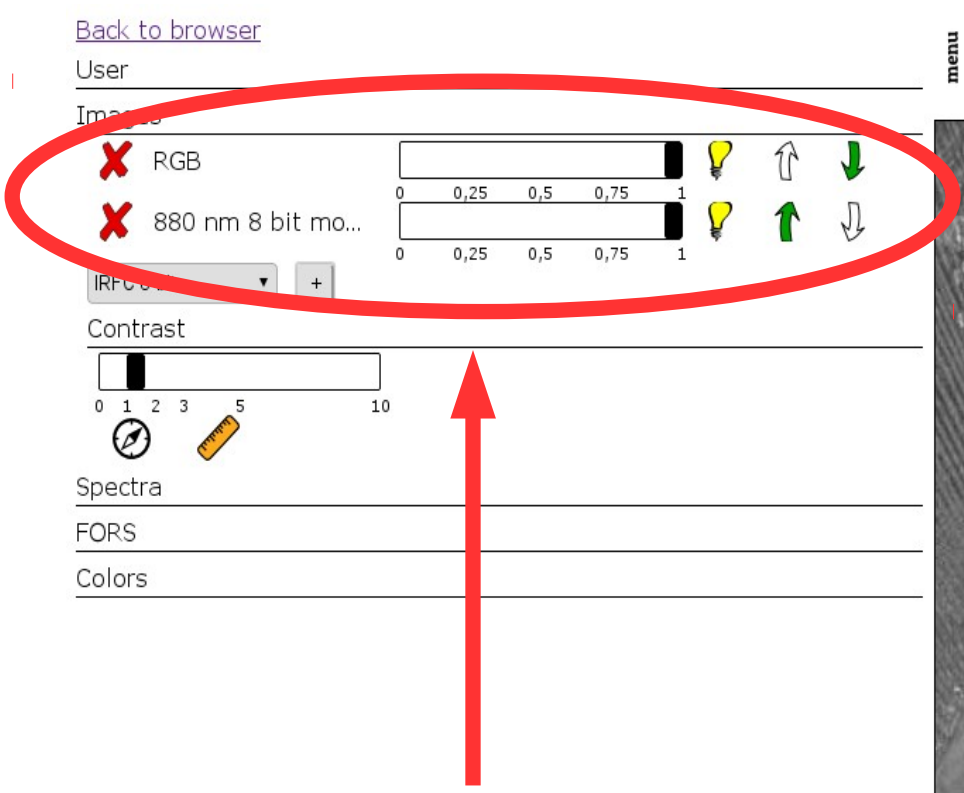


Viewer features: blending

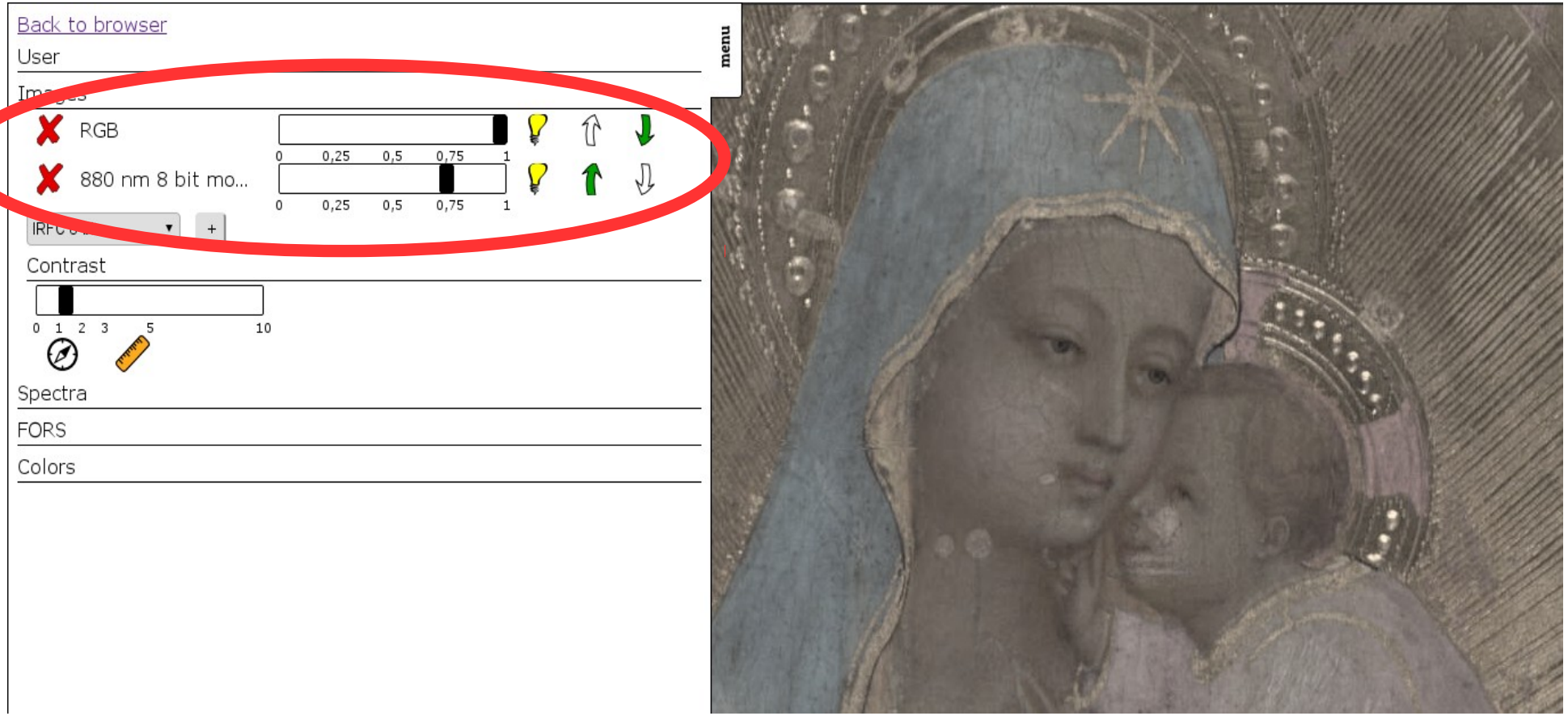
Viewer features: blending

COLOR & SPACE IN CULTURAL HERITAGE

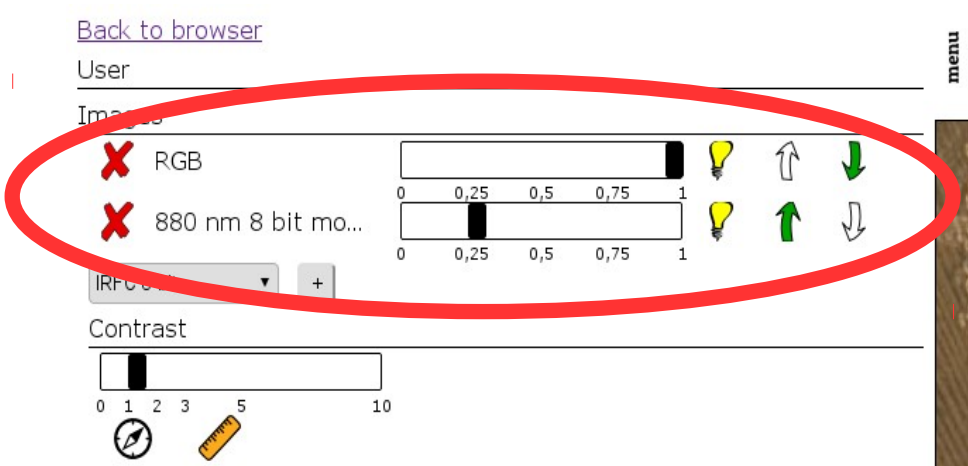


Images controllers

Viewer features: blending

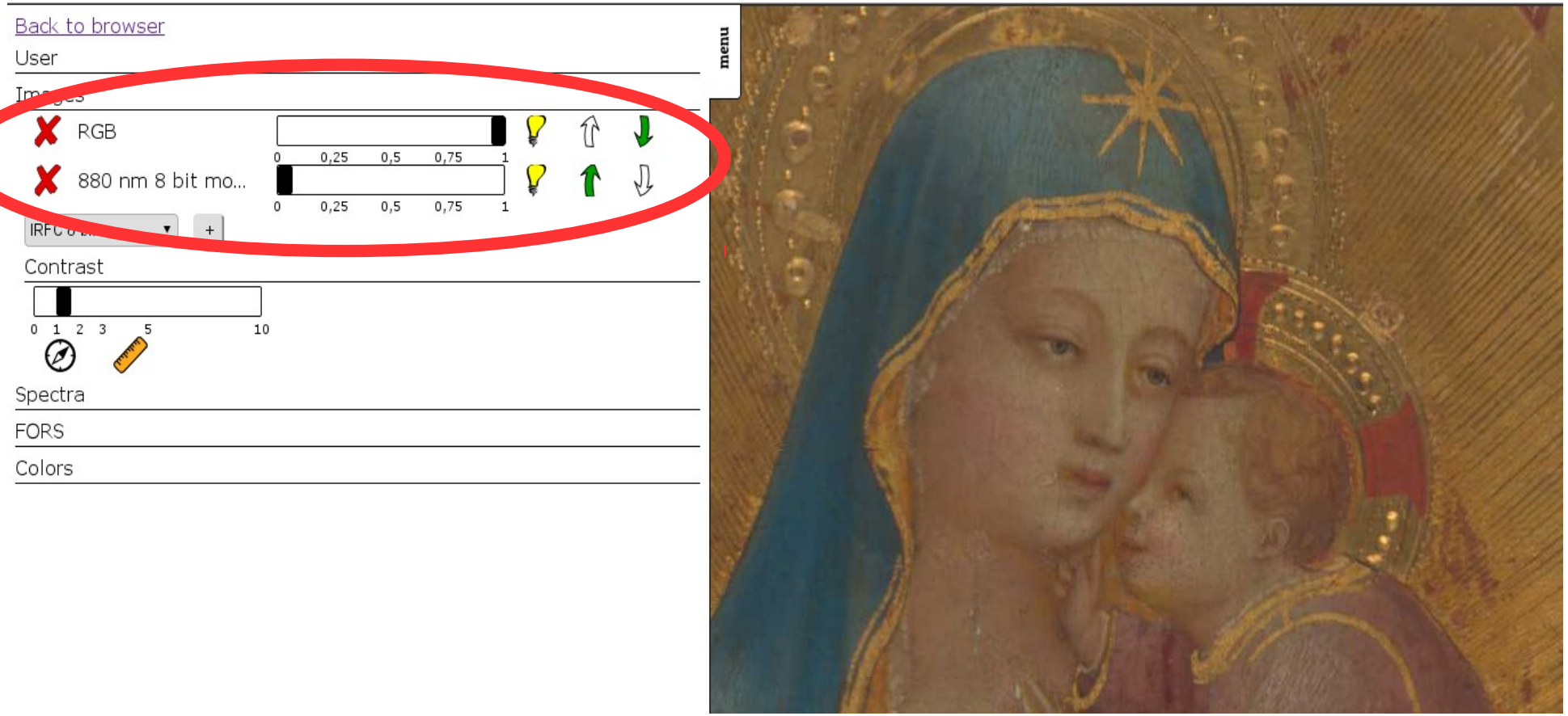


