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composite materials



Science and  
Technology  
Facilities Council

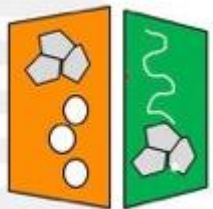
ISIS



# Physics for Cultural Heritage

Giulia Festa

*CREF - Museo Storico della Fisica e  
Centro Studi e Ricerche «Enrico Fermi»*



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# Physics for Cultural Heritage



Food residues can help  
dating of ancient pottery?



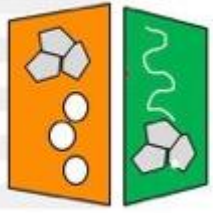
What is the earliest  
Evidence of a trading  
gold mine?



These are some of the  
questions that can be  
answered by following a  
scientific approach  
through archaeometric surveys.



**NANOINNOVATION 2020 – 16<sup>th</sup> September 2020**



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# Physics for Cultural Heritage

Why

How

What

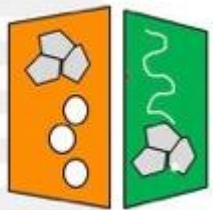
To solve archaeological/conservation problems

“Archaeometry: the use of science and modern technology in archaeology to examine and interpret archaeological remains” -  
Collins Dictionary

Application of scientific methods and  
technology to archaeological and conservation  
studies

Innovative and integrated data analysis  
approaches have proven to increase the  
effectiveness of multidisciplinary study  
campaigns





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# Physics for Cultural Heritage

**IDENTIFY THE  
GOAL  
OF THE STUDY**



**INTEGRATED APPROACH:**  
Combination of  
chemical-physical techniques

Plug under  
the linen  
stripes?

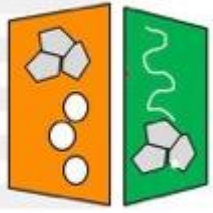
Content?

Seal?

Full or empty?

NON-DESTRUCTIVE AND  
NON-INVASIVE methods

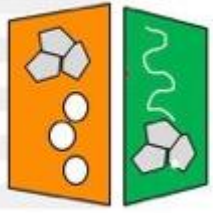




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# Physics for Cultural Heritage





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# Successful studies



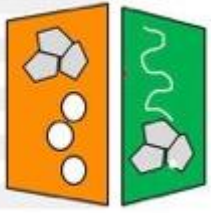
Egyptian grave goods of Kha and Merit  
studied by neutron and gamma techniques



