

## **Easel paintings on canvas and panel: application of Nd:YAG laser at 355 nm, at 1064 nm and UV, IR and visible light for the development of new methodologies in conservation**

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Although the beginnings of the application of laser technology in the conservation of easel paintings date from the early 1980s, it has not yet become part of the standard procedure in the conservation studios. The reason is a complicated and expensive procedure. This paper aims to present a set of mobile equipment that is applicable for conservation of other materials too, and therefore its acquisition could be more profitable for the institutions of protection of cultural heritage. It will show application of different light sources - the classical and laser radiation, before, during and after conservation treatment of the easel painting. In order to analyse the painting layers, subsequent interventions and retouching, the UV lamp, infrared cameras and a digital microscope with UV, visible and infrared light were used. A commercial Nd:YAG mobile laser system was used for thinning of the varnish. For the monitoring of the cleaning process, the fluorescence was induced on the surface of the painting by the UV lamp.

The subject of research and conservation was the picture "*Portrait of Jelena Milojevic with her daughters*" from 1922, the work of the Russian painter Valentin V. Volkov. By observing the results of the tests of chemical cleaning under the UV light, it was concluded that due to the very high sensitivity of some pigments, it was impossible to apply this methodology on such delicate surfaces. The laser cleaning instead, proved to be an acceptable alternative for cleaning of the easel paintings, but in this case it was even the only solution. Further tests, in which different parts of light spectra (IR, VIS, and UV) were used, revealed numerous pentimento, old retouching, micro-cracks in the varnish, as well as an advanced process of oxidation of the upper layer of the varnish. The final decision about the method of thinning of varnish layer was taken after observing the surface of varnish by a digital microscope which provided useful information about the layers and their mechanical structure. The process of laser cleaning of varnish was controlled by visible and UV light. Due to different effects of UV fluorescence on the varnish layer and the paint layer, it was possible to control the presence of varnish, taking paint layer as the reference. By combining these techniques, optimal results were achieved both from the conservation as well as from the aesthetic

Another case of this study is separation of layers on the icon, using the same laser. The object of study was the icon *Holy Mother of God*. The icon was made with technique of egg tempera in the 19th century in Ukraine. A bronze coating was subsequently added on the aureoles, below which there is a gilding sheet. Gilding sheet was poorly linked to the preparation layer, so that every intervention whether it is mechanical, chemical or laser cleaning had caused its removing, together with the bronze coating. But when the surface layer was irradiated at 1064 nm in Q-switched regime, with low energy that did not cause ablation of material, the added layer of the icon was separated from the original layer as a result of the shock waves on the surface. This allowed, subsequently, an easy mechanical removal of unwanted layers. Combination treatment of the aureoles using two techniques - laser cleaning and mechanical removal, is faster and more uniform than in the case of treatment by other techniques.