Viewer features: blending

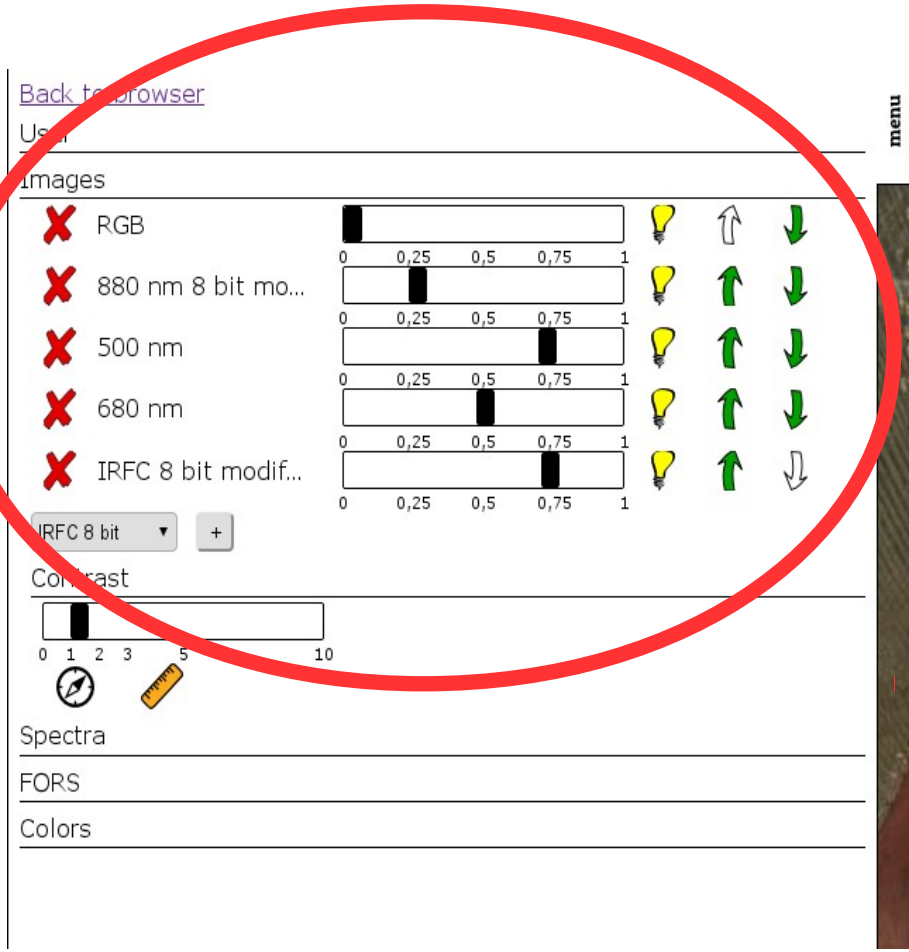


Viewer features: blending

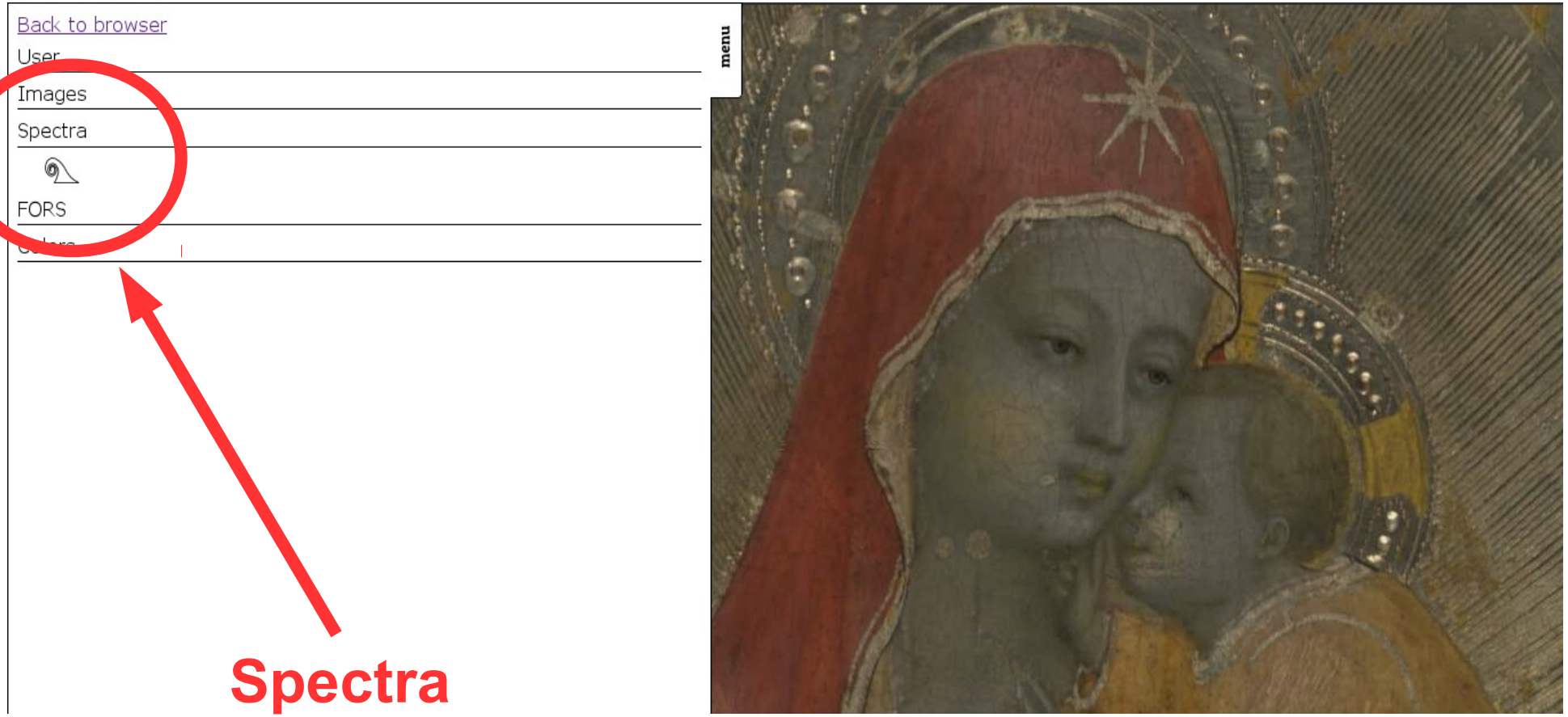
COLOR & SPACE IN CULTURAL HERITAGE



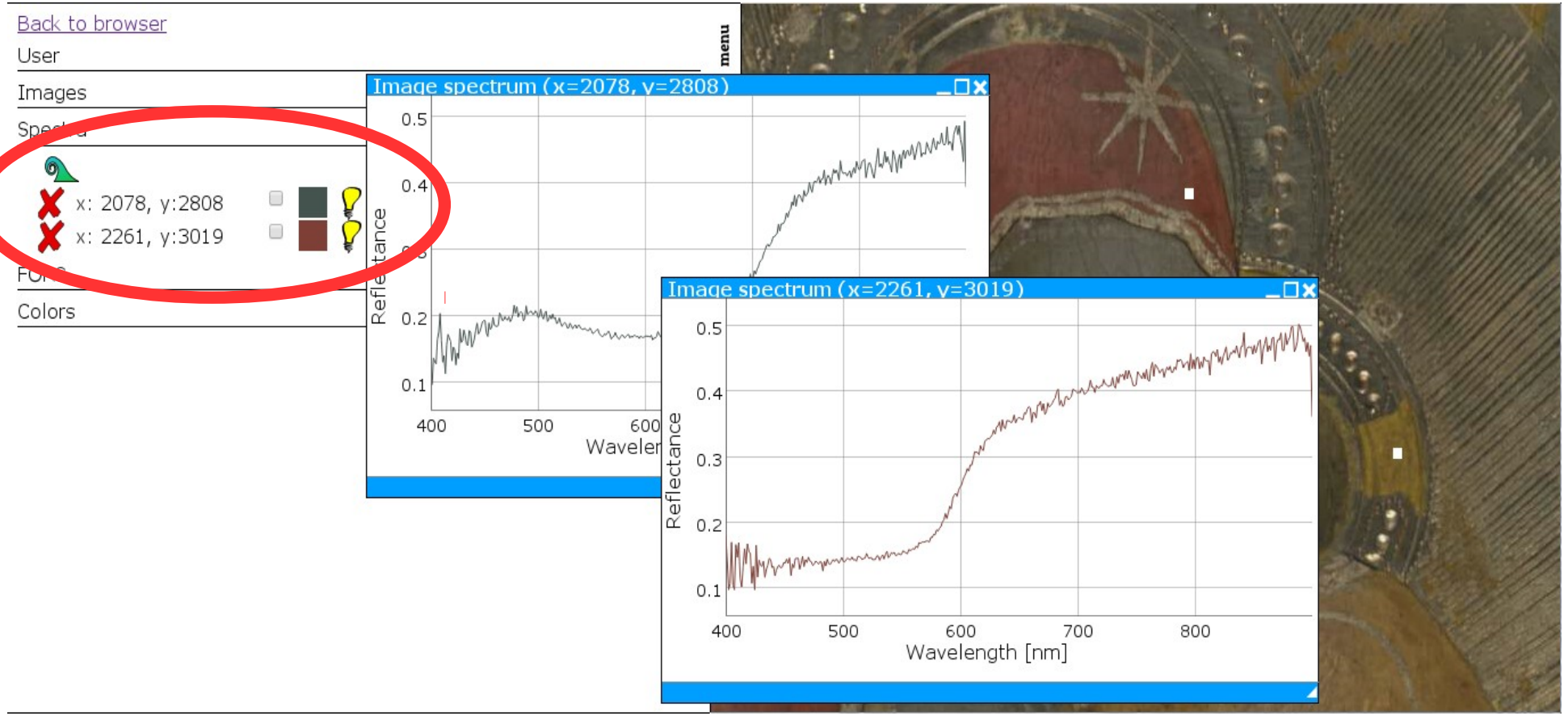
Viewer features: blending



Viewer features: spectra viewer