# Egyptian grave goods of Kha and Merit

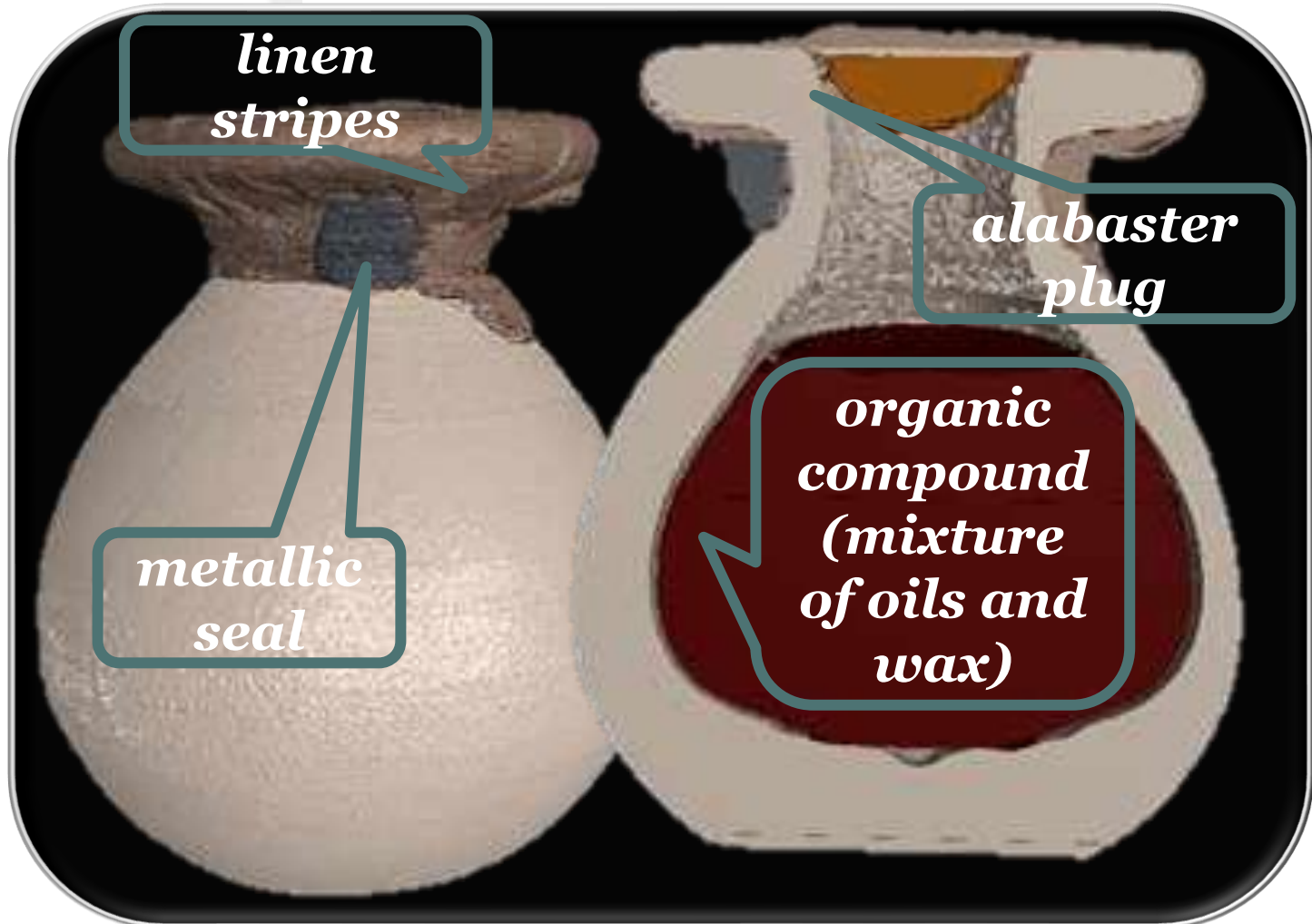
The investigated collection was property of the ancient architect Kha and his wife Merit: it represents the richest and most complete non-royal burial assemblage (1425-1353 BC) housed in a museum outside of Egypt (Turin – Italy)



