

New trends and applications of ionizing radiation for preservation of cultural heritage tangible materials

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2nd International Conference on
Applications of Radiation
Science and Technology

#ICARST2022

22 – 26 August 2022

IAEA Headquarters
Vienna, Austria

Nuclear and Energy Research Institute -IPEN

Ministry of Science and Technology

National Nuclear Energy Commission



Nuclear and Energy Research Institute



Brazilian weather conditions + tangible materials



Natural disasters

Insects



Fungi attack

Nuclear Techniques to Support Conservation and Preservation of Cultural Heritage (CH)

Studies for CH restoration, provenance, authentication using NNA, XRF, PIXE , PIGE, microscopic, photographic techniques, Characterization

Ionizing Radiation for preservation and conservation of CH:
disinfection, consolidation & new materials
Radiation Processing: gamma, EB, X-rays

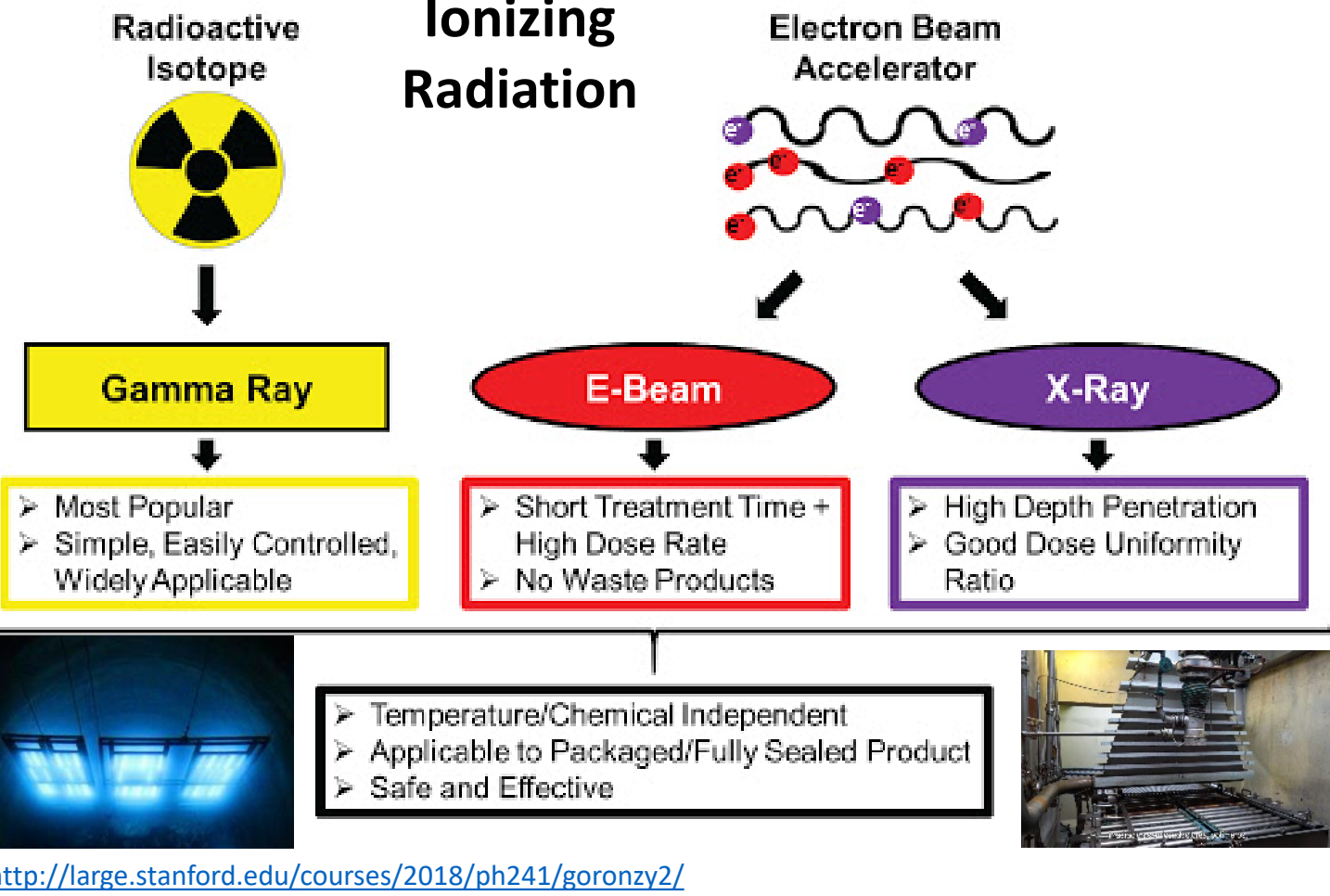
Dating for archaeology and art (AMS C14,TL)