Viewer features: spectra viewer



Viewer features: spectra viewer

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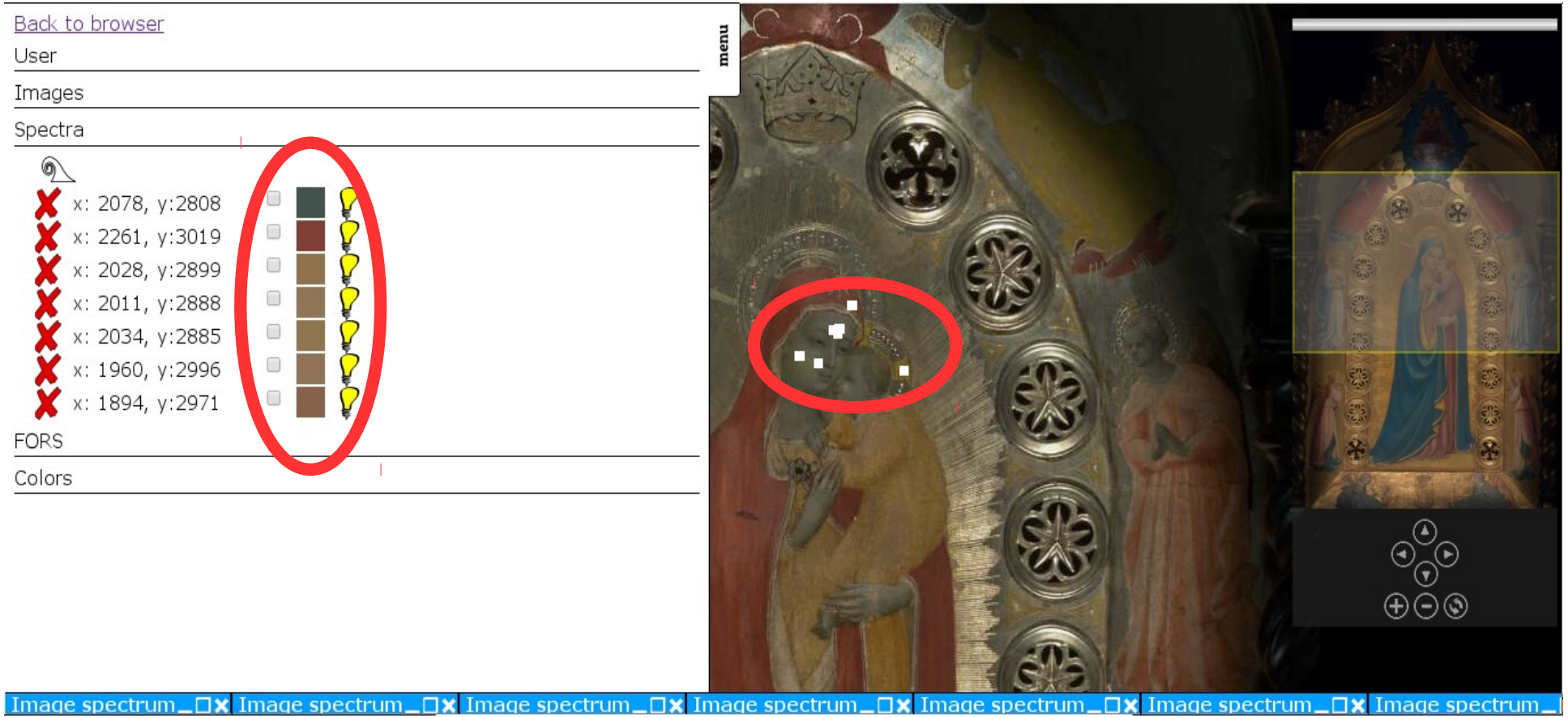
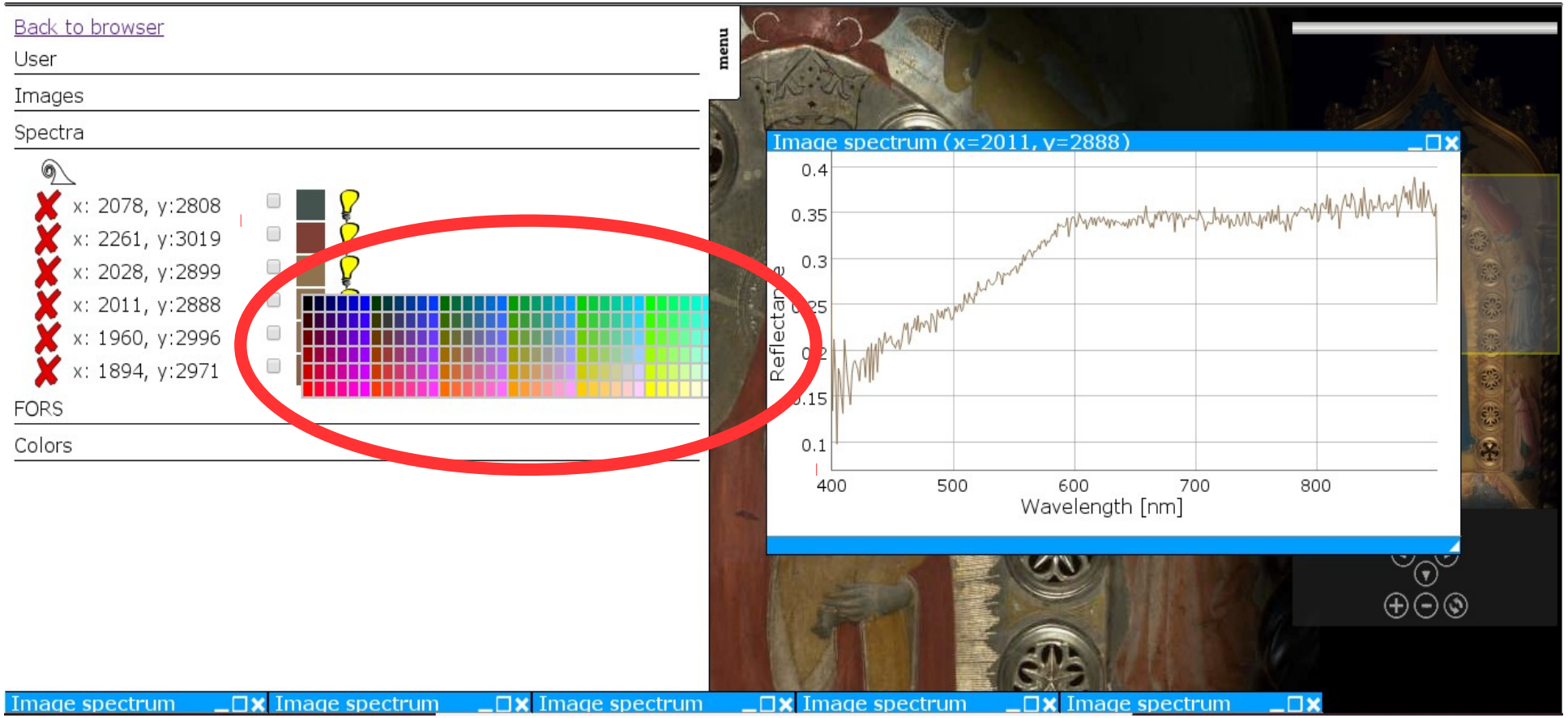
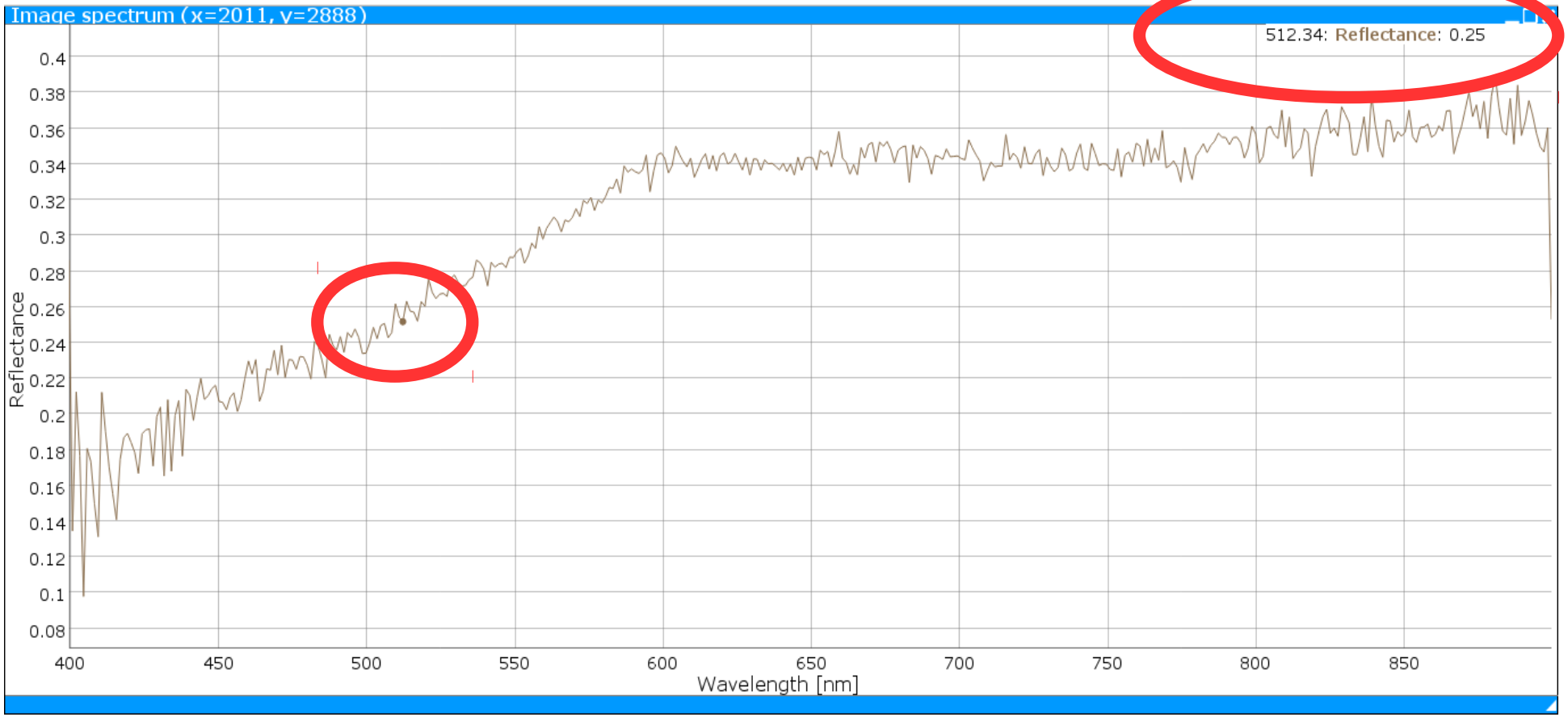
Viewer features: spectra viewer



