INVITED SPEAKERS AND THEIR PRESENTAIONS:

Iacopo Osticioli is a chemist and he works as a senior researcher at the Institute of Applied Physics “Nello Carrara” (IFAC-CNR) in Florence (Italy). He has a PhD in conservation science from the University of Florence. He worked as a Marie Curie fellow at the Institute of Electronic Structure & Laser (IESL-FORTH) in Greece and as a post-doc at Politecnico di Milano (Italy). His research is focused on the innovation and application of spectroscopic and imaging techniques for the study and characterisation of artistic and raw materials, particularly Raman, LIBS and fluorescence spectroscopy. He has been involved in several RTD projects, developing novel devices, analytical protocols, and chemometric methods in archaeometry. Author of more than 70 ISI-WoS publications and many others in proceedings, books, and journals.

MULTI-ANALYTICAL MOLECULAR MAPPING FOR ASSESSING THE QUALITY OF NATURAL ULTRAMARINE BLUE PIGMENT IN PAINTING CROSS-SECTIONS

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Keywords: multi-analytical, molecular mapping, paintings, cross-sections, ultramarine

Natural ultramarine is a well-studied pigment due to its precious and unique blue colour as well as its complex composition. Several papers have been published regarding its use in the past, the trading network and provenance. Interesting considerations regarding the discrimination between the synthetic and natural pigments, as well as their conservation state in paintings, have been made in the literature. However, literature lacks answers regarding the quality and purity grade of this pigment in works of art. Purity grade and compositional details provide information on the origin and production process. Moreover, high purity and deep blue are typically associated with the Afghan mines of Sar-e-Sang. Aspects of great relevance in authentication studies and conservation interventions.This work aims to address this issue, establishing an innovative analytical protocol for the analysis of micro-samples from paintings containing ultramarine, using a combination of spectroscopic data generated by different analytical techniques (Raman, FTIR and Fluorescence) to gain more detailed compositional information. The purpose is to overlap the information contained in each map, consisting of large spectroscopic data sets, using modern algorithms to enable a complete statistical compositional evaluation. The experimentation has involved the analysis of several standards of natural ultramarine pigment powders from Afghanistan with different purity grades used to train each spectroscopic technique in mineral identification. The study has been focused not only on the identification of the mineral lazurite, which is responsible for the blue colour, but also on the associated silicates, carbonates, oxides, phosphates and sulphides. This multi-analytical and holistic approach has allowed for the first time the selection of a few minerals as purity markers of the pigment. Preliminary and promising results in this sense have been achieved on some cross-sections from old master paintings of The Courtauld's Easel Painting Conservation archive collection, which have been subjected to this analytical approach for the first time. This research brings a significant contribution from Prof. Austin Nevin, who passed away last year. This talk is also the occasion to celebrate his memory as a point of reference for the scientific community working in the Cultural Heritage field, as well as a valuable member of the scientific committee of this conference.

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Ioana Maria Cortea holds a PhD in Physics from the Politehnica University of Bucharest, along with an interdisciplinary Master's degree in Conservation Science and Technology for Cultural Heritage. Since 2012, she has worked as a heritage scientist within the Centre of Excellence for Restoration by Optoelectronic Techniques (CERTO) at the National Institute of Research and Development for Optoelectronics INOE 2000. Her research activity is mainly centered on the study of art and archaeological objects using non- and micro-invasive spectroscopic techniques, with a special focus on the analysis of polychrome works of art. With over 10 years of experience in the field and a portfolio of 40+ scientific publications, she is an active contributor to the heritage science research landscape.

MATERIALS AND PAINTING TECHNIQUES OF ANCIENT WALL PAINTING FRAGMENTS FROM ROMAN DACIA: CURRENT STATE OF RESEARCH

Ioana Maria Cortea

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Keywords: Roman wall painting; Roman Dacia; painting technique; pigment; multi-analytical investigation; heritage science

Renowned for their aesthetic beauty, Roman wall paintings have long captivated both scholars and the general public. Although extensively studied, these artworks continue to spark interest and inspire new avenues of research. A substantial body of data exists on wall painting materials and techniques from well-known sites such as Rome and Pompeii, and similar studies have been conducted in other regions of the Roman Empire, including Northern Italy, Spain, and France. In contrast, the frontier provinces—such as Roman Dacia—remain underrepresented in scientific studies of mural painting practices. Preserved examples of mural painting in Dacia are scarce, typically consisting of isolated fragments associated with monumental buildings, setting the region apart from other Roman provinces in terms of available material and scholarly attention.