-Organic origin artefacts: wood, paper, leather, textile, canvas, etc.
-Mass contamination, war.
-Emergency intervention, large structures or assemblies.

Conservation is defined by ICOM-CC as:
all measures and actions ... safeguarding tangible cultural heritage ...accessibility to present and future generations.
Preventive conservation, remedial conservation and restoration.
All measures and actions ... respect the significance and the physical properties of the cultural heritage item.

Radiation Processing or Irradiation

Ionizing Radiation



- a) Physical effects
- b) **Chemical effects**
- c) **Biological effects**

Biocidal action
 *Eliminates/inhibits/sterilizes...
 insects and Microorganisms
 such as bacteria and fungi

Polymerization
Cross-linking
Grafting

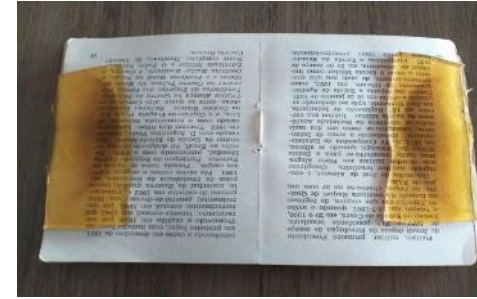
***Virus Inactivation**

The block contains several illustrations: a red arrow labeled with the Greek letter gamma (γ) pointing to the biocidal action text; a blue arrow pointing to the polymerization text; four 'no' symbols over cartoon germs representing biocidal action; a 3D model of a virus representing virus inactivation; and a molecular diagram showing the process of polymerization.

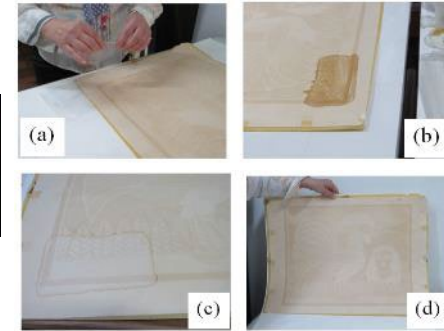
<http://large.stanford.edu/courses/2018/ph241/goronzy2/>

Ionizing Radiation to Support Conservation and Preservation of Tangible Cultural Heritage (CH) at IPEN/Brazil

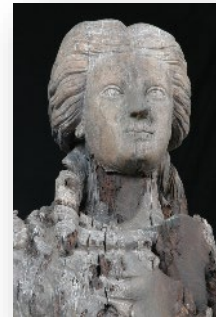
1. Disinfection by ionizing radiation
gamma / Electron Beam-EB / X-rays
characterization, R&D on several tangible materials,
Side-effects studies / limitations



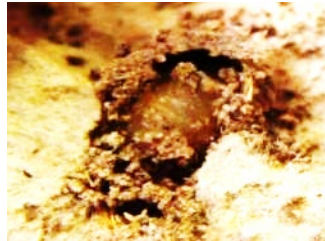
2. Consolidation by ionizing radiation
Impregnation of Porous Material with resins
– polymerization – cross linking – radio curing



