Re∽member
创忆遗产 数字经济
Heritage-driven Economy
2018 / 9 / 12 - 9 /16 北京 · 清华大学 Tsinghua University, Beijing
CHCD2018 SYMPOSIUM
The 5th International Symposium on Cultural Heritage Conservation and Digitization
第五届文化遗产保护与数字化国际论坛

发言题目
New methods and materials for the Conservation of Cultural Heritage

汇报人姓名(Piero Baglioni) / 工作单位(University of Florence and CSGI, Italy – baglioni@csgi.unifi.it)

FACTS ON ART

Cultural heritage is a strategic resource for a sustainable society

If properly managed, it can:

- enhance **social inclusion and cohesion**,
- encourage **intercultural dialogue,**
- improve the quality of the immediate **living environment**,
- and stimulate **tourism**.

Effective strategies to ensure the long-term conservation of irreplaceable cultural heritage resources are therefore necessary

FACTS ON ART

The best way to realize these benefits is **to increase the access to cultural heritage.** However, **access is possible** only if the **original artefacts** are properly conserved, which is **NOT** an **EASY TASK**

An example: **MODERN and CONTEMPORARY ART ONLY**

Museums	Modern/contemporary Works of art
MOMA	150,000
Musée d'art moderne de la ville de Paris	10,000
Centre G.Pompidou -Le Beaubourg	100,000
MAV/VAL - Musée d'Art Contemporain du Val-de-Marne	2,000
Tate	ca. 1,000 on display
Museo Nacional Centro de Arte Reina Sofía	10,000
Peggy Guggenheim Collection - Venice	ca. 500
Rijks Museum of Amsterdam	30,000

Huge # of artfacts: cannot be conserved with conventional technologies
NEED FOR NEW FAST AND SAFE METHODS

A NEW SCIENTIFIC FRAMEWORK IS NECESSARY

Horizon 2020
European Union Funding
for Research & Innovation

What is conservation?

ICOM-CC resolution adopted at the 15th Triennial Conference held in New Delhi in September 2008

Conservation - all measures and actions aimed at safeguarding tangible cultural heritage while ensuring its accessibility to present and future generations.

Accessibility means the possibility to access and enjoy not only the conceptual value of the artwork (i.e. by using ICT technologies such as 3D reconstruction) **but also (more important) the ACTUAL OBJECT**

ART: natural aging, degradation

WORKS OF ART DEGRADE

Templo Mayor (Mexico City)

Beato Angelico wall paintings, Florence

Horizon 2020
European Union Funding
for Research & Innovation

Although the **conservation of cultural heritage** involves a different code of ethics, it can be **compared to medicine**, where **artefacts** are analogous to **patients** and **conservators** are similar to **doctors**.

Diagnosis, treatment and prevention are relevant to the conservation of artefacts: **SCIENCE** is contributing to such activities.

Horizon 2020
European Union Funding
for Research & Innovation

What's being done? A comparison with medicine..