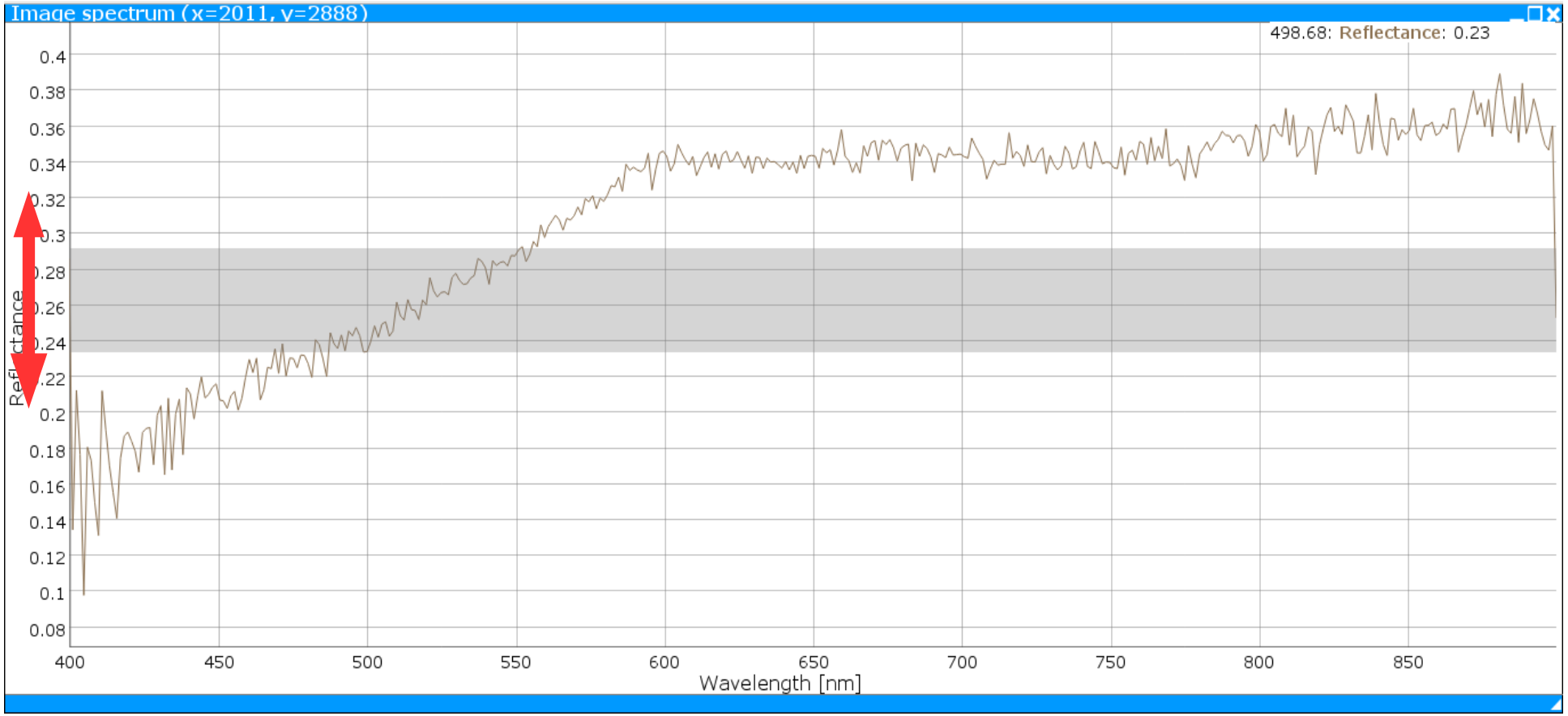
Viewer features: spectra viewer



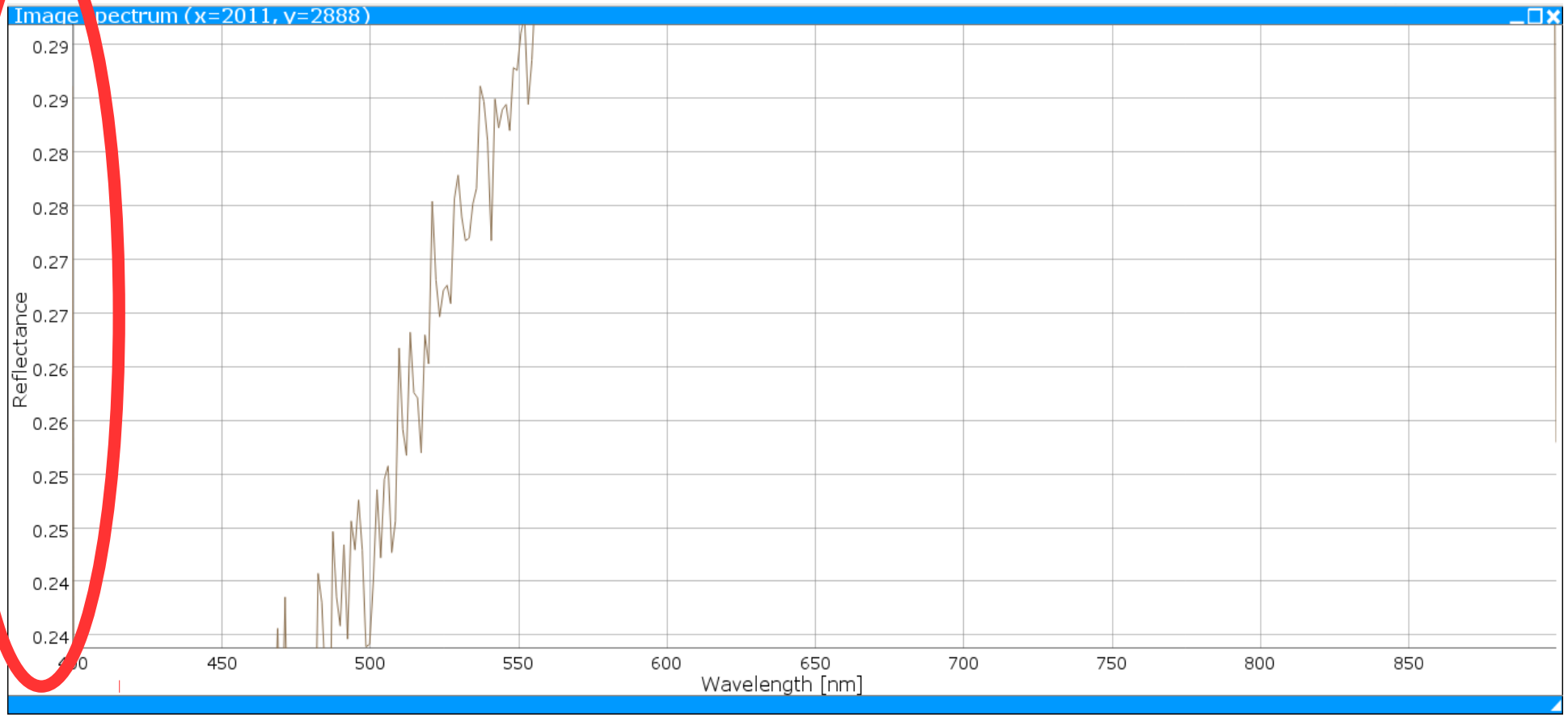
Viewer features: spectra viewer



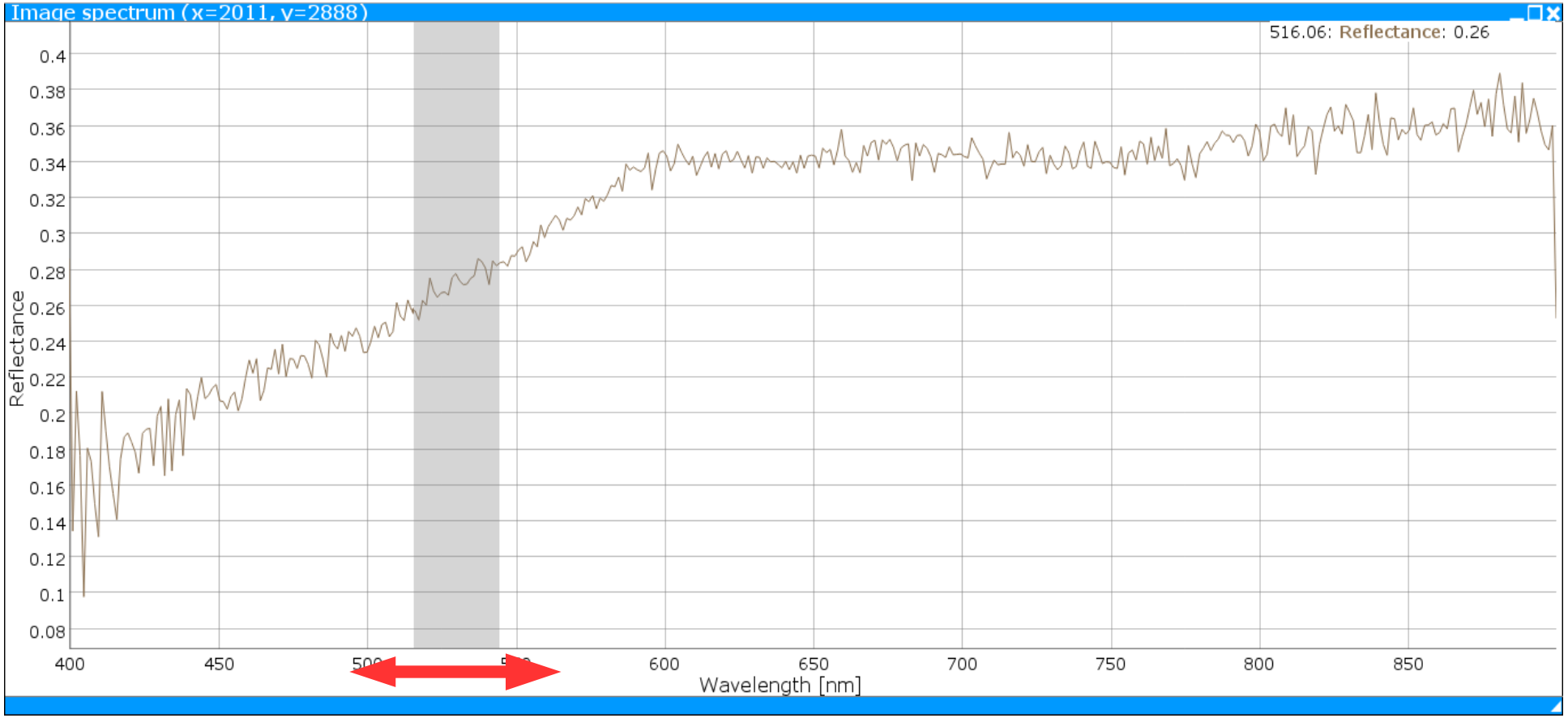
Viewer features: spectra viewer