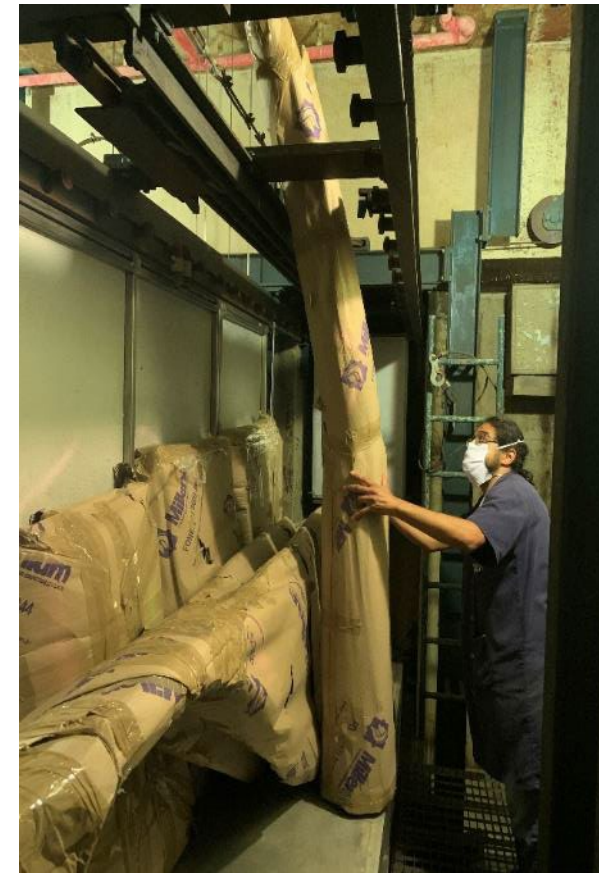
3. Developing of new nanostructured materials for cleaning surfaces of CH by ionizing radiation
R&D, natural polymers, blends



Since 2004, more than 50,000 cultural artifacts preserved by this technology



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Since 2004, more than 50,000 cultural artifacts preserved by this technology



Before irradiation

Before irradiation+ cleaning



Several paintings disinfected by gamma radiation at IPEN.
Remarkable Modern Brazilian Paintings:
Tarsila do Amaral
Anita Malfatti
Di Cavalcanti
Clóvis Graciano
Candido Portinari
Alfredo Volpi
Tomie Ohtake



Since 2004, more than 50,000 cultural artifacts preserved by this technology



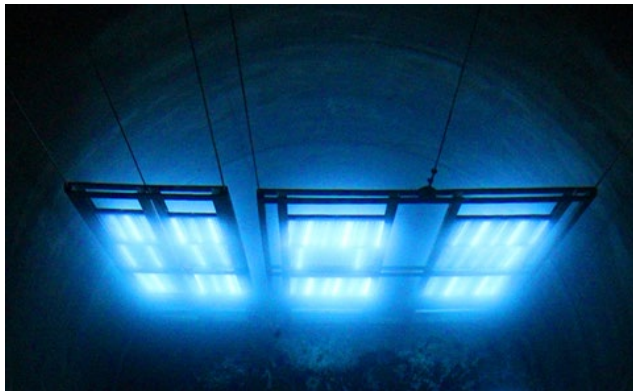
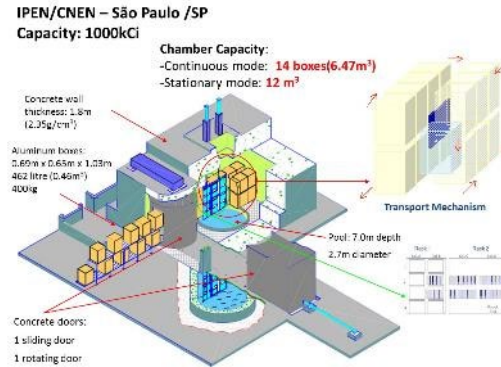
Since 2004, more than 50,000 cultural artifacts preserved by this technology



Radiation Technologies at IPEN

Gamma Irradiation

Cobalt-60



Multipurpose Gamma Irradiation Facility



Brazilian technology - 2004 :
1000kCi
Category IV (IAEA -SSG-8)

EB Accelerators



JOB 188 – 1,5 MeV 37.5kW
Radiation Dynamics, Inc. (RDI)
R&D



JOB 307 - 97.5 kW, 1.5MeV
Continuous treatment system
(300 m/min)
Commercial applications



-Mobil Unit



0.7MeV-20kW

How to make an African Art Collection Accessible?