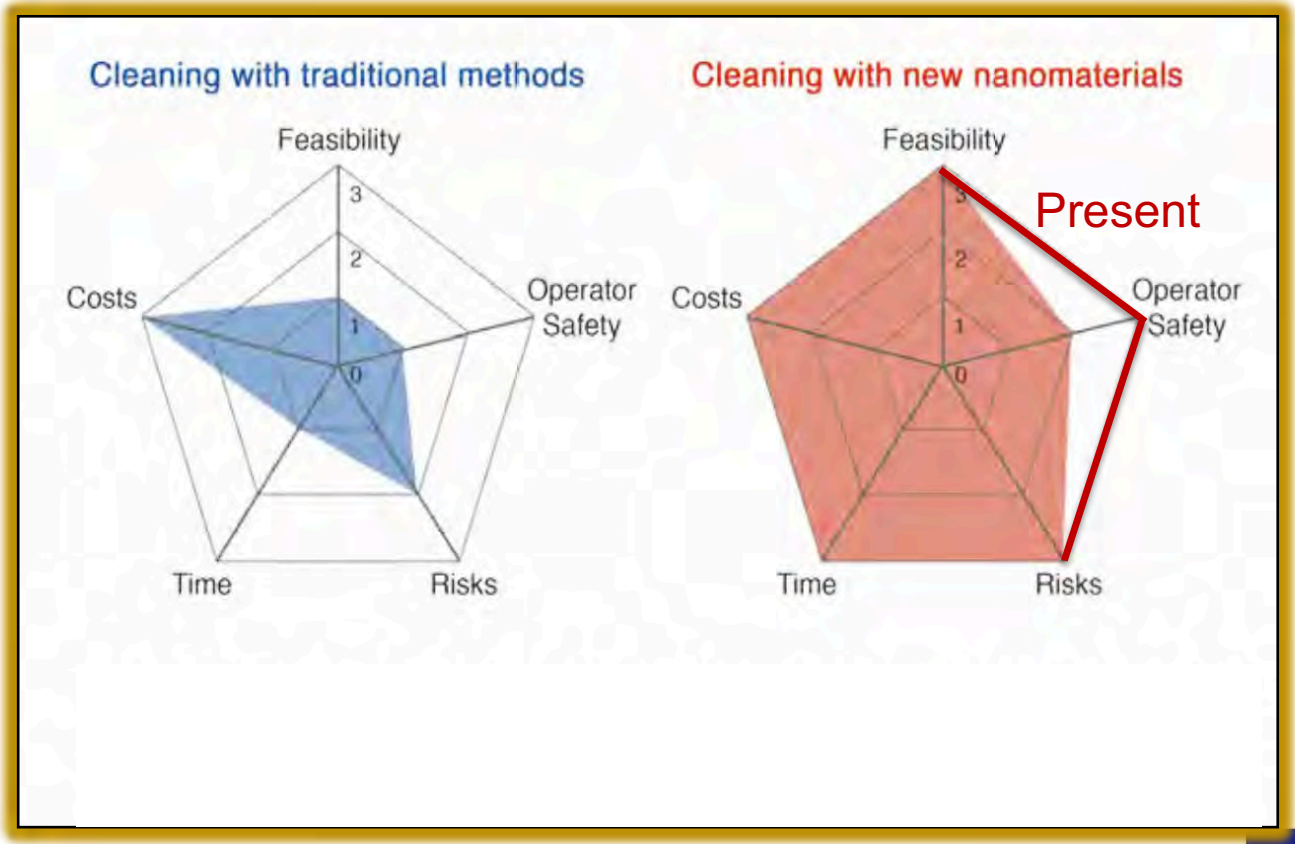
- ✓ Diagnosis ⟹ **diagnostics**
- ✓ Prevention ⟹ **preventive conservation** and
- ✓ Treatment ⟹ **remedial conservation**

The main tools are already available to transfer to future generation our patrimony

The treatment is **(therapy)** the final action, and the drugs used for therapies are **new smart materials and methods** coming from **groundbreaking technologies**

New groundbreaking materials and methods

so far more than 50 new materials, 36 from CSGI based on nanoscience for the conservation of our HERITAGE are now available


Cleaning with traditional methods
Feasibility
3
2
1
0
Operator Safety
Risks
Time
Costs
Cleaning with new nanomaterials
Feasibility
Present
3
2
1
0
Operator Safety
Risks
Time
Costs

New materials and methods for Cultural Heritage

1) NANOPARTICLES, from 1991-
   - ✓ calcium hydroxide nanoparticles (magnesium, strontium barium, and zinc)

2) DETERGENCY (MICELLES AND MICROEMULSIONS), from 1986-

3) SOFT CONTAINERS, from 1999-
   - ✓ physical and chemical gels

4) CONFINED AND RESPONSIVE SYSTEMS, from 2002-
   - ✓ hybrid systems: nanoparticles/gels; microemulsions/gels)

Horizon 2020
European Union Funding
for Research & Innovation

nature sciencenow

NEWS

Nanotechnology restores flaking frescos.

An off-the-wall application of tiny particles re-unites paint and plaster.

