

## Symposium Physics of Ancient Materials (SYAM)

jointly organized by

EPS-CMD Section Structural And Dynamical Properties Of Solids,  
the Thin Films Division (DS),  
the Chemical and Polymer Physics Division (CPP),  
the Crystalline Solids and their Microstructure Division (KFM),  
the Magnetism Division (MA),  
the Metal and Material Physics Division (MM), and  
the Surface Science Division (O)

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From paleontological to archaeological or art materials, ancient materials provide a fundamental window on our Past. They are essential to elucidate the origin and evolution of life forms on Earth. They are tangible testimonies of past Human activities. They are key to assess anthropic impacts on Earth climate and environment. Their chemistry has been the subject of numerous workshops and conferences but, apart in limited scientific areas (e.g. mechanics of architectural materials), only recently did the Physics of ancient materials start to be considered with greater attention. This symposium will focus on aspects where Physics can be enriched by properties observed and studied in ancient materials. Some of these materials have been thoroughly optimised in past societies, mostly in an empirical manner, to a point where they can therefore be considered as model systems for their optical behaviour (lustres, glazes, pigments, coatings, etc.), their durability (specific alloys, built heritage, etc.), their mechanical resistance... The complex and heterogeneous character at multiscale of their composition, structure and morphology, in relation with their environment through time, govern their long-term evolution and physical properties: percolation and transport, adsorption and reactivity, ageing and mechanical behaviour. New imaging approaches now provide the length scale dynamics from the nano- to the macro-scale to explore these physical properties. The specific constraints raised by ancient materials are also a source of methodological inspiration, from advanced instrumentation to the mitigation of radiation damage occurring during the study of precious samples and artefacts. This symposium will also trigger new interdisciplinary interactions that are of the highest relevance in the context of the setting up the European Research Infrastructure for Heritage Science (E-RIHS), which has entered its preparatory phase in February 2017, and of the European Year of Cultural Heritage in 2018.

## Overview of Invited Talks and Sessions

(Lecture room H 0105)

### Invited Talks

SYAM 1.1	Fri	9:30–10:00	H 0105	<b>Bringing Dino-Birds to life – Synchrotron X-ray fluorescence and Raman imaging of ancient materials</b> — ●UWE BERGMANN
SYAM 1.2	Fri	10:00–10:30	H 0105	<b>Linear and Nonlinear Optical Properties of Cultural Heritage Materials</b> — ●MARTA CASTILLEJO
SYAM 1.3	Fri	10:30–11:00	H 0105	<b>Morphology and topology of multiscale pore networks: Imaging structural alteration and hydric invasion</b> — ●PIERRE LEVITZ
SYAM 1.4	Fri	11:15–11:45	H 0105	<b>Painting cracks: a way to reveal physical properties of matter</b> — ●LUDOVIC PAUCHARD
SYAM 1.5	Fri	11:45–12:15	H 0105	<b>Finite element analysis and biomechanical interpretation of fossil material properties</b> — ●EMILY RAYFIELD

### Sessions

SYAM 1.1–1.5	Fri	9:30–12:15	H 0105	<b>Physics of Ancient Materials</b>
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## SYAM 1: Physics of Ancient Materials

Time: Friday 9:30–12:15

Location: H 0105

**Invited Talk** SYAM 1.1 Fri 9:30 H 0105  
**Bringing Dino-Birds to life – Synchrotron X-ray fluorescence and Raman imaging of ancient materials** — ●UWE BERGMANN — SLAC Stanford, CA, USA

**Invited Talk** SYAM 1.2 Fri 10:00 H 0105  
**Linear and Nonlinear Optical Properties of Cultural Heritage Materials** — ●MARTA CASTILLEJO — Instituto de Química Física Rocasolano, CSIC, Serrano 119, 28006 Madrid, Spain

The study of Cultural Heritage substrates and materials represents an interesting challenge due to their complex morphology, structure and composition. The identification of constituents, in often multilayer, multimaterial substrates, the study of the behaviour with ageing and of the response to irradiation by photon or particle beams, used for characterization or conservation purposes, are highly stimulating tasks, as multifaceted interactions among individual components induce important effects on the final encountered physical properties. This talk will focus on the linear and nonlinear optical properties of Cultural Heritage materials and components, on how these can be measured with unprecedented micrometric resolution and on how they provide information on the interactions among constituents. Changes experienced by these properties effected upon laser irradiation used for superficial cleaning or for analytical purposes will be also discussed. Examples on various types of substrates, including stone, paintings, metals and glasses will serve to illustrate the mentioned aspects.

**Invited Talk** SYAM 1.3 Fri 10:30 H 0105  
**Morphology and topology of multiscale pore networks: Imag-**

**ing structural alteration and hydric invasion** — ●PIERRE LEVITZ — Phenix laboratory, Univ. Pierre et Marie Curie, Paris, France

15 min. break

**Invited Talk** SYAM 1.4 Fri 11:15 H 0105  
**Painting cracks: a way to reveal physical properties of matter** — ●LUDOVIC PAUCHARD — FAST, Orsay, France

Craquelures in pictorial layers are the most visible aspect of the "life" of a painting. The large variety of morphologies is caused by the different mechanical behaviours of the layers such as support, ground and paint exhibiting specific physicochemical properties. In general, cracking affects the quality of a paint layer: thus, from a strictly aesthetic point of view, craquelures are undesirable. However the presence of craquelures can be of great interest in judging the authenticity of a painting, for conservation and restoration of paintings, and to characterize the stability of a network of craquelures as a function of the surroundings. Moreover, the morphology of craquelures reveal the mechanical behaviours of the pictorial layer that change due to the ageing of the painting and give information about the methods used by the artist or the conditions of conservation. These processes are highlighted using model nanoparticle gels that provide quantitative information about physical properties of pictorial matter.

**Invited Talk** SYAM 1.5 Fri 11:45 H 0105  
**Finite element analysis and biomechanical interpretation of fossil material properties** — ●EMILY RAYFIELD — Univ. Bristol, UK