1 - Art Donor

Ivani & Jorge Yunes Private
Collection - CIJY's

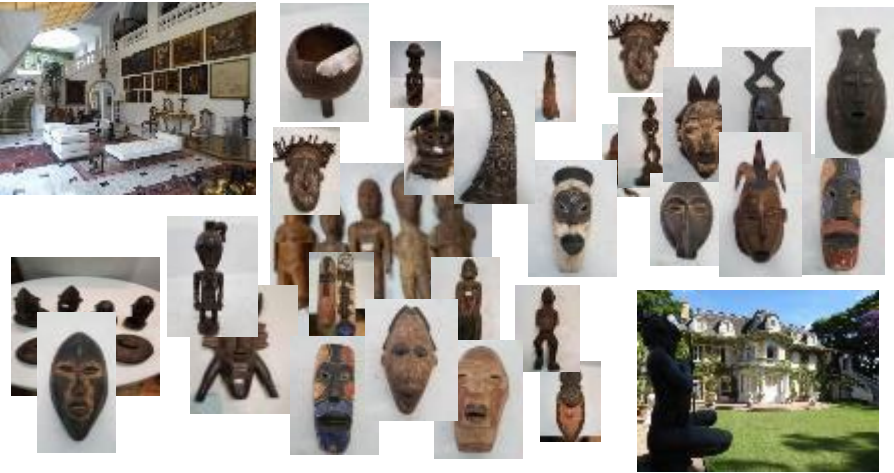


1500 African artworks:

Democratic Republic of Congo, Angola,
Cameroon, Côte d'Ivoire, Nigeria, Mali and
Ghana.

Masks, sculptures in wood and bronze, jewelry,
furniture and musical instruments.

Xylophagous insects contamination



2 – Pre-treatment Procedures :

- packaging & labeling
- specialized transportation
- registration

Basic Guidelines - IPEN support.



3



<https://www.museoscarniemeyer.org.br/exposicoes/exposicoes/africa>

https://www.ipen.br/portal_por/portal/interna.php?secao_id=38&campo=14995

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How to make an African Art Collection Accessible?

2

3 – Reception and storage of materials to be decontaminated at IPEN

4 – Disinfection using ionizing radiation at the Multipurpose Gamma Irradiation Facility
-report & documentation

5



<https://www.museuscarniemeyer.org.br/exposicoes/exposicoes/africa>
https://www.ipen.br/portal_por/portal/interna.php?secao_id=38&campo=14995

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How to make an African Art Collection Accessible?

4

5 – Procedures after irradiation
Cleaning & Restoration
Oscar Niemeyer Museum

6 – Art Exhibition

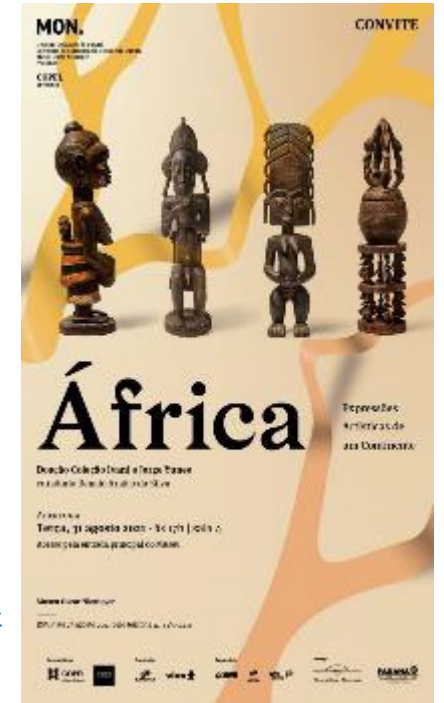
Oscar Niemeyer Museum
Africa - Artistic Expressions of a Continent



On-line Exhibition:



https://artsandculture.google.com/exhibit/%C3%81frica-m%C3%A3e-de-todos-n%C3%B3s/IgICgD_GxFzxlw