13 July 2001

PHILIP BALL

Had Leonardo da Vinci known about nanotechnology, his Last Supper might not be in its present sorry state. Italian chemists have shown that particles of slaked lime – a staple of the Renaissance palette – just a few millionths of a millimetre across can rescue old frescoes from decay.

Leonardo's painting is one of the worst affected by the ravages of time. The damage was largely the result of ill-informed experimentation with materials – Leonardo was no chemist. Similar fresco deterioration is a common problem for conservators.

Piero Baglioni and colleagues from the University of Florence have salvaged a lesser-known work: Gli Angeli Musicanti painted in the sixteenth century by Sandro di Tito in the Santa Maria del Fiore Cathedral in Florence. This image is disfigured where flakes of paint-impregnated plaster, having lifted off the wall below, are threatening to fall off, damaging the painting irreparably.

A beautiful bottom – thanks to the restorative effects of nanotechnology.

Before Italian painters began to use canvas in the fifteenth century, many made frescoes. They applied pigment directly to damp plaster on a wall, so that it bound fast as the plaster dried. Giotto and Michelangelo were masters of this technique.

Done skilfully, the results were robust. Unfortunately half a millennium later, flaking of the top layer has become a common problem, especially in damp areas.

Plaster was typically made from sand and lime (calcium

Plaster was typically made from sand and lime (calcium oxide), which becomes slaked lime (calcium hydroxide) when wet. As it dries, slaked lime reacts with the carbon dioxide in air to make chalky calcium carbonate.

Baglioni and his colleagues use humble slaked lime as a kind of glue to re-adhere flaking paint. They apply it as a suspension of tiny calcium hydroxide crystals in alcohol. As the alcohol evaporates, the crystals absorb water and carbon dioxide, and merge with the calcium carbonate in the paint layer and the underlying plaster, sending them together with an almost invisible bond[1].

Ordinary ground-up calcium hydroxide doesn't work too well. More than a thousandth of a millimetre across, commercial powder particles are too big to penetrate deeply into all the cracks of the paint layer. Worse still, they tend to settle out from the solvent, producing an indelible white film on the paint surface.

The Italian chemists' particles are smaller: they are hexagonal plates about 100–250 nanometres (millionths of a millimetre) across. These penetrate a fresco more thoroughly, and, being light, do not settle out. The particles' flat shape makes them very water-absorbent, aiding their transformation to calcium carbonate as the alcohol evaporates.

Creating such small crystals is one of the objectives of nanotechnology, the manipulation of matter at the nanometre level. Nanotechnology, usually portrayed as the futuristic pursuit of molecular-scale machines, has something to offer the past too, it seems.

References

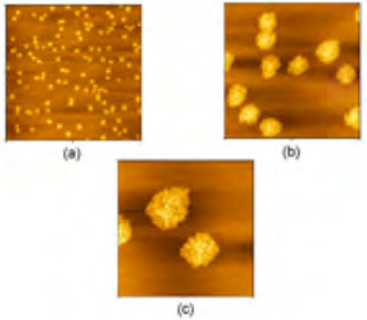
1. Ambrosi, M., Dei, L., Giorgi, R., Neto, C. & Baglioni, P. Colloidal particles of $Ca(OH)_2$: properties and applications to restoration of frescoes. *Langmuir*, **17**, 4251–4255 (2001).

Synthetic strategies:

Microparticles 1989-1992

Nanoparticles

Top-down 1995
Bottom-up 1997
Confined systems 1997
Alkoxides 1998
Sol-gel 2001
Direct reaction 2012-2017 (particles from 2nm – up)