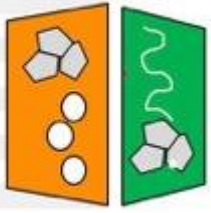


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# Sealed alabaster vases



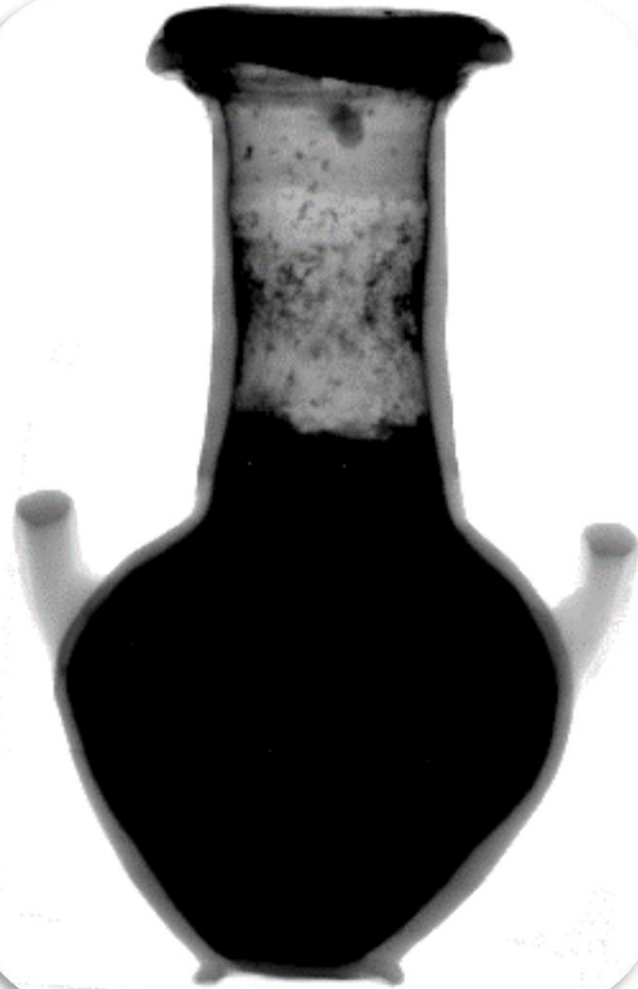


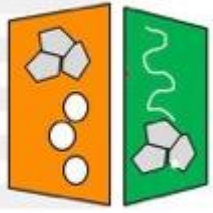


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# Sealed ceramic vases

S.8619



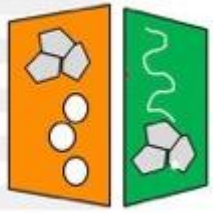


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# Successful studies



Burned bones tell us about  
ancient civilisations



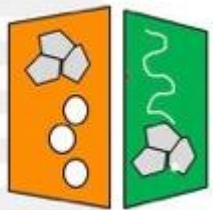
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# Burned bones tell us about ancient civilisations

An innovative approach to the study of archaeological burned human bones provide archaeologists and anthropologists with unique information on past civilizations (funerary, burial and cooking practices and environmental settings)







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# Successful Access to ISIS@MACH

## RESEARCH TEAM:

**Professor Mauro Rubini** (Director of Anthropological Service S.A.B.A.P.-LAZ., Ministero per i Beni e le Attività Culturali Foggia University)

**Dr Paola Zaio, Dr. Nunzia Libianchi, Dr. Alessandro Gozzi** (Anthropological Service S.A.B.A.P.-LAZ)

**Dr Giulia Festa** (CREF - Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi)

**TITLE:** “Characterization of Ancient Roman’s Aebutia Quarta remains using FTIR, SEM/EDX, XRF and RAMAN spectroscopy”

**Accepted by the review panel**

ISIS@MACH Experimental Proposal

Co-Investigator: Professor Mauro Rubini (Director of Anthropological Service S.A.B.A.P.-LAZ., Ministero per i Beni e le Attività Culturali Foggia University)

Co-Investigator: Dr. Paola Zaio (Anthropological Service S.A.B.A.P.-LAZ)

Co-Investigator: Dr. Nunzia Libianchi (Anthropological Service S.A.B.A.P.-LAZ)

Co-Investigator: Dr. Alessandro Gozzi (Anthropological Service S.A.B.A.P.-LAZ)

Co-Investigator: Dr. Giulia Festa (CREF - Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi)

Experimental Title: Characterization of Ancient Roman's Aebutia Quarta remains using FTIR, SEM/EDX, XRF and RAMAN spectroscopy

Instrument: RAMAN, SEM/EDX, FTIR, XRF

Access Route: Rapid Access - ISIS@MACH

Science Areas: Materials, archaeometry, anthropology.

Sponsored Grant: NO

Grant Number:

Grant Title:

EU Access?: NO

Industrial Links: YES

Company Name: Anthropological Service S.A.B.A.P.-LAZ.

Non-Technical Summary: The chamber hosted two sarcophagi remains, identified as Aebutia Quarta, remains using FTIR, SEM/EDX, XRF and RAMAN spectroscopy. The chamber hosted two sarcophagi remains, identified as Aebutia Quarta, remains using FTIR, SEM/EDX, XRF and RAMAN spectroscopy. The chamber hosted two sarcophagi remains, identified as Aebutia Quarta, remains using FTIR, SEM/EDX, XRF and RAMAN spectroscopy.

Start Date: - Finish Date: -

Similar Submission? NO

Sponsor: NO

Days Requested: 2

Previous RB number: -

ISIS pulsed neutron and muon source

Instrument: TOSCA

Access Route: Rapid Access ISIS@MACH

Science Areas: Materials, archaeometry, anthropology

Sponsored Grant: NO

Grant Title:

Grant Number:

