**LABORATORY: SMAArt-UNIPG (1) - CNR-SCITEC (2)**

**NAME OF THE INSTRUMENTS**

1. Integrated spectroscopic system for Reflectance and Fluorescence UV-VIS-NIR (prototype) (200-1600 nm)
2. ASD FieldSpec 4 High Resolution spectrometer (350-2500 nm)

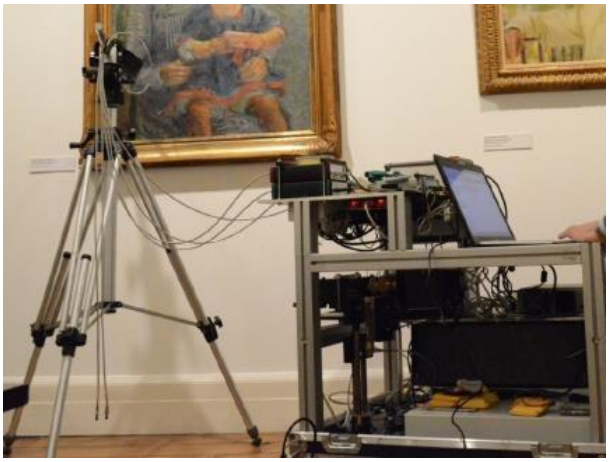
**GENARAL DESCRIPTION:**

In the last years, in-situ UV-VIS-NIR reflectance and fluorescence spectroscopies have become an effective non-invasive technique for the identification of different organic and inorganic materials in art objects such as paintings, manuscripts, textiles, etc. The absorptions due to electronic and vibrational transitions in the broad spectral window from visible to SWIR (400-2500 nm), can be exploited for the identification of most of the pigments and the characterization of several organic materials. The possibility to work in emission mode allows us to acquire characteristic fluorescence profiles and to identify some organic dyes and luminescent pigments, such as zinc oxide, cadmium pigments, and Egyptian Blue. Moreover, fluorophores with similar emission spectra can be distinguished based on their characteristic emission lifetimes.

**TECHNICAL DESCRIPTION:**

1. **Integrated spectroscopic system for Reflectance and Fluorescence UV-VIS-NIR (prototype) (200-1600 nm)**

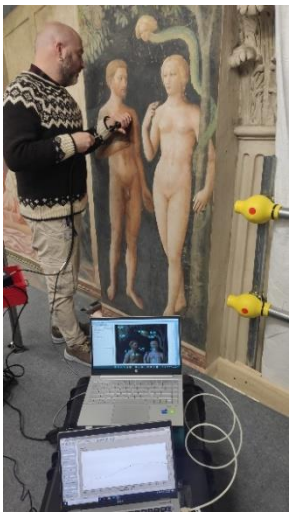
The prototype portable instrumental is composed of different light sources: a compact deuterium-halogen lamp for reflection-mode measurements; solid-state lasers and laser diodes for steady-state fluorescence measurements; pulsed diodes and LEDs for emission lifetime measurements in the time interval from ns to ms. The sources are coupled with high sensitivity CCD spectrometers working in the UV-VIS-NIR range and which allow to acquire reflectance spectra in the range 200-1600 nm and luminescence spectra in the range 300-1600 nm. Lifetimes can be measured for species emitting in the spectral range 350-850 nm. A dedicated fiber optic system allows measurements on any surface with a lateral resolution < 2 $mm^2$.



2. **ASD FieldSpec® 4 Hi-Res High Resolution spectroradiometer (350-2500nm), Malvern Panalytical**

The instrumnet is equipped with three detectors: a 512 element silicon array detector for the 350-1000 nm range, and two InGaAs Photodiodes (TE Cooled) for the 1000-1800 and the 1800-2500 nm

ranges. The spectral resolution is 3 nm in the VNIR range (350-1000 nm) and 10 nm in the SWIR range (1000-2500 nm). A complete spectrum can be recorded in the scanning time of 0.1 s.
The instrument is supplied with a 1 m long optical fiber directly connected to the spectrophotometer with a 25° FOV. Using an external lighting consisting of a 12V quartz-tungsten lamp with ventilated cooling (placed at 45° with respect to the surface) and the permanent fiber (placed perpendicular to the surface), measurements with CIE 45/0 geometry can be carried out. The lateral resolution in this setup depends on the working distance: indicatively, the measurement area is about half of the working distance. Alternatively, the instrument is equipped with two bifurcated fiber optic systems (*large and small diameter reflectance probe)* which can be connected to the permanent fiber and to an external source with nominal power 12VDC, 30W. The *large diameter reflectance probe* consists of 156 fibers (200 micron), 78 for the excitation and 78 for collecting the reflected light, the stainless steel tip has a diameter of 6.3 mm . The large diameter fiber can be used with a collection probe for reflected light at approximately 20°. The *small diameter reflectance probe* is composed of 6 illumination fibers (600 microns) surrounding a single collection fiber (600 microns), the stainless steel tip has a diameter of 6.3 mm .
SpectralonTM is used for the white reference calibration. RS3 Software Package A3500370 is used for data acquisition. A backpack and batteries are provided to perform standing up analysis.



**RIFERIMENTI:**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- Pallipurath A.R., Skelton J.M., Ricciardi P., Elliott S.R., "Estimation of semiconductor-like pigment concentrations in paint mixtures and their differentiation from paint layers using first-derivative reflectance spectra", Talanta, 154, 63-72. (2016).



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