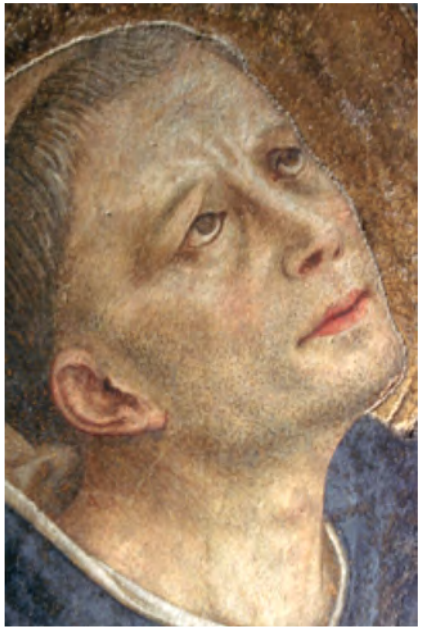


Atomic force microscopy AFM

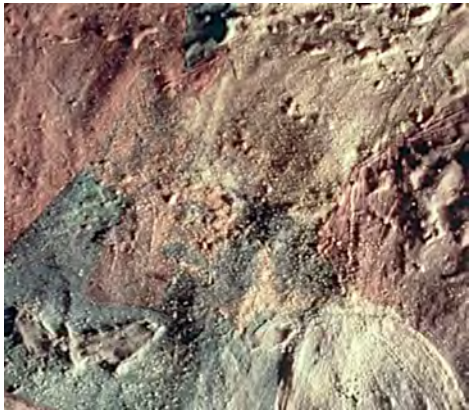
22 different systems

$Ca(OH)_2$, $Ba(OH)_2$, $Mg(OH)_2$ in 2-propanol, and/or ethanol and cyclohexane dispersion

Horizon 2020
European Union Funding
for Research & Innovation

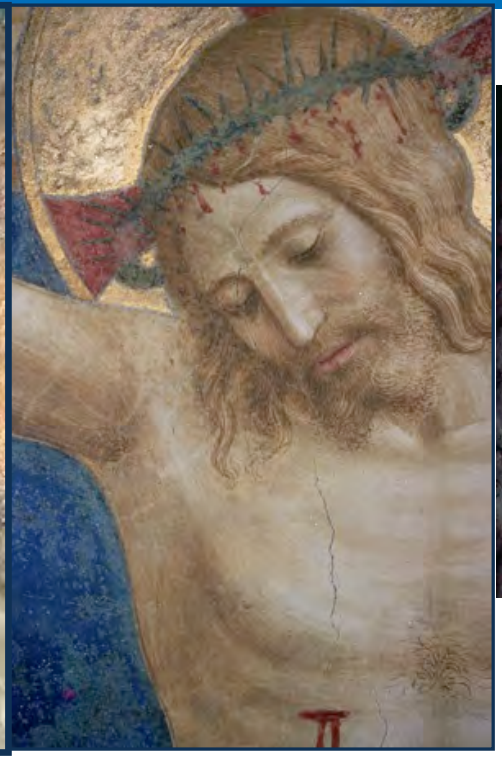


BEATO ANGELICO
WALL PAINTINGS, FLORENCE



PIERO DELLA FRANCESCA
(AREZZO (1987 – 1991)