This lecture presents on overview of the most significant results obtained in recent years from the scientific investigation of Roman wall painting fragments uncovered at key archaeological sites in Dacia—most notably *Ulpia Traiana Sarmizegetusa* and *Alburnus Maior*—as well as recent, unpublished findings from *Buridava* and *Histria*. The material composition of the pictorial layers and the production techniques behind Roman wall paintings are examined and discussed through several surviving examples of decorative polychrome plaster fragments. The results are derived from several interdisciplinary studies conducted by CERTO INOE 2000, in collaboration with key stakeholders in the cultural heritage field, including museums and archaeological institutions. Given the rarity of the findings, the research prioritized non- and minimally-invasive methods to ensure preservation. Analytical techniques used to explore the pigments, stratigraphy, and painting techniques included X-ray fluorescence (XRF), Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy, laser-induced breakdown spectroscopy (LIBS), scanning electron microscopy with energy-dispersive X-ray spectrometry (SEM–EDS), and X-ray diffraction (XRD), complemented by advanced imaging methods such as hyperspectral imaging. These investigations form part of the first interdisciplinary studies dedicated to Roman wall paintings from the former province of Dacia, an ongoing series exploring the technical know-how behind decorative wall paintings found in Roman archaeological sites in Romania.

Irina Crina Anca Sandu (PhD in Chemistry for Conservation, 2003) is the Conservation scientist of Munch museum in Oslo since 2016. She has authored and co-authored several books, chapters and more than 130 scientific papers. She also led many challenging research projects, her current interests being focused on: characterizing modern art materials and techniques, dating works with imprecise or no date, understanding and mitigating the degradation phenomena on paintings and works on paper, testing and validating new/greener formulations for cleaning and consolidation of paintings, applying innovative approaches and AI tools for studying and safeguarding collections of art-objects and engaging the wider public into immersive experiences stemming from scientific research in conservation. Irina also has been organizer and chair of international events and invited speaker at different conferences and webinars. She is currently project leader on behalf of Munch for the EU-funded project PERCEIVE (PERCEIVE - Perceptive Enhanced Realities of Colored collEctions through aI and Virtual Experiences) working with an interdisciplinary group in the development of tools and services to showcase, simulate and regenerate colors in the iconic Scream (1910?).

THE SCREAM MOTIF: NEW PERSPECTIVES TO ITS STUDY AND COLORS PERCEPTION

Irina Crina Anca Sandu, PhD
Munch Museum, Oslo, Norway

Abstract:
This presentation will show the latest results around the studies of the most iconic motif in the collection of Munch Museum in Oslo and how these researches brought new perspectives in understanding the Scream and its change in appearance over time.
Main projects presented here are the Dating Scream, still ongoing, and the PERCEIVE ((PERCEIVE - Perceptive Enhanced Realities of Colored collEctions through aI and Virtual Experiences) project, a EU-funded initiative, where AI and digital technologies are used to showcase the color change and propose tools and services for monitoring and simulation.
The Dating Scream is an internal project considered priority for the research agenda of MUNCH museum and involved different partners and scientific tools aiming to define the date of the iconic Scream, that nowadays still las a question mark on it (1910?). Started at the initiative of the art historian Petra Pettersen in 2023, the first part of the project involved the use of two scanners (MA-XRF and MA-XRPD) in a campaign run in Spring 2024 with the support of AXIS group at Antwerpen University. The research involved until now 7 paintings (on cardboard and canvas) from the early period (1893-1895) and also around 1907 and it considers to further access MOLAB facilities for analyzing other paintings in the MUNCH's collection from a later period (from 1910 onwards).
MUNCH museum made available for the PERCEIVE project two versions of the Scream, highly sensitive to light and relative humidity: the painting on cardboard dated around 1910 and the hand-colored lithograph dated from 1895. These versions are case studies in the Scenario 2 dealing with color change in paintings and works on paper.
The main research questions around the Scream fading (or darkening, for those colors prone to this phenomenon) that support the creation of novel tools and services based on AI algorithms and color science processes are:

- How a Scream without colors would look like and what this would mean for the European CH?
- Can we recreate the original appearance of the Scream?
- What is the main input data that we need in order to safeguard the memory of these iconic art-objects?
- Are we able to simulate how the objects will look into the future, if we do nothing to mitigate the color fading?
- How can we better transfer to a large public the complex knowledge around sensitive colored materials for painting and print making?
- What kind of experiences (digital, immersive, hybrid) can be designed to enhance perception, authenticity and sense of care of colored collections?

The scientific methodology of PERCEIVE around the Scream case study will be presented along with first results from the combination of analytical results and simulations.
The presentation will resume the main challenges and findings coming from these 2 projects and also the contribution of Heritage science in advancing knowledge and improve conservation practices in important art collections.