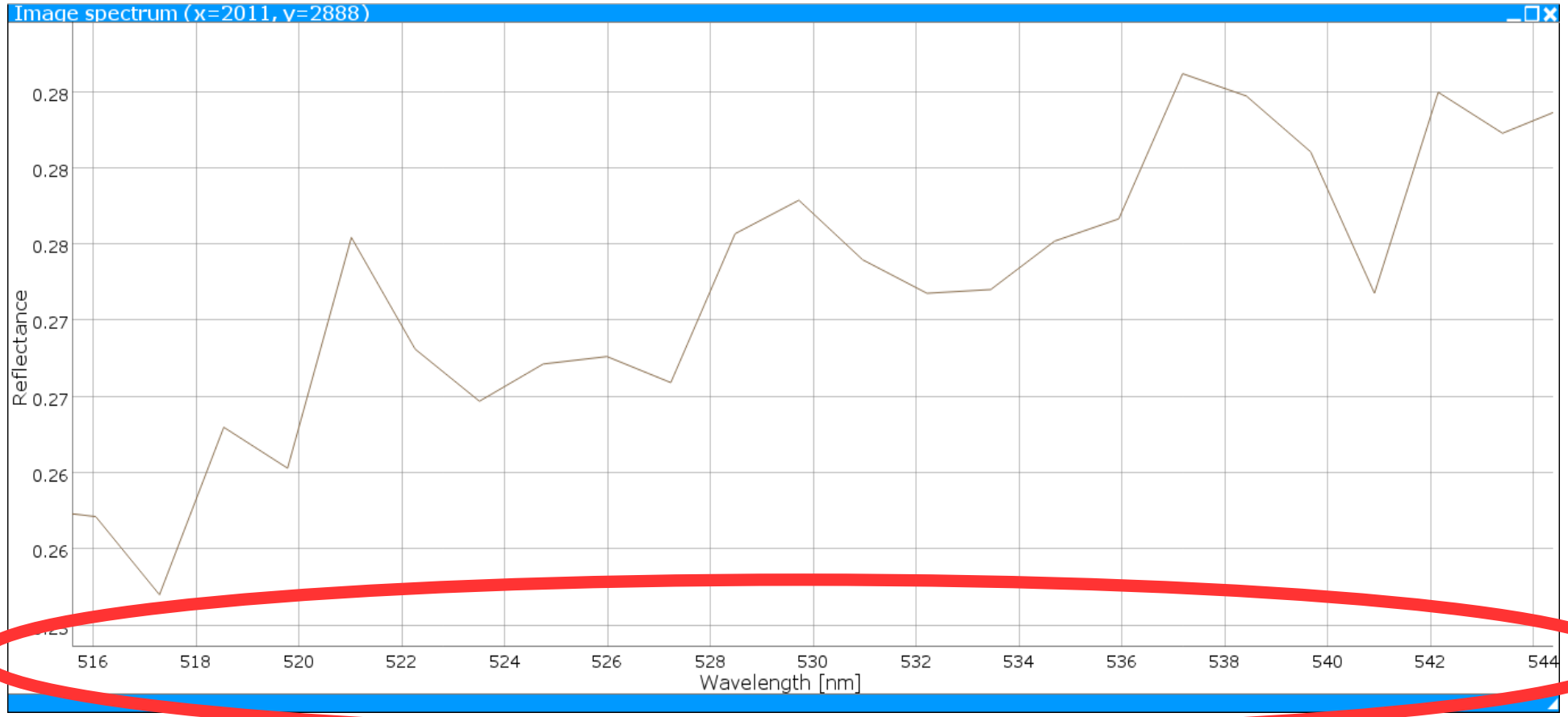
Viewer features: spectra viewer



Viewer features: spectra viewer

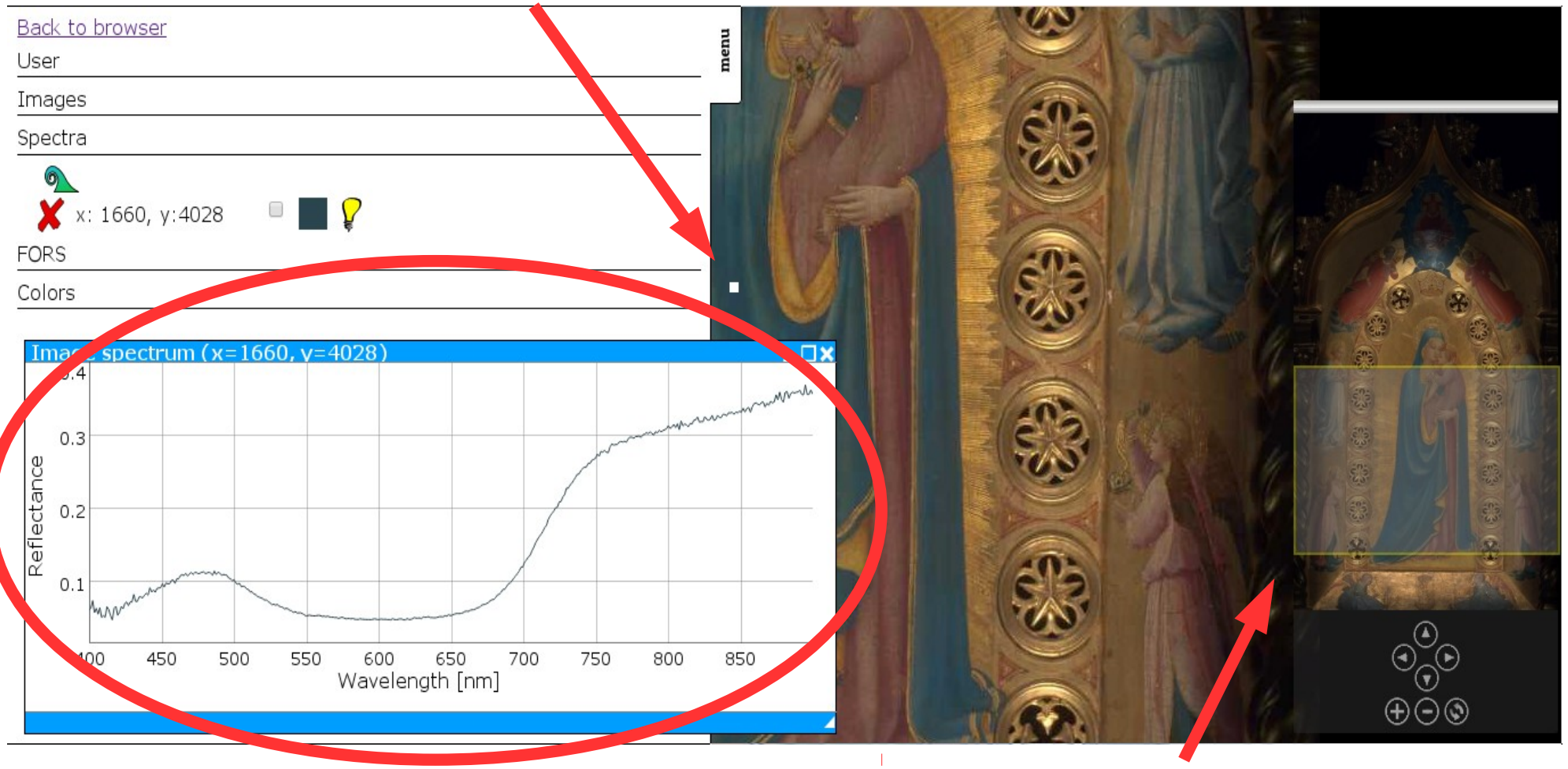


Viewer features: spectra viewer



Viewer features: spectra viewer