Horizon 2020
European Union Funding
for Research & Innovation



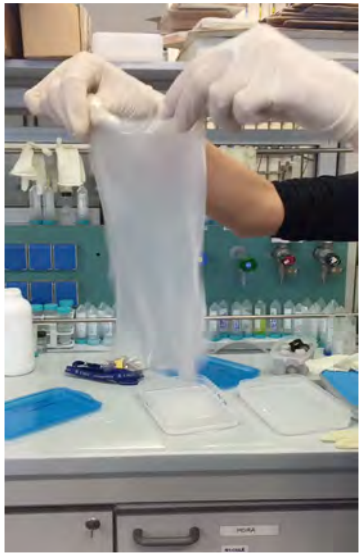
FERRONI & DINI 1967, BAGLIONI 1979

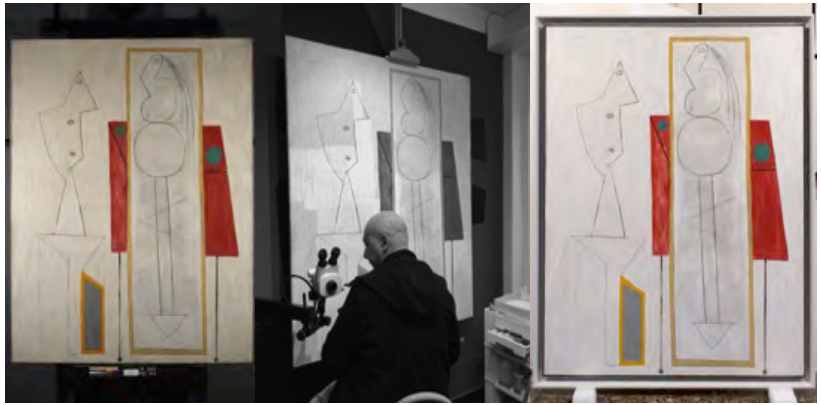
Wall paintings by Beato Angelico - Italian Renaissance