Monica Dinu is a senior researcher at INOE. She holds a MS in Spectroscopy, Plasma, Lasers and a PhD in Physics obtained at the Polytechnic University of Bucharest. Her main research interests and experience are focused on laser spectroscopic techniques for investigation and diagnosis of artworks, as well as studies on the effects of solid-state lasers on different materials.

CHARACTERIZATION OF COMPLEX LAYERS IN CULTURAL HERITAGE USING A MULTIVARIATE AND MULTIMODAL ANALYTICAL APPROACH

M. Dinu*, L. Ghervase, I.M. Cortea, L.C. Ratoiu, L.M. Angheluță, V.A. Cristea

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Keywords: spectroscopy, imagistic, stratigraphy, multivariate, multimodal

The characterization of complex stratigraphic layers in cultural heritage objects is critical for understanding their construction, history, and degradation processes. This study presents a multidisciplinary approach combining Laser-Induced Breakdown Spectroscopy (LIBS), Fourier-Transform Infrared Spectroscopy (FTIR), X-Ray Fluorescence (XRF), hyperspectral imaging, and digital X-ray radiography to analyse heritage objects non/micro-invasively. Spectral data acquired from LIBS, FTIR, and XRF were processed using chemometric methods to classify and differentiate material compositions. Concurrently, hyperspectral and digital X-ray imagistic data were processed using supervised and unsupervised classification techniques, to map surface and subsurface features. The integration of spectral and imagistic datasets was achieved through correlation analysis, where chemometric classification results were spatially aligned with image-derived maps. This synergistic approach enabled the identification and mapping of underlying layers and hidden features not visible to the naked eye. The spectral signatures of specific pigments or materials were correlated with corresponding regions in the hyperspectral and X-ray images, revealing concealed artistic details, restoration interventions, or structural anomalies. The combined methodology demonstrated its efficacy in uncovering complex stratigraphies, providing new insights into the material composition and historical context of the analysed heritage objects. This integrated framework offers a powerful tool for conservators and researchers, enabling detailed non-destructive analysis and preservation planning for cultural heritage artefacts.

Acknowledgements

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Sorin Hermon is associate professor at The Cyprus Institute. His research is situated within two converging fields: Digital Cultural Heritage and Heritage Science:
[a] applying computer graphics and computer vision-based methods to the shape analysis of heritage assets, in order to characterize their form, materiality, production techniques, technologies of manufacture and their state of conservation, from macro to micro-scale;
[b] integrating hyper-spectral and technical imaging data with 3D documentation, and
[c] defining formal knowledge representation structures, including domain ontologies, their associated knowledge graphs and related digital repositories.
He applies these methodologies on current grant challenges of Cultural Heritage (CH), namely
[a] tackling the grand research challenges of the late prehistory of the southeastern Mediterranean with novel multi-disciplinary approaches;
[b] developing open-science workflows for the research-conservation-valorization of CH;
[c] designing sustainable disaster risk management strategies to reduce Climate Change impact on CH,
[d] combatting the illicit trafficking of cultural goods.
Sorin has published more than 120 peer-reviewed research papers, supervised several PhD and MSc students and is director of the MSc program in Digital Cultural Heritage at The Cyprus Institute.
He is a member of the Steering Committee of ECHOES, the recently-EU funded project aimed at developing and implementing the European Collaborative Cloud for Cultural Heritage, being responsible, among others, to frame the concept of Heritage Digital Twins as digital commons and to ensure their digital continuum.
He currently is the PI on competitive EU grants summing up to ca. 2 million Euro for the next 5 years.

Vincent Detalle's Augmented Heritage Object - a visionary approach towards a unified framework in Cultural Heritage studies

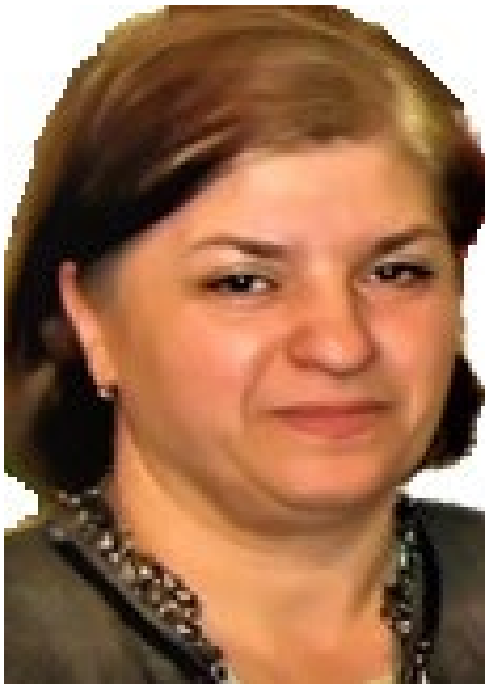
Sorin Hermon (presenter), Vania Virgili, Livio de Luca, Xavier Rodier, Michel Menu