Got point



Zoom level

Viewer features: spectra viewer

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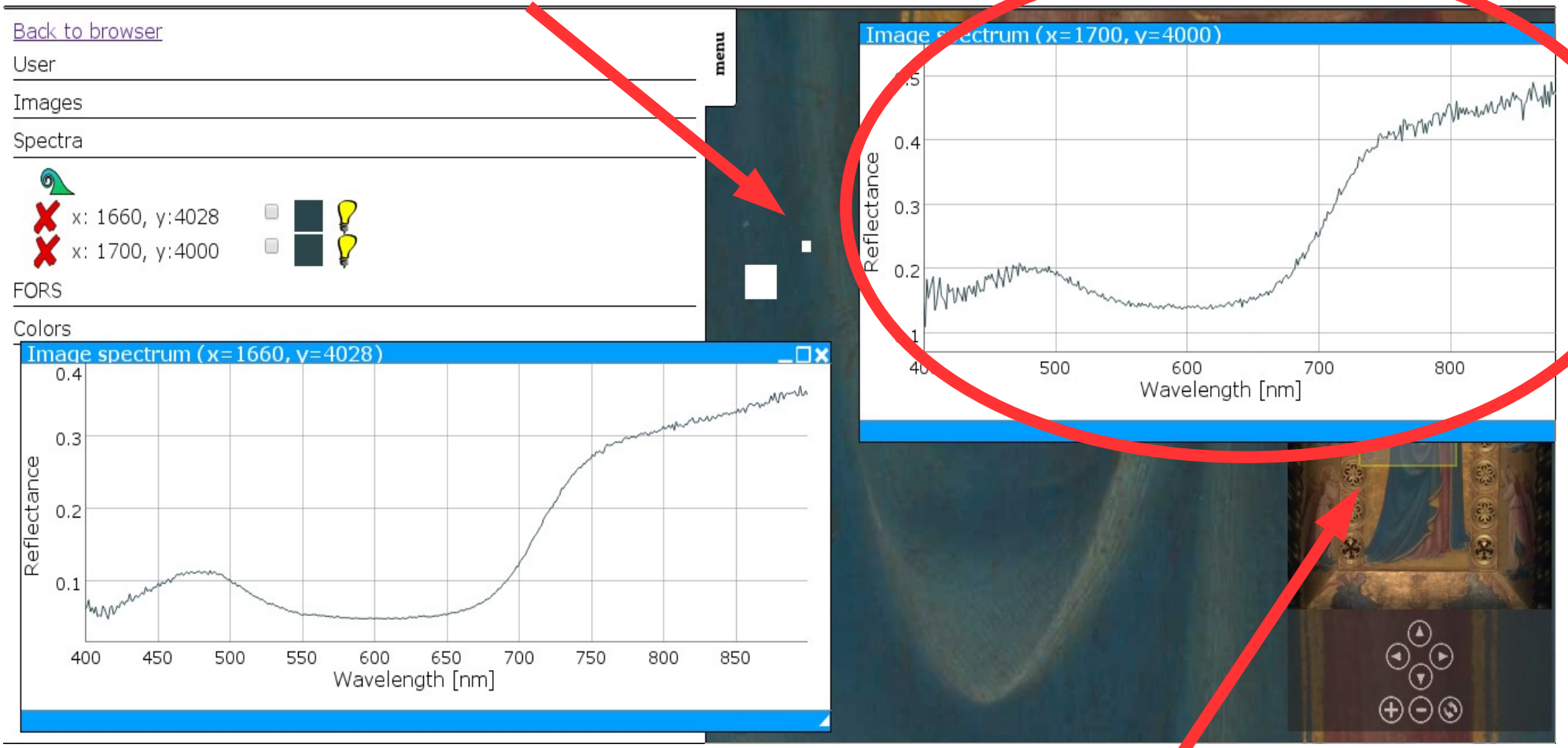
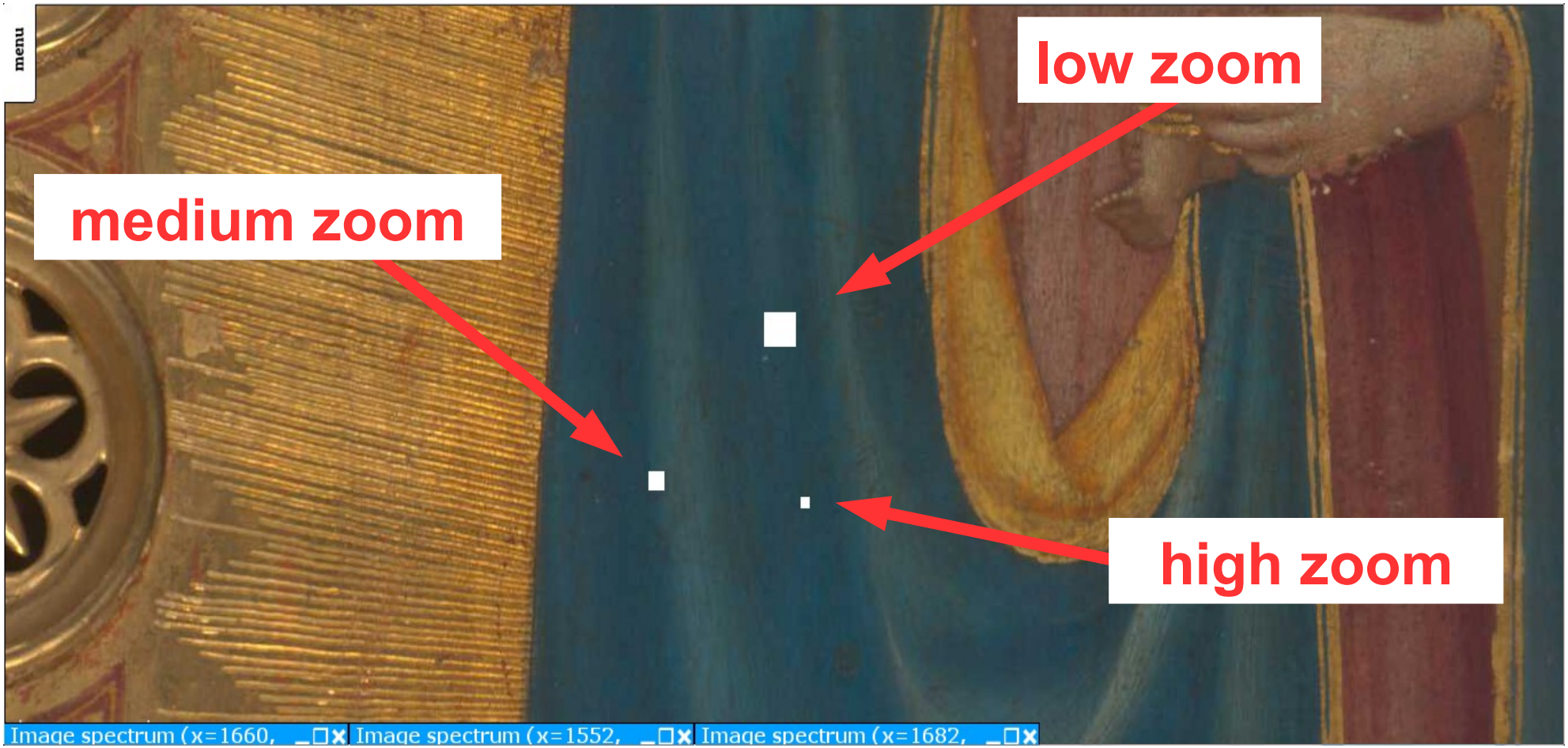
Got point