Horizon 2020
European Union Funding
for Research & Innovation

ADVANCED CHEMICAL HYDROGEL FOR WATER SENSITIVE CLEANING 2016-18

THE PEGGY (GUGGENHEIM) FAMILY GELS and TATE FAMILY GELS



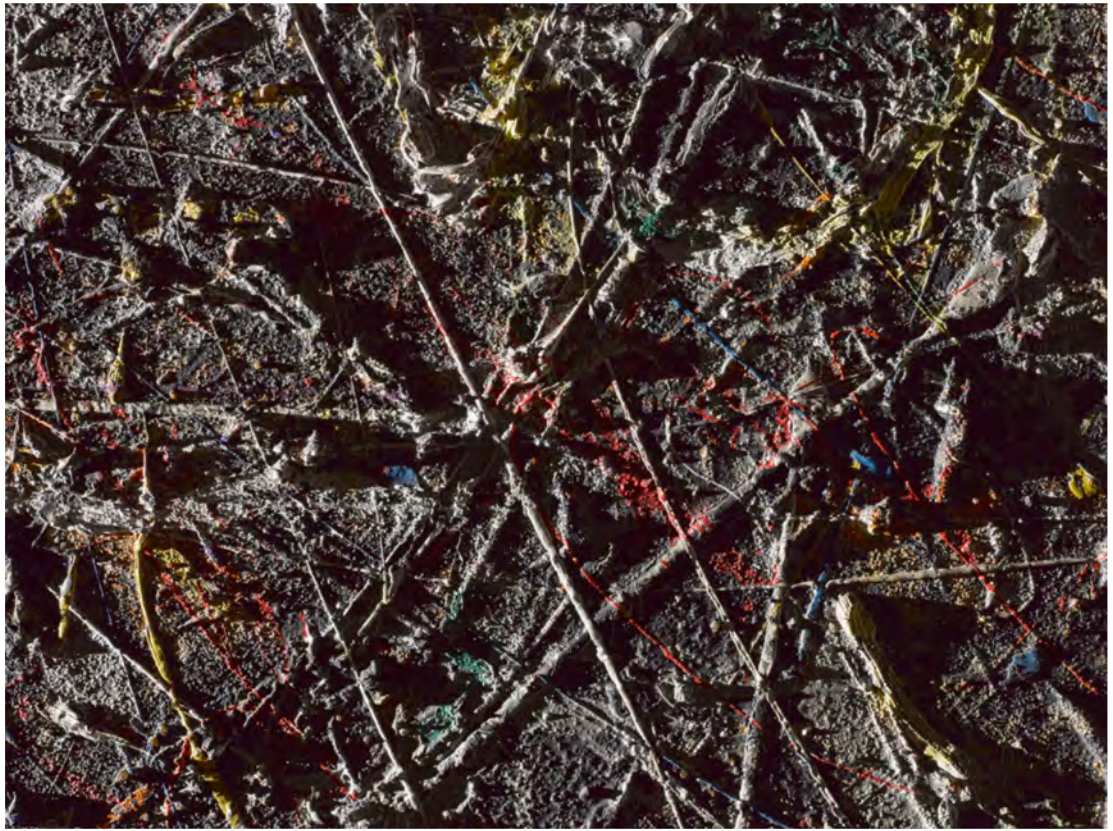


PABLO PICASSO

JACKSON POLLOCK

baglioni@csgi.unifi.it GIORGIO DECHIRICO

Horizon 2020
European Union Funding
for Research & Innovation



Horizon 2020
European Union Funding