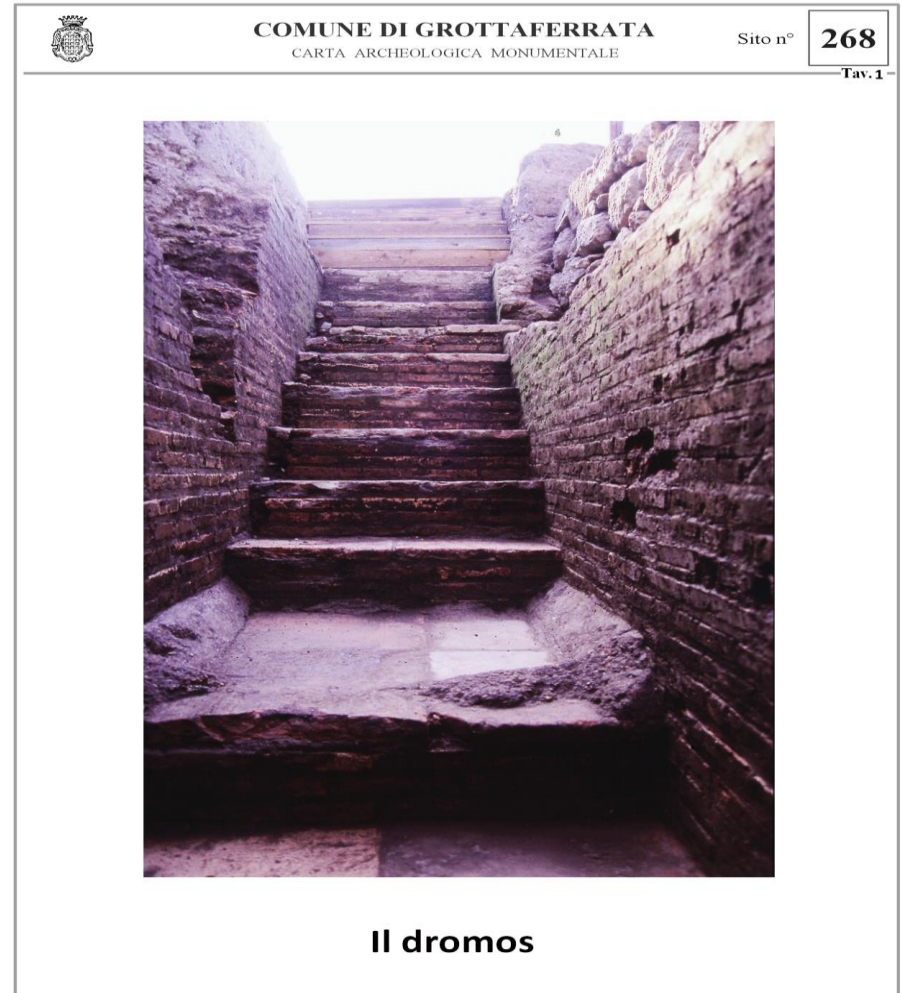
EU Access?: NO

Industrial Links: YES

Company Name: Anthropological Service S.A.B.A.P.-LAZ.

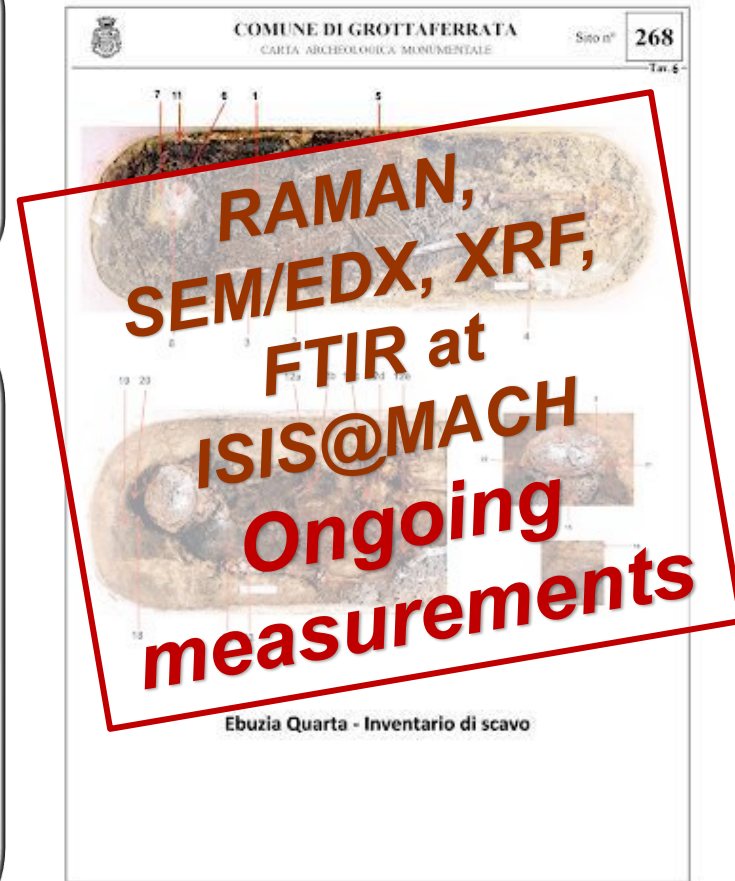
# Successful Access to ISIS@MACH

- “**Hypogeum of the Garlands**” is a extraordinary ancient Roman sepulchral site discovered in the spring of 2000 at Grottaferrata (Rome) and **dated back of I-II century AD.**
- The chamber hosted **two sarcophagi** (Aebutia Quarta and Carvilius Gemellus) **decorated by vegetal garlands** that have been preserved intact.