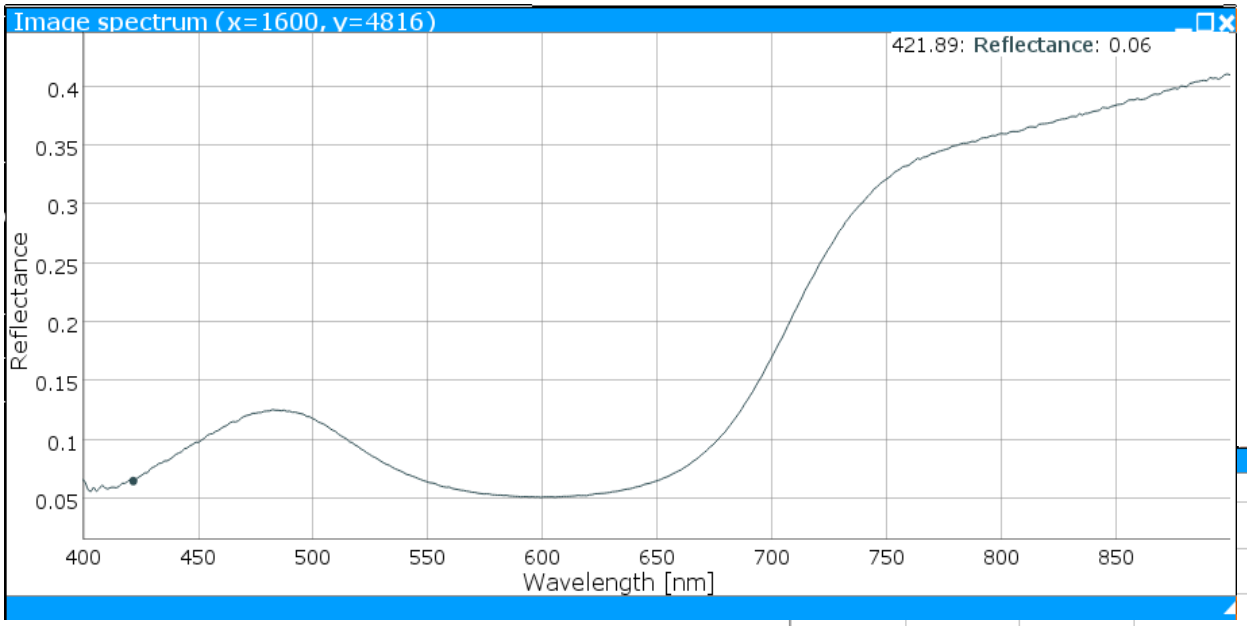


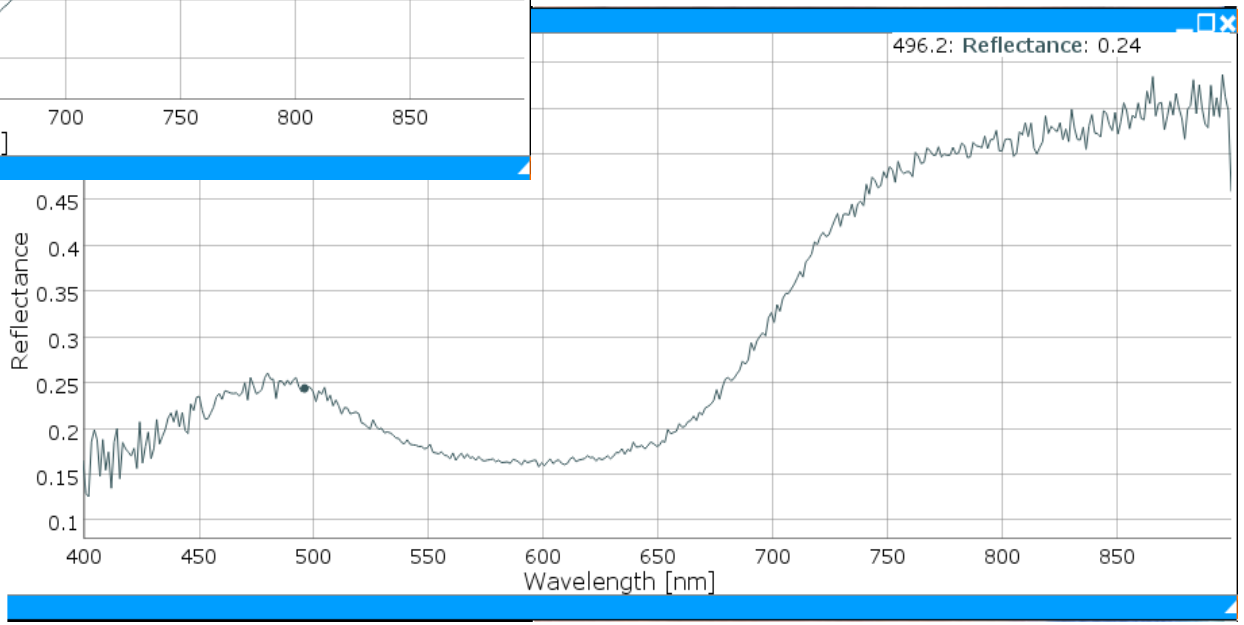
Zoom level

Viewer features: spectra viewer



Viewer features: spectra viewer





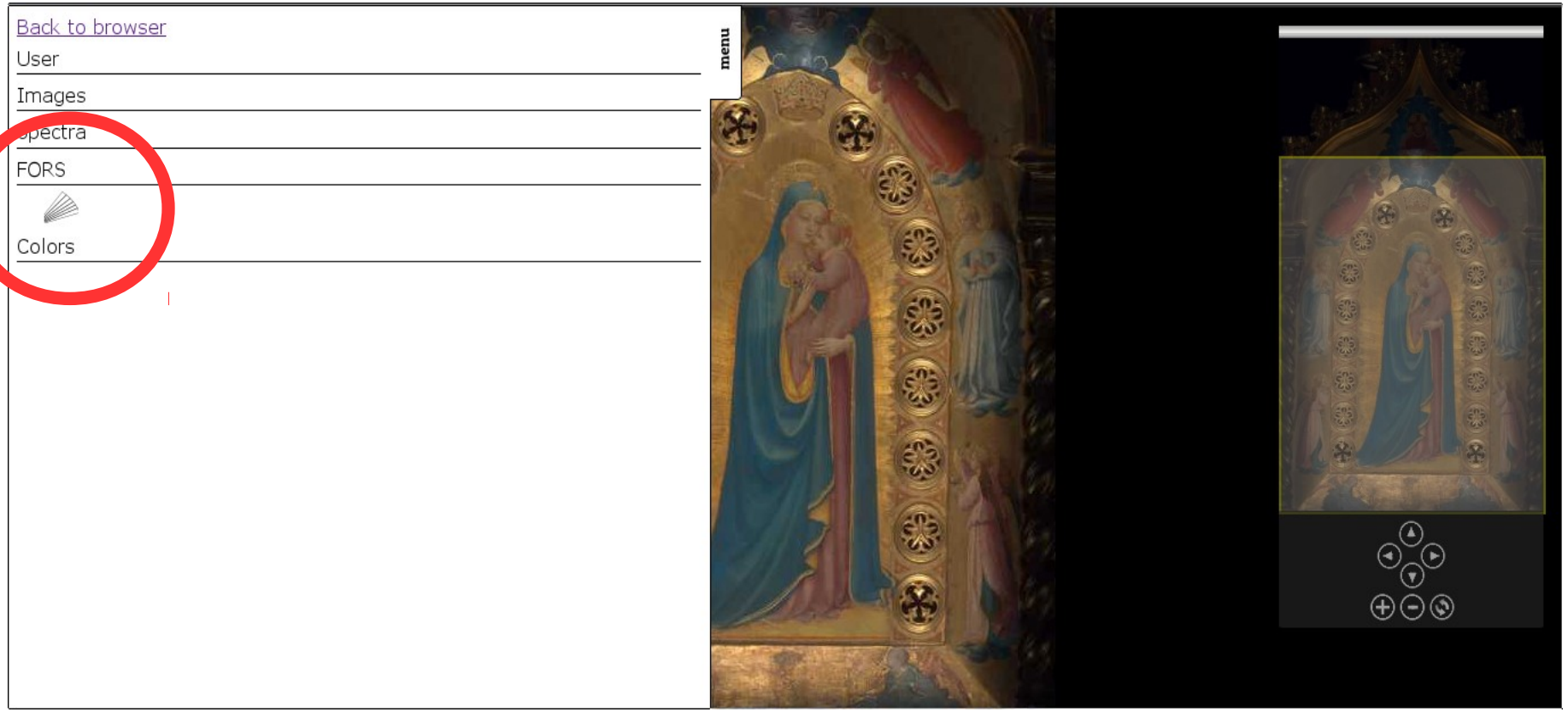
Viewer features: on point measurements

Viewer allows to display other kind of measurements, in particular “on point” ones, like FORS (Fiber Optic Reflectance Spectroscopy)

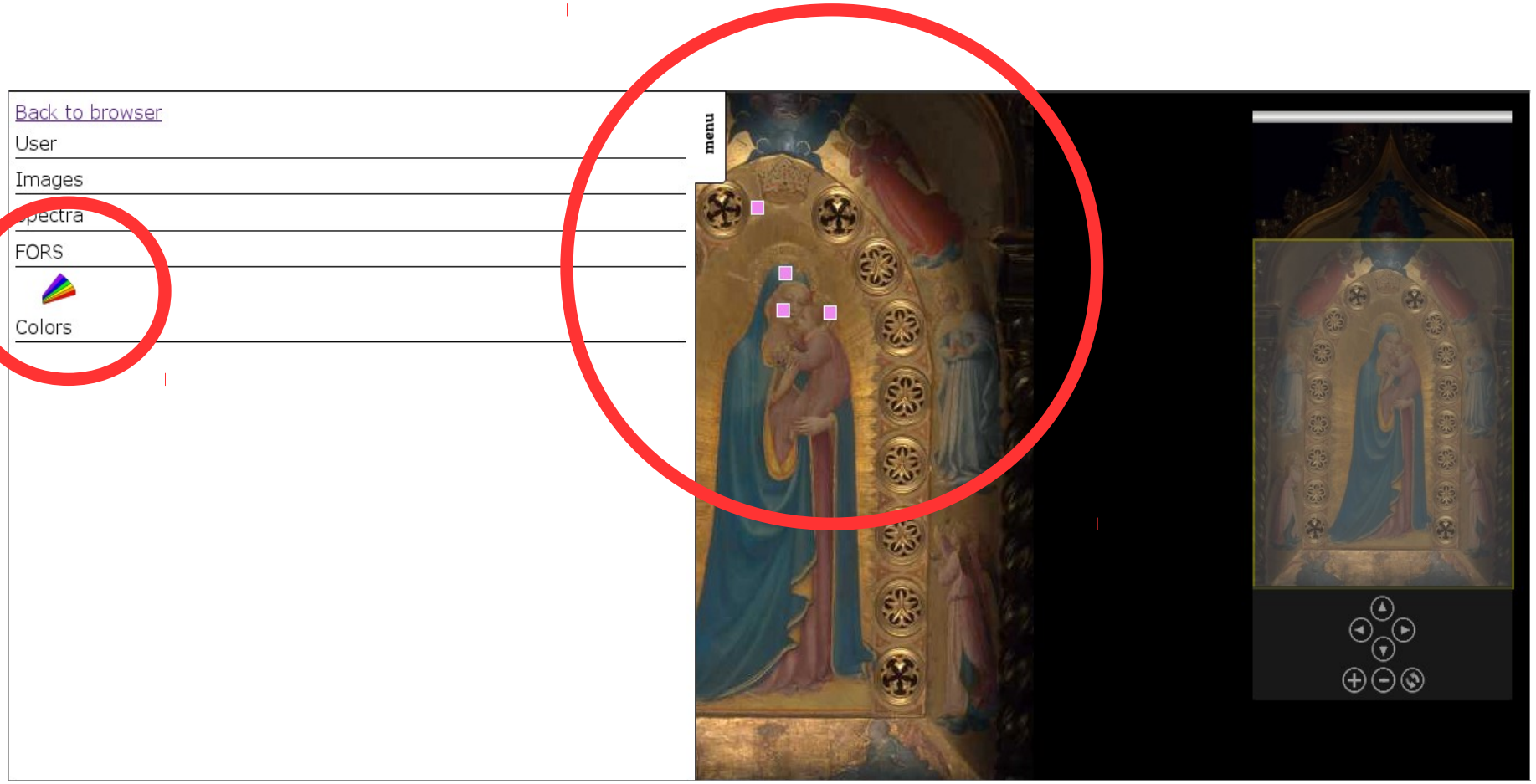
The keyword is still spatial sincronization

On point measurements must be referred to the 2D coordinates on the full resolution base image displayed from the viewer