for Research & Innovation

JACKSON POLLOCK

ALCHEMY
Partly Cleaned

Pollock paintings are water sensitive and were cleaned with water

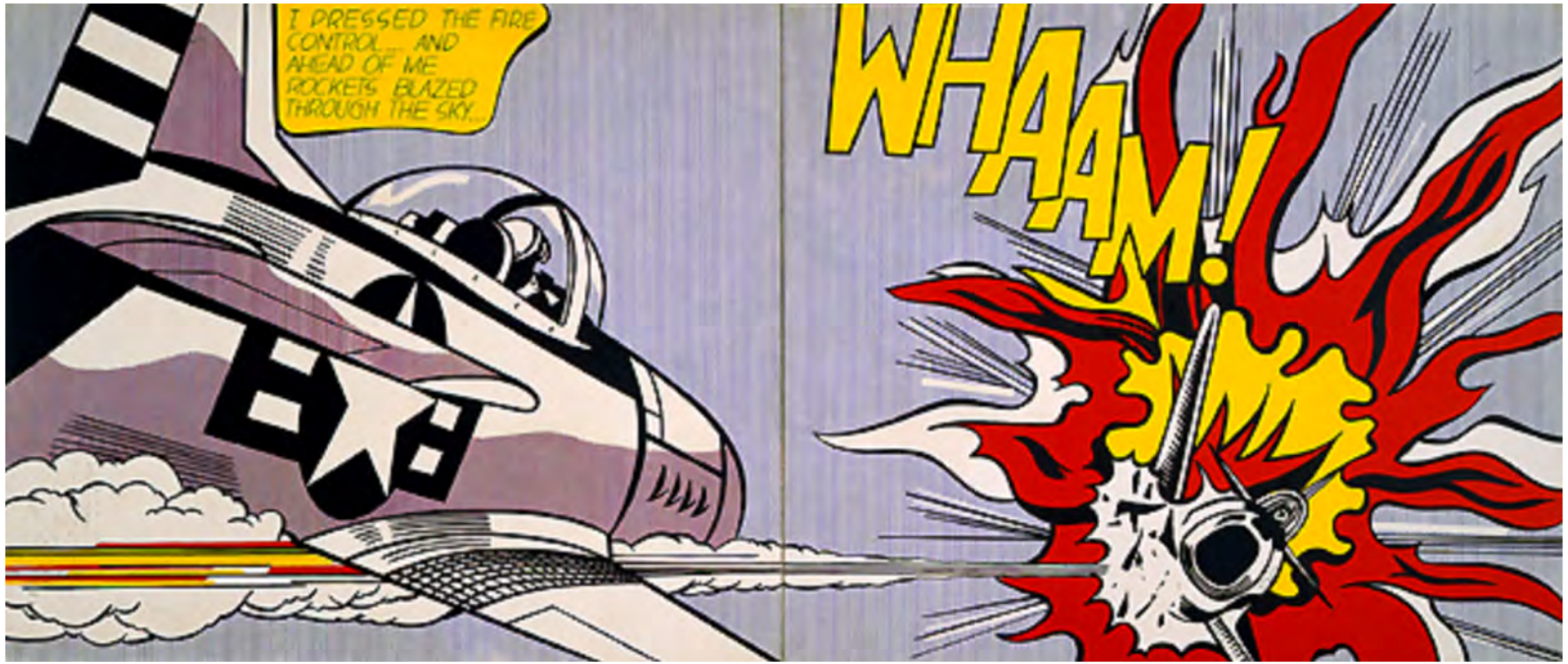
Cleaning with chemical gel: J. Pollock

Horizon 2020
European Union Funding
for Research & Innovation

PICASSO ATELIER

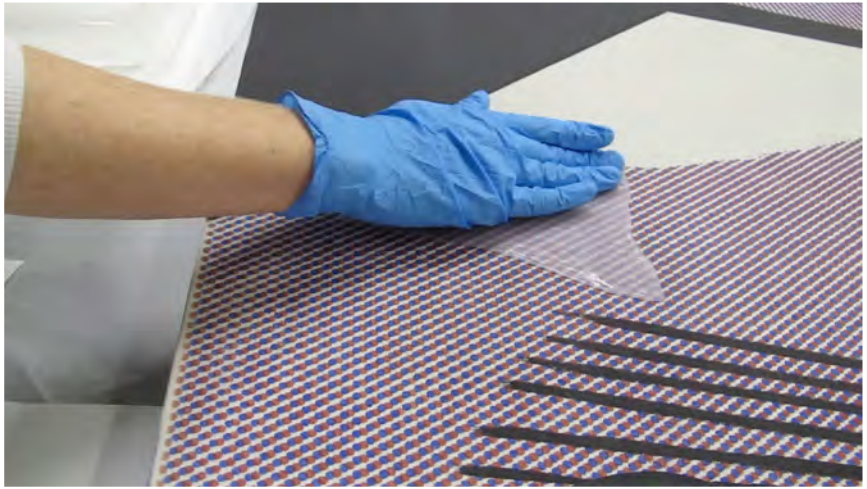
Horizon 2020
European Union Funding
for Research & Innovation