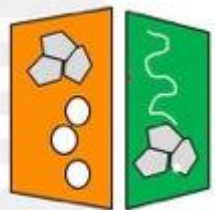


# Successful Access to ISIS@MACH

- **Problem to solve:** The Aebutia Quarta remains show traces of possible combustion of the bones. Is it “combusted or not”?
- Characterisation of the bone samples to be carried out using RAMAN, SEM/EDX, XRF and FTIR at **ISIS@MACH** + Inelastic Neutron Scattering investigation using **TOSCA beamline at ISIS pulsed muon and neutron source**, through the **ISIS@MACH neutron gate**.







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# ISIS@MACH Neutron Gate

## RESEARCH TEAM:

**Prof M Rubini, Dr A Gozzi, Dr N Libianchi, Dr P Zaio** (Anthropological Service S.A.B.A.P.-LAZ, MIBACT, ITALY)

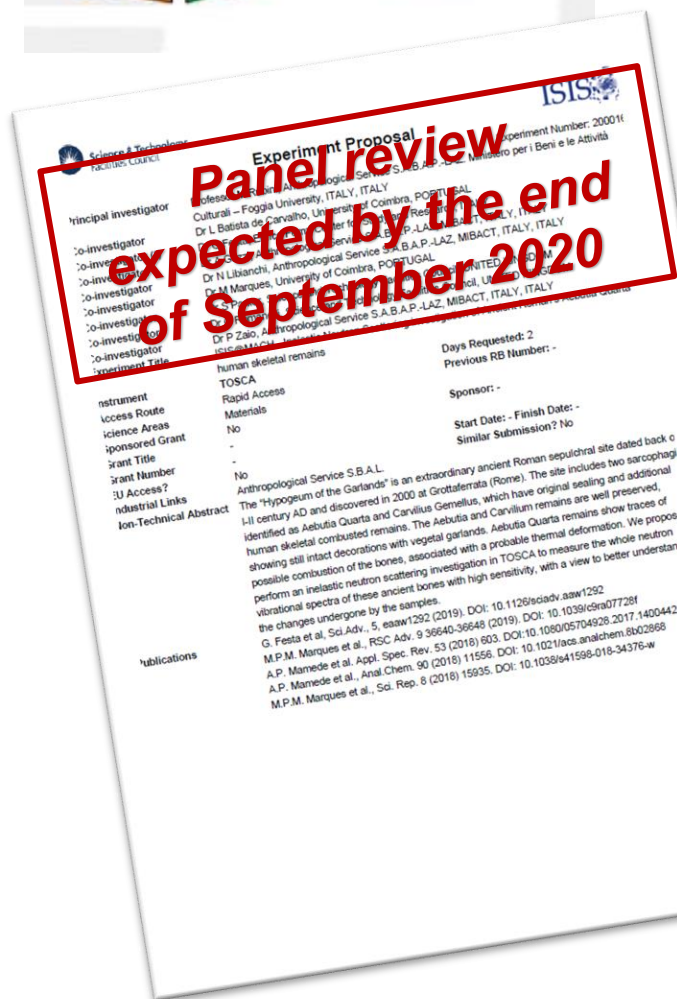
**Dr M Marques, Dr L Batista de Carvalho** (University of Coimbra, PORTUGAL)

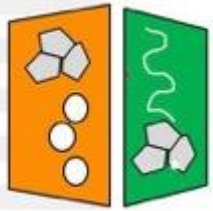
**Dr G Festa** (CREF - Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi), ITALY

**Dr S Parker, Dr G Romanelli**, (Science and Technology Facilities Council, UNITED KINGDOM)

**TITLE: “ISIS@MACH - Inelastic Neutron Scattering investigation of Ancient Roman’s Aebutia Quarta human skeletal remains”**

**NANOINNOVATION 2020 – 16<sup>th</sup> September 2020**





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Thank you for your attention

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