Abstract:

Cultural Heritage encompasses a multitude of discipline, disparate in their applied methodologies and approaches, spanning from humanities and social sciences, such as art history, archaeology, cultural anthropology or sociology, to natural and experimental sciences, including chemistry, physics, earth sciences or biology, and exact sciences, such as mathematics, engineering or data sciences. Their aims are to have a better grasp on past socio-cultural or economic events, understand how artefacts, monuments or sites have been constructed, used and discarded, or characterize their materiality and conservation state today. Some objects are musealized, other archived, while unfortunate ones perish or buried under modern developments. While the effort on working in a cross-disciplinary way has been long recognized as a priority, there are effectively few attempts at offering sustainable and realistic solutions to this challenge. Among them, the visionary approach advanced by the late Vincent Detalle, suggesting the definition of a new framework for data integration, and thus a new digital object, the Augmented Heritage Object, outstands.

His main suggestion was to align data along three main axes: historic, conservation and mediation, and thus bring together the disciplines associated with them into a unified framework, generating the augmented heritage object. Consequently, this idea frames the foundation for ESPADON, one of the French national flagship projects in Heritage Science, and influenced further developments in major EU-funded initiatives, such as the recently launched European Research Infrastructure for Heritage Science (E-RIHS – ERIC) and its DIGILAB and the European Collaborative Cloud for Cultural Heritage (ECCCH) and its main implementation project ECHOES.

The talk will detail the fundamental principles guiding the developments in DIGILAB and the core principles framing ECHOES’s digital commons and advancing its digital continuum.



Rodica-Mariana Ion is a distinguished Romanian professor and scientist specialized in nanomaterials for cultural heritage conservation. She holds the position of Full Professor at Valahia University of Târgoviște, where she serves as the Director of the Council for Doctoral Academic Studies (CSUD) and Vice-Rector. Additionally, she is affiliated with the Polytechnic University of Timișoara, lecturing on material properties relevant to architecture and urbanism, including Cultural Heritage monuments and buildings. Her research encompasses the development of nanomaterials and she leads the Research Group of Evaluation and conservation of Cultural Heritage at the National Institute for Research and Development in Chemistry and Petrochemistry (ICECHIM) in Bucharest.

Beyond academia, Professor Ion contributes to European scientific policy. Since 2015, she is member of the European Commission's Scientific Committee on Health, Environmental and Emerging Risks (SCHEER), and from 2025 is involved in **Agency Universitaire of Francophonie in Central and Eastern Europe (AUF), Bucharest, Regional Working Group on Doctoral Schools in Central and Eastern Europe (GR-D-ECO).**

Professor Ion's prolific scientific output includes over 300 ISI publications and 56 patents (national and international), notably in the fields of antimicrobial agents and conservation materials. Her work has garnered significant recognition, with over 8,000 citations and an h-index of 42, placing her among the top researchers in nanoscience and nanotechnology in Romania.

METHODS AND TECHNIQUES IN DIAGNOSTICS, CONSERVATION-RESTORATION OF CULTURAL HERITAGE

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Keywords: spectroscopy, laser ablation, diagnostics, conservation, painting (max. 5)

The conservation and understanding of cultural heritage rely on the integration of scientific research, advanced technologies, and conservation practices. This paper provides a multidisciplinary overview of recent developments in heritage science, emphasizing innovative diagnostic tools and conservation/restoration treatment methods. Analytical techniques such as X-ray diffraction (XRD), X-ray fluorescence (XRF), optical and electron microscopy (OM, SEM-EDS, TEM), FTIR and Raman spectroscopy, all these enable non-invasive, high-resolution characterization of materials, including pigments, binders, stratigraphy, and previous restoration layers, thereby supporting informed conservation strategies. Furthermore, the application of nanomaterials—such as hydroxyapatite, and carbonated hydroxyapatite—offers compatible and reversible consrervation/restoration treatments. Case studies, including the **Micia fort** - large Roman fort for auxiliary troops and an important part of the western Dacian limes (limes Dacia), used for defense of Ulpia Traiana Sarmisegetuza, **Sacidava Fortress** - Geto-Dacian settlement and Roman castrum, from the Roman era (Trajan era), known as Danube harbour, **Roman Mosaic of Constanța**, and **Trophaeum Traiani Roman fortress, Adamklissi** - founded by Trajan on the site of the old Geto-Dacian settlement, are discussed in this paper. For all these monuments, the characterization of materials, degradation status and preliminary conservation/restoration tests with nanomaterials, including 3D reconstruction of some of them, will be discussed.

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