WHAAM – Roy Lichtenstein

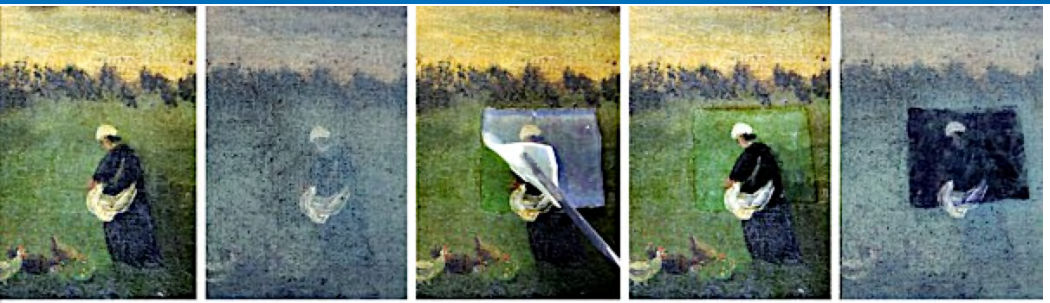


Horizon 2020
European Union Funding
for Research & Innovation

Roy Lichtenstein



Horizon 2020
European Union Funding
for Research & Innovation



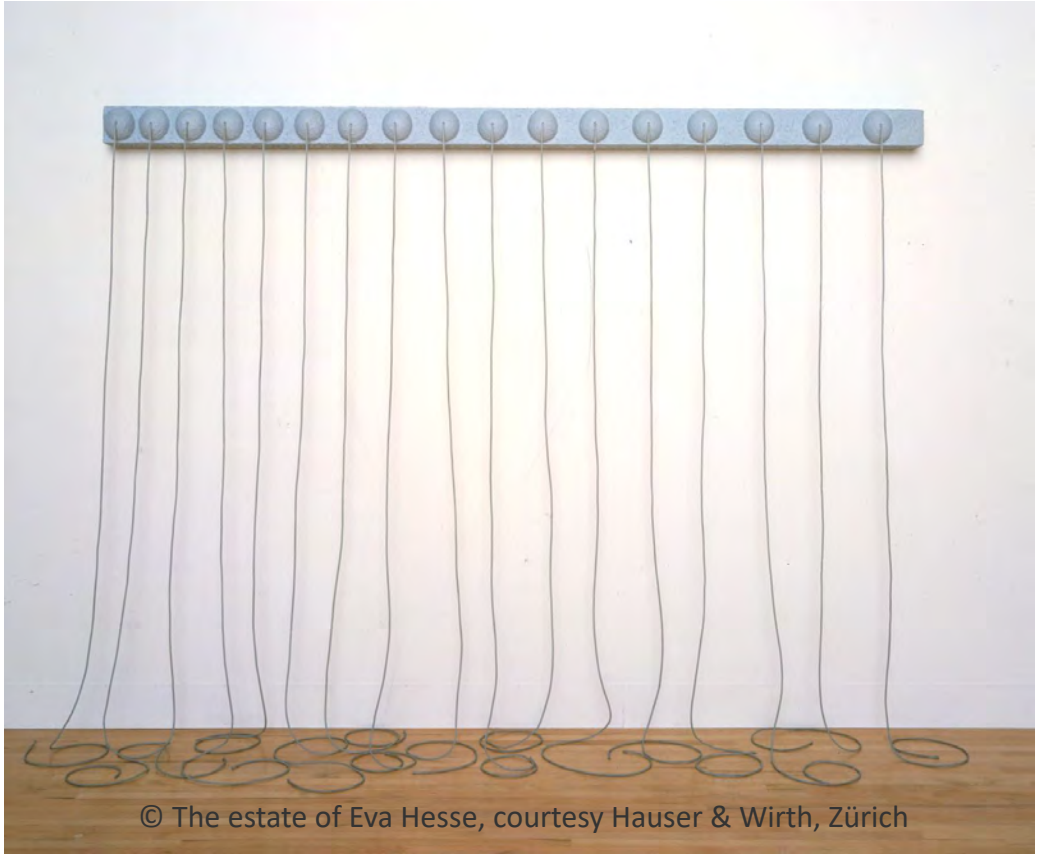
Piero Baglioni, Emiliano Carretti,
David Chelazzi

Nature Nanotechnology 10, 287-291
(2015)

Horizon 2020
European Union Funding
for Research & Innovation

Nicole Bonelli, Costanza Montis, Antonio Mirabile, Debora Berti, and Piero Baglioni
PNAS May 21, 2018. 201801962

NanoRestART



Eva Hesse (1967)

Horizon 2020
European Union Funding
for Research & Innovation

MEMBERS

Current Members

Nanomaterials for the Restoration of Works of Art
www.nanorestart.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646063.

Nano-Cathedral
Innovation for Europe Cultural Heritage Protection and Conservation
www.nanocathedral.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646178

ECHOES is a community driven bottom-up action to connect all conservation science activities and stakeholders in Europe.

BECOME A MEMBER!

Cluster Chair

CSGI

Piero Baglioni
Via della Lastruccia 3, Sesto Fiorentino (FI)
baglioni@csgi.unifi.it

Technical Secretary

Isella Vicini
Via Bazzanese 32/7
Casalecchio di Reno (Bo)
051-9840863
isella.vicini@warrantgroup.it

Patrizia Zitelli
Via della Lastruccia 3
Sesto Fiorentino (FI)
055-4573244
patrizia@csgi.unifi.it

EC Contact

René Martins
European Commission
DG Research & Innovation
Advanced Materials & Nanotechnologies
rene.martins@ec.europa.eu

ECHOES
Enabling Cultural Heritage Oriented European Strategies

www.echc.eu
echoes.cluster@csgi.unifi.it

Horizon 2020
European Union Funding
for Research & Innovation

ECHOES

Enabling Cultural Heritage European Strategy

CSGI Warrant GRUPPO TECNOINVESTIMENTI

2018 EUROPEAN YEAR OF CULTURAL HERITAGE #EuropeForCulture

ENROLL: echoes.cluster@csgi.unifi.it

PIERO BAGLIONI - CSGI
COORDINATOR

ISELLA VICINI
Warrant Group

PATRIZIA ZITELLI
CSGI

European Commission

René Martins
DG Research and Innovation
rene.martins@ec.europa.eu

http://www.echc.eu

ECHOES

THANK YOU

baglioni@csgi.unifi.it

Horizon 2020
European Union Funding
for Research & Innovation