<https://www.museuoscarniemeyer.org.br/exposicoes/exposicoes/africa>

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Art Exhibition



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Art Exhibition



IAEA Related Projects & Collaborations

- **IAEA-RLA 0058** Using Nuclear Techniques to Support Conservation and Preservation of Cultural Heritage Objects
- **IAEA-RER 1021** To contribute to improving human health, keeping a cleaner environment, and developing advanced materials through the extended and qualified use of radiation technologies
- **IAEA- CRP F23032** Developing Radiation Treatment Methodologies and New Resin Formulations for Consolidation And Preservation of Archived Materials and Cultural Heritage Artefacts
- **IAEA RLA 1019** Strengthening Capabilities for the Utilization of Nuclear and Radiation Technology to Characterize, Conserve and Preserve the Cultural Heritage

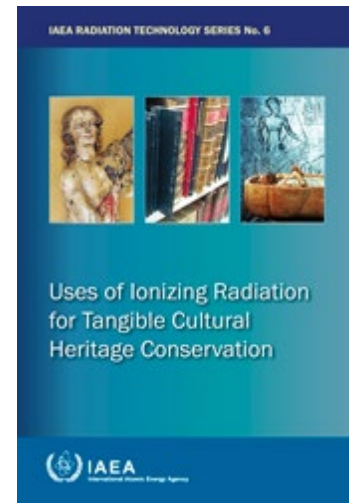
Uses of Ionizing Radiation for Tangible Cultural Heritage Conservation

IAEA Radiation Technology Series No. 6

Subject Classification: 0300-Nuclear Measurements, Techniques and Instrumentation

STI/PUB/1747; (ISBN:978-92-0-103316-1); 241 pp.; 92 figures; € 50.00; Date Published: 2017

<https://www-pub.iaea.org/books/iaeabooks/10937/uses-of-ionizing-radiation-for-tangible-cultural-heritage-conservation>



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IPEN actions for the Conservation and Preservation of Cultural Heritage in Brazil

End Users
National Museums &
Conservation Institutes, etc.

IPEN
Support & Provider
-Radiation Technology
-Characterization - R&D
-Basic Guidelines to
decontamination of CH by
ionizing radiation

-Extensive dissemination and training workshops aimed to restorers and conservators
-Promotional material: videos, newspapers, TV and internet:
-Research & Scientific Publications



Radiation Technology: the industrial revolution behind the scenes



1st INTERNATIONAL SYMPOSIUM
Gamma Ionization: technology for preservation of cultural heritage

October 25, 2019
São Paulo, Brazil

Abstract Book

Radiation Technology Center, IPEN
Avenida Lineu Prestes, 2242
Cidade Universitária
São Paulo - SP, Brazil

Realization:   

Support:  



**MUSEU
PAULISTA
— USP**

Cooperation with National Museums & National Conservation Institutes

-Institute o Brazilians Studies - IEB/USP

-Afro Brazil Museum

-Lina Bo & P.M. Bardi Institute

-Modern Art Museum - MAM

-Mario de Andrade Public Library

-Pinacoteca of the Sao Paulo State

-Sao Paulo Cultural Center – CCSP

-Public Archive of the Sao Paulo State (APESP)

-Government State *Bandeirantes* Palace Museum

-Butantan Institute Historic Museum

-Historic Museum of the Medical School of the Sao Paulo University

-Immigration Museum of the Sao Paulo State

-Contemporary Art Museum of the Sao Paulo University – MAC

-Santo Andre Museum

-Libraries of the Sao Paulo University: Laws School, Communications and Arts School, Chemistry School, etc.

-Integrated Library System SIBi-USP

-National Center for Industrial Learning – SENAI

-City Co. - planning and development -

-MRIZZO Restorations

-Margot Crescenti – Research and Restorations

-Visual Arts Museum – MAV of the University of Campinas – UNICAMP

-Moreira Salles Institute

-Tomie Ohtake Institute

-Lasar Segall Museum among others.



Thank you



Acknowledgements:

- International Agency of Atomic Energy – IAEA
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