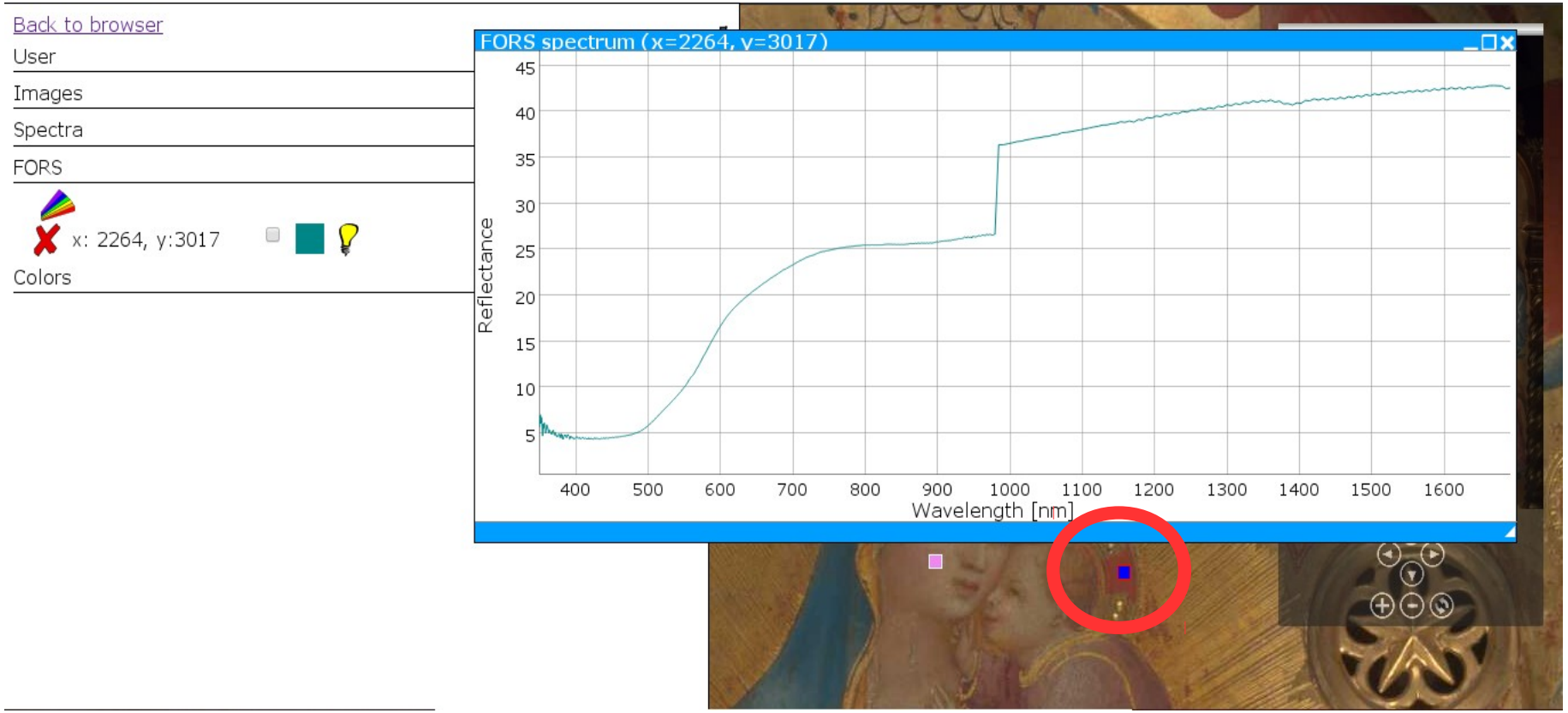
Viewer features: on point measurements



Viewer features: on point measurements

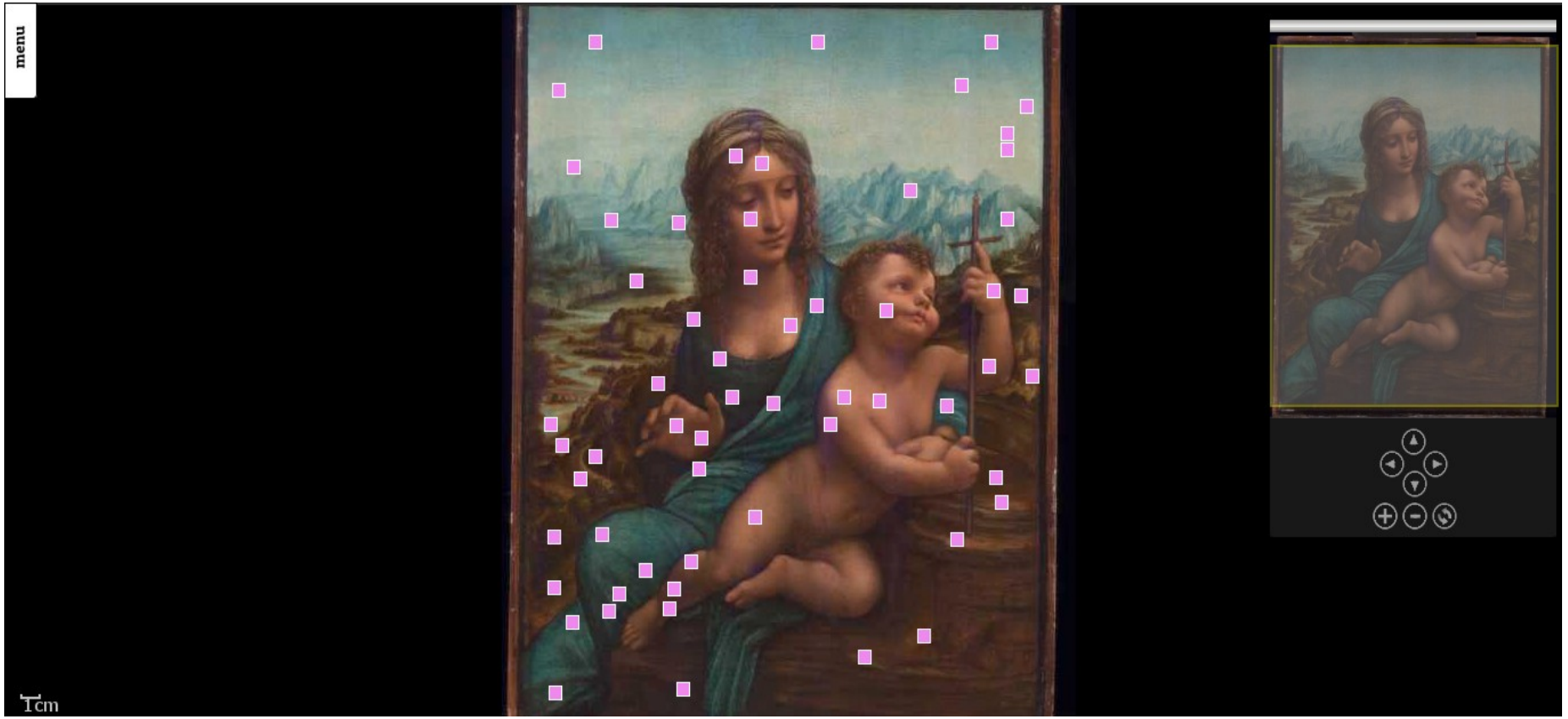


Viewer features: on point measurements

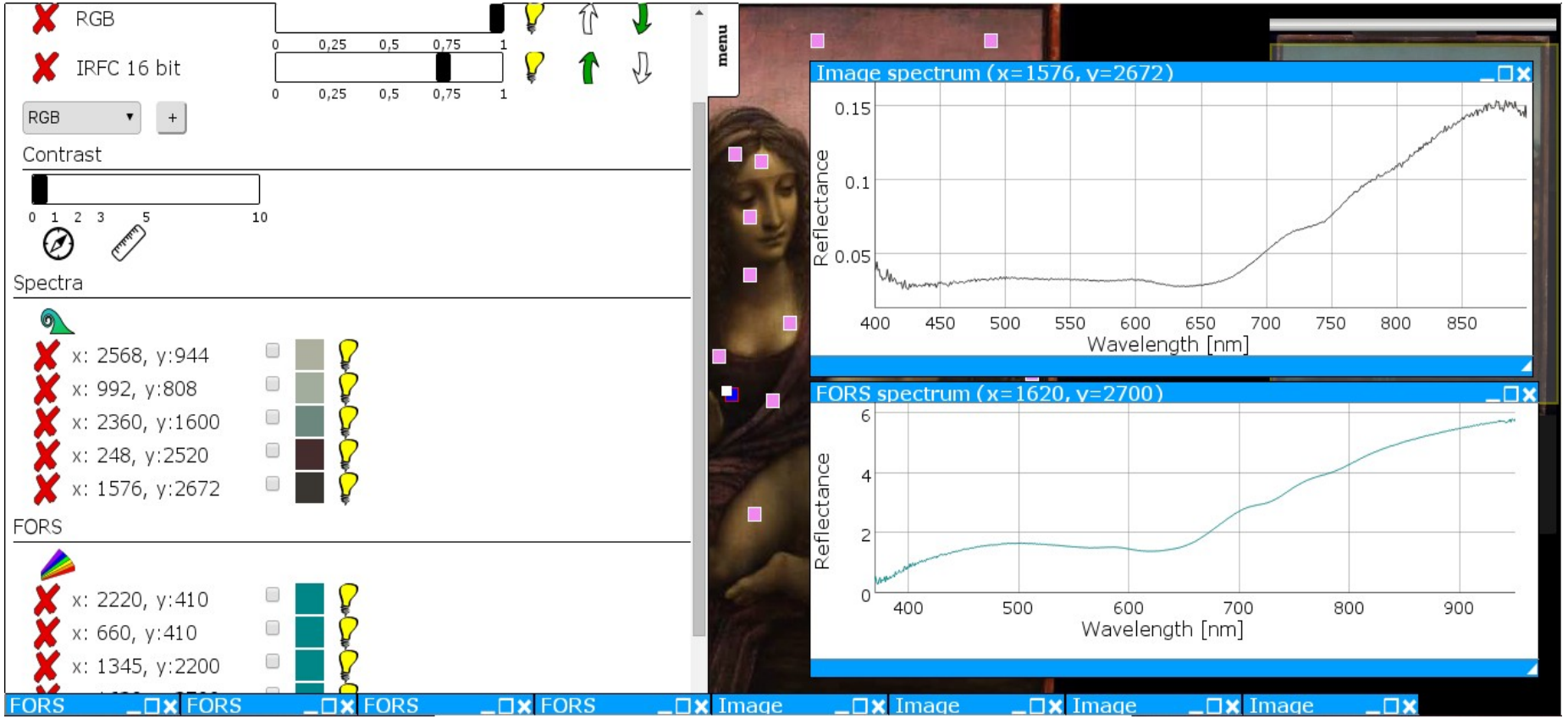


Viewer features: on point measurements

Viewer features: on point measurements



Viewer features: on point measurements



Developments, perspectives and conclusions

Developments

Elaboration tools

- Extraction of cub files portions and images
- Automatic maps on images (neural networks)
- Automatic artefacts detection (neural networks)

User tools

- Session manager (already developed, needs to be refined)
- User level access
- Annotation tool

Community

- Discussion forum
- Newsletter

Perspectives

Build a network of labs, authorities, companies, universities and users to share not only data but also (and mainly) experiences and expertises on the field of hyperspectral data.

Conclusions

A new tool is available on your hands, still in a development version, still with a lot of bugs and lacks to be fixed, but it exists.

Please use it and give your feedback.

That